THE FUN NEVER STOPS – TEN YEARS OF ENVIRONMENTAL RESTORATION SUCCESS AT SANDIA NATIONAL LABORATORIES

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ABSTRACT

This paper provides an overview of the many contributors to the success of the Environmental Restoration Project at Sandia National Laboratories between 1992 and 2002.

INTRODUCTION

In 1990, the U.S. Department of Energy (DOE) began to fund Sandia National Laboratories (SNL) to conduct environmental restoration (ER) work for all locations for which SNL might be responsible. When the ER Project was formally established in 1992, the work was projected to be completed by 2020; 117 sites had been identified for attention. As the ER Project began, the staff consisted of less than a dozen people. Minor scoping sampling had been conducted at a few sites, and several groundwater monitoring wells had been installed at two landfill locations. Rapport with regulators and other stakeholders had yet to be established.

Ten years later, the ER Project is planned for completion in 2006. The expected life-cycle cost has been reduced by more than $200M. After peaking at about 140, the number of ER staff currently is 93 (31 SNL employees and 62 contractors). The number of sites to be addressed grew to more than 500; of these, every site not located at the SNL New Mexico facility on Kirtland Air Force Base (KAFB) has been completed, and No Further Action (NFA) proposals have been submitted to the regulators for 202 of the 268 sites on KAFB. Four major landfills and numerous smaller sites have been remediated without significant injury. All 268 sites have been characterized, as have four areas of low-concentration groundwater contamination. Excellent teaming relationships with the regulators are in place, and substantial interaction with stakeholders is ongoing. The Project has received several SNL quality awards, seven consecutive years of top ratings from the DOE customer (1995-2001), and awards from the New Mexico Environment Department (NMED) in 2001 and 2002 for environmental excellence.

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The remainder of this paper touches on some of the many reasons for the achievements of the ER Project. Unfortunately, a paper cannot capture the roles of individual people in ensuring success. Several dozen individuals have made critical and substantial contributions to the Project over the years, and over 400 people have worked on the Project. This paper represents the collective achievements of all of them.

SETTING THE STAGE…CONTINUOUSLY

Exemplifying the management phrase "beginning with the end in mind", the focus of ER work in the beginning was establishment of long-term infrastructure and technical capabilities that would serve as the framework for dealing with individual sites; primary responsibility for this was taken by ER management. Initial activities included hiring of SNL staff to serve as Task Leaders. As the Task Leaders joined the Project, they immediately began collection and documentation of information on sites for which they were responsible. (Division of responsibility and execution of work in parallel has continued throughout the history of the ER Project.)

Contracting

Two major contracting efforts created mechanisms for acquiring ER-specific expertise and on-site staff. First, a task-order contract was competed, resulting in awards to three major environmental companies which shared task-type work in support of ER for the next ten years. This contract mechanism addressed (and a follow-on task-order contract continues to address) all technical areas for which the ER Project might need to access expertise on short notice (in a matter of days to weeks) for the foreseeable duration of the Project.

The second contracting effort addressed the need for full-time on-site staff with extensive prior ER experience. A nation-wide solicitation was issued; from the almost 300 resumes which were submitted as a result, 15 individuals were selected, representing 8 different companies. In one step, ER acquired expertise with a wide variety of contaminant types, characterization and remediation methods, and regulatory environments.

Several years later, the ER Project used the task-order model to pre-qualify companies for drilling jobs and for remediation activities. In each case, contracts were placed with multiple companies as a result of the initial contracting effort, then these companies competed for each pertinent job defined for ER. For example, the drilling companies bid for jobs based on equipment availability and cost per linear foot of drilling, with successful bids placed as fixed-cost contracts. In contrast, contracts for remediation work can be awarded with whatever contract mechanism is appropriate to the job. Work at the Chemical Waste Landfill and at the Corrective Action Management Unit (CAMU) is accomplished primarily through a time-and-materials contract with a task-completion award fee structure, placed with a single company.

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Quality and Project Management

During the first year, an entire hierarchy of procedures was initiated, ranging from a Quality Assurance Program Plan to a Project-level generic health and safety plan and including a large number of procedures to implement the technical aspects of the Project. The requirements to create such procedures (environmental laws, DOE Orders) were followed, but were tempered by Project staff experience with bureaucratic quality assurance (QA) such that few extraneous requirements were self-imposed by the Project. As a result, ER QA was user-friendly from the beginning, and was graded such that only activities related to data generation or personnel health and safety were subject to the highest level of control. (In 2001, an SNL self-assessment cited ER's QA program as a model of how to balance QA rigor with functionality.)

The size of the Project (yearly funding typically in excess of $20M) made it a Major System Acquisition, and subject to requirements for formal Project Controls. All aspects of this were put in place immediately. Thus, Project Controls software and staff have been used for almost the entire ten years in support of the technical work. In the beginning, because of the unwieldiness of the software, the temptation arose to create many small databases on the side for tracking labor hours, manpower projections, waste volumes, etc. However, the Project Manager had the insight to realize that, however efficient this might be in the short term, it would not take long for information in the separate databases to become inconsistent. Thus, effort instead was invested in the quality and streamlining of the Project Controls software, which now serves as a major tool in the day-to-day performance of the Project.

Technical Aspects

In order to present a successful proposal for NFA for a contaminated site, several technical "framework" pieces were required – background concentrations of all naturally occurring contaminants, definition of the hydrogeologic framework, and an agreed-upon risk-assessment methodology (requiring the definition of future land use) to use in support of risk-based NFA proposals. Work on each of these was initiated during 1992 and 1993. Agreement on the suite of naturally occurring contaminants for both soil and groundwater was reached with the NMED by 1994, and a formally documented set of background concentrations for all of these materials was complete by 1997. The site-wide hydrogeologic project completed definition of the geologic, structural, and hydrologic setting of KAFB by 1997 as well.

Negotiating a risk-assessment methodology was somewhat more time-consuming. SNL began by proposing to develop probabilistic risk assessment as part of its technology development program. This was abandoned in favor of deterministic methods in 1994, with agreement on human-health risk assessment in 1997. Final agreements on ecological risk assessment were not achieved until 1999. Nevertheless, of the 202 NFA proposals submitted to the regulators, most have been risk-based.

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Future land-use designations for all of the land comprising KAFB (including the land withdrawn from the U.S. Forest Service) were attained by 1997 by a stakeholders group which included representatives of SNL, DOE, the U.S. Air Force, the U.S. Forest Service, and the U.S. Environmental Protection Agency (EPA), as well as local government officials and local citizens. This was the first of several successful stakeholder groups convened by the ER Project.

As is common for many environmental projects nation-wide, preliminary remediation goals are established with the regulator prior to initiating a remediation. SNL ER extended this practice to the characterization step. For example, the ER Project has 84 septic systems to address. Rather than approaching each system individually, sampling it, then checking with the regulator to determine if more work is needed, a different tactic was employed. The SNL staff responsible for the septic systems negotiated a strategy with the NMED that defined quantitative analytical results as Go-No Go criteria for each step of the characterization process, so that both sides agreed to points at which field work could stop. In addition, each individual site was visited by a team of SNL and NMED staff and evaluated to pre-define sampling locations. All systems now have undergone shallow soil sampling; the agreement stipulates that additional characterization must occur at only the "worst" 10% of the systems. (Depending on the results for these systems, additional systems may or may not undergo further investigation.) The up-front planning enabled substantial efficiencies to be achieved in all aspects of work on these sites.

In addition to these purely technical areas, the need for definition of any environmental constraints (because of the requirements of the National Environmental Protection Act [NEPA]) was identified. Biological and cultural-resource surveys were conducted in 1991 and 1995, respectively. In 1991, the ER Project initiated a study to determine whether an Environmental Assessment (EA) or an Environmental Impact Study was appropriate for the ER work. The ER Project began work on an ER-specific EA in 1994; the EA was approved and issued in March 1996. Coincident with this effort was an evaluation of the similarities and differences of RCRA and CERCLA and identification and evaluation of all laws and statutes that needed to be considered as ARARs (Applicable or Relevant and Appropriate Requirements) for all states in which SNL had identified ER sites.

Public Interaction

Public outreach began with quarterly public meetings in 1992, which continue to be conducted. In the early years of the Project, as environmental concerns associated with SNL achieved higher visibility, negative attention from the media and public became more frequent. In response, the ER Project extended invitations to individuals and groups to tour the ER sites and to participate in citizens' groups on specific topics. Early success with involving the stakeholders was achieved through two of these groups – one focused on site prioritization, and one convened to define future land use, as mentioned above.

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Public participation played a critical role in the eventual permitting (under RCRA) and construction of the first CAMU in the DOE Complex. (The existence of the CAMU for storage, treatment, and disposal of waste enabled the timely remediation of the Chemical Waste Landfill; soil treatment by low-temperature thermal desorption and stabilization was completed in January 2003.) In 1993, the EPA issued the "CAMU Rule", which established the option of using a CAMU to facilitate remediations that were hampered by the existing time limits for off-site waste disposal. The ER Project quickly grasped the potential of this rule, and in 1995, established a CAMU Working Group with membership from SNL, DOE, EPA, the NMED, and representatives of numerous stakeholder groups, including the most energetic activists. This group met monthly for almost a year, establishing a set of group values, debating the pros and cons of various on-site and off-site waste-disposal options, and ultimately reaching agreement on a recommendation to pursue permitting and construction of a CAMU. The process consumed immense quantities of time and energy, but was invaluable in establishing a broad base of support for the CAMU that was extremely important during the lengthy permitting process which followed. (One EPA hearing officer commented that the strong public support was considered to be a key factor in EPA's approval.)

As the ER Project matured, the national setting for public participation on environmental matters moved toward Site-Specific Advisory Boards, to include members from regulatory agencies, local governments, and citizen stakeholders. The implementation of this concept for SNL was the Citizens' Advisory Board (CAB), which was created in the spring of 1995. The CAB, the membership of which varied from 15 to 20 individuals, served as a sounding board for many of ER's activities between 1995 and the fall of 2000, and provided valuable insight into community values and preferences. In the fall of 2000, as the ER Project approached the end of the phase in which unknowns are defined and major remediations conducted, the CAB evolved into a Community Resource Information Office which serves as coordinator and clearing-house for topic-specific citizens groups to continue to provide input to the ER Project.

Mixing the Large and the Small

Discerning what would be needed to obtain approval of NFA proposals was one aspect of setting the stage for conducting the ER Project. Another seminal decision was made not to lock the Project into a single approach to characterization and cleanup. Early in the Project, all ER sites were grouped into Operable Units, and the effort began to draft RCRA Facility Investigation Workplans that described how to assess each of these groups as a whole. In some cases, this approach seemed workable. However, it became apparent that many sites would be better handled individually, or even jointly with single sites in other Operable Units for efficiency. From the time of this realization, Operable Units continued to exist only for the purposes of budgeting and tracking; the field work was designed around any combination, however large or small, that made logistical sense.

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Two examples of the "large" are the surveys and cleanups conducted site-wide for depleted uranium (DU) and unexploded ordnance (UXO). After decades of use of the remote areas of KAFB as firing ranges, these materials were scattered over large land areas. The UXO was primarily a safety hazard which, in some cases, prevented conduct of work at an ER site. Coordinated efforts by SNL and KAFB staff accomplished removal (and subsequent destruction) of UXO from the surface of SNL ER sites in a single continuous field campaign.

On the other hand, the DU was identified as a contaminant of concern at many sites. It was decided that a coordinated cleanup of the DU at all affected sites at once would be far more efficient than collecting the DU from each site as the site was assessed and remediated for all contaminants. Thus, from October 1994 to October 1996, 38 ER sites (totaling 908 acres) were cleaned of DU, freeing many of the sites to be addressed either as clean or as RCRA-only sites and to be handled much more quickly.

An example of the "small" is drill-rig scheduling. A significant component of the cost of drilling groundwater wells is that for mobilization and demobilization of the equipment to and from the site. Individual Task Leaders responsible for their own sets of ER sites occasionally needed to install small numbers of monitoring wells near their sites. To minimize the percentage of dollars going to mobilization and demobilization, any Task Leader planning a drilling effort would contact the other Task Leaders who might also need wells and negotiate a mutually compatible schedule and cost-sharing such that all non-characterization expenditures were minimized. This process is facilitated by a single Task Leader who has responsibility for implementation of the drilling contract in addition to responsibility for one of the more challenging ER sites.

Faster, Better, Cheaper

The title of this section has been a mantra within the DOE for years, and most often pertained to development of technologies that would enable those descriptors to apply to a remediation effort. In the beginning, the SNL ER Project accepted the premise that new technologies could be developed that would, indeed, make remediation faster, better, and/or cheaper.

However, in 1994, the ER Project was poised to begin remediating sites, and pertinent technologies were, in general, not yet available. Rather than waiting for the technologies, Project management rapidly concluded that wherever a low-tech remedial solution was available, it should be implemented in order to achieve the "faster" and "cheaper" parts of the equation. Thus, in an inelegant manner, with the focus on people and heavy equipment, ER proceeded to complete remediation after remediation.

This is not to say that the ER Project didn't use any innovative technologies. When a new technology was available at the time it could be utilized, ER incorporated it into site work if it made fiscal sense. A prime example of this was the use of the segmented gate system for

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reducing the volumes of radionuclide-contaminated soil at several ER sites. For four sites with a single primary radionuclide as the contaminant of concern (the system was not useful at sites with multiple radionuclides), a cumulative cost avoidance of almost $900K was realized.

THE STEP-FUNCTION SUCCESS

Implementation of one specific process has been the primary driver in cost and schedule reduction for the SNL ER Project – the "one-pass" process. When initially incorporated in the Project baseline, the life-cycle cost was reduced by more than $240M, and the expected Project schedule was shortened by 19 years. (Subsequent reductions in annual funding and scope increases related to landfill excavations have offset some of these gains.)

On the surface, the "one-pass" process is deceptively simple – eliminate all of the standard RCRA documents and review cycles, and replace them with a voluntary process that, in most cases, produces no more than two documents for delivery to the regulators (a Voluntary Corrective Action Plan and an NFA proposal) for regulatory review. The simplicity of the process is deceptive because, although it is straightforward, it relies heavily on rapport and real-time interactions with regulatory staff in order to avoid disconnects in adequacy of sampling, sufficiency of data, agreement on remediation goals, etc.

Nevertheless, the "one-pass" process was incorporated in ER's HSWA Module in 1997, significant effort was invested in the interactions with regulatory staff at all levels, and the productivity of the ER Project (in terms of sites completed and NFA proposals submitted) soared.

THE CULTURAL FRAMEWORK

As is too often the case, the cultural aspects of a successful business or activity are difficult to capture in words. So it is with the ER Project. Without the human side of things, the ER Project would have been significantly less productive. Below are descriptions of a few of the aspects of the culture that have been integral to ER success.

Teaming

Almost everything accomplished by the ER Project involves teams, both formal and informal. These range from the professional (teams involving management from the NMED, the EPA, DOE, SNL, and even the Los Alamos National Laboratory ER Project; management teams internal to SNL; staff teams focusing on specific technical topics) through informal (each Task Leader manages a team of people, but the composition of those teams is continually changing to adapt to work needs) to the athletic (numerous ER staff have participated in the Mt. Taylor Quadrathlon, in various types of teams, for the last seven years). At the same time, the entire Project staff is a team (or, as stated by more than one person, a family) that celebrates birthdays

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and marriages, mourns deaths and divorces, and finds many reasons to endure and enjoy together.

Within SNL, ER staff team effectively with numerous organizations, including those responsible for facilities maintenance and construction, purchasing, material transport, security, and environment, safety and health. One particular example pertains to groundwater monitoring. All groundwater sampling (staffing, timing, frequency, methods, analytes, and subsequent data management) are communicated and coordinated between ER staff and the corporate staff responsible for the SNL groundwater protection program. Both programs derive benefit from the leverage of two sources of funding and the avoidance of duplication of efforts. In addition, because the teaming is understood by the regulators, only one unified report is required as a deliverable each year.

In terms of accomplishing the ER goals, the most critical external teaming needs are with the customer (DOE) and with the regulator (the NMED). One reason for long-term ER success has been the teaming between SNL ER staff and local DOE staff. With few exceptions, these relationships have been focused on common goals, with mutual effort to remove barriers to those goals, rather than a more typical customer-supplier relationship in which SNL would be expected to solve problems and achieve goals on behalf of the DOE.

SNL and DOE have established excellent teaming relationships with the regulators, and particularly with the NMED. This was not always the case; in the early years, discussions were strained, disagreements were common, and the review-and-approval cycle could take several years. However, negotiation of the "one-pass" process broke many of the barriers to honest communication between the parties. Another major factor in breaking down the barriers was interaction between the SNL ER Project Manager and the NMED in Santa Fe to gain a mutual understanding of objectives and constraints relative to accomplishing the ER Project. Finally, several regulatory staff from the NMED have on-site offices collocated with the SNL ER Project. This proximity facilitates timely exchange of information as well as enabling Project staff to obtain real-time input on topics such as sampling adequacy and data defensibility.

"Just Do It"

Every member of ER is allowed to, and at times expected to, suggest innovative approaches to any part of the Project, from soil handling to sampling methods to better car-pooling to and from work. In fact, if something isn't illegal or unethical, and it maintains or enhances worker safety, staff are encouraged to try things and ask permission later. Making decisions and taking calculated risks is an every-day part of all levels of the Project. Some of the resulting improvements are moment- or activity-specific. Others carry into the entire Project and result in significant savings in time, labor, or money. Two examples are provided below.

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In the early years of the ER Project, ER funding came from EM-40, whereas funding for disposal of SNL waste, including ER-generated waste, came from EM-30 and was managed by non-ER organizations at SNL. As ER field work became more frequent, field projects began to stall because waste could not be generated unless it could be disposed, and disposal funds typically had been planned without regard for ER. The impasse led a staff member to ask "Why can't we pay for our own disposals, so we aren't hostage to EM-30 planning and funding?" The idea took hold, was negotiated with DOE, and before long the ER baseline included funding for off-site disposal of all ER-generated waste, so that ER field work became seamless and vertically integrated. A remediation could proceed from beginning to end without dependency on funding streams beyond ER's control.

Another example of staff initiative pertains to the way decontamination and decommissioning (D&D) has been handled at SNL. Originally, D&D was slated to be funded with ER by EM-40. The disconnect was that SNL had such low-priority facilities (in a national context) that no D&D funding was ever allocated to SNL. At the Project level, management began to ignore D&D under the assumption that the receipt of funding was so far in the future as to not warrant attention. However, some buildings at SNL still needed to be subject to D&D immediately. An ER staff member, teaming with two staff members from the SNL Facilities organizations, established an informal, staff-level committee in 1994 that began to accomplish D&D work in compliance with all applicable regulations without management involvement. By the time the relevant managers began to pay attention (and to subsequently give the committee an award for their quality processes), multiple buildings had been successfully processed through D&D. (The committee continues in operation, with landlord funding of $6M in FY2002.)

"Just Don't Do It"

One key to ER's success has been a philosophy that there are no sacred cows, either in ER processes or in nationally accepted approaches to doing ER work. When it was time to disinvest in an aspect of ER, the disinvestment was done quickly, and the Project moved on. As described earlier, ER didn't wait for high-tech solutions for remediation. Instead, the assumption that waiting for such solutions was the correct path was discarded, and a low-tech, "do it now" approach was implemented. Furthermore, ER decided after less than two years to discontinue funding its own internal technology development efforts and to focus funding on on-the-ground characterization and cleanup.

This disinvestment approach extended into different arenas. At the beginning of the Project, SNL was responsible for a number of ER sites at the Tonopah Test Range (TTR) in Nevada. Rather than retaining control of these sites and the funding associated with them, Project management suggested to the DOE customer that responsibility and funding be transferred to DOE/Nevada and be consolidated with the other TTR sites for which DOE/Nevada was already responsible. A Memorandum of Understanding was negotiated, and the SNL ER sites at TTR were transferred.

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Another key approach in this area is being selective about which battles to fight. For example, agreement was reached with the NMED on a set of background concentrations, as mentioned earlier. However, the provenance of each concentration varies. To start with, SNL derived each concentration using rigorous statistical analysis of hundreds of analytical results. Many of the concentrations used today as background are these statistical results, but not all. For some constituents, the NMED counter-proposed concentrations that they preferred, even though there was no statistical basis for the values. Rather than rigidly adhering to the statistics, Project management quickly evaluated the cost-benefit of the choices of concentrations, determined that acceptance of the NMED values would not unduly affect the status of any of the ER sites, and yielded to the NMED preferences. This choice saved time and money, and contributed to the ability to negotiate more difficult technical issues with the NMED.

Health and Safety

Throughout everything discussed above runs the thread of a focus on health and safety. The primary boundary condition for the ER Project is the objective that no one gets hurt and no additional harm comes to the environment as a result of Project activities. Health and safety plans, daily tailgate safety meetings, safety audits, and management involvement in the field all contribute to ER's record – no significant injuries and no environmental releases in over ten years of work.

THE BOTTOM LINE

The following are the highlights of the accomplishments of the ER Project to date:

- Submittal of 202 NFA proposals for the SNL/NM facility.
- Site Evaluation Accomplished (SEA) for 3 ER sites at the Kauai Test Facility.
- Completion and closure of all ER activities at the SNL facility in California.
- Evaluation and documentation of the SNL environmental liability at more than 250 other locations throughout the world.
- Remediation of the Gas Cylinder Disposal Pit (Level A with body armor; compressed toxic gases in corroded cylinders more than 30 years old; thorium; metals).
- Remediation of the Radioactive Waste Landfill (Level C; robotics; uranium, cesium, plutonium, tritium; some metals; nitric acid).
- Remediation of the Classified Waste Landfill (Level C; metals, tritium, PCBs; millions of individual classified items).
- Remediation of the Chemical Waste Landfill (Level B; metals, acids, bases, solvents, PCBs; tritium, uranium).
- Remediation of the Centrifuge Dump Site (Level C; depleted uranium, asbestos).
- Remediation of the old reapplication yard (PCBs, metals).
- Remediation of an explosive burial mound (UXO, expired munitions).

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- Numerous smaller remediations.
- Site-wide DU cleanup.
- Site-wide UXO cleanup.
- Site-wide hydrogeologic characterization.
- First RCRA-permitted CAMU in the DOE Complex.
- Project-specific EA.
- Characterization of four low-concentration groundwater plumes.

CONCLUSIONS

Over the last ten years, the Sandia ER Project has accomplished a great deal, and moved close to the goal of completing all ER work for which it is responsible. Many tangible products have been realized, laws have been complied with, and customers satisfied. Yet there was no recipe for this success, no flow chart to follow. Ultimately, the reason for the success to date has been the intangible: a group of people in multiple organizations who all have been focused on the same goal – a cleaner environment – and would rather move toward that goal than follow their personal agendas. The ER Project is a stirring example of what can be done when people care more about doing the right thing than they do about long-term job security for themselves, or about avoiding risk, or about what people think of their actions. People who can find fun in whatever situation is thrown at them, and who can continue to focus on the goal, can accomplish almost any task. Until the SNL ER Project draws to a close, the fun will never stop.

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