U. S. Army Corps of Engineers
Remedial System Evaluation
Instruction Guide

I. Introduction: Why perform RSEs? There are several reasons to be excited about the Remediation System Evaluation (RSE) initiative. This is a small effort, in cost and time, to potentially provide significant benefits to our customers. It allows the US Army Corps of Engineers to better serve its customers by:

A. Identifying ways to save money on operations and maintenance;
B. Shortening the time to closure, through periodic optimization and consideration of new technologies;
C. Meeting the requirement of the National Contingency Plan (NCP) for periodic (at least every 5 years) reviews of the protectiveness and performance of the remedy;
D. Verifying that there are clear goals and realistic closure criteria for the project (which is strongly advocated by the Department of Defense); and .
E. Assuring that Government-owned equipment is being adequately maintained.

The USACE can provide follow up support to the customer in implementing changes identified during the RSE process.

II. What are RSEs? RSEs are meant to be low-cost, rapid assessments of available information and current conditions; not detailed engineering or technical studies. They are meant to be a positive action with a focus on the future and not the past; not a finger-pointing exercise. Remember the original designers usually had much less information available than the data provided by years of operation. The RSEs consist of data review, interviews, a site visit, data analysis, and report generation.

A. <u>Review of Existing Data.</u> There are certain data that should be gathered and reviewed prior to performing other RSE activities. Though it was found during the trials of RSE that the data was often not easily available prior to the site visit, effort should be made to obtain and review the following information prior to conducting interviews and visiting the site.

1. design analyses, final plans and specifications, and process flow diagrams.
2. limited remedial investigation or RCRA facility investigation data (if not summarized in the DA),
3. current monitoring (performance) data (e.g., water levels, contaminant contours, and contaminant levels before and after treatment).
4. operational performance data, for the entire system and each component of the treatment system (examples include, pH measurements before and after an acid-feed system, specific capacity information for extraction wells, or influent and effluent sampling results for an air stripper).
5. costs for O&M, including utilities (electric, gas, water, phone lines), labor, maintenance (if done by subcontractor and not by dedicated staff) consumable items (such as chemicals, protective clothing, carbon), analytical (for both process monitoring and environmental monitoring), and disposal costs (for sludge, carbon, condensate, etc.). Refer to the guide specification for gathering cost and performance data (CEGS 01240 Cost and Performance Reports), and
6. reports summarizing and previous performance and/or optimization studies (such as any CERCLA 5-year review reports, annual reports, etc., modeling studies).

Refer to the General RSE checklist and the various subsurface performance evaluation checklists (e.g., ground water extraction, air sparging) for more discussion.

B. Interviews. An integral step in performing RSEs is the process of conducting interviews with the Customer, Operator, and Regulator. In order to obtain a history of how a particular treatment system was selected for use, treatment system startup, and operation of the treatment system, interviews are essential. Interviews with the Customer and Regulator should provide insight on why a particular alternative was selected, specifically in the areas of regulations, public comments, technical practicability/feasibility, and cost. Interviews with system operators can provide valuable information on how the treatment system has performed since startup, operational costs, any significant changes in site conditions, or specific performance problem areas. When conducting these interviews, a concerted effort should be made to minimize impacts on the installation (ex. agree to an interview schedule ahead of time with all involved parties and try to closely adhere to it when arriving on site).

C. Site Visit.

1. Purpose. In order to conduct an RSE, a site visit is an absolute requirement. Several purposes are served when conducting a site visit. Only by physically examining the remedial system extraction, treatment, and discharge equipment can a proper evaluation be made of the system's performance, reliability, and structural integrity. The site usually contains a repository of data, such as influent/effluent (degree of treatment provided) contaminant concentrations. Review of such data is required in order to evaluate the degree of protectiveness the remedial system currently provides and to evaluate if significant site changes have occurred which would warrant changes in the type of treatment equipment provided. . The site visit can also serve to further establish communication links between the RSE team conducting the review, the system operator, and regulatory representatives.

2. Duration. Duration can vary based on the complexity of the remedial system, however, a complete RSE site visit should be take no longer than a 1 ½ to 2 days. This would include entrance and exit meetings as well as the hands on evaluation of the remedial system.

3. Sequence. A suggested sequence would be as follows.

a. Conduct Entrance Meeting
   1) Introduce team members
   2) State and define objectives
   3) Describe site evaluation methods to be used
   4) Establish communication links
   5) Outline schedule
   6) Conduct preliminary interview of operator

b. Conduct Evaluation of Remedial System and Treatment Data

c. Exit Meeting
   1) Review findings and observations
   2) Discuss areas in detail where corrective action is required

d. Revisit Treatment System
   1) Should further issues/question arise from exit meeting

4. Coordination with Various Parties. It is of obvious importance to coordinate with all parties well in advance of the planned RSE. It is necessary to confirm the availability of on-site personnel to interview as well as the regulator(s).

D. Data Analysis. The key component of the RSE is the analysis of data gathered during the interviews and site visit or contained in the reports available from other sources. Often data about the system are collected, but not evaluated. The analyses to be performed generally fall into the following categories.

1. Closure Objectives. There is a strong interest at the Department of Defense to assure that long-term remediation systems have clear, realistic objectives and that there is a well-defined process to compare system performance and monitoring data against these objectives and to take specific actions based on the comparison. The RSE process includes asking specific questions of the site "owner" (the agency or installation responsible for the system) and operator regarding their understanding of the system objectives, and an independent evaluation of the objectives to assure that they are realistic and still currently applicable. In some cases, decision documents were cast long ago and such issues as technical impracticability and risk-based clean-up were not considered. In these cases, it may be prudent to revisit the goals in light of these recent considerations. In other cases, clear objectives may not exist, such as situations where actions were driven primarily by public or regulatory pressures. The owner/operator must have a plan (an "exit strategy") that defines how the system will be operated toward ultimate close out, including a contingency for the situation where it becomes clear that the system will not reach the initial objectives. The RSE team should verify that there is a regular program to technically evaluate the implications of the treatment performance and environmental (ground water, soil, surface water, sediment, soil gas, air) monitoring data. *(Refer to the General RSE checklist for more information – see section VII A).*

2. Performance/Protectiveness. The evaluation of the performance of the system is a key component of the RSE process that is closely related to the issues discussed in the previous section. The RSE requires the team to compare the progress of the cleanup against goals, identify potential performance problems, recommend changes to address the problems or speed cleanup, and revisit the protectiveness of the system. For sites addressed under CERCLA, the National Contingency Plan requires that the performance and protectiveness of the remedy be evaluated at least every five years (these evaluations can be and often should be done more frequently).. The system should continue to protect the public by preventing undesirable and unplanned exposures in the present or future. The nature of these analyses is very site and technology specific. *(Refer to the General RSE checklist and the various subsurface performance evaluation checklists for specific analyses to be performed – see Section VII A).* In addition, the performance each component of the treatment system are evaluated relative to specific design criteria or good engineering. *(These issues are addressed in each of the component checklists, as appropriate performed – see Section VII A).*

3. Optimization. The RSE process goes beyond the CERCLA five-year review to address optimization, here defined as a process by which the costs for operation are reduced to the extent possible given the remedial action objectives and the level of effort for the RSE. Optimization may be necessary for several reasons. In some cases, the design was not well matched to the conditions encountered during construction. In other cases, as the remediation progresses, conditions changed both in the subsurface and for the above-ground equipment (e.g., influent concentrations have changed, plume size changed). There may have been changes in the regulatory environment as well. Real cost savings can, therefore, often be realized if a fresh look is taken of the current operations. Savings can be achieved by changing the operation or monitoring of the existing system (e.g., changing pumping rates or frequency of sampling). The savings can also be gained by the replacement of existing treatment equipment and technologies with other alternatives (e.g., replacing thermal treatment of off-gases with vapor-phase carbon or addressing all or part of the plume with natural attenuation). The RSE process guides the application of good engineering and scientific judgment and creativity to recommend these changes to the system. *(The RSE checklists can suggest some alternatives to the existing equipment or technology – see Section VII A).*

4. Maintenance of Equipment. In most cases, the equipment in place at the site is owned by the Government or by an entity other than the operator. It is in the best interest of the Government or the owner to evaluate the degree to which the equipment and facilities are being properly maintained. In some cases, the operator is not given the authority or the funds to perform necessary maintenance. In other cases, the operator may not be aware of the maintenance needs. In any event, the RSE process provides a mechanism to identify existing or potential maintenance problems for action by both operator and owner.

5. Analyses Beyond RSEs. The RSE process is meant to provide a "first-look" appraisal of the remediation system, and is not meant to be a detailed engineering study or redesign effort. The RSE can, however, recommend that further studies where it seems that the studies would likely yield significant cost savings above the costs of the study. Examples of these studies include:

a) computer modeling for optimizing extraction rates , etc.

b) re-analyses of site risks to human health and the environment (this is also a potential part of the EPA five-year review program),

c) pilot studies of alternative technologies,

d) feasibility studies of suggested alternatives, or

e) engineering design of changes to the system.

The RSE report can estimate the costs associated with the recommended studies.

E. Report Preparation.

1. Length/Level of Detail. The level of detail in the report will vary depending on the nature and complexity of the site. In general, the report should be of sufficient detail so that the site's characteristics, remedial objectives, RSE findings and recommendations are clearly communicated to the customer in a concise manner. It is expected that the majority of the reports will be 25 pages or less. Additional information such as field notes, checklists, interviews, figures or tables may be included in the report, but may not necessarily be required. In order to assist in this aspect of the RSE process, a standard outline for an RSE report is available, along with a sample report.

2. Schedule. In general, the report should be prepared by the RSE team and submitted to the customer within 30 days of the site visit. A quick response is usually received positively by the customer while the site visit is still fresh in everyone's mind. If the site under evaluation is complex, additional time may be required to prepare a final report. Potential changes to the schedule should always be discussed with the customer.

3. Copies to HTRW-CX. Copies of RSE reports should be provided to the HTRW-CX. The CX will then track cost savings achieved from the RSE process, extract lessons-learned for the Corps lessons-learned database, and fine-tune or add RSE checklists as necessary.

F. Target Costs. One key objective of the RSE process is to provide the service to our customers at a reasonable cost. In particular, if the primary motivation is to reduce operating costs, the cost of the evaluation should be much less than the reasonable expectation of the potential cost savings. As a rule of thumb, the RSE should cost approximately $15,000 to $20,000, though there will be some projects that would easily justify higher costs. This would not include additional studies or design work that may be recommended as part of the RSE.

1. Contributing Costs. There are three main categories of costs including the site visit, data review and analysis, and management costs. Typical costs based on test cases are shown below for each category to provide an idea of the relative proportions of the costs.

a. Site Visit Labor/Travel Costs. Assuming a 2.5-day trip, two senior professionals at around $75/hour, and a high cost destination, these costs could exceed $4500.

b. Data Review/Report Preparation Costs. Assuming 40 hours (a reasonable amount based on three RSE test cases) for four professionals at $75/hour, this would result in a total of $12,000.

c. Management Costs. Assuming project management costs at approximately 15% of the direct labor hours, this would be 15% of 200 labor hours at $80/hour. This would be $2400. (This totals $17,400 for the typical RSE).

2. Costs as a Function of System Complexity, Customer Goals. The target costs should be identified in consultation with the customer before commencing the RSE and these costs depend on the goals of the RSE and the complexity and operating costs of the system. The $15,000 to $20,000 "rule of thumb" costs suggested above should cover most sites, but acceptable costs may be much lower or higher, based on these considerations. Again, if the goal is system optimization, the costs of the RSE should be small enough that they do not offset the potential cost savings. The more complex the remediation system and the higher the costs of operating it, the more likely the RSE can identify significant potential cost savings. Thus it follows that the RSE costs for large expensive-to-operate systems can be larger than for small inexpensive projects. For small sites or short-term remedies, it may not be possible to justify performing an RSE, unless it is a very cursory review. In some cases, the RSE could only include the data review and a site visit could be skipped. In those cases where the customer's primary purpose is to

perform an "five-year" review, the target costs are not necessarily linked to the system complexity, but the target costs for simple systems should be smaller than for complex sites since there should be less data to analyze.

3. CX Test Site Costs. The USACE HTRW CX has performed three test RSEs. These included a "five-year review" at Superfund site consisting of a landfill, leachate collection system and a complex leachate treatment system and an annual operating cost of over $600,000; and two large Army pump and treat projects including air stripping as treatment, one with an annual operating cost of over $1,000,000 and one with an annual operating cost of less than $400,000. The costs for the RSE ranged from $14,000 for the Superfund project to $23,000 for one of the large Army projects. The costs have been corrected for the typical labor and overhead rates for district staff. These projects are probably as complex as most offered by our customers and should reflect typical RSE costs.

III. Which Projects to Evaluate.

The National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR 300.430 (f) (4) (ii) requires review of on-going remedial operations at HTRW sites at least every five years. OSWER Directives 9355.7-02 (May 1991) and 9355.7-02A (August 1994) define Department of Defense and other Government Agency five-year review responsibilities.

In the event there is a large backlog of sites to be reviewed, reviews will need to be prioritized. One way of setting priorities would be to perform an economic analysis to determine the order in which projects should be reviewed

Sunk costs have no place in an economic analysis since there is nothing that can be done now or in the future to change them. We must look elsewhere for future savings.

Long term projects having substantial operating and maintenance costs are suitable candidates for remedial system analysis. In order to justify the $20,000 cost of a remedial system evaluation, sufficient savings must be identified. For example, a remedial system evaluation identifying annual savings of 2.5% for a project having an annual O & M cost of $200,000 would break even in four years. (0.025 x 200,000 x 4 = $20,000)

Since system optimization can be expected to identify a minimum of 2.5% annual savings, shorter payback times can be anticipated. It is suggested that projects having annual O & M costs of $200,000 or higher be high on the priority list for remedial system evaluation.

IV. When Should RSEs be Prepared?

A. EPA 5-Year Review Sites. Reference “Five-Year Review Guidance (Second Interim Draft)”, dated March 16, 1998. Section II of this guidance entitled, “When Five-Year Reviews Are Required”, discusses the legal authority to conduct five-year reviews, which sites are subject to five-year reviews, the timing of five-year reviews, prioritizing reviews, when reviews can be discontinued, and that deletion of sites from the National Priorities List (NPL) does not affect the need to conduct a five-year review. Section II of this guidance document also explains the difference between statutory reviews and policy reviews; events that trigger reviews differ for statutory and policy reviews. Data from the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)/WasteLAN database is used to set trigger dates. In general, statutory reviews are triggered by the initiation of remedial action (planned remedial action onsite construction date); policy reviews are triggered by construction completion. Complex treatment systems, changed site conditions (ex. significant increase or decrease in influent contaminant concentration), or changes in degree of treatment required may necessitate more frequent reviews.

B. Army (DERP) Sites. Reference “Guidance for U.S. Army Compliance with CERCLA Five Year Review Requirements at Army Installations”, dated July 17, 1998. This guidance details the system for tracking the completion of five-year reviews at Army installations and guidance on the format, scope, and costs for such reviews.

V. Who Participates in RSEs

A. Team Composition. The composition of each review team will vary from site to site and could include Engineers (Geotechnical, Mechanical, Environmental, Chemical, etc.), Scientists (Geologists, Hydrogeologists, Chemists, etc.), or others with unique or specialized skills (Regulatory, Industrial Hygiene, Cost Estimating, etc.). In general, the team will have 2 or 3 technical reviewers, depending on the site's complexity and/or size. By keeping the team relatively small, costs can be kept to a minimum. Teams may be made from in-house personnel, contractors, or a combination of the two if necessary.

B. Team Qualifications. Each member of the review team should have substantial experience in the design and operation of the remedial system(s) under evaluation at the site. The team should have the collective knowledge and ability to quickly provide solutions or alternative methods to any problems or processes existing at the site.

C. Customer and Regulator Involvement. Early involvement of the Customer and Federal, State or Local Regulators in the RSE process is strongly encouraged. Maintaining a good working relationship with those involved in various aspects of the site will help to produce a comprehensive and well received review. Although the technical review team prepares the RSE report, the customer and regulators should be invited to participate in the review during the site visit.

D. CX Oversight and Assistance. The HTRW CX is available for assistance with the RSE process, use of the checklists, report review, and is able to participate in site visits as the need dictates. It is anticipated that the role of the HTRW CX will be to provide general oversight of the RSE process to ensure technical accuracy and consistency between site reviews.

VI. Lessons Learned and Process Improvement.

The HTRW Center of Expertise has developed and is maintaining an environmental lessons learned system for the US Army Corps of Engineers. The Internet address of this system is http//www.environmental.usace.army.mil/environmental/llrn.html. Lessons learned during remedial systems evaluation may be documented in this web site. Information can be shared, successful practices adopted, and repetition of mistakes avoided by using this system during remedial system evaluations. In addition, these lessons learned may be used to update and improve the RSE Checklists as experience is gained during site investigations. Those performing the RSEs can directly enter the lessons learned into the system or can provide them to the CX for entry.

VII. RSE Tools.

A. RSE Checklists. The primary tools for the personnel performing the RSE are the various RSE checklists. These checklists are available on the Internet at http://w3.environmental.usace.army.mil/.

1. Purpose of the Checklists. The RSE checklists are meant to be a tool, not a rigid system that must be followed. The user has the freedom to use them as they see fit. The checklists remind the user of the data to collect, questions to ask, problems to look for, analyses to perform, and alternative technologies or equipment to consider. They provide references useful in evaluating the process or system and spaces to record observations in the field.

2. Kinds of RSE Checklists. The three types of RSE checklists include:

a) A general checklist, applicable to every site, which describes the RSE team, needed data, suggested report format, appropriate questions about remediation goals and exit strategy, and interviews with the owner, operator, and regulator.

b) Subsurface performance evaluation checklists for ground water extraction, soil vapor extraction, bioventing, and air sparging. These are meant to describe necessary monitoring data, performance analysis, typical problems, and alternative technologies. An above-ground treatment system checklist provides prompts for evaluating the performance of an above-ground treatment system as a whole.

c) Finally, there are "component" checklists for evaluating the performance of various pieces of the remedy. These include checklists for air stripping, carbon adsorption, metals precipitation, chemical feed systems, solids handling, filtration, treated water disposal, long-term monitoring programs, blowers, piping, wells, thermal treatment (of air) units, advanced oxidation processes, control systems, and oil-water separation. These checklists identify data to collect regarding the unit performance, maintenance issues to check on, typical problems with the component, and suggested alternatives.

3. How to Use the Checklists. As stated previously, the checklists are meant to be tools used as the team sees fit. The checklists are based on current good practice and lessons learned; however, the user should supplement the checklists with their own questions and analyses as required by the specific project. The checklists can be completed as the team tours the site facilities or during interviews of the owner or operator. Spaces are provided for data and observations right on the checklists. In the test RSEs conducted by the USACE Hazardous, Toxic, Radioactive Waste Center of Expertise (HTRW CX), the teams found that the checklists are useful primarily during the gathering of data, in preparing for the site visit, and as a mental prompt following the site tour to ask follow-up questions. The teams found it was not as useful to complete the checklist during the initial site visit. The team found it more useful to visit each aspect of the system and ask questions as they occurred to the team members. Many of the questions were spurred by a review of the checklists prior to going on site. Note that it is an undue burden to request that the operator or owner complete the checklists; it is much better for the RSE team to complete them.

B. Sample Report. The General RSE checklist offers a standard outline for an RSE report. Obviously, the contents and detail contained in the final report depends on the complexity of the site and the customer's needs. To help the teams understand the kind of detail that can be included in a report, an example report is available on the same Internet site as the checklists. This sample is based on a report done by the HTRW CX for one of the test sites.

C. Briefing Materials (for Customers, Regulators, etc.). ***To Be Developed***. These will be available for use by USACE districts to describe the RSE process to customers. The RSE process should be tailored to the needs of the customer and the types of sites. The materials will be available on the same Internet site as the checklists in a form that can be modified by the districts as necessary.

D. Sample Scope of Work. ***To Be Developed***. Since in many cases contractors will conduct the RSE, a sample scope of work for conducting an RSE will be developed for use by the districts. Again, the scope will be available in a form that allows it to be tailored to the needs of the project.

E. Sample O&M Scope of Work Addenda for Monitoring Data. ***To Be Developed***. In the future, sample technical operations and maintenance (O&M) contract language defining required system monitoring and data quality objectives will be written. These will probably be prepared specifically for a remediation technology. If these requirements are included in the O&M contract, it will increase the likelihood that the right information will be available for assessing the performance and protectiveness of the system at a later time.

F. RSE Website: http://www.environmental.usacae.army.mil/info/technical/process/rsechk/rsechk.html In addition to being the access to RSE checklists and other tools, the RSE website may ultimately be used to allow users to post comments and experiences, RSE reports, and report actual/potential cost savings.

G. Points of Contact for Tools. The POCs for the RSE tools are Dave Becker (402)-697-2655, dave.j.becker@usace.army.mil) and Bob Saari (402)-697-2581, robert.b.saari@usace.army.mil, USACE HTRW CX.