

ASSESSING AND IMPLEMENTING LONG-TERM SURVEILLANCE AND MAINTENANCE REQUIREMENTS FOR REMEDIATED SITES UNDER THE FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

ABSTRACT

The U.S. Department of Energy (DOE) initiated the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1974 to address concerns about radiological conditions at locations where work was performed for the Manhattan Engineer District and the U.S. Atomic Energy Commission. The DOE Office of Legacy Management (LM) is responsible for 27 FUSRAP sites and will ultimately assume responsibility for more than 50 FUSRAP sites. DOE–LM assumed responsibility for 25 FUSRAP sites in 2004 and began an assessment of site conditions to ensure that complete site knowledge was preserved in DOE records and that the sites are and will remain protective of human health and the environment.

For the assessment, site conditions were assumed to be dynamic. Therefore, the most restrictive site exposure scenarios were considered, as well as the implications for disturbing materials to which supplemental limits were applied. If conditions under these possible future scenarios were found to be protective, no use restrictions were needed. However, if future use or exposure scenarios could result in potential unacceptable risk, restrictions on site use were indicated. The assessment relied on access to documentation of site activities, characteristics, remedial action activities, remediated conditions, and land-use restrictions. In addition, an ongoing program of site visits commenced in 2005. DOE–LM assessed the level of knowledge and sought to identify and preserve site information for use by future custodians.

DOE–LM has applied lessons learned in site management since 1989, when a formal DOE program was established to implement long-term surveillance and maintenance (LTS&M) activities. Former FUSRAP staff members with the DOE Office of Environmental Management also conveyed lessons learned. We present the assessment process that was used, the application of results, and a framework for evaluating LTS&M requirements for FUSRAP sites.

INTRODUCTION

The U.S. Department of Energy Office of Legacy Management (DOE–LM) establishes long-term surveillance and maintenance (LTS&M) requirements for Formerly Utilized Sites Remedial Action Program (FUSRAP) sites to ensure that the sites remain protective of human health and the environment. These LTS&M requirements include evaluations of site conditions and any risks posed by hazardous materials or conditions that may remain. The evaluations also consider changes to land use or site configurations. General and site-specific measures to control risk and maintain protectiveness are identified, and issues concerning preservation of knowledge are discussed. Several case studies are offered to demonstrate how these principles are implemented. Fig. 1 presents the conceptual framework for site evaluation.

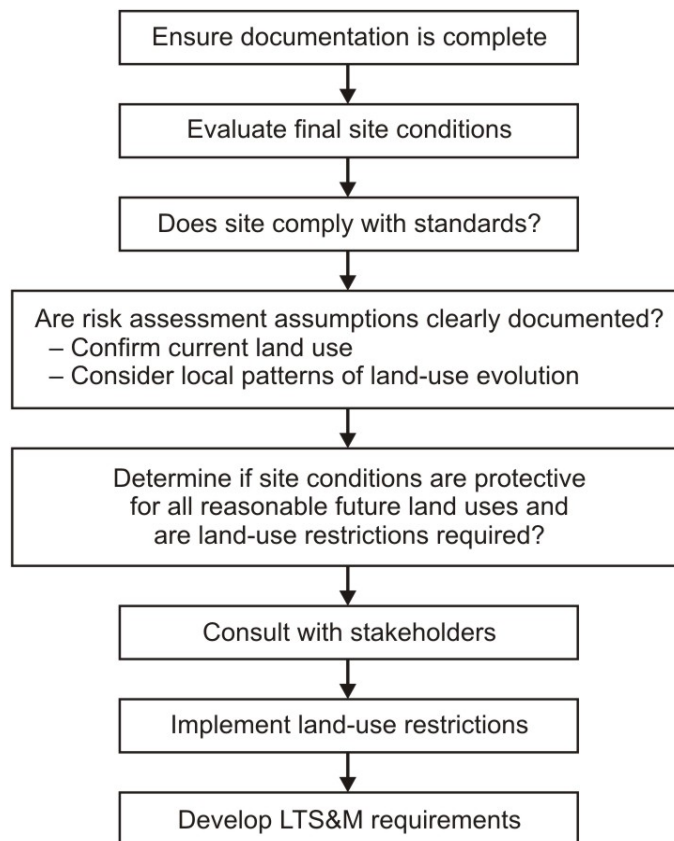


Fig. 1. Conceptual framework for evaluation of site protectiveness and LTS&M requirements.

PROGRAM BACKGROUND

DOE initiated FUSRAP in 1974 to address residual radioactive contamination remaining at sites where work was performed for the Manhattan Engineer District (MED) or the U.S. Atomic Energy Commission (AEC). Forty-six sites were identified for remediation under FUSRAP. DOE completed remedial action at 25 “Completed” FUSRAP sites before 1997, at which time remedial action responsibility was assigned to the U.S. Army Corps of Engineers (USACE).^a Additional sites have been added to FUSRAP by congressional direction. Fig. 2 presents FUSRAP site locations.

Roles and responsibilities for the agencies were defined in a 1999 Memorandum of Understanding [1], which stipulates that DOE will retain LTS&M responsibility for remediated FUSRAP sites. DOE and USACE initiated the FUSRAP Working Group in 2001 to coordinate transfer activities for remediated sites. In 2002, USACE received regulatory concurrence that remediation of two FUSRAP sites was complete, and DOE assumed LTS&M responsibility for those sites.

The DOE Office of Environmental Management (EM) transferred responsibility for the 25 Completed sites to DOE–LM in 2004. DOE met with DOE–EM FUSRAP staff to plan a transition of site information and institutional knowledge. In 2005, DOE–LM completed an appraisal of site conditions and documentation, which was reported in the *Long-Term Surveillance and Maintenance Needs Assessment for the 25 DOE FUSRAP Sites*. [2] This report recommended follow-on work to resolve questions or issues pertaining to documentation and LTS&M requirements. In 2006, DOE evaluated the follow-on recommendations and defined a path forward to resolve the remaining issues. Scope was added to the program to achieve resolution in fiscal year 2006.

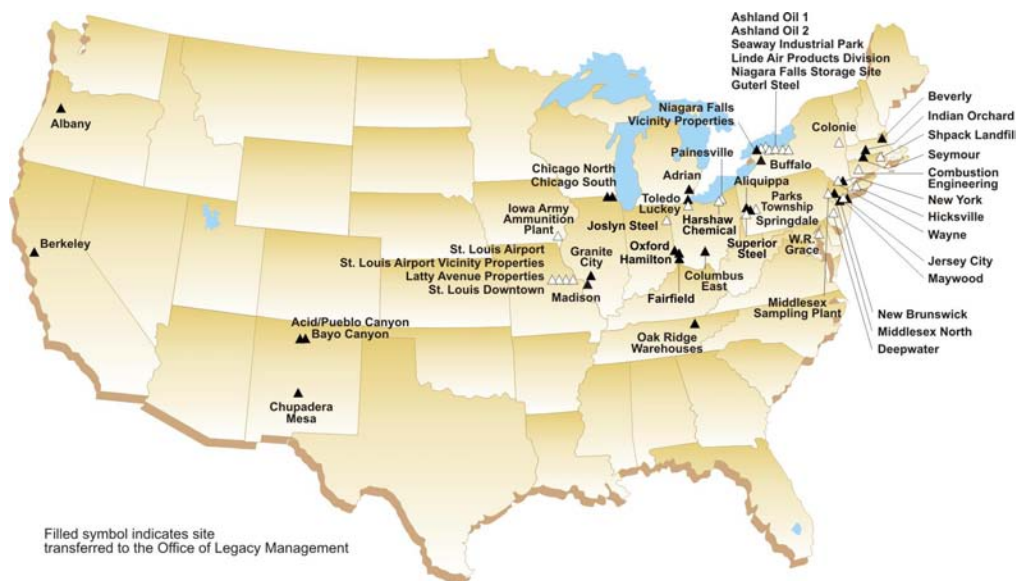


Fig. 2. FUSRAP site locations.

DOE-LM has been working to document and confirm the final conditions of the Completed sites and consequent LTS&M requirements. DOE began visiting Completed sites in 2005 to determine if land use or site conditions have changed since certification. To date, 15 sites have been visited. Information from these visits, combined with information in site documentation, is being evaluated to determine if LTS&M requirements for all remediated FUSRAP sites are appropriate.

FUSRAP Site Characteristics

FUSRAP sites are typically smaller industrial or research facilities. Most are privately owned, but some sites are owned by other government agencies. Five sites are owned by DOE; DOE transferred a sixth site in Wayne, New Jersey, to Wayne Township in September 2006. Non-DOE ownership compels DOE to resort to institutional mechanisms to prevent unacceptable risk at remediated FUSRAP sites that cannot be released for unrestricted use.

Typical processes that resulted in contamination include machining, manufacturing, metallurgical research, processing, and storage. Potential contaminants include uranium, uranium or thorium ore, and processing tailings and associated waste. Contaminated media include soil, ground water, and structures.

Permanent disposal options were not available for contaminated soil and debris early in the program. Therefore, DOE acquired properties for interim on-site storage so that remediation could proceed at nearby vicinity properties. As facilities became available to accept FUSRAP waste for permanent disposal, radiological waste at five of these DOE-owned locations was (or is planned to be) shipped to off-site permanent disposal facilities. The remedy for the Niagara Falls Storage Site has not been selected.

Upon transfer of the 25 Completed sites in 2004, DOE-LM commenced a program to evaluate site conditions and develop LTS&M practices that ensure ongoing protection of human health and the environment. Site documentation was reviewed. Documentation was available on the Considered Sites Database and in files assembled by DOE-EM for FUSRAP to determine site eligibility; all records were transferred to DOE-LM in 2005. Until 1997, DOE had managed remediation from its Oak Ridge,

Tennessee, Office. In 1997, Oak Ridge transferred records for the Completed sites to the Federal Records Center in Kansas City, Missouri. Records for the Active sites were transferred to USACE. DOE is still in the process of locating all historical records pertaining to FUSRAP sites. The records review indicated several issues for further evaluation. These included application of supplemental limits and restrictive future-use assumptions, and the need to record institutional controls.

At some sites, minor radiological contamination was left in place because it posed no risk and remediation either was not safe or the cost of remediation far exceeded the benefit to remove contamination that posed no unacceptable risk in its left-in-place configuration. Remediation guidance contained provisions for applying supplemental limits in cases where the numerical limits could not be achieved except at an unreasonable cost or through activities that were unsafe to workers or the environment. If reasonable future exposure scenarios would not result in unacceptable risk, DOE Headquarters approved the application of supplemental limits, and the contamination was left in place.

At some locations where supplemental limits were applied, DOE assumed that land use would remain unchanged, which was the case at several industrial sites where minor residual contamination was fixed in place by grouting drain lines. Exposure scenarios were developed for maintenance and utility workers. Risk resulting from residential use was not addressed in site documentation in every case. Use restrictions may not be required for some of these sites. Although based on lessons learned from more than 20 years of formal postclosure care operations, DOE assumes that land use will likely change before radiological contaminants cease to be hazardous (Fig. 3). Therefore, restrictions should anticipate change and, if needed, should be recorded in public records to preserve knowledge.



Fig. 3. The Hamilton, Ohio, Site (HMM Safe Co) is situated in an area that is undergoing land-use change from light industrial to commercial. Residential use is nearby.

DOE–LM began visiting Completed sites to establish a baseline of site conditions and determine appropriate future oversight actions. These were generally drive-by visits to ascertain if land use has changed at the site and in the site vicinity. Physical conditions were noted and concerns were recorded for follow-up evaluation (Table 1). These visits, which were conducted by staff trained to evaluate site protectiveness on the basis of physical site conditions, were in conjunction with DOE–LM inspection trips to other sites to reduce cost.

Table 1. Summary of FUSRAP Site Visits

Site (former name)	Date Visited	Land Use as Remediated	Land Use as Found	Notes
Aliquippa, Pennsylvania (Aliquippa Forge)	9/2005	Industrial	Industrial	Found monitor wells
Springdale, Pennsylvania (C.H. Schnorr)	9/2005	Industrial	Industrial	Appears unchanged
Middlesex North, New Jersey (Middlesex Municipal Landfill)	9/2005	Landfill	Landfill	Found monitor wells
New Brunswick, New Jersey (New Brunswick Laboratory)	9/2004	Research	Vacant	Applied use restrictions for arsenic in soil
Wayne, New Jersey (Wayne Interim Storage Site, W.R. Grace)	9/2005	Vacant	Vacant	Applied best management practice; ground water use restriction
Oxford, Ohio (Alba Craft Laboratory)	6/2006	Industrial	Residential	Fabrication shop razed; duplex on portion of property
Hamilton, Ohio (HHM Safe)	6/2006	Industrial	Commercial	Used for storage; area being redeveloped
Toledo, Ohio (Baker Brothers)	6/2006	Industrial	Industrial	One building razed
Fairfield, Ohio (Associate Aircraft)	6/2006	Industrial	Industrial	Addition on front of building
Columbus East, Ohio (B&T Metals)	6/2006	Industrial	Derelict	Distressed urban area near Ohio State University
Chicago North, Illinois (National Guard Armory)	9/2005	Nat'l Guard Armory	National Guard Armory	Land use appears stable
Acid/Pueblo Canyon, New Mexico	8/2006	Recreation	Recreation	Additional assessment and remedial action by NNSA
Bayo Canyon, New Mexico	8/2006	Recreation	Recreation	Additional assessment and remedial action by NNSA
Buffalo, New York (Bliss and Laughlin Steel)	9/2006	Industrial	Industrial	USACE informed DOE of change in ownership
Niagara Falls Vicinity Properties	9/2006	Industrial	Industrial	Mostly derelict or vacant properties; some used for commercial municipal or hazardous waste disposal

Characteristics of individual Completed sites are summarized in *Long-Term Surveillance and Maintenance Needs Assessment for the 25 DOE FUSRAP Sites*. [2] Detailed site descriptions are posted in documentation on the Considered Sites Database at <http://csd.gjo.doe.gov/index.cfm>.

Regulatory Framework

USACE and DOE generally have followed the remedial action process prescribed in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). [3] However, some of the earlier remedial actions conducted by DOE predate CERCLA and followed practices established at that time for radiological protection. These practices were equivalent to the CERCLA process, following a process of assessment, planning, remediation, validation, and certification.

MED and AEC had programs for monitoring exposure and managing radiological hazards. At the conclusion of contracted activities, MED or AEC oversaw site decontamination and determined the sites were suitable for use without unacceptable risk. Depending on contracting provisions, the various sites were remediated by MED or AEC, or remedial action was conducted by owners with agency oversight. In the intervening time between when MED or AEC released the sites and the advent of FUSRAP, land use changed as sites were redeveloped. Knowledge of historical activities, cleanup, final conditions, and use restrictions was dissipating. Some radiological protectiveness standards and guidelines evolved. DOE established FUSRAP to ensure protectiveness at MED and AEC sites.

Candidate sites for FUSRAP remediation were those with a potential for radiological contamination. When FUSRAP was first implemented, no radiological cleanup standards existed that were broadly applicable to FUSRAP sites. Cleanup standards were developed on a site-specific basis, drawing from applicable standards and guidance then in effect. Field offices conducted cleanups using local procedures and protocols for addressing local contaminant suites and occurrences.

DOE established general standards in the *Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites* (FUSRAP Guidelines).[4] The FUSRAP Guidelines are generally equivalent to DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, which still governs cleanup goals for DOE-sponsored radiological remediation. The FUSRAP Guidelines established numerical limits for radionuclides in soil and for surface contamination. They also stipulate total dose limits from all routes of exposure, protocols for averaging contamination residuals for comparison to numerical limits, protocols for addressing a mixture of radionuclides, and maximum (“hot spot”) concentration (or specific-activity) limits.

The FUSRAP Guidelines established exceptions to attaining numerical limits. Supplemental limits could be applied if an occurrence of contamination met certain stringent conditions. One condition is that the occurrence cannot pose unacceptable risk to human health and the environment (FUSRAP Guidelines, Section F).[4] Each application of supplemental limits was evaluated and approved by DOE Headquarters.

The 25 Completed sites (remediated by DOE before 1997) conformed to then-current standards for radiological safety. In remediating the Completed sites, DOE was technically self-regulated under the authority of the Atomic Energy Act. [5] However, the FUSRAP record contains many examples of DOE interaction with state regulators to establish applicable cleanup criteria and select a remedy.

Since 1997, USACE determines the remedy and obtains concurrence from site regulators. Six sites are listed on the National Priorities List (NPL), in which cases the U.S. Environmental Protection Agency is typically the lead regulator. At non-NPL sites, state regulators provide regulatory oversight. At all Active sites, USACE conducts an analysis of Applicable or Relevant and Appropriate Requirements (ARARs), which are presented in a decision document and approved by regulators. DOE does not formally provide input to remedy selection. Restrictions on future land use will be part of the selected remedy at some FUSRAP sites. For regulator concurrence in site completion and protectiveness, enforcement protocols will typically be defined that identify enforcement mechanisms and entities with oversight authority.

FINAL SITE CONDITIONS

Radiological conditions at completion of remedial action are documented in FUSRAP records. Contaminant levels were compared to numerical limits. Typically, protectiveness was validated through a risk assessment. The risk assessment would consider potential future uses. Final radiological conditions can be separated into two cases: (1) radiological concentrations or activities conform to numerical

standards or limits and risk assessment verifies that unrestricted use will not result in unacceptable risk and (2) supplemental limits or standards are applied for contamination left in place, future land use may be restricted, and long-term management may be required to maintain protectiveness.

Unrestricted Use Sites

An unrestricted use site is a remediated site that can be used for any possible land use without posing unacceptable risks to the public or the environment. Public, or human, health is quantified through a risk-assessment process. This process is followed in establishing regulatory numerical limits, so conformance to these limits and standards implicitly establishes that use restrictions are not required. The numerical limits are established to ensure that dose limits are not exceeded.

For unrestricted use, risk resulting from any exposure scenario must not be unacceptable. A residential farming scenario is usually the most conservative land use because of the duration of exposure and the potential for biouptake of contamination residuals in locally produced foodstuffs. If this land use does not pose unacceptable risks, the property usually can be released for unrestricted use. However, other scenarios may also need to be considered to ensure that all anticipated future land uses pose no unacceptable risk. Because of the persistence of radiological contaminants at these sites, DOE must carefully consider if current, less restrictive land use will be equally persistent. Environmental risk is considered through the remedy selection and implementation process by adhering to National Environmental Policy Act requirements.

An unrestricted use site (Fig. 4) has no occurrence of residual radioactive contamination that exceeds standards and limits established for the site. These standards and limits may be referred to as remediation criteria and can be either numerical values established in regulations or values derived for a specific site. Regulator concurrence in cleanup criteria should be documented. A site cannot be eligible for unrestricted use if supplemental limits, supplemental standards, or another form of alternate concentration limits have been applied to any occurrence of residual radioactive contamination *and* a change of the land use or the configuration of the supplemental limits material will result in unacceptable risk or will violate applicable laws and regulations.



Fig. 4. The Columbus East, Ohio, Site (B&T Metals) may be redeveloped for any land use because the site was released without restrictions.

Compliance with cleanup criteria is documented in a verification or closure report that includes or references final radiological measurements and compares those results to standards and limits to demonstrate that there are no exceedances. The report should reference data quality objectives and demonstrate that those are met so that the measurements of site conditions accurately represent actual conditions. The report also should demonstrate that any residual contamination does not pose an unacceptable risk under any reasonable future-use scenario. Regulators acceptance of the final report should be documented.

Supplemental Limits Sites

At some DOE-remediated sites, residual radioactive contamination was left in place, even though contaminant concentrations exceed the numerical maximum concentration levels for the site. The regulator(s) may approve the application of supplemental limits to the occurrence, which is justified by criteria in the FUSRAP Guidelines or other remediation standards. Material could not be left in place unless DOE documented that there would be no unacceptable risk to human health or the environment for defined land uses or appropriate controls were placed on the residual contamination to maintain protectiveness.

USACE may apply supplemental limits or their equivalent to contamination left in place, as well (this can include ground water) as permitted in approved ARARs. USACE would also have to demonstrate that exposure is controlled.

Application of supplemental limits pertains to a precisely defined occurrence of residual radioactive contamination and must be coupled with an assessment of risk. The risk assessment will contain assumptions about the relationship between the contamination and possible receptors. To maintain protectiveness, the assessment conclusions will determine whether the material can be handled or moved or it must remain in its as-left configuration.

RISK ASSESSMENT

Potential risks posed by various site uses are directly related to the nature of residual contamination and its occurrence, potential exposure pathways, and occupancy patterns (e.g., proximity to the residual contamination, exposure duration, and identified receptors). Risk assessments are used to determine permissible future land use and LTS&M requirements.

To ensure that the Completed sites remain protective, DOE reviewed site documentation that describe final (remediated) site conditions and assumptions about future use. Documentation included closeout reports and risk assessments.

It should follow that if standards and limits are not exceeded, there should not be unacceptable risks for future site occupants *provided the criteria are established for the most restrictive possible future land use*. Any derived remedial action criteria should be based on an analysis of risk or an exposure scenario. Any less restrictive land use was flagged for further evaluation.

Land-use assumptions and exposure scenarios used to model risk should consider potential future changes in land use. Land uses or disturbances that would require follow-on action in the future should be identified. Use restrictions will derive directly from the assessment of unacceptable risk for certain activities or uses, including the consequences of dispersal or disposal. Land-use restrictions based on unacceptable risk should hold valid for as long as the residual radioactive contamination remains hazardous. This approach is consistent with DOE and U.S. Environmental Protection Agency (EPA) guidance.[6,7]

If a residential-use scenario, or that scenario that includes the maximally exposed receptor, would not result in unacceptable risk, DOE will likely conclude that any future land use will be protective. The residential-use scenario should consider inadvertent handling or disposing of any residual contaminated material.

If protectiveness depends on constraints, such as limiting property to industrial or recreational use or otherwise limiting exposure, use restrictions and controls will be established to ensure that the constraints are observed. Various future site scenarios are considered in the following sections. These pertain to sites where certain uses may result in unacceptable risk.

Site Conditions Unchanged

For supplemental limits sites, the remedy will remain protective as long as site conditions remain unchanged. Reassessment of risk is not required.

Site Redevelopment

Redevelopment or other change in land use can invalidate land-use assumptions and exposure scenario parameters used to assess risk. Changed land use may result in increased risk. For example, a building may be constructed over buried contamination, or site topography may be modified and change the isolation parameters for residual contamination left in place.

If surveillance reveals that land use has changed or a change is proposed, DOE must ensure that the new use is protective (Fig. 5). This will likely entail an evaluation of risk-assessment parameters to determine if they remain valid. If not, the parameters should be redefined and risk reassessed for the changed land use. Restrictions will be implemented to prevent inappropriate use, and ongoing LTS&M is required to ensure that the restrictions are not ignored or forgotten. DOE-LM will review the established LTS&M Plan to determine if it appropriately manages the new risk profile and will revise the plan appropriately.

Dispersal

Risk assumptions will likely change significantly if residual radioactive contamination in a supplemental limits area is moved or otherwise disturbed. Absence of risk for a given land use is a criterion for applying supplemental limits. When the configuration of an occurrence of supplemental limits material changes, the assumptions for approval of supplemental limits are also changed, and the material is likely subject to (and may be treated as if it exceeds) numerical concentration limits.

If supplemental limits were applied because the material was inaccessible, removal cost outweighed the benefits, or removal posed an unacceptable risk to workers or the environment, then disturbing supplemental limits material implies that the material is no longer inaccessible or too expensive or risky to relocate. The material reverts to hazardous material that exceeds numerical limits. DOE will remain a responsible party, at least in part, for regulated or hazardous FUSRAP waste. DOE will consider if dispersal of the material would result in unacceptable human health, environmental, or programmatic risks. If so, DOE will implement effective controls to prevent dispersal.

Disposal

The possibility exists that supplemental limits material might be disposed of at some future time. Disposal must conform to applicable requirements. These can include waste classification requirements (e.g., low-level waste or Atomic Energy Act Section 11e(2) waste[5]) or disposal restrictions for solid or other

waste (these restrictions often limit the radioactivity that can be disposed of in a licensed or permitted landfill or wastewater treatment facility). DOE will consider if the supplemental limits material would violate applicable disposal requirements if it were removed to another location in the future. If so, DOE will implement effective controls to ensure proper disposal.



Fig. 5. The Alba Craft Laboratory at the Oxford, Ohio, Site, was razed and a duplex was built on a portion of the property.

MAINTAINING PROTECTIVENESS

This section discusses the many facets of the LTS&M program established for FUSRAP sites. The principles are the same as for any DOE-LM site, but some FUSRAP attributes present unique challenges to site custodians, such as private ownership.

Objectives for LTS&M of FUSRAP sites are to maintain protectiveness through

- Controlling exposure to site hazards;
- Restricting use, as needed;
- Establishing enduring controls; and
- Preserving knowledge.

DOE assumes that land use will change and knowledge can be lost. LTS&M operations are designed to address these vulnerabilities.

LTS&M Activities at Transition

As FUSRAP sites are transferred to DOE for long-term care, DOE-LM will acquire site documents and institutional knowledge of operations and final site conditions to allow evaluation of LTS&M requirements and informed decision-making by future custodians. DOE will evaluate the exposure scenarios and the risk assessment used to determine protective future uses. For unrestricted use, DOE will ensure that all likely future land uses are considered in the risk assessment and the most restrictive (i.e., highest risk) land use does not result in unacceptable risk. If certain land uses result in unacceptable risk, such uses will be restricted, and DOE will define postclosure care requirements in an LTS&M Plan.

USACE will provide plans for maintaining active ongoing remediation systems and use restrictions that are a part of the selected remedy, which will be incorporated into the LTS&M Plan.

LTS&M Operations: Maintaining the Remedy

After remedial action is complete, DOE–LM conducts activities necessary to ensure that sites remain protective and in full compliance with applicable regulations. LTS&M requirements for FUSRAP sites are defined by the remedy selected by DOE for Completed sites and the remedy selected by USACE and approved by regulators for Active sites. If residual contamination remains on a site, LTS&M activities can include maintaining access or institutional controls, conducting inspections or monitoring, and reporting site conditions to stakeholders. Other activities will likely include periodic evaluations of site protectiveness (similar to CERCLA 5-year reviews), evaluations of monitoring results, and updating risk assessments. DOE–LM conducts all activities using LM federal and contractor staff members and draws upon existing resources and expertise. LTS&M requirements for FUSRAP sites released for unrestricted use will typically consist of managing site information and providing any requested support to stakeholders.

DOE–LM will continue the process of visiting and researching the 25 Completed FUSRAP sites to ensure that land-use assumptions remain valid, all postclosure care requirements are satisfied, and site information is documented for future program staff. A discussion of general principles and FUSRAP-specific implementations for various LTS&M elements is presented in the following sections.

Institutional Controls

For this discussion, institutional controls (ICs) are defined as in DOE Policy P 454.1, *Use of Institutional Controls* [6], except that this discussion addresses mostly legal controls rather than engineered or administrative controls. IC legal instruments rely on governmental and private entities to help control exposure to residual radioactive contamination. Properly designed ICs take advantage of established systems to retain institutional knowledge of site conditions and use restrictions.

For a site released for unrestricted use, protectiveness does not depend on site-specific land use (i.e., all uses are acceptable). Therefore, DOE–LM will not have an interest in ensuring that site conditions remain unchanged. The site may be redeveloped for any use.

ICs will be required for FUSRAP sites where residual radioactive contamination was left in place and unmanaged disturbance may create unacceptable risk. DOE will implement appropriate ICs at sites where engineered and administrative controls do not fully control risk. ICs are indicated where ongoing protectiveness relies on prevention of some action (e.g., use, redevelopment, or disposal). ICs may also be indicated to control programmatic risk, for instance, to prevent inappropriate disposal of FUSRAP materials.

If ICs are a component of a selected remedy for an Active site, USACE will develop and implement the necessary ICs and demonstrate their effectiveness before the remediation is determined protective.[8]

The evaluation of the 25 Completed sites may indicate ICs are prudent for several of the sites, although none have been implemented. At several of these sites, residual radioactive contamination was left in place in a protective configuration but should not be disturbed. Examples are the Adrian, Michigan; Seymour, Connecticut; and Bayo Canyon, New Mexico, sites.

Contaminated ground water will remain at several FUSRAP sites. At these locations, DOE will likely conduct monitoring to evaluate water quality and ensure that contaminant levels are safe at points of exposure. ICs create another layer of protectiveness to prevent exposure through measures such as restricting water well installation.

Institutional Controls Management—ICs for FUSRAP sites must be managed. A management plan must be designed and implemented to ensure that an IC remains effective in controlling public health, environmental, and programmatic risks. Possible consequences of IC failure include no harm, harm or damage to human or environmental health, loss of control of hazardous or regulated materials, costly responses to loss of control, and diminished public perception of safety. In this context, “failure” is any loss of oversight and control and does not necessarily result in diminished protectiveness. Failures have resulted when the party responsible for IC oversight has not followed through in establishing or maintaining an IC or when a party violates an IC because it is unaware of it. DOE–LM complies with the IC management policy established in DOE Policy P 454.1, *Use of Institutional Controls*.^[6]

DOE assumes that any IC may fail and will implement a management program to counter the means by which failure may occur. In developing an LTS&M Plan for a FUSRAP site (which may incorporate a land-use controls plan developed by USACE as part of an Active site remedy), DOE will consider possible activities that might result in loss of control of regulated or hazardous materials. DOE will design the management program to ensure that all entities that have an oversight role will be made aware of activities involving the materials (e.g., well drilling, site redevelopment, response to severe weather, site or regional development). To prevent loss of awareness, the plan may stipulate regular contact between DOE and involved parties. IC information will often be recorded in real property records to inform future owners. DOE will consider layering ICs to provide redundant controls (“defense in depth”) and will work closely with local, state, and federal regulators and land-use agencies to design a management program that is adapted to land-use systems in place, such as development and construction permitting, water use permitting, or zoning systems. An IC management plan may prescribe surveillance for sites with constraints on permissible usage to ensure that protective site conditions have not changed.

DOE IC management policy is consistent with the principles underlying a CERCLA periodic (5-year) review. States may also regulate IC implementation. DOE–LM determined that the previously stated principals for IC management are consistent with New Jersey Department of Environmental Protection regulations that apply to the New Brunswick, New Jersey, FUSRAP site, where DOE–LM is establishing an IC to prevent disturbance of an occurrence of arsenic in soil.

Institutional Controls Enforcement—ICs must be enforceable or there is no assurance of risk control. The often-stated enforcement mechanism is to seek an injunction through the appropriate court to halt an activity that violates an IC. Other mechanisms work through local, state, and federal laws to establish police powers for agencies that have IC oversight responsibilities. Several states (e.g., Colorado and Utah) have recent environmental covenant regulations that establish enforcement authority. Ideally, effective oversight will prevent a violation of an IC that would lead to an enforcement action. In any case, timely awareness of an IC violation will reduce the potential risk of exposure (or at least the exposure duration), dispersal, remediation, and diminished public trust.

DOE will evaluate enforcement mechanisms to ensure that a particular IC can be enforced in case of violation. Implementing an effective IC may require DOE to obtain concurrence from regulators and oversight agencies that the enforcement mechanisms comply with applicable laws and regulations. If ongoing enforceability is required, DOE will periodically determine if laws and regulations have changed.

Inspections and Monitoring

Remedial action results in an end state that is protective as long as site conditions do not change. Inspections and monitoring programs are designed to assess the degree to which physical conditions at a site have changed. Inspections and monitoring may be appropriate for any site that cannot be released for unrestricted use. These activities may be intended to provide “negative data” to stakeholders to demonstrate that a site remedy continues to perform as designed (i.e., the site remains protective). Inspections may be designed to also evaluate whether an IC has been violated.

DOE–LM will conduct follow-up inspections or focused monitoring from time to time in response to inspection or monitoring results or stakeholder questions or concerns. Often, this entails a simple site visit to check conditions but may require a more complex response, such as on-site measurements and evaluation by subject matter experts. DOE will design inspection and monitoring programs to provide early warning of a departure from final remediated site conditions or acceptable protective site conditions. The programs will provide sufficient data to reveal trends in site conditions. Inspections and monitoring will also disclose departures from compliance with applicable laws and regulations (e.g., off-site sediment transport, noxious weeds, and litter).

Monitoring of any environmental medium may be indicated. Monitoring may be required in perpetuity or for a finite period of time to demonstrate that performance assumptions for a remediated site remain valid. Monitoring objectives need to be clearly defined and documented so criteria for terminating monitoring are established. A monitoring program will often be designed with input from (“in consultation with”) regulators and public agencies, even if DOE activities are authorized under the Atomic Energy Act.[5] This ensures that agencies that might be contacted by other stakeholders to understand monitoring and inspection drivers and objectives and to concur that the monitoring and inspection program adequately contributes to and demonstrates protectiveness. DOE presents monitoring and inspection results to stakeholders through the LM website (<http://www.LM.doe.gov/>). DOE–LM may identify local resources for sites with routine inspection or monitoring requirements for instances in which a site condition needs to be checked to determine an appropriate response to a site concern.

Maintenance

DOE will conduct maintenance to ensure that site conditions remain protective. Site-specific maintenance requirements are driven by features of the selected remedy, regulations and laws, and best management practices. DOE policy and guidance will impose additional requirements for maintenance activities, such as compliance with worker safety regulations and environmental laws.

DOE–LM must maintain the physical controls that are part of a remedy. This will include maintenance of engineered controls (disposal cells or other waste isolation systems), configuration of supplemental limits areas, access controls (such as fences and gates), and notification devices such as signs and boundary monuments. Laws and ordinances that apply to land owners or permittees drive other maintenance requirements, such as well maintenance, litter control, or noxious and invasive weed control.

Inspection and monitoring activities include an evaluation of maintenance needs. DOE requests sufficient funding to keep maintenance current to ensure that physical and engineered structures function as designed. Maintenance is also required to maintain site appearance to reassure stakeholders that DOE is managing risk.

DOE often establishes local resources for sites where the remedy includes maintenance of structures or facilities for instances in which a site condition needs to be checked to determine an appropriate response

to a site concern. This has the added benefit of establishing some institutional knowledge in the local community.

Maintenance requirements and associated costs are estimated for about 75 years into the future and incorporated into DOE long-range planning.

Stakeholder Support

Stakeholder support addresses controlling risk and maintaining public trust in site protectiveness through an active program of stakeholder interaction. DOE–LM partners with stakeholders to extend site oversight, establish awareness of LTS&M activities and requirements, and maintain institutional knowledge. Stakeholders can include owners, regulators, state and local officials, and the public.

DOE–LM site, program, and contact information is available on the Internet at <http://www.LM.doe.gov/>. Stakeholders can also request specific information that is not available online. DOE–LM provides information directly to stakeholders in response to inquiries or Freedom of Information Act (FOIA) requests. DOE–LM expects to receive between 12 and 18 FOIA requests each year related to FUSRAP activities.

The Considered Sites Database is available on the LM public website at <http://csd.gjo.doe.gov/index.cfm>. This database presents the results of eligibility evaluations for the approximately 600 candidate FUSRAP sites, documentation that supports decisions, and documentation of activities through cleanup and site closure for remediated sites.

Local and state government representatives are often the first point of contact for a concerned citizen. Government agencies may have an oversight role in managing ICs. If a stakeholder contacts DOE–LM about a FUSRAP site, DOE may contact local representatives and provide contact information and information about how to retrieve site documentation from the LM website.

Until 1997, DOE maintained local public information repositories for sites during remediation. USACE has continued this practice, as required under CERCLA.[3] Upon site transition, DOE–LM will inventory the local information repository and determine if there is sufficient interest to maintain it. For repositories that will be kept current, DOE will submit new information as it is available and include current contact information for use by stakeholders.

Most FUSRAP sites are *not* owned by DOE or another federal agency. For sites released for unrestricted use, USACE will inform owners of site closure and transfer to DOE. After transition, owners will likely not need to contact DOE. For sites that are released with use restrictions (including sites with occurrences of residual radioactive contamination for which supplemental limits have been approved), owner notification will prevent the *inadvertent* disturbance of the supplemental limits material. This information will be included in the IC package for such a property. ICs will typically entail regular contact with the owner and local oversight stewards (e.g., land-use planning or permitting agencies).

Information Management

Site records are archived for the use of future custodians. Records must be located and retrieval ensured, and the information must be preserved. Records must describe site operations that resulted in waste generation, the extent of contamination, remedial action activities, final site conditions, site verification, and regulator concurrence. Records documenting postclosure protectiveness and use restrictions must be

preserved. FUSRAP staff must be able to retrieve records in response to inquiries related to worker health and safety and determinations of responsible parties.

Information and records management for FUSRAP sites presents challenges not associated with single transition sites, such as the Fernald, Ohio, site. FUSRAP activities were conducted by MED and AEC, beginning in the 1940s, and were administered from multiple offices. Agency succession resulted in records being disseminated to different storage locations or DOE facilities. Multiple DOE Area and Operations Offices conducted remediation activities during the early years of FUSRAP. Records were further sorted and dispositioned when the DOE Oak Ridge, Tennessee, Operations Office passed remedial action responsibility to USACE in 1997, and DOE-EM maintained a small project staff in Germantown, Maryland.

Upon transition of a site to DOE, USACE provides records that would be included in an Administrative Record and an information repository. DOE-LM will request electronic copies of site documents, geospatial data, monitoring results, photographs, and any other available electronic information. Milestone documents will be posted on the DOE-LM website (<http://www.LM.doe.gov/>). DOE-LM will use the geospatial data for base maps for use at sites with active LTS&M requirements. Monitoring data are needed to track trends and demonstrate protectiveness. DOE-LM also requests metadata for USACE remediation records sent to Federal Records Centers.

Historical records are needed for eligibility determinations (i.e., does a site meet eligibility criteria for remediation and postclosure care under FUSRAP). Eligibility determination involves evaluating the contractual relations and physical activities for a site, as DOE had done for approximately 600 candidate FUSRAP sites.

Real Property Management

DOE owns five FUSRAP sites. In keeping with the Department's goal of returning sites to beneficial use, DOE-LM intends to disposition the sites as quickly as possible after transition from USACE. DOE transferred the Wayne, New Jersey, site to Wayne Township through the General Services Administration and the National Park Service Land for Parks program in September 2006. DOE-LM expects the New Brunswick, New Jersey, site to be released by USACE in the near future, and DOE intends to also transfer that property to local government. For these and future transfers, required ICs are incorporated into transfer documents, and DOE will monitor use as necessary to ensure that institutional controls remain effective in controlling risk.

CASE STUDIES

Two examples are presented of issues identified as a result of the evaluation of the Completed sites initiated by DOE-LM in 2004. Resolution is ongoing, but LM has confirmed these two sites and the remainder of the 25 Completed sites are protective.

Bayo Canyon, New Mexico—This site was used by MED to develop implosion devices. Sr-90 contamination was assessed on soil. Los Alamos demolished affected structures, and most of the contaminated soil was removed to a permanent disposal facility. Some contaminated material was left at depth, so six boundary monuments were installed and the remedy specified recording excavation restrictions with the property deed. The property was transferred to Los Alamos County in 1967.

DOE-LM reviewed site documents and determined that the excavation restrictions had not been recorded. LM staff visited the site in 2006 and found the boundary markers in place, but one of the engraved caps

was missing. DOE Los Alamos staff surrounded the contaminated area with chain link fence and posted it as a soil contamination area (Fig. 6).

This site was transferred to FUSRAP in 1974, but additional remediation has since been conducted. Because LM does not perform remediation, it is appropriate that Los Alamos has ongoing involvement at this site and is ensuring protectiveness. However, FUSRAP information in the Considered Sites Database does not yet direct the public to NNSA staff, and the remedy requirement to record the excavation restriction has not been implemented. DOE–LM will coordinate FUSRAP activities with NNSA to ensure that there are no gaps or duplication in site management.



Fig. 6. Markers were set at the Bayo Canyon, New Mexico, Site to inform the public of an excavation restriction imposed because of Sr-90 residuals in soil.

Adrian, Michigan—AEC conducted metallurgical research on uranium metal at this location. During remediation, supplemental limits were applied to residual contamination left in drains and grouted in place. The action to apply supplemental limits included an assessment of risk, which indicated the site could be released for unrestricted *industrial* use.

DOE–LM is reviewing the assessment of risk posed by the supplemental limits material to residential users to determine if the supplemental limits material, in its present configuration, would pose unacceptable risks to residents. There are many examples of industrial areas being redeveloped for residential use (“gentrification”) to provide urban housing opportunities in formerly industrial settings; Therefore, a redevelopment scenario is not implausible albeit unlikely. The evaluation will consider if residential use may ensue and if it can be allowed without controls, if the material poses unacceptable risks if it is handled during construction, or if disposal restrictions would apply if the material is removed. If any of these conditions apply, LM will recommend that deed restrictions be implemented to preserve knowledge of the residual contamination and prevent inadvertent exposure or improper disposal.

REFERENCES

1. U.S. Department of Energy/U.S. Army Corps of Engineers DOE/USACE, “Memorandum of Understanding between the U.S. Department of Energy and the U.S. Army Corps of Engineers Regarding Program Administration and Execution of the Formerly Utilized Sites Remedial Action

Program (FUSRAP),” available at http://www.lm.doe.gov/documents/3_pro_doc/8_references/framework/fusrapmou.pdf (March 1999).

2. U.S. Department of Energy, “Long-Term Surveillance and Maintenance Needs Assessment for the 25 DOE FUSRAP Sites,” DOE M/GJ8342005–DOE-LM, Grand Junction, Colorado, March, available at http://www.lm.doe.gov/documents/4_land/fusrap/FUSRAP_needs_assessment_March05.pdf (2005).
3. Comprehensive Environmental Response, Compensation, and Liability Act of 1980, Title 42, United States Code, Part 9601, et seq.
4. U.S. Department of Energy, “Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites,” Rev. 1, (July 1985).
5. Atomic Energy Act of 1954, 42 United States Code 2011, *et seq.*
6. U.S. Department of Energy, “Use of Institutional Controls,” Policy P 454.1, Washington, DC, available at <http://www.directives.doe.gov/cgi-bin/explhcgi?qry1687066732;doe-261> (April 2003).
7. U.S. Environmental Protection Agency, “Land Use in CERCLA Remedy Selection,” OSWER Directive No. 9355.7–04, Washington, DC, May 25, available at <http://www.epa.gov/superfund/resources/landuse.pdf> (1995).
8. U.S. Environmental Protection Agency, “Guidance for Evaluation of Federal Agency Demonstrations That the Remedial Actions Are Operating Properly and Successfully Under CERCLA Section 120(h)(3),” Washington, DC, available at <http://www.epa.gov/fedfac/documents/896mm.htm> (August 1996).

FOOTNOTE

^aThe 1999 “Memorandum of Understanding between the U.S. Department of Energy and the U.S. Army Corps of Engineers Regarding Program Administration and Execution of the Formerly Utilized Sites Remedial Action Program (FUSRAP),” defines “Completed” sites as those FUSRAP sites where DOE completed remediation before the 1997 transfer of remediation responsibility to USACE. “Active” sites are those designated for remediation by USACE.

ACKNOWLEDGMENT

This work was conducted under DOE contract number DE–AC01–02GJ79491 for the U.S. Department of Energy Office of Legacy Management. The authors gratefully acknowledge the review comments from Laura Cummins of S.M. Stoller Corp and Cheri Bahrke of Batelle, particularly with regard to the presentation of DOE–LM practice in assessing risk and designing and implementing institutional controls.

This document was authored by the following individuals on behalf of the Office of Legacy Management:
C. Clayton (U.S. Department of Energy)
M. Widdop (S.M. Stoller Corporation)