



US Army Corps
of Engineers®
Great Lakes and
Ohio River Division

Formerly Utilized Sites Remedial Action Program Cost and Schedule Risk Analysis Process Fact Sheet

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The Formerly Utilized Sites Remedial Action Program (FUSRAP) was initiated in 1974 to identify, investigate, and clean up or control sites throughout the United States that were part of the Nation's early atomic weapons and energy programs during the 1940s, 1950s, and 1960s. Activities at the sites were performed by the Manhattan Engineer District or under the Atomic Energy Commission. Both were predecessors of the Department of Energy. Management of the program was transferred to the US Army Corps of Engineers from the U.S. Department of Energy in October 1997. This is one in a series of fact sheets that provide information about regulatory, technical, and other issues considered in decision making within the FUSRAP.

BACKGROUND

The Great Lakes and Ohio River Division (LRD) of the US Army Corps of Engineers (USACE) has completed remedial activities at three Formerly Utilized Sites Remedial Action Program (FUSRAP) sites and continues remediation at two sites; the Linde Site in Tonawanda, New York, and the Painesville Site in Painesville, Ohio. Due to the complexity of these sites, unforeseen difficulties sometimes result in significant increases in cost and schedule during remediation. Historically, the greatest unforeseen difficulty has been encountering contaminated areas not fully characterized during the Remedial Investigation (RI). To improve our ability to accurately forecast project budget and schedule over the years it takes to clean up these sites, the Corps' LRD adopted a method of identifying, analyzing, and accounting for a wide range of uncertainties that can affect a project's cost and schedule.

Earlier this year, Buffalo District project teams reached out to subject matter experts from Corps' offices nation-wide, including Corps' contractors, to help develop a Cost and Schedule Risk Analysis (CSRA) process specific to FUSRAP projects. This risk analysis focuses only on cost and schedule uncertainties. The human health and ecological risks identified during the Remedial Investigation are addressed by implementation of the Selected Remedy that is documented in the Record of Decision.

Team members for this effort included experts from the following:

- USACE Headquarters
- USACE Great Lakes and Ohio River Division
- USACE Buffalo District
- USACE Environmental and Munitions Center of Expertise Omaha District
- USACE Cost Engineering Directory of Expertise for Civil Works, Walla Walla District
- Argonne National Laboratory

PROCESS

The CSRA process includes several steps that allow the project team to build on site-specific information and develop a complete understanding of potential cost and schedule risks and how to manage them. These steps begin during the Feasibility Study (FS) phase, when the nature and extent of, and human health and ecological risk associated with FUSRAP-related site contamination is known.

Step 1: Estimate Contaminated Material Volume

The cost of cleaning up a contaminated site is primarily driven by the volume of FUSRAP-related contaminated material that requires remedial action. Estimating this volume accurately requires a thorough understanding of how the materials got to the site; where they are; and if they are moving. As more is

learned about the site during Remedial Action, the actual volume of FUSRAP-related material often exceeds the original volume estimate. This increases cost and causes schedule delays. With the help of Argonne National Laboratory, the Corps has incorporated the use of a geostatistical method of estimating how much material is contaminated and will require remedial action. This method uses not only laboratory data from samples taken from the site, but also incorporates data from historical aerial photos and information learned from community members and others who have specific site knowledge. This estimating method gives a range of potential volumes and a percent confidence level associated with values in the range. The higher the confidence level associated with a certain contaminated soil volume, the more likely the actual volume found will be below the volume estimate.

Step 2: Base Cost and Schedule Estimate

During the Feasibility Study (FS), a base estimate of the cost and duration required to clean up the site will be developed for each of the remedial alternatives undergoing detailed analysis, using software and techniques accepted as the industry standard.

Step 3: Risk Register

The project risk register is a table of all known and suspected uncertainties related to cost and schedule for cleaning up a site. The human health and ecological risks identified during the Remedial Investigation are addressed by implementation of the Selected Remedy that is documented in the Record of Decision. This register is compiled by the project team and each risk is discussed and assigned a qualitative likelihood and cost and schedule impact (high, medium, or low). Current risk registers include thirteen risk categories and between 60 and 90 individual cost and schedule risks. Each of these risks is evaluated by the project team to determine the probability of the project being affected by any one risk, and how much project cost and schedule will be impacted. Once input from

the team has been included, the risk register goes through a second team review to ensure that each risk has been fully considered. For the sites listed below, the project uncertainty causing the greatest impact to cost and schedule has been the increase in volume of FUSRAP-related contaminated material.

Step 4: Cost and Schedule Risk Analysis

The results of steps one through three then serve as the basis of a statistical analysis that incorporates all of the risks. This mathematical evaluation determines how individual risks, and combinations of risks, can change the project cost and schedule. This risk analysis is applied to the base cost and schedule estimates, resulting in a range of contingency costs. These contingency amounts are added to the base cost and schedule estimates and are each associated with a confidence level. The higher the estimated cost and duration, the less likely the actual cost and schedule duration will exceed the estimate.

Step 5: Annual Updates

This process is refined each year to account for the greater knowledge obtained about the sites. The cost estimate, schedule, and risk register are revised with new and current information, and the cost and schedule risk analysis is re-run to provide the most current range of contingencies for each project. As our site knowledge increases, this annual analysis will progressively decrease the range of cost uncertainty.

CSRA PROJECTS AND RESULTS

The process described above was applied to the FUSRAP sites listed below and resulted in the ranges of cost-to-complete estimates shown on the next page. Cost-to-complete estimates include all costs associated with the management and implementation of the project. The low cost represents the 5% confidence level in the cost-to-complete estimate and the high cost represents the 99% confidence level in the cost-to-complete

estimate. A cost and confidence level from within the range for each site will be chosen as a budgetary estimate.

1. Painesville (in Remedial Action)
\$22,013,000 - \$42,358,000
2. Linde (in Remedial Action)
\$54,500,000 - \$193,253,000
3. Luckey (in Remedial Design)
\$86,765,000 - \$596,260,000
4. Seaway (approaching Record of Decision)
 - o Alternative 2: Complete Excavation with Off-Site Disposal
\$106,415,000 - \$632,909,000
 - o Alternative 4: Partial Excavation with Off-site Disposal
\$49,944,000 - \$210,270,000
 - o Alternative 6: Containment with Limited Off-Site Disposal
\$24,697,000 - \$58,754,000

In the future, the Corps' LRD will perform this analysis for each of their remaining FUSRAP sites during the FS phase of the CERCLA process so that costs can be more accurately portrayed when considering remediation alternatives.

For More Information

Call the toll-free public access line:

1-800-833-6390

Visit the Buffalo District Web Page for FUSRAP:
www.lrb.usace.army.mil/fusrap

Electronic mail can be sent to us at:
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Please let us know if you would like to be included on the mailing list for any of our FUSRAP sites.

You may also contact us by writing to the:
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