ABSTRACT

Soon after becoming the Program Secretarial Officer (PSO) for the Department of Energy (DOE) Environmental Management (EM) Program, Jessie Roberson initiated a thorough Top-to-Bottom review of the EM Program and challenged the sites to conduct business differently. As an example, she emphasized risk reduction, not just risk management. INEEL’s 2070 cleanup baseline was considered too long and must be completed significantly sooner. The cleanup costs must also be significantly reduced from the current baseline of $41 Billion. The challenge is to complete most of the cleanup by 2012 and to reduce the EM footprint at the INEEL to one site area, the Idaho Nuclear Technology and Engineering Center (INTEC), also by 2012. The difficulty of the challenge is increased by the requirement to perform the work within nearly flat budgets. The bottom line: do more work in less time for less money. Further complications were added when funding for EM’s technology development program was greatly reduced, cutting out most of the technology support to the operational projects. To face this incredible challenge, the INEEL began a several month effort to develop an implementation strategy and the tactics required for success.

The strategies to meet EM’s challenge under these constraints require the scope of work to be crisply defined with a clear understanding of the completion criteria. A number of techniques will be discussed in this paper that were used to more fully define the completion criteria as well as redefine the cleanup projects and their system boundaries. The mechanics of redefining and recasting cleanup projects at the INEEL to focus on how all the work fits together for an entire site area along with some of the advantages will be discussed.

This paper highlights how roadmapping techniques and processes were used to gather information about the site’s cleanup programs, review the system boundaries, identify the project risks to completing the cleanup tasks, and to help recast the projects to meet the stewardship requirements for that portion of the site. This paper will discuss how site cleanup projects were recast into geographical areas. Some geographical areas were divided into several sub-projects while others site areas were completed within one project depending on the amount and type of integration required to complete the cleanup. The paper also addresses some of the other changes that are needed to facilitate implementation of the revised structuring of the cleanup project. Some of these changes include organizational modifications and resources allocation enhancements.

The EM Program at the INEEL has accepted the challenge to do its work faster, better, and cheaper. However, changing the INEEL is a little like the challenge to quickly change the course
of an aircraft carrier. This paper will address the results to date, the lessons learned, and what was useful in changing the INEEL’s course.

INTRODUCTION

The Idaho National Engineering and Environmental Laboratory’s (INEEL) Environmental Management (EM) Program has been estimated to cost $41 billion and take roughly seventy years to complete. The scope of this program includes dispositioning High Level Waste (HLW), Spent Nuclear Fuel (SNF), Special Nuclear Material (SNM), both contact (CH) and remote handled (RH) Transuranic (TRU) waste, Mixed Low Level Waste (MLLW), Low Level Waste (LLW), hazardous, and industrial wastes, along with remediating hundreds of release sites, and deactivating, decontaminating, and decommissioning (D&D&D) up to 544 buildings.

The DOE PSO sponsored Top-to-Bottom review was released at about the same time as the EM sites were being challenged to find improved, cheaper, and faster ways to get EM cleanup completed. The Top-to-Bottom review team concluded that the sites were spending more time and money managing the environmental risks than eliminating or reducing the risks. Contrary to their conclusions, many sites, including the INEEL, were completing work. SNF was being moved from wet basins to dry storage; TRU was being transported to WIPP; mixed, low, and hazardous wastes were being dispositioned; a few buildings were being D&D&D’ed; and many remedial sites were remediated and closed. However, EM found the life cycle costs across the DOE complex continuing to rise, with several sites, such as the INEEL, not finishing until 2070.

REDEFINING THE EM MISSION

The new challenge from DOE to accelerate the reduction of risk and mortgage and complete the EM cleanup work provided an opportunity for the INEEL to reevaluate the EM Mission work at the INEEL. As part of the Top-to-Bottom recommendations, DOE and the state of Idaho negotiated a letter of intent that established the vision for the INEEL cleanup focuses on the objectives to: 1) continue the protection of the Snake River aquifer by accelerating the reduction of human health risk, and 2) consolidate EM activities to create savings and hence, reinvestment dollars for accelerating the accomplishments of other tasks\(^1\). INEEL’s project strategies became focused on these two elements; accelerate the risk reduction and reduce the mortgage costs to free up funds to further accelerate risk reduction. This focus led to nine strategic initiatives specifically focused on accelerating risk and mortgage reduction at the INEEL. These nine strategic initiatives were developed from the shared vision and objectives between the DOE, the Idaho Department of Environmental Quality (IDEQ), and the Environmental Protection Agency (EPA) and are shown in Table 1. The mini-roadmapping approach\(^2\) was used to review the INEEL EM
mission and to develop accelerated schedules to support a re-planning and prioritization process focused on performing risk and mortgage reduction with these new initiative directions.

Table I. EM Cleanup Objectives and Priorities Developed 9 Strategic Initiatives

<table>
<thead>
<tr>
<th>Strategic Initiative Number</th>
<th>Cleanup Initiative Scope</th>
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<tbody>
<tr>
<td>SI 4.1</td>
<td>Accelerate INTEC’s Tank Farm Closure</td>
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<tr>
<td>SI 4.2</td>
<td>Accelerate HLW Calcine Removal from Idaho</td>
</tr>
<tr>
<td>SI 4.3</td>
<td>Accelerate Consolidation of SNF to INTEC</td>
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<tr>
<td>SI 4.4</td>
<td>Accelerate Off-Site Shipments of TRU Stored at the Transuranic Storage Area</td>
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<tr>
<td>SI 4.5</td>
<td>Accelerate Remediation of Miscellaneous Contaminated Areas</td>
</tr>
<tr>
<td>SI 4.6</td>
<td>Eliminate On-Site Treatment and Disposal of LLW and MLLW</td>
</tr>
<tr>
<td>SI 4.7</td>
<td>Transfer All EM-Managed SNM Off-Site</td>
</tr>
<tr>
<td>SI 4.8</td>
<td>Remediate Buried Waste at the Radioactive Waste Management Complex</td>
</tr>
<tr>
<td>SI 4.9</td>
<td>Accelerate Consolidation of INEEL Facilities and Reduce EM Footprint.</td>
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DEFINING THE PROBLEMS

While each of these initiatives are important for both risk and mortgage reduction, each initiative represents an important step towards the completion of the EM Mission at the INEEL. With the previous baseline completion for the EM mission scheduled at 2070, focus had not been given to optimizing the completion of the entire EM mission at the INEEL. Instead, measurable success was based on accomplishing intermediate milestones. Part of the problem with the baseline came from programs optimizing the individual steps or milestones that they were responsible for rather than optimizing the process to complete the entire workscope. For a given program, completion meant finishing a scope of work and handing off to another program (eg. Spent Nuclear Fuel Program removes fuel from water basins then the facility is handed over to the Deactivation Program) to work the next step in the completion process. Each program would plan and execute their portion of scope in the most effective manner. However, rarely does sub-optimizing lead to an optimized whole and this was true for the INEEL. Individual programs assigned priority within their program objectives that often did not consider the completion of the EM Mission, primarily because the 2070 end date was so far out. Often, work that required multiple program involvement was segregated in time due funding being available in one program but not the others.

Two difficulties arose in defining the word, ‘complete’. First, there wasn’t any single program responsible for the definition of complete at any given geographical area. Since the Snake River Aquifer (SRA) cumulative effects are not concerned with program completion goals, a higher level, more general geographical evaluation and cleanup approach is necessary to achieve this first objective of protecting the SRA. Secondly, without the overall decision framework for a geographical area, each program would select a cleanup approach that could be inconsistent with another program’s decision.
REDEFINING THE PLAN

Two significant steps were taken to help define the EM Program endstate. First, the EM Mission was combined into a single project where all the work to finish the cleanup was viewed as a single scope of work with a single authority to integrate the endstate across all the different scopes of work affecting it. This step effectively redrew the system boundaries large enough that the SRA and other environmental concerns will be considered as a whole in each sub-decision. The second redefinition comes from the roadmapping process of defining the destination first. As with any long trip, knowing the destination helps focus the direction such that all efforts are focused on arriving at the destination. However for the EM Project at the INEEL, the specific destination is not well defined at this time in terms of cleanup levels and other specific land use and stewardship issues. But, by defining the general direction of the destination, all efforts are focused in the right direction. Thus, completion was defined for now as finishing the cleanup actions, performing the D&D, and installing whatever was needed to enable long-term stewardship (LTS) to perform the required long-term surveillance and monitoring. Even though this completion definition lacks detail, it does provide enough guidance to proceed for now towards the final goal, completion of the EM Program Mission. With a general direction defined, the entire project can continue to move as the exact destination is worked out over the next couple of years.

The next step in the replanning process was to define and integrate the steps needed to complete the EM cleanup. Given the two primary objectives; continued protection of the SRA and consolidation of EM activities to provide reinvestment dollars, the work was organized by geographical areas. A geographical area, as used in this replanning effort, was an area of co-located facilities and release sites where the cleanup actions would use similar infrastructure, resources, and where the risk reducing work scope would result in lessening the long-term cumulative impact to the aquifer. The site geographical areas selected are: Test Area North (TAN), Test Reactor Area (TRA), Idaho Nuclear and Engineering Center (INTEC), Central Facilities Area (CFA), Power Burst Facility (PBF), and the Radioactive Waste Management Complex (RWMC). Currently, these geographical areas have as many as five EM programs at work performing disposition of HLW, SNF, MLLW, TRU, LLW, cleaning of contaminated facilities, and remediation of release sites. Integrating the scope, cost, and schedule to complete a geographical area continues to be a difficult task. Due to this expected complexity, the Test Area North (TAN) was selected to pilot the planning integration using a team that crossed all the EM programs with scope to perform at TAN. The task was to identify and define the scope, cost, and schedule necessary to complete the EM Mission at TAN and be able to transition to a long-term stewardship program for stewardship type surveillance and monitoring. The TAN team used an approximate endstate that included 1) waste and materials were disposition appropriately, 2) excess facilities were eliminated, where useful facilities were transitioned to a new program, 3) contaminated sites were remediated to the existing records of decision (RODs), and 4) stewardship functions were enabled (e.g. monitoring stations installed as required) such that transition to a stewardship program could take place. Specific cleanup goals are yet to be defined.
Other issues were discovered through the pilot that would need to be resolved if the INEEL was to fully complete the mission of accelerating risk reduction and eliminating the mortgage costs (both direct and indirect costs). The existing program boundaries left uncertain ownership issues and unclear programmatic roles and responsibilities. For example, buildings no longer needed were often left in a condition that differed from the assumed condition by the D&D program. Areas outside the buildings requiring cleanup that were not release sites were not part of the scope of work assigned to any given program. These issues became clear to the TAN team as they looked at what it would take to complete cleanup. With a clear roadmap destination, the area completion became defined as completing the risk reduction, eliminating the mortgage and base activities, and transitioning those long-term stewardship activities to an LTS like program.

**Mortgage Reduction Improvements**

Another result of the pilot evaluation was a number of work sequence opportunities that could improve the execution effectiveness of the area completion and ultimately reduce the total cost. The closer the work phases could be pushed together, the more efficiently the work could be performed avoiding costly re-planning, re-characterization, re-training workers, and risk management through surveillance and maintenance. The strategy to reach facility completion, shown in Figure 1, is to complete the operations and complete the deactivation and/or inactivation needed to highly minimize the required surveillance and maintenance (S&M) costs. The TAN team found three types of mortgage costs that could be eliminated or minimized.

The first mortgage type centered around the specific facility S&M required as long as the facility was open or contained significant risks to be managed. Sometimes in the past, a facility would be shut down as quickly as possible to eliminate landlord cost yet resulting in lengthy S&M and upgrade costs while awaiting deactivation. The results of this strategy was a larger cost to cleanup the facility due to 1) the cost of S&M, 2) the re-training of different, less experienced personnel than those intimately familiar with the facility, 3) the upgrade requirements to perform the cleanup in an un-maintained facility, and 4) the re-characterization and re-planning needed to define the condition of the facility and define the cleanup required. When the TAN pilot team considered performing the activities in an optimized sequence to complete the cleanup, reductions in planning, characterization, and training were identified. Instead of a facility being characterized by each program for their individual needs, a facility characterization would be completed that would support cleanup whether it be a RCRA closure, deactivation, D&D, or a CERCLA action. Additionally,
maintaining ownership of the facility from start to finish would eliminate the need and expense involved with program ownership transition. With the project focused on completion, the intermediate steps along the way are aimed at the same conclusion and can provide synergistic results towards the EM Mission endstate. As a result of this sequencing evaluation, the roles and responsibilities of the geographical sub-project managers are being modified to maintain facility ownership from start to finish.

A second mortgage cost to be eliminated deals with the site area infrastructure, utilities, life safety, and general surveillance. These costs were generally not affected by the shutdown of a building or two due to the fact that these activities support and entire geographical area. This is a result of these activities having a larger proportion of fixed costs versus variable costs. For example, as long as heat is needed, the operation of the boiler (heat source) is required. The fixed cost of labor is a much larger percentage of the entire cost compared to the cost of the variable amount of heating oil needed. Thus, to eliminate this portion of mortgage, the heating requirements for the whole area supported by the boiler must be eliminated. Other site area mortgage includes the life safety surveillance requirements. As long as EM has people working at TAN, EM must pay for life safety activities. Thus, to eliminate all site area-type mortgages, all systems and people must be removed or fully transitioned to another program that pays for their life safety and infrastructure needs. One sure-fire method to ensure the mortgage costs are reduced is to eliminate the facilities and thus the need for infrastructure and personnel. Alternatively, the costs can be minimized by remediating all the facilities to a state ready for demolition, often described as ‘cold, dark, and dry’ where systems are deactivated and no longer maintained or watched. The pilot team found this mortgage to be minimized optimally by a sequencing strategy that coordinated the completion of facility remediation of a given area at about the same time.

The third type of mortgage was associated with the program management and support for the work planning and execution support. Program management and support often did not reduce as the program finished major scopes of work. With the area concept, project management and support are reduced as the project nears the EM Mission endstate and are eliminated at project completion, now defined as the transition to a long-term stewardship type program.

**D&D Improvements**

Other improvements in execution found by this TAN pilot team dealt with the D&D phase. In the past, due to the limited funding available for D&D, facilities were demolished one at a time. Each facility had a planning package developed for it, and the mobilization and demobilizations were completed for each building. When the facilities were considered together in larger D&D projects, economies of scale were potentially thought to reduce the expected overall cost and schedule of the D&D. Functions such as the planning, characterization, mobilization, and demobilization were areas where costs could be decreased through this strategy.
Aligning the Planning, Improvements, and Work Breakdown Structure (WBS)

Concurrent with the TAN pilot evaluation, the INEEL EM Program evaluated how to best move to a single completion project much like the Rocky Flats model. As part of the single project concept and using the TAN team evaluation results, the INEEL EM Program’s WBS was reorganized into geographical area boundaries where each area focused on fully completing the EM Mission. The TAN, RWMC, and INTEC site areas were defined as individual sub-projects and the less complex site areas were grouped under one sub-project called the Remaining INEEL. In addition to the geographical cleanup completion portions of the WBS, important program specialties were identified to preserve for efficiency and cost-effectiveness. These areas are cross-cutting, and dealt with mixed and low level waste disposition where offsite contracts are used, environmental services where EM is currently the main customer, RCRA closures under the Voluntary Consent Order, and the D&D function. The geographical area teams will plan the integrated workscope to complete the area EM Mission using the appropriate cross-cutting team’s functional expertise. Although the baseline (scope, schedule and cost) will be maintained by each area project, the cross-cutting teams will be used by the areas in a coordinated manner to execute these specific functions. The Idaho Completion Project (ICP) WBS is shown in Figure 2.

Many issues of ownership, transition, and prioritization should be resolved using this WBS. Each geographical area will prioritize the elimination or reduction of the highest risks early in the schedule and fully understand the work needed to eliminate the mortgage costs in a site area. In this evaluation, it was found that some site areas were easier to complete than others. In fact, by focusing on specific accelerated completion, mortgage costs at some areas could be eliminated earlier than previously thought and this could effectively free up funds to further accelerate risk and mortgage reduction at other site areas. This strategy could have an effect of increasing the funding by converting mortgage dollars to cleanup, resulting in less additional funding required for the same acceleration using traditional prioritization practices.

With the site geographical areas used to define the project boundaries, the logic-driven activities needed to complete the cleanup work for each geographical area provides a tool to prioritize the work based on the critical path to completion, as the funding is available. The focus on EM cleanup mission is more comprehensive with this integrated area view even though the end-state cleanup goals are still incomplete. The logic-driven defined activities needed to complete the EM Mission at the geographical area can also be used to begin evaluating the project risks to completion within cost and schedule.
PROJECT RISK ANALYSIS

Risk analysis, mitigation, and tracking are being added to the EM Project baseline planning. Although a number of projects had performed risk analysis before, the analysis has not been developed in a comparable manner across the entire project. The roadmapping process includes a step and associated methodology to support making investment decisions on potential risk mitigation strategies. With this strategy in mind, risks will be collected and evaluated using relative semi-quantitative scales such that the overall project can distinguish the various levels of risk to the overall project success versus the typical approach where each project manager manages their top risks. The project managers still play an important role in risk management. However, by using relative ranking across the entire project, strategic investments that benefit the project as a whole begin to surface.

The risk identification and analysis process is being initiated in conjunction with the life cycle baseline development for the ICP using the previously discussed WBS. Several risk collection techniques are being considered at this time with the results of the chosen method to be reported at the time of the presentation. One particular method under consideration that has worked well in the roadmapping process is a risk collection process where each sub-project team identifies...
their risks and uses the same relative ranking scale. The use of defined semi-quantitative scales
of probability and consequence facilitate the first step where each risk is ranked relative to other
risks across the whole project. These scales are important for a couple of reasons. First, the
scales provide normalization across the sub-projects such that the risks are ranked in magnitude
and probability across the project. This means that an identified risk for one sub-project that
may be the biggest risk to that project is comparatively ranked with the risks of others. This
provides the ability to see where, perhaps the third largest risk for one sub-project is still a bigger
risk to the ICP than the top risk to another sub-project. Without such normalization, a project-
equity approach is generally used but does not serve the single project concept in the most
effective manner. The second and third reasons these scales are important come from the follow
on actions after the risks are captured and ranked.

After the highest risks are identified and ranked, risk mitigation is important to consider. Two
secondary decisions are made after the risks are ranked and segregated into categories that either
require aggressive mitigation and those requiring awareness only. The first decision deals with
selecting the most cost-effective solution from the mitigating alternatives for each risk. By first
screening out the low risks, a lot of mitigation development time can be saved. For the
remaining higher-level risks, mitigation alternative solutions are developed from generally four
categories of alternatives; risk acceptance, risk avoidance, risk transfer, or risk reduction. To
find which alternative is best, a delta risk reduction (using the same relative scale to evaluate the
before and after mitigation risk) versus the cost of mitigation is used to provide comparative data
that can rank the effectiveness of risk mitigation. The change in risk becomes the benefit unit of
value and the cost of the alternative solution/mitigation becomes the required investment. By
using the same relative scale, the risk reduction return on investment can be calculated and
compared and ranked to find the highest value mitigations.

The third step in identifying what risks to invest in requires another identification process, except
this time, it is focused on enhancements (sometimes called opportunities). Enhancements are
defined as positive, beneficial, or opportunistic risks that could produce a cost-effective
alternative solution to the baseline. Instead of attempting to lessen the consequence or reduce the
probability, an attempt is made to increase the consequence (positive) and/or increase the
probability of occurrence (success). Positive risk alternatives are generally categorized by one of
the following; 1) exploiting the opportunity which seeks to proactively facilitate the opportunity
occurrence, 2) sharing the opportunity which seeks to maximize the chances of the success
recurring and increasing benefits, 3) enhancing the opportunity to increase the probability and/or
impact to maximize the affect on the project, or 4) ignoring the ignoring which is used for when
a low probability and/or benefit impact is likely.3

By using the same relative risk scales as were used with the negative risk identification and
ranking discussed earlier, the level of importance of the positive and negative risks and their
mitigation effectiveness can be compared. This provides the ability to focus on both types of
risks. The conceptual picture, provided in Figure 3, shows where management’s attention must
be focused on the important risks to consider. The cost benefit analysis is performed with the
potential risk alternatives such that the top negative mitigation and top positive enhancement
alternatives such that the most beneficial risk management solutions can be selected. The
number of solutions pursued is based on the amount of funding available for risk management.
The diagonal lines in matrix, shown in Figure 3, are representative of the different levels of budget available to invest in risk management. These prioritized risks become the need statements as defined in the roadmapping process with the mitigation or opportunity plan fulfilling the fourth roadmapping process step, referred to as the technical response in the roadmap guidance. Depending on the potential project risk reduction and return on investment, some of these risks will be invested in and others will be observed.

INEEL’s FOLLOW ON ACTIVITIES

The INEEL is performing a life cycle baseline (LCB) update and will be using this opportunity to develop an integrated schedule for the Idaho Completion Project with an area completion emphasis. Project risk analyses will be conducted in conjunction with the LCB update where contingency will be established for the risks that are within the control of the contractor. The GFSIs will be used for those elements outside the control of the M&O contractor with negotiated delivery dates established between the Department of Energy and the M&O. Those areas of positive or negative risk with cost-effective management available will be considered in the funding prioritization.

As a result of the roadmapping process, the general destination for the endstate was defined, however, the explicit ICP endstate with cleanup goals does not exist for the entire INEEL EM cleanup. Future steps are planned to prepare a “big picture” evaluation of each of the geographical sites as well as the INEEL as a whole to evaluate each of the cleanup decisions in context to one another. The decision process involves an integrated regulatory strategy bringing CERCLA and RCRA regulatory teams together to integrate decisions towards the desired results. Several tradeoffs will be identified for evaluation such as near-term cleanup levels versus long-term responsibilities, removal versus reuse of INEEL facilities, more-sophisticated cleanup versus lower worker doses, etc. The process discussed in terms of risk mitigation investment decisions can also be customized to identify those environmental risk reductions with the most effective (not just cost) investments. These activities are just beginning and reportable results are not expected in the time period of this paper.

Figure 3. The Risk Focusing and Risk Solution Prioritization Concept
Another major supportive activity needed for the completion of the EM cleanup is a result of the major change in operations needed. Instead of using the facilities for their original purpose, the facilities need to be deactivated, decontaminated, and demolished (D&D&D). The D&D&D activities are often not evaluated in the safety analysis and have required multiple safety analysis updates for a facility as the activities proceed. Alternatively, the INEEL is investigating the potential to create a more generalized safety analysis that is customized for the D&D&D process once the original use of the facility is completed. This concept is still new at the INEEL but appears to be a promising way to facilitate the tailoring of safety analysis requirements that will allow safe and cost-effective D&D&D.

The changes discussed in this paper are expected to make significant improvements in the EM Project cost and schedule. Already, there is evidence that the completion of the EM Project cleanup work can be accelerated dramatically, some areas by as much as 20 years and INTEC by as much as 30 years. The life cycle baseline analysis is not yet complete but suggests that the overall EM Project cost to completion could be 35 - 45% less than last year’s baseline. Some of the difficult encounters remaining come from the change in sequencing of activities from those planned or sometimes even agreed upon by regulators to manage the critical path or get the economies of scale or proper work logic.

The application of roadmapping methodology has provided a focus for the ICP destination and has helped identify the uncertainties that need to be resolved to better define the route to take on the way to the destination. The entire ICP benefits with the definition of the final destination and then can consider the EM Mission endstate during each step along the way. What this means is that each time a cleanup activity is performed, not only is an important step completed, but the condition of the handoff towards the next step can be more in line with the overall completion goal. Roadmapping will continue to be used to evaluate areas with high uncertainty or risk as one of the mechanisms to increase project success, that is completing the scope within cost and schedule or better. Roadmapping will also play an important role in creating the overall picture of the ICP for both internal and external communications and interactions with decision makers.

REFERENCES


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