A Review of the Use of Risk-Informed Management in the Cleanup Program for Former Defense Nuclear Sites

by

Omnibus Risk Review Committee

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Dedication

The Review Committee dedicates this report to our colleague Harrison Pannella, who passed away during the preparation of this report.

Congressional Direction

Excerpt from Consolidated Appropriations Act, 2014. Public Law 113-76.

ENVIRONMENTAL AND OTHER DEFENSE ACTIVITIES

DEFENSE ENVIRONMENTAL CLEANUP

The agreement provides $5,000,000,000 for Defense Environmental Cleanup.

Outstanding Risks to Public Health and Safety.- The Department is directed to retain a respected outside group, such as the National Academy of Sciences, to rank and rate the relative risks to public health and safety of the Department of Energy's remaining environmental cleanup liabilities. Additionally, the group should undertake an analysis of how effectively the Department of Energy identifies, programs, and executes its plans to address those risks, as well as how effectively the Defense Nuclear Facilities Safety Board identifies and elevates the nature and consequences of potential threats to public health and safety at the defense environmental cleanup sites. The group shall provide a report to the Committees on Appropriations of the House of Representatives and the Senate not later than one year after enactment of this Act.

The Statement of Task to the Omnibus Risk Review Committee as agreed to by DOE and congressional staff is provided as Appendix A to this report.

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EXECUTIVE SUMMARY

OBJECTIVES

The **Consolidated Appropriations Act, 2014** (H.R. 3547, sometimes known as the **Omnibus**) is an omnibus spending bill that packaged several appropriation bills together in one larger bill. Language attached to that Congressional Omnibus appropriations legislation directed the Department of Energy (DOE) to "retain a respected outside group … [to] undertake an analysis of how effectively [DOE] identifies, programs, and executes its plans to address risks [to public health and safety from the DOE's remaining environmental cleanup liabilities], as well as how effectively the Defense Nuclear Facilities Safety Board (DNFSB) identifies and elevates the nature and consequences of potential threats to public health and safety at the defense environmental cleanup sites." In accordance with the omnibus legislation and a task statement further defining the charge of this group, known as the Omnibus Risk Review Committee (Committee), the Committee focused primary attention on evaluating the extent to which cleanup priority setting and resource allocation has been in alignment with the public health and safety risks posed at individual DOE sites as well as nationally, across the DOE former weapons complex as a whole. (Appendix A provides the full task statement).

METHODS

The DOE Office of Environmental Management (EM) requested the Consortium for Risk Evaluation with Stakeholder Participation (CRESP), an independent multi-disciplinary consortium of universities led by Vanderbilt University, to organize a review in response to the Congressional direction provided in the Omnibus legislation. It constituted a Committee of eight nationally distinguished individuals with diverse experience in risk analysis, public health and safety, nuclear safety, risk management, and environmental law, regulation and public policy, to carry out the review. (Their short resumes can be found in Appendix B.) The Committee's review was conducted and its report was prepared during the period from July 2014-June 2015.

The Committee interviewed DOE EM staff at headquarters (HQ) and at the Hanford, Oak Ridge and Savannah River sites, and DNFSB staff at headquarters and at the Hanford and Savannah River sites. In addition, while DOE EM and the DNFSB are the primary focal points of the review, the Committee recognized that it was important to interview representatives of the US Environmental Protection Agency (EPA) (headquarters and Regions 4 and 10), and selected states (Washington, South Carolina, and Tennessee), as well as three representatives of contractors who have worked at DOE sites for many years. Overall, more than 100 interviews were conducted. (Summaries of the interviews can be found in the appendices). In addition, the Committee reviewed many documents and discussed the body of information that it had assembled during the course of three on-site interview trips, several trips to DOE-EM and EPA headquarters, three in-person plenary meetings and numerous conference calls.

Interview summaries were submitted to the respective agencies for fact-checking, and any factual errors identified in the summaries were corrected before the report was prepared. Additionally, a final draft of the report was provided for factual accuracy review to DOE, EPA, DNFSB, and to representatives of the states of Tennessee, South Carolina, and Washington before finalization and issuance of this report.

FINDINGS AND RECOMMENDATIONS

The Committee recognizes that decision-making in a resource-constrained environment is an extremely difficult challenge, especially so when communities in DOE-site regions present legal, moral, economic, as well as human-health-related reasons to assume unconstrained funding. The Committee understands that there are notable variations among states in legal mechanisms used to provide input and direction to DOE's site management and that some states have the authority to call for more stringent environmental standards than the federal government. The Committee realizes that sites vary with respect to state and local environmental priorities, the economic importance of the DOE site, the presence of Tribal nations with important legal rights, the terms of labor agreements, and other issues that factor into site cleanup decision-making. While these variations cannot be ignored, the Committee's primary role was to view the DOE sites as part of a national complex. As such, our thinking and recommendations focus on how to most effectively protect human health across the complex when there are, as now, more limited resources for that purpose than there had been in the recent past.

The Committee also realizes that some of our recommendations may need further exploration, and views the Interagency Task Force recommended by the Committee as a mechanism to further explore some of these ideas.

With this context noted, this section summarizes the major findings and recommendations.

The Committee divided its findings and recommendations into three areas:

- Nuclear Safety and Human Health
- Inconsistencies in Cleanup Requirements and Policies Among Sites
- DOE Risk Informed Prioritization and Resource Allocation

A total of more than two dozen findings and 24 recommendations are described in section 3 of the report (themes), and the recommendations are assembled and repeated in section 4. The Committee notes that many of the recommendations intersect. The Committee divided the recommendations into those for Congress, and those for the DOE, DNFSB, and EPA, as well as for an Interagency Task Force proposed by the Committee. The Committee chose the following key findings and recommendations for this summary.

GENERAL FINDING

The Review Committee **finds** that concern for human health and safety plays a significant role in prioritization and budgeting at the sites the Review Committee visited. The extent to which allocation of resources is risk driven at individual DOE sites −and nationally− is, however, unclear. As a practical matter, a host of other factors also come into play. These factors can include: consent decrees (which give priority to activities where DOE has missed milestones, even if those activities would not otherwise be given priority); regulatory requirements (that may not directly correlate with significant risk to human health and safety); and stakeholder inputs such as citizen advisory boards, local chambers and officials, and worker groups. The views of Tribal nations in the vicinity of DOE sites to exercise their treaty rights will be part of the decision-making considerations in order to ensure that the remedial standards where Native American access occurs are protective of their uses. The DOE must consider work force stability and maintenance of specialized nuclear expertise in its risk management decisions. In addition, DOE must take into account the need for maintaining minimum requirements for safe operations (min-safe) at all nuclear facilities; resources required for security of nuclear materials and facilities; recently identified concerns with the reliability and operability of critical infrastructure; social justice issues and DOE's commitment to assure some measure of support to all its remediation sites.

The Committee further **finds** that the Department, in cooperation with its regulators and overseers, has developed a process that provides strong nuclear safety protection though there are important safety initiatives on-going, including safety improvement in the areas of safety culture, tank vapor concerns, Waste Isolation Pilot Plant (WIPP) and regarding emergency preparedness, which remain "works in progress". By contrast those cleanup processes and practices which are governed by environmental laws, and designed to achieve cost-effective protection of human health and the environment, have not been consistently implemented at sites in accordance with specified regulatory procedural steps and have not obtained a similar level of nation-wide consistency and cost-effectiveness. Nevertheless, the Review Committee is of the view that given the many factors that contribute to the prioritization process (summarized above), EM is, at both the sites and nationally, endeavoring to place the safety of workers, the public and the environment first and appropriately to consider other relevant factors.

After meeting minimum safety requirements, a more systematic effort to assess and rank risks within and among sites, including through headquarters guidance to sites, and to allocate federal taxpayer monies to remedy the highest priority risks through the most efficient means would help secure more effective use of available resources and greater overall protection.

Currently, achieving the best risk-reduction use of available resources is significantly impeded by inconsistencies in the regulatory approaches followed at different sites, by selection of cleanup remedies that are not appropriately tailored to the risks presented, and by requirements in federal facilities agreements and consent decrees; all of these factors cause disproportionate resources to be directed at lower priority risks. DOE and EPA should take steps to realize opportunities for improved targeting of resources to risks and using the most cost effective remedial approaches including by

strengthening risk-informed remedial decision-making through transparent use of National Contingency Plan (NCP, part of CERCLA process) and Resource Conservation and Recovery Act (RCRA) procedures including critical assessment of Applicable or Relevant and Appropriate Requirements (ARARs) and land use decisions, which are major cost drivers. In other cases, Congressional action is needed in order to ensure that scarce resources are targeting the most important risks nationally, and within sites.

FINDINGS AND RECOMMENDATIONS FOR CONGRESS

- The Committee **finds** substantial inconsistencies in cleanup decision-making among sites within the DOE complex that are skewing risk-informed prioritization and allocation of increasingly scarce EM resources; inconsistencies with respect to major cost-drivers such as ARAR identification and land use determination, as well as in the use of NCP remedy selection procedures, are of particular concern. Such inconsistencies, where risks at some sites are addressed through remedies substantially more costly than those used at other sites, result in misdirection of scarce cleanup resources and slowing risk reduction across the complex. More cleanup progress would be achieved and overall protection of health and the environment would be increased by using the most cost-effective best practices among DOE sites to address similar risks at all sites. The Committee **recommends** that Congress establish a standing Interagency Task Force, with allocation of appropriate resources, comprised of senior officials from DOE, EPA, DNFSB, and independent experts in risk-informed management, site assessment, regulation/policy, and remediation, and co-chaired by DOE and EPA. The Interagency Task Force should be appropriately staffed, supported by technical staff and have a budget line. It should prepare an annual report for Congress and the Secretary of DOE and the Administrator of EPA.

- The mission of the Interagency Task Force should be to advise and assist DOE in promoting consistency and risk-informed decision-making and results, both within DOE sites and across the DOE complex. The Committee has identified the following issues that this Interagency Task Force should address: (1) site cleanup priority-setting; (2) resource allocation; (3) integration of regulatory requirements, policies and guidance under CERCLA, Federal Facilities Compliance Act (FFCA) and RCRA; (4) choice of cleanup technology and approaches; (5) milestone flexibility; (6) dispute resolution; and (7) other activities that impact the cost-effectiveness and risk-informed decision basis for cleanup decisions at individual sites and across the DOE complex. The Committee believes that these seven issues are the top priorities requiring the proposed Task Force's attention and should be the starting point for its deliberations; however, we do not mean to suggest that these are the only issues that the proposed Interagency Task Force should undertake to address.

- The Committee further **recommends** that Congress instruct the Interagency Task Force to: (1) develop an appropriate role for EPA in the formulation process for the President's annual budget process for the DOE Environmental Management program; (2) task EPA and DOE to work together to ensure that potentially high-cost state Applicable or Relevant and Appropriate Requirements (ARAR) decisions are made on the basis of a rigorous, written, publicly-available analysis of the grounds for the decision and through a transparent, well-documented process; (3) task EPA and DOE to limit interim

and early actions, return to NCP remedy selection procedures, and ensure rigorous and in-depth analysis of the nine CERCLA criteria in evaluation of alternative remedies, as soon as possible at all DOE sites; (4) establish clear and consistent criteria and procedures for making land use determinations and ensuring that such land use determinations are adhered to in cleanup standard setting and decision making at all facilities under DOE purview; and (5) include appropriate DOE input in NRRB deliberations on CERCLA remedies and create an EPA RCRA team analogous to the National Remedy Review Board (NRRB) (with the provision of adequate resources and inclusion of DOE in RCRA team deliberations) to expeditiously review all high cost RCRA corrective action remedies at DOE sites, and develop an effective procedure for ensuring action by EPA, DOE, and applicable state officials in response to NRRB and RCRA team recommendations.

- The Committee further **finds** that increasing use of court litigation and Consent Decrees to enforce missed cleanup requirements and milestones established in Federal Facility Agreements (FFAs)—a process currently being led by Washington state and being threatened by South Carolina—skews remediation priorities by requiring that limited funds be targeted on the requirements and milestones chosen by the state independent of the risks posed and competing cleanup program needs nationally. Many cleanup requirements and milestones were agreed to long ago and have become inappropriate in light of changed circumstances and new information. In the current constrained budget environment, where available resources are not sufficient to meet all of the milestone commitments currently contained in DOE site FFAs, state use of FFA and consent decree litigation undermines the need for national, risk-informed priority-setting and resource allocation across the DOE complex, and inappropriately removes these DOE decision functions to uncoordinated case-by-case decisions by local federal courts in diverse states. Further, use of Consent Decree litigation to resolve concerns with an FFA effectively cuts out one of the parties to the FFA, the EPA. The Committee **recommends** that Congress establish an alternative dispute resolution process to follow exhaustion of dispute resolution procedures under FFAs and FFA Consent Decrees, with respect to missed milestones and other controversies over the implementation of FFA and FFA Consent Decrees. The federal government would establish a dispute settlement body composed of independent experts; composition of the body and qualifications for the panel members could be developed with advice from the Interagency Task Force recommended above. The panel's decision would be binding, subject to opportunity for review by the United States Court of Appeals for the District of Columbia Circuit.[1] This process would ensure that disputes about federal facility cleanup priorities would be resolved through a national perspective. The proposed federal legislation should remove the option of a Consent Order or Consent Decree as a remedy for enforcement of the FFA provisions, but ensure that an independent national body brings final resolution to disputes.

[1] In the event there is no governing FFA consent decree, the Court of Appeals would have jurisdiction to issue orders to resolve the dispute, including orders on consent. In cases where another federal court had already issued such an order, including an order on consent, jurisdiction over such orders would be transferred to the D.C. Circuit.

- The Committee **finds** that not all wastes encompassed within the regulatory category "High Level Waste," (HLW) necessarily pose high risks at DOE sites. Hence in some cases HLW may not need very costly treatment methods, such as vitrification. Under current law, wastes are classified as HLW based primarily on their origins, not on their degree of hazard and intrinsic characteristics. DOE by regulation, however, developed a process for classifying low-activity fractions of reprocessing wastes, termed Waste Incidental to Reprocessing (WIR), to allow for management and disposal of some wastes previously regarded as HLW as LLW. After this initiative was challenged in litigation, and recognizing the substantial cost and management consequences of treating such low activity reprocessing wastes as HLW, Congress enacted Section 3116 of the National Defense Authorization Act of 2005, which authorizes treatment and disposal of wastes meeting specified criteria as LLW. This provision, however, applies only to HLW at SRS and Idaho, and does not apply at Hanford or West Valley. DOE asserts continuing regulatory authority to adopt and implement WIR classification of low activity reprocessing wastes at sites not covered by Section 3116. However, some exercises of this authority have been and could in the future be challenged in litigation. The WIR process can also provide a clear path forward to HLW tank closure at the West Valley cleanup project in New York, which is also not covered by Section 3116. To remedy this cost-ineffective disparity, which is not risk-informed, the Committee **recommends** that Congress extend the Section 3116 WIR provisions for low activity fractions of reprocessing wastes to Hanford and West Valley. The Committee further encourages Congress to consider reclassification of radioactive wastes generally, based on their respective degrees of hazard and intrinsic characteristics.

- The Committee **finds** that site managers have limited and insufficient flexibility to adjust to emerging issues at the sites, and that their concerns about the need for greater flexibility have increased as a result of reduced budgets. Site managers have limited ability to move funds from one budget category to another, though, at a higher level, EM HQ can request reprogramming authority from Congress. However, the Committee was presented several instances (e.g., problems with critical infrastructure during severe weather at SRS) where inability to move funds from one budget category to another had impacted the site's ability to address safety-related issues. The Committee recommends that Congress and DOE HQ provide a mechanism that will provide site managers with more flexibility in moving funds within and among PBS's and control points in order to address emerging issues. This will permit EM and the site managers, who are charged with, and accountable for, operations and safety at complex nuclear sites, to be responsive to emerging situations that could impose significant risk, as well as to have the flexibility to address risk reduction and cost efficiency as may be required.

FINDINGS AND RECOMMENDATIONS FOR DEPARTMENTS AND AGENCIES

- DOE EM HQ: The Committee **finds** that important infrastructure systems are operating past their design lives and are showing the stress of extended operations. This is in large measure because cleanup of DOE sites was expected to be completed more quickly, and accordingly, the premise for not allocating significant resources to infrastructure maintenance and repair has often been to "run to failure." The Committee is concerned about urgent risks posed by inadequate maintenance of certain,

decaying and obsolescent critical infrastructure at certain DOE sites; recent problems have included major water supply problems at Hanford and obsolescent electrical distribution equipment at SRS. A likelihood exists that failures of critical infrastructure such as these could lead to unforeseen major human health risks. Response to and remediation of such failures could also have a significant unanticipated impact on EM's future budgetary priorities. At the same time, the Committee recognizes that addressing urgent infrastructure needs will require significant resources, and so must be balanced against other priorities, given EM budget constraints. For sites like Savannah River and Hanford, some vital yet aging infrastructure systems are increasingly difficult to maintain and their maintenance has not been deemed a high priority until very recently. DOE HQ and the sites have begun to focus on this concern. The Committee **recommends** that DOE should develop and issue reliability, maintainability, and availability analysis expectations—taking advantage of available industry standard practices—and implement an engineering analysis of aging facilities and infrastructure at major EM sites (Hanford and Savannah River on a priority basis) to identify urgent priorities for maintenance and repair of critical infrastructure systems and components necessary to support safety systems and emergency management. Furthermore, the Committee **recommends** that DOE create a separate budget category (PBS) for maintenance and renewal of priority critical infrastructure, and should implement a consistent infrastructure prioritization process complex-wide (e.g., the Critical Infrastructure Integrated Priority List (CIIPL) process at SRS). EM should provide guidance on how to integrate such requirements into each site's annual budget scenario input to EM HQ, in balance with resources needed for other priorities.

- DOE EM HQ: The Committee **finds** that while the prioritization and budgeting for DOE sites was described to the Committee as a collaborative process, the predominant role appears to be played by the sites, with guidance and oversight from HQ that was limited and not transparent to the Review Committee. The process appears to be risk-informed to the degree that it provides the highest priority to maintaining basic safe and secure operations at the sites (what is referred to as "min-safe" requirements) which includes: cleanup of nuclear contamination; disposition of nuclear materials; maintenance of facilities, equipment and infrastructure; addressing regulatory requirements and commitments; and more recently a focus on support operations. However, the seven categories of activity (e.g., min-safe, tanks, HLW, other radioactive waste, on-site groundwater and soil, off-site groundwater, D&D and other priorities) enumerated in HQ guidance to sites (see Appendix C for more) intended to guide site priority-setting and budgeting are too general and too numerous to act as sufficient direction, and the hierarchy among them may fail to match the relative importance of different sources of risks at specific sites. Further detailed guidance for use by the sites to ensure that human health and environmental risks play the major role in prioritization and resource allocation -- including through performance of risk evaluations based on site risk assessments, site risk review results and other key information -- is needed from HQ, as well as oversight by HQ to ensure that this guidance is being followed. Further, site budgeting scenarios are based on the prior year's budget, which more or less assures sites of level budgets from year-to-year; for example, this means that Hanford garnered approximately 38% of the total EM remediation budget in 2014 and again in 2015, and approximately 40% of the remediation budget in the President's FY 2016 request, while other sites receive far less. It is not evident to the Committee that current allocations among DOE sites correlate to the relative risks at

one site versus another, nor exactly on what criteria DOE EM integrates the site budgets into the overall EM budget. While DOE HQ needs to be certain that some progress is being made at every site, the Committee **recommends** that DOE HQ EM, with advice from the proposed Interagency Task Force, if it is created, should provide more detailed guidance and greater oversight to the site priority setting and budgeting process and work with the sites to develop a consistent and transparent approach to development of risk-informed priorities and resource allocation at the sites and nationally. The aim should be to assure best use of limited budgets funded by federal taxpayers by ensuring the focus is on top risks nationally. The Committee further recommends that this process should be informed by risk reviews at all major DOE sites.

- DOE-EM HQ and Sites: The Committee **finds** that DOE has been slow to implement industry-standard quantitative methods to analyze nuclear safety risk such as Probabilistic Risk Assessment (PRA), for high-hazard activities—unlike NASA, the process chemical industry and the U.S. Nuclear Regulatory Commission (USNRC). This leads to a situation where the nuclear safety risk associated with high-hazard activities at DOE sites is not as comprehensively characterized as it could be, and does not provide the quantitative information for risk-informed decision-making that has been so beneficial in these other high-hazard industries. DOE EM has not embraced the use of PRA and the insights it can provide for risk-informed decision-making in its high-hazard non-reactor nuclear facilities. The Committee **recommends** that DOE EM move ahead in a timely manner to achieve the benefits which could be derived from implementing PRA in its risk-informed decision-making for its high-hazard, non-reactor nuclear facilities, as follows. DOE EM should form a small group of senior nuclear managers and PRA experts to identify several limited-scope, but high-leverage, pilot PRA studies and launch the planning and execution of these studies; further, this group should monitor the funding needed for performing such studies, and assist EM-1 in incorporating the results of these pilots into a DOE EM's risk-informed decision-making process. Further, the Committee **recommends** that EM-1 set aside funding to accomplish these pilot studies.

- DOE-EM HQ and Sites: The Committee **finds** that slow progress in addressing technical and safety issues such as those associated with stabilizing high hazard nuclear materials, addressing chemical vapor concerns at the Hanford Tank Farms, and implementing PRA suggest that DOE-EM needs stronger engineering and technical capabilities to guide contractor actions and advise DOE management. The Committee **recommends** that DOE-EM should review its capacity to address technical issues, both emergent and endemic, to retain key technical experts to advise senior decision makers, and to propose innovative ways to ensure that important technical and safety issues are tracked through to resolution. A strong engineering capability should be built into the DOE-EM organization, taking into consideration the role of the applicable DOE national laboratories, along with appropriate roles for site deployed and centralized technical staffs.

1. INTRODUCTION

1.1 STUDY BACKGROUND AND CHARGE

The **Consolidated Appropriations Act, 2014** (H.R. 3547, sometimes known as the **Omnibus**) is an omnibus spending bill that packaged several appropriation bills together in one larger bill. Language attached to that Congressional Omnibus appropriations legislation directed the Department of Energy (DOE) to "retain a respected outside group … [to] undertake an analysis of how effectively [DOE] identifies, programs, and executes its plans to address those risks [to public health and safety from the DOE's remaining environmental cleanup liabilities], as well as how effectively the Defense Nuclear Facilities Safety Board (DNFSB) identifies and elevates the nature and consequences of potential threats to public health and safety at the defense environmental cleanup sites" (Appendix A provides the full task statement) (U.S. Congress 2014).

DOE Office of Environmental Management (EM) requested the Consortium for Risk Evaluation with Stakeholder Participation to form a committee to carry out an independent review in response to the Congressional direction provided in the Omnibus bill.[2] A Committee of eight nationally distinguished individuals was created with diverse experience in risk analysis, public health and safety, nuclear safety, risk management, environmental law and public policy to carry out the review.[3]

The Committee charge was as follows:

1. identify and review how specific federal policies and guidance shape DOE-EM's evaluation and use of risks to human health and safety as part of program decisions;
2. review how the DNFSB identifies and elevates threats to public health and safety, and how DOE considers DNFSB concerns as part of program decisions;
3. review how risks to public health and safety are considered as part of state and federal regulatory compliance and priorities at DOE-EM cleanup sites;
4. review how DOE-EM uses human health risk and public safety input and information from a broader range of sources as part of program decisions; and
5. review how DOE-EM uses the range of human health risk and safety information available along with the broader range of input and constraints to balance cleanup priorities within and between cleanup sites.

This charge centers on the DOE and the DNFSB, but the Committee recognizes that addressing this charge requires consideration of the role of the US Environmental Protection Agency (EPA), state

[2] Appendix A provides the full task statement for the committee.

[3] Appendix B provides biographies for the Committee members.

regulators, Office of Management and Budget (OMB), and other parties that influence DOE's policies and decisions.

In order to carry out the review, the Committee focused on evaluating the extent to which cleanup priority setting and resource allocation has been in alignment with the public health and safety risks posed at individual DOE sites as well as nationally, across the DOE former weapons complex as a whole, seeking answers to the five following questions:

1. How do specific federal policies and guidance shape DOE's evaluation and use of human health and safety risk-related information as part of environmental cleanup program decisions? How does DOE headquarters balance a broad set of objectives to set priorities? *These questions primarily were directed at DOE Headquarters.*
2. How does the DNFSB identify and elevate threats to public health and safety, and how does DOE consider DNFSB's concerns as part of DOE program decisions? *These questions focus on the DNFSB headquarters and its interactions with the DOE.*
3. How does U.S. EPA prioritize human health and safety risks at the DOE sites? How does EPA help shape DOE EM's priorities in order to emphasize human health and safety risks at DOE sites? *This question focuses on the role of the EPA at the national and site levels.*
4. How are risks to public health and safety considered as part of state and federal regulatory compliance and priorities at DOE-EM cleanup sites? *This question focuses on the DOE's major sites, such as Hanford and Savannah River, and includes comments from the state representatives, and the DNFSB site representatives, as well as from DOE.*
5. DOE has access to data from the Nuclear Regulatory Commission (USNRC), EPA, OMB, state and local government, the National Academies, academic and other institutions, the media, and other sources. How does DOE-EM gather, filter, and determine which data sets and sources should be incorporated into its human health risk and public safety actions? Are current efforts adequate? If not, what might make them more valuable to the DOE? These questions focus primarily on DOE HQ and its decision-making processes and tools.

The Committee reviewed documents and conducted interviews of more than 100 key managers and staff from DOE, DNFSB and EPA in Washington, D.C. and Regions 4 and 10; DOE at Hanford, the Savannah River Site, and Oak Ridge; DNFSB at Hanford and Savannah River; and state regulatory agencies at Hanford, Savannah River, and Oak Ridge. In addition, Committee members spoke with staff in the field as part of site tours and over the phone. Committee members also met with several executive-level contractor personnel with significant history and experience with EM nuclear cleanup. (A list of people interviewed can be found at Appendix F.)

The Committee's summary notes of interviews are found in Appendices C and D. To assure accuracy and consistency in the presentation of the results, the Committee Chair and Committee staff prepared a summary of each interview, and a representative at each location was asked to review the notes for factual accuracy. In addition, several Committee members provided their notes. Feedback in regard to the Review Committee's notes generally was not extensive and was incorporated into the notes in

Appendix C and Appendix D. Unlike for other interviews, EPA's written response to the Review Committee questions is added as part of Appendix C at the request of EPA.[4] Appendix C includes sub-questions to each of the basic questions asked in the field interviews. All individuals interviewed are listed but specific statements are not attributed to individuals. Rutgers University Institutional Review Board approval was obtained for the basic questions and this process. Excerpts from several documents that the Review Committee found to be particularly important are woven into the fabric of Appendix C using text boxes. Appendix E adds several insights about risk, risk assessment and management in the DOE EM context. Lastly, Appendix G is a brief list of abbreviations and acronyms.

DOE has been engaged in the cleanup of the defense sites for decades, and a complex web has evolved of the partners (including regulators, Tribal Nations, oversight groups, and other stakeholders), legal obligations, and human health and safety requirements, as well as other policy drivers at the national and site levels. Given this inherent complexity of the EM mission, four caveats are in order. First, while the Committee realizes that DOE EM shares responsibility for non-cleanup missions, for example, securing and safeguarding nuclear materials, this report does not focus on DOE missions other than cleanup, even though some comments reported address other missions as part of the interviews and document review.

Second, had time and resources permitted, the Committee would have also conducted interviews with officials at Paducah, Portsmouth, Idaho, and WIPP, each of which has a life-cycle cost estimated at more than $5 billion. The Committee also did not have an opportunity to meet with community representatives at key DOE sites, that is, the Site Specific Advisory Boards, nor were we able to interview representatives of Tribal Nations. Furthermore, the Committee requested an interview with the Office of Management and Budget (OMB) examiner for DOE, but that request was not granted.

Third, in the timeframe within which the Committee conducted its review, it was not possible to independently verify all the comments made by officials by reviewing written reports and/or speaking with multiple unconnected officials. In some cases, the same information was indicated from multiple sources, and in other cases, documentation enlightened specific comments or vice versa. Some Committee members have considerable experience with particular agencies, and they were able to use their contacts and experience to verify Committee interpretations of information provided. For some aspects, written documentation or third party verification was not available.

Fourth, during the study, the Committee encountered issues that were not the focus of our design. For example, safety culture has been an issue on the DOE and DNFSB agendas for many decades. Senior DOE officials discussed the topic with us and there were several discussions at the sites visited.

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[4] The Committee has honored EPA's request that, in order to most accurately represent EPA's views, only the Agency's written responses to the Committee's questions be provided with this report. The unedited EPA written response is included in Appendix C. Accordingly, the report does not include a summary of the Committee's interviews with EPA.

However, the Committee does not have sufficient information to make major findings about safety culture at this time.

1.2 ORGANIZATION OF THE REPORT

The report is divided into four major sections. Section 2 facilitates understanding of the major themes presented in the report by providing definitions and context about factors influencing DOE's decisions, and summarizes DOE EM's budget and life cycle cost estimates. Section 3 is the heart of the report, presenting three major themes that have been the focus of the Committee's work, and providing major findings and recommendations. Section 4 presents all 23 recommendations.

2. MANAGING HEALTH AND SAFETY RISKS IN THE DOE COMPLEX

Before addressing the questions derived from the charge to the Committee, contextual information is presented about the history of the EM program, definitions of risk analysis relevant to DOE EM cleanup activities, and human health and safety and other factors influencing DOE EM's decisions.

2.1 A SYNOPSIS OF THE HISTORY, CHALLENGES AND PARTICIPANTS

The process of managing defense-nuclear waste followed from building nuclear weapons during World War II and the Cold War. The U.S. government mined, refined, transported, and tested uranium products containing nuclear materials at hundreds of sites across the U.S. and has already remediated thousands of release sites on the nuclear complex it built (Department of Energy 1995a, U.S. EPA 2004). The federal government has spent over $150 billion managing the defense nuclear legacy at 107 major sites (See Figure 1 at the end of section 2.3 for a visual representation). Currently, the DOE-EM program manages cleanup at 16 sites in 11 states, including large and complex cleanup and decommissioning responsibilities at the Hanford (WA), Savannah River (SC), Oak Ridge (TN), Idaho (ID), Portsmouth (OH) and Paducah (KY) sites. While few in number, these 16 sites contain nuclear and chemical substances that represent expensive waste management, as well as public, occupational, and environmental health challenges. These sites also have been significant, and in the cases of the largest sites, dominant contributors to the local economy for many decades (Greenberg et al. 2003). Remediation of DOE sites is funded by federal taxpayers.

In managing nuclear materials and nuclear wastes as part of its mission, DOE, like the Nuclear Regulatory Commission (USNRC), is required by the Atomic Energy Act (AEA) to conduct its activities so as to maintain "adequate safety"; this is expanded in DOE's nuclear safety policy (DOE P 420.1) to state:

> "*It is the policy of the Department of Energy to design, construct, operate, and decommission its nuclear facilities in a manner that ensures adequate protection of workers, the public, and the environment*."

In addition, DOE's health and safety cleanup efforts are overseen by the Defense Nuclear Facilities Safety Board (DNFSB), and DOE consults with the Nuclear Regulatory Commission (USNRC) and the Nuclear Waste Technical Review Board in several relevant areas.

Much of DOE's cleanup is mandated by environmental laws, most notably the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and relevant provisions of the Resource Conservation and Recovery Act (RCRA), and associated regulations, guidance and policies. With respect to cleanup, the objective of both laws is to reduce the risk of contaminated sites to levels that are protective of human health and the environment. Some of these laws and regulations include requirements for restoration and protection of natural resources, such as groundwater and endangered

species, imposing additional requirements beyond protection of human health. Their implementation by DOE is overseen by the U.S. Environmental Protection Agency (EPA) and state environmental agencies, under federal facility agreements (FFA), and through regulatory permits and remediation decision procedures that provide opportunities for public involvement.

The roles of the DOE, EPA and states are well known because these bodies are generally parties to the FFAs. But other government agencies are important players, and each of these brings their own perspective to the table in regard to the relative importance of human health and safety. For example, DOE EM is guided by Risk Principles that were developed by OMB (see section 2.2.2 for highlights) and the Office of Science and Technology Policy (Dudley, Hays 2007) and recommendations from several studies carried out by the National Research Council of the National Academies.

The primary goal of these regulations, requirements and guidance is the protection of worker and public health and safety and the environment. Risk management decisions, however, depend on not only on findings from safety analysis and risk assessment, but also on legal requirements, political processes, and economic costs. Hence, DOE must factor in efficiency in risk reduction (i.e., appropriate work sequencing, cost effectiveness), regulatory compliance, the available capacity to achieve program objectives (i.e., workforce availability, technological limitations, disposition pathways), financial constraints, treaty rights of Tribal Nations, and input from local, state and other stakeholders.

2.2 RISK, RISK ASSESSMENT, AND RISK MANAGEMENT

2.2.1 DEFINITIONS AND DECISION-MAKING

The Committee's assignment requires a common understanding about risk, and also what is meant by risk assessment, risk management, and risk analysis, which are terms widely used in DOE, DNFSB, EPA and in studies. This is a challenge because the literature provides no common definition for risk, and for purposes of this study there are differences in definitions and processes among the departments and agencies. The study used the following definition developed by William Lowrance (1976), which is perhaps the most widely cited and consistent with DOE's use: Risk is a measure of the probability and severity of adverse events. Likelihood and consequences are common to almost all definitions.

In regard to protecting human health and safety, the DOE, DNFSB, EPA and other agencies focus on making the most effective risk management decisions, which requires answering many questions and can be aggregated into six major ones as follows:

1. What can go wrong?
2. What are the chances that something with serious consequences will go wrong?
3. What are the consequences if something does go wrong?
4. How can consequences be prevented or reduced?
5. How can recovery be enhanced, if the scenario [events and events that follow from it] occurs?

6. How can key local officials, expert staff, and the public be [organized and] informed to reduce concern and increase trust and confidence?

The first three questions constitute risk assessment, the second three constitute risk management, with the focus on answering the risk assessment questions in order to make good risk management decisions. There are other versions of these six questions, and Appendix E compares several of these. An important distinction for this study is that between nuclear safety risk analysis and human health and environmental risk assessment. In the context of regulating for nuclear safety, DOE focuses on assessing life cycle risks; it uses these life cycle risk assessments to establish operating and engineering controls for nuclear facilities. Under CERCLA, EPA specifies protocols, procedures, and training required to assess the human health and environmental risks associated with potential exposure to releases of hazardous substances from facilities; EPA uses the risk assessments as one key input to a multi-step remedy selection procedure required for cleanup decision making at contaminated sites (See appendix E.) Thus, both DOE's life cycle risk assessments and EPA's human health and environmental risk assessments are used to inform these bodies' risk management decisions.

Another issue is who makes risk management decisions. Risk management decisions are rarely made by a single decision maker. They are made by groups of managers. For example, a report (G-ESR-G-00082) that the Review Committee received from the Savannah River Site (Savannah River 2013) provides what it calls "a simple and structured, process for managing and controlling changes to the Critical Infrastructure Integrated Priority List (CIIPL)." This report defines the group membership to include site organizations and appropriate DOE representatives, as well as additional members who are called upon to provide support and guidance in the areas of technical and administrative support. Risk management decisions are based on the current state of knowledge of the decision makers. The state of knowledge consists of awareness of commitments, regulatory requirements, costs, and various kinds of risks, e.g., to health and safety of workers and the public, environmental, and programmatic. It also includes relevant engineering and scientific knowledge and past experience.

A key reality is that regulatory and environmental decisions are never entirely ***risk-based***, that is, driven solely by risk calculations. Such decisions are informed by risk and not solely based on human health and safety risk-based criteria. Thus, decisions are said to be ***risk-informed****:* risk information is an input, along with other relevant factors to the deliberative part of the process.

2.2.2 FACTORS INFLUENCING DOE RISK-INFORMED DECISIONS: TWO KEY PERSPECTIVES

It was the Review Committee's observation that the DOE is pulled in different directions by different organizations within and external to DOE, and also by different factors that influence its environmental management decisions. The following two short presentations underscore two of the most important forces.

Federal Facilities Environmental Restoration Dialogue Committee (FFERDC)

In 1992, recognizing the magnitude of contamination at federal facilities (including DOE's), and the significant costs of cleanup, the **Federal Facilities Environmental Restoration Dialogue Committee (FFERDC)** was convened at the request of the U.S. EPA to address setting of priorities regarding where and how to spend available environmental cleanup funds. The goal of the Committee was to develop consensus policy recommendations aimed at improving the process by which federal facility environmental cleanup decisions are made. FFERDC in 1996 issued a set of recommendations that DOE, EPA, and other governmental bodies in charge of cleanup of federal facilities, have used to guide their cleanup decision making ever since.

A primary recommendation of the FFERDC report in relation to the issues that the Committee report addresses is that "risk plus other factors" should be weighed in setting priorities and budgeting for cleanup at DOE sites;[5] among all factors, however, human health risk is the *primary* consideration. The significance of the 1996 FFERDC report is that representatives of major stakeholder groups acknowledged the primary significance of human health risk in site priority-setting and resource allocation, while expecting other factors to be taken into account. In 2012, DOE and states involved in DOE site cleanup developed a set of principles to guide state-DOE planning and prioritization of cleanup, "*recognizing that cleanup funding is not likely to be sufficient to meet all milestones in state-DOE compliance agreements for the foreseeable future" (italics emphasis added).* The 2012 principles reaffirmed the use of "risk plus other factors" in priority setting as recommended and defined in the 1996 FFERDC report.[6]

FFERDC listed multiple other "plus" factors that can be considered in remedial decision-making at the federal facility sites, summarized to include:

- cultural, social, and economic factors, notably environmental justice;
- long and short-term ecological impacts, especially degradation of resource value and hence use;
- land use decisions, especially as these impacts the economic health of the area:
- acceptability of the proposed action to regulators, and the public;
- incorporation of the views of Tribal Nations into project designs;
- life cycle costs;

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[5] This is the deliberative process discussed in Section 2.2.1.

[6] National Governors Association, "Federal Facilities Task Force Principles and Associated Expectations for State-DOE Engagement," (2012). The report states: "Recognizing that cleanup funding is not likely to be sufficient to meet all milestones in state-DOE compliance agreements for the foreseeable future, in December 2011 the FFTF set out to create, in consultation with DOE, a set of principles around how state regulators and DOE would jointly approach the planning and prioritization of cleanup work. The FFTF approved the following principles on May 2, 2012, at the FFTF Spring Meeting in Knoxville, Tennessee. FFTF states participating in the meeting were Idaho, Kentucky, Missouri, Nevada, New Mexico, New York, Ohio, Oregon, South Carolina, Tennessee, Texas, and Washington….. *States support a "risk plus other factors" approach to priority-setting, as defined in the Final Report of the Federal Facilities Environmental Restoration Dialogue Committee*." Id. Emphasis added

- importance of reducing infrastructure and operation-maintenance costs:
- availability of new technologies;
- legal and statutory requirements;
- cost and effectiveness of proposed actions;
- availability of funding; and
- practical considerations, such as accomplishing projects and working on remediation projects without hindering others activities.

To formally implement the FFERDC recommendations and connect the process of priority setting with budgeting for cleanup at federal facilities, EPA in 1998 issued a policy that recognizes risk as "a major factor" in establishing sequencing of remedial work; EPA further endorses the use of relative risk ranking of sites (high, medium, low), with stakeholder input, to help establish priorities, sequence remediation projects, and inform budget allocations.[7] In its policy, EPA asserts that the results of appropriately conducted relative risk rankings and "federal fiscal constraints" should inform establishment and revision of "milestones" in the federal facility agreements that establish enforceable cleanup obligations at federal facility sites.

DOE has affirmed that the FFERDC recommendations have substantially informed its cleanup program and decision making[8] that were defined in the 1996 FFERDC report.[9] The significance of the 1996 FFERDC report and its aftermath is that the federal bodies responsible for federal facility cleanup and oversight, as well as representatives of major stakeholder groups, acknowledged the primary significance of human health risk in site priority-setting and resource allocation, while expecting other factors to be taken into account. Additionally, both EPA and DOE recognize that funding constraints and risk prioritization must inform DOE site cleanup priorities and resource allocation decisions.

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[7] See EPA, "Interim Final Policy on the Use of Risk-Based Methodologies in Setting Priorities for Cleanup Actions at Federal Facilities (1998). EPA cautions, however, that federal facilities must comply with all of their cleanup obligations under relevant authorities; while risk ranking, funding limitations and other factors can appropriately be taken into account in decisions about the *sequencing* of cleanup, they should not result in decisions not to conduct or complete remediation, even at low-risk sites. See id. (emphasis added).

[8] See, e.g., Mark Gilbertson, DOE-EM, "Presentation to Environmental Management Advisory Board: Risk and Cleanup Decision Making," (slides) (May 31, 2012), available at In 2012, http://energy.gov/sites/prod/files/em/EMFMRiskandCleanupDecison-makingPresentationtoEMABonMay312012rev1.pdf

[9] National Governors Association, "Federal Facilities Task Force Principles and Associated Expectations for State-DOE Engagement," (2012). The report states: "Recognizing that cleanup funding is not likely to be sufficient to meet all milestones in state-DOE compliance agreements for the foreseeable future, in December 2011 the FFTF set out to create, in consultation with DOE, a set of principles around how state regulators and DOE would jointly approach the planning and prioritization of cleanup work. The FFTF approved the following principles on May 2, 2012, at the FFTF Spring Meeting in Knoxville, Tennessee. FFTF states participating in the meeting were Idaho, Kentucky, Missouri, Nevada, New Mexico, New York, Ohio, Oregon, South Carolina, Tennessee, Texas, and Washington….. *States support a "risk plus other factors" approach to priority-setting, as defined in the Final Report of the Federal Facilities Environmental Restoration Dialogue Committee*." Id. (Emphasis added.)

Office of Management and Budget (OMB)

OMB's role in DOE's decision-making is critical. The Dudley and Hays's (2007) 13-page memo about risk analysis for all heads of executive departments and agencies is a visible demonstration of OMB's role. The document states general principles, and principles for risk assessment and risk management. Drawing on recommendations from the National Academies, and from federal agencies, the guidance emphasizes achieving risk reductions with different policy options. It states:

> "As a whole, the Memorandum endeavors to enhance the scientific quality, objectivity, and utility of Agency risk analyses and the complementary objectives of improving efficiency and consistency among the Federal family." (p.2)

The memo describes risk analysis as a "tool" and states that it is an evolving process that requires agencies to be flexible in their use of it in order to include new scientific advances. It reiterates the recommendation from a National Research Council (2007) report that each agency/department should develop its own guidelines to include consideration of risk analysis within the jurisdiction of their agency. The use of risk analysis as a whole, and especially risk assessment, has been an issue for DOE, and is discussed below.

One OMB principle, distinguishing risk assessment from risk management, is quite important for DOE:

> "In undertaking risk analyses, agencies would establish and maintain a clear distinction between the identification, quantification, and characterization of risks, and the selection of methods or mechanisms for managing risk. Such a distinction, however, does not mean separation. Risk management policies may induce changes in human behaviors that can alter risk." (p. 4)

Another noteworthy principle is as follows: "The depth or extent of analysis of risks, benefits and costs associated with decisions should be commensurate with the nature and significance of the decision" (p. 4). Another principle calls for peer review of risk assessments.

In regard to risk assessment, the OMB document calls for the use of the best information, whatever its form. Then it calls for risk characterization so that the data, the limitations, the uncertainties, criticisms and positive attributes, and other attributes are presented to inform a broad group of decision makers and the public. An issue, discussed below, is that a good risk assessment takes time and could slow down remediation. The OMB document points to the limitations of characterizing important risks by singular central tendencies, such as mean values, that provide a false sense of precision, and thereby in essence, calls for characterization of the uncertainty associated with risk assessments. One of the major criticisms of risk assessment is the reliance on default values and unstated assumptions. The OMB document calls for assumptions to be made explicit.

The OMB principles discussed above could conflict with agency policies that set absolute human exposure and safety standards, and with legal agreements. For example, what does the OMB principle 2

that calls for "net improvement in social welfare" mean during the next five years or the next 50 years or even longer? This illustrates that in implementing the OMB principles, many more decisions must be made. In the case of DOE, some of its facilities are already a half century old, are aging , have radioactive and/or toxic substances, and could be subject to deterioration, potentially increasing the risk. Should such a facility be fully remediated and demolished, including removal of all contaminants, thereby exposing workers to hazardous chemical and radioactive contaminants during cleanup? Or should the contamination be sealed in a cocoon-like structure, and left until such time as the radiological portion of the hazards has decreased and a new technology can be in place that will reduce health and safety issues? DOE, the Review Committee believes, faces a most complex balancing challenge. A risk-informed design might legitimately be quite different depending on the period of time at issue (for example, considering the relative importance of risks to human health under current site conditions and practices, and under near-term anticipated use of the site and water resources, or under unknowable uses far into the future).

2.3 DOE EM ESTIMATED LIFE CYCLE REMEDIATION COSTS AND CURRENT ALLOCATIONS

DOE's legal and moral commitment to close the circle on the production of nuclear weapons has led to date to the commitment of more than $150 billion to complete cleanup at more than 90 sites. The 16 sites that remain, however, disproportionately account for much of the EM's remaining liability. A DOE report (US DOE 2013) defined liability as "a probable future outflow of or other sacrifice of resources as a result of past transactions and events." Included in the drivers of these costs are legal requirements and regulations, compliance agreements, and waste management system plans.

DOE-EM has been estimating and auditing its environmental costs and liabilities at DOE sites for two decades. DOE's annual budget request and annual reports detail the costs to remedy site liabilities through cleanup. For example, DOE (1995a, b) in 1995 estimated remediation life cycle costs ranging from $200 to $350 billion during the period 1995 to 2070. The mid-range cost was $230 billion. Twenty years on, assuming EM's budget remains at current levels, DOE has estimated life cycle cleanup costs for remaining liabilities at DOE sites at $300-335 billion, and that cleanup will extend 'for many decades after 2060."[10]

Table 1 summarizes the data, including only the sites with total estimated future costs in excess of $5 billion, lists DOE budget allocations to those sites, and summarizes the key reasons for the costs. Table 1 shows that Hanford (which has two separate budgets, one for RL and a second for ORP) and Savannah River account for almost two-thirds of the life cycle costs. Much of the remainder is associated with the Idaho, Paducah, Oak Ridge, Portsmouth, and WIPP sites. Thus, about 85% of total life cycle costs and

[10] DOE, Secretary of Energy Advisory Board, "Report of the Task Force on Technology Development for Environmental Management," 1 (Dec. 2014).

current allocations by DOE EM are being spent at eight sites in seven states. The largest share of this money is for radioactive waste tank closure and associated waste treatment; the next largest share is for decontamination and demolition. Another way of looking at the cost of different elements of the EM remediation program is captured in a DOE graphic (Figure 1), which shows what percentage of the $144 billion spent for DOE site cleanup from 1989-2013 was spent on each major category of cleanup activity and how much of the additional $205 billion estimated to be needed for DOE site cleanup is expected to be expended by EM on each cleanup category from 2014-2060. Figure 1, taken from an EM Program Update and FY15 budget overview, highlights that disposition of tank wastes has consumed almost one-quarter of total EM remediation funds to date and will likely consume over one-third of such funds in the future; D&D will also consume a larger share of funding (20%) in the future than it does now (17%). DOE expects the remaining categories of cleanup activity (i.e., waste management, spent nuclear fuel (SNF)/special nuclear material (SNM), groundwater and soil, and infrastructure) to consume smaller shares of EM funds in the future.

While DOE EM currently focuses on cleanup at 16 sites, its role could be enlarged. A GAO report (U.S. General Accounting Office 2015a) identifies 83 facilities at six NNSA sites requiring remediation that should be transferred to the DOE EM program and urges that EM factor cleanup costs for these facilities into its budget. The Committee notes that such a transfer would add additional pressure to the DOE EM budget and underscores the need to view the EM program as a national endeavor.

Cleanup at DOE legacy sites typically takes place mainly under two federal laws, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the primarily federal hazardous substance[11] cleanup program, and the Resource Conservation and Recovery Act (RCRA), the federal program regulating hazardous waste[12] "from cradle to grave." At large DOE sites, some portions of the site may be undergoing remediation pursuant to CERCLA, while other areas—sometimes as "islands" within a larger CERCLA cleanup area—are being cleaned up under RCRA.

CERCLA Section 120 specifically governs cleanup of federal facilities, including DOE sites, and provides for negotiation of Interagency Agreements, commonly known as Federal Facility Agreements (FFAs), between EPA and the federal site owner (and states if they choose) specifying cleanup obligations and

[11] Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. Secs. 9601-9675.The term "hazardous substance" is defined under CERCLA Section 102 and EPA implementing rules to include all RCRA hazardous wastes, as well as "pollutants and contaminants" regulated under other environmental laws, including the federal Clean Air, Clean Water, and the Toxic Substances Control Acts. The definition and a detailed list of hazardous substances appear at 40 C.F.R. Part 302.4 and Table 302.4.

[12] Resource Conservation and Recovery Act, 42 U.S.C. Secs. 6901-6992k. The term "hazardous waste" is defined under RCRA and EPA implementing regulations to include two categories of waste: (1) "listed wastes," namely those appearing on one of four hazardous waste lists promulgated by EPA and (2) "characteristic wastes," namely those exhibiting one or more specified properties (i.e., ignitability, reactivity, corrosivity, and toxicity), as defined under 40 C.F.R. Part 264, Subpart C. RCRA hazardous wastes also fall within the definition of "hazardous substances," which are subject to CERCLA requirements.

timetables at federal facility sites, including DOE's major sites, on the National Priority List (NPL). According to the DOE Inspector General, DOE site remediation "program costs are largely 'driven' by 37 individually negotiated Federal Facility Agreements (FFA) at key Department sites across the Nation. The FFAs involve no less than 350 milestones at these sites. The FFAs are augmented by numerous other local agreements with their own set of actions, requirements, milestones and due dates... However, the current strategy may not be sustainable if the Department's remediation budget suffers major reductions."[13] Although dispute resolution procedures must be used to resolve FFA disputes before initiation of court litigation, DOE has been sued in local federal court at Hanford and a court-approved consent decree has been imposed (and may be expanded) because of numerous missed FFA milestones at the site relating to HLW tanks; similar judicial action is being considered to remedy missed FFA milestones at SRS.

Under CERCLA and Executive Order 12580, DOE is the "lead agency" for cleanup at its sites, and EPA is the principal agency charged with overseeing DOE's site cleanup activities. States are not delegated the authority to oversee DOE site cleanup by the CERCLA statute, although they can be active participants in the CERCLA decisional process[14] and partners in site FFAs if they choose to enter into them. State requirements that are more stringent than federal requirements can be "applicable" or "relevant and appropriate" requirements (ARARs) applicable to cleanup of DOE sites, unless there are grounds for a waiver; state ARARs can be a significant cost driver at some DOE facilities. Determinations of future land use can also lead to imposition of costly cleanup requirements at vast, highly-contaminated DOE sites if residential-type assumptions are used. Expenditures to date for remediating the Hanford River Corridor to "unrestricted-surface" standards (residential-level cleanup of the surface, down to 15 feet, not including groundwater remediation) has already cost almost $3.8 billion.

Although remediation of DOE's former weapons complex sites could be accomplished under existing CERCLA authority alone, DOE sites are also being cleaned up under EPA-approved state RCRA programs. The federal RCRA program, administered by EPA, imposes (among other requirements) permitting requirements and standards and for hazardous waste treatment, storage and disposal facilities (including for facility closure); such permits may also include requirements for "corrective action," (i.e., cleanup) at such facilities. Because radionuclides do not fall within the purview of RCRA, however, where DOE wastes containing both hazardous constituents and radionuclides are involved (i.e., so-called "mixed wastes"), closure and corrective action permitting are complicated by further dual-regulation: "hazardous" components of the waste are regulated by EPA (or authorized states) under RCRA, while "radioactive" components are regulated by DOE under the Atomic Energy Act. To expedite federal facility cleanup, CERCLA Section 121(e) provides that where a remedial activity is being conducted entirely "onsite" under CERCLA, federal facilities do not have to obtain any federal, state or local permits

[13] Department of Energy, Office of the Inspector General, Special Report: Management Challenges at the Department of Energy, DOE/IG 0858, November, 2011.

[14] CERCLA Section 120(f) makes clear that states shall have an opportunity to participate in the planning and selection of remedial action, in accordance with Section 121.

that might otherwise be required; this includes permits under RCRA. The CERCLA Section 121(e) permit exemption has not been interpreted by EPA to allow an exemption from permitting procedures where solely-onsite remediation is being conducted under RCRA, however; DOE believes that state RCRA permitting procedures at some sites have added significantly to the time required to develop remedies and increased site remediation costs.

Cleanup procedures, criteria and results under CERCLA and RCRA are supposed to be equivalent; however, this intention is not being realized in practice at some DOE sites. Unlike CERCLA, RCRA expressly authorizes EPA to delegate implementation and enforcement of the Agency's RCRA program to "authorized states," i.e., states with equivalent programs that are not inconsistent with, or less stringent than, EPA's RCRA program and that are approved by EPA. Requirements imposed by states under EPA-authorized state RCRA programs can, however, be more stringent than EPA's. Further, the Federal Facilities Compliance Act (FFCA), enacted in 1992, authorizes states with EPA-approved RCRA programs to take the lead in addressing "mixed wastes" (wastes that are both RCRA-hazardous and radioactive) at DOE sites, such as mixed high-level tank wastes at Hanford and SRS, using their state RCRA programs. As described above, these state programs operate through RCRA permits, which can complicate and delay decision making and cleanup and add to costs, raising the question whether the exemption from permitting under CERCLA Sec. 121(e) does, or should as a matter of policy, apply.[15]

In states with EPA-authorized RCRA programs that include the necessary cleanup authority, state environmental officials, rather than EPA officials, are the primary remedial decision makers for those portions of DOE sites that are being cleaned up under RCRA, and their requirements—and decisions--can have substantial impacts on expenditures at the site, the resources available to address priorities at that and other sites, and more generally, DOE's cleanup budget for the national DOE weapons complex as a whole.[16] For example, cleanup of 177 HLW tanks at Hanford—which contain 53 million gallons of RCRA-regulated "mixed HLW waste"-- is being led by the Washington Department of Ecology pursuant to a site-wide state RCRA permit and the state's EPA-approved RCRA underground storage tank (UST)

[15] Where the permit exemption under CERCLA Section 121(e) does apply, state substantive RCRA requirements that are more stringent than EPA's would be treated as ARARs and applied if applicable or relevant and appropriate, but state procedural RCRA requirements, such as those pertaining to permitting, would not apply.

[16] Following approval of a state's RCRA program, however, under 40 C.F.R. Part 271.19 EPA retains authority to enforce RCRA requirements, and it can revoke part or all of an authorized state's RCRA authority, under certain circumstances. States with major DOE sites, including Washington (Hanford), Idaho (INL), South Carolina (SRS), and Tennessee (Oak Ridge), Kentucky (Paducah) and Ohio (Portsmouth), have received EPA authorization to conduct equivalent state RCRA corrective action programs in lieu of the federal program. See EPA, Authorization Status by Rule (StATS Data as of June 30, 2014). Available at: <http://www.epa.gov/osw/laws-regs/state/stats/authall.pdf>. However, even with RCRA authority for cleanup, some authorized states may be able to conduct certain cleanup activities under other relevant legal authorities. For instance, South Carolina, although a RCRA authorized state, has elected, at least for now, to address waste tanks at SRS under the Clean Water Act, rather than RCRA.

closure and cleanup requirements.[17] As shown on Table 1, below, activities to remediate HLW tanks at DOE sites have consumed a sizable portion of the EM cleanup budget for the complex and will continue to do so in future.[18]

In addition to being "mixed waste" under RCRA, the wastes in tanks at DOE's Hanford and SRS sites are designated "high-level waste" (HLW). A point that will appear in multiple places in the report is the definition of HLW and the distinction between HLW and other categories of radioactive waste, including "low level waste" (LLW). Neither HLW nor LLW is defined in terms of the radiological characteristics of the wastes, and each category includes wastes which vary widely in such characteristics. Because management and disposal requirements are geared to these categories, there may often be a mismatch between such requirements and the hazards that particular wastes pose.[19]

HLW, which must be disposed of in a geologic repository, is defined in the Nuclear Waste Policy Act of 1982 (NWPA) as "(a) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste **that** contains fission products in sufficient concentrations; and (b) other highly radioactive material that the U.S.NRC, consistent with existing laws, determines by rule requires permanent isolation" (Department of Energy 2004). With some exceptions, the general policy has been to treat all reprocessing wastes, regardless of their radioactive characteristics, as HLW, notwithstanding the wide variation in the radiological characteristics of different components of reprocessing wastes and the regulatory option of classifying low-activity fractions of reprocessing wastes as not "highly radioactive materials" and hence not HLW.

LLW is defined in the Low-Level Radioactive Waste Policy Act of 1985 as all radioactive waste other than HLW, spent nuclear fuel, transuranic (TRU) waste, and certain non-reactor wastes. LLW includes material that has become contaminated with radioactive substances, such as protective clothing, shoes, mops, rags, filters, tools, tubes and needs, swabs, syringes, laboratory animal carcasses and tissues, and other items. The level of contamination of LLW can range from slightly above background to highly contaminated parts from inside a reactor vessel (U.S.NRC 2015). The LLW category applies to DOE wastes disposed in civilian disposal facilities, which currently cannot receive some of the more radioactive DOE LLW. DOE wastes disposed of at DOE facilities are governed by performance-based

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[17] Using its FFCA authority, Washington state has exercised RCRA permitting and regulatory authority over the entire Hanford site, including for high level waste tanks, the Waste Treatment Plant, and a substantial number of other facilities designated by the state as requiring a RCRA permit. The initial RCRA site-wide permit for Hanford, issued in 1994, was jointly issued by EPA and Washington State because at the time, the state lacked authorization to conduct some portions of the RCRA program. The initial permit expired in 2004, and in 2005 the state received from EPA the RCRA authorization it had lacked. It is notable, however, that over a decade later Washington has not yet issued a new final RCRA permit for Hanford, and RCRA activities at the site continue to be governed by the expired permit.

[18] Concerns regarding costs of tank waste treatment have also been recently discussed in a GAO report (U.S. GAO 2015b).

[19] For a detailed discussion of the regulatory, cost and practical implications of the current classification scheme for radioactive waste, including HLW, LLW and TRU, see Stewarts, Fuel Cycle to Nowhere (2011).

disposal requirements under DOE Order 435.1 and are not termed LLW by DOE. However, for purposes of the Committee's report, we have used the term "LLW" to describe DOE site wastes that would be classified as LLW if they were generated by or disposed of at civilian facilities.

This distinction between HLW and LLW is important because it markedly influences how waste can be managed, as will be seen in multiple places in the report. This waste management disparity is embedded in the costs on Table 1.

Table 1. Environmental Management Costs by Site, 2015, $ billions*

Site	Life cycle costs, 50% confidence level	FY 2014 current	FY 2015 enacted	FY 2016 requested	Major cost elements
Savannah River	65.88	1.255	1.260	1.337	Liquid waste tanks
Hanford, ORP*	65.77	1.210	1.212	1.414	Tank farms
Hanford, RL*	58.12	1.013	1.007	0.914	Central plateau remediation, River corridor cleanup
Idaho National Laboratory	19.61	0.394	0.405	0.367	Cleanup and waste disposition
Paducah Gaseous Diffusion Plant	11.23	0.325	0.270	0.232	Decommissioning of gaseous diffusion plant
Oak Ridge	10.75	0.429	0.431	0.366	Cleanup and disposition, Nuclear facility D&D, Bld 3019 (UR-233), uranium enrichment
Portsmouth Gaseous Diffusion Plant	9.21	0.199	0.276	0.227	Decommissioning of gaseous diffusion plant
Waste Isolation Pilot Plant	7.03	0.221	0.324	0.248	Operate TRU waste facility
All Other, 24 sites & HQ	42.73	0.784	0.682	0.713	
Total EM** program	290.33	5.830	5.861	5.818	

Sources: U.S. DOE, 2014; Department of Energy, FY 2015 Congressional Budget Request, Environmental Management; U.S. DOE, April 2013; Whitney, EM FY 2016 Budget rollout Presentation, February 2, 2015

*The Office of River Protection and the Richland Site Office each manage a distinct set of cleanup activities, priorities and budgets at the Hanford site.

**Totals may not add to program total due to rounding

Figure 1. DOE EM Expenditures: Past and Exptected Future (Source: Jack Craig, Acting Associate Principal Deputy Assistant Secretary for Environmental Management, EM Program Update and FY 15 Budget Overview, April 23, 2014.)

3. MAJOR THEMES, FINDINGS AND RECOMMENDATIONS

The Review Committee has divided its analysis into three major themes for the purpose of evaluation and presentation:

1. Nuclear Safety and Human Health,
2. Inconsistencies in Cleanup Requirements and Policies Among Sites, and
3. DOE Risk Informed Prioritization and Resource Allocation.

The discussion of each major theme is directly followed by related findings and recommendations.

3.1 MAJOR THEME: NUCLEAR SAFETY AND HUMAN HEALTH

3.1.1 DEPARTMENT OF ENERGY (DOE)

The following identifies and reviews how specific federal policies and guidance shape DOE-EM's evaluation and use of risks to human health and safety as part of program decisions (Task i).

DOE is the line manager of its nuclear cleanup projects and sites and also regulates its own activities and those of private entities with whom the Department contracts to manage and operate its nuclear cleanup projects and sites. DOE's regulatory authority applies to nuclear safety management (10 CFR 830), occupational radiation protection (10 CFR 835), and worker health and safety (10 CFR 851).[20] This section provides a brief overview of the regulations, guides, standards and practices that DOE has developed to accomplish its responsibilities as both manager and regulator, and to direct and regulate the activities of contractors at DOE sites.

3.1.1.1 DOE Regulations and Policy

Like the Nuclear Regulatory Commission (USNRC), DOE is required by the Atomic Energy Act (AEA) to conduct its activities so as to maintain "adequate safety." This is expanded in DOE's nuclear safety policy (DOE P 420.1) to state:

> *"It is the policy of the Department of Energy to design, construct, operate, and decommission its nuclear facilities in a manner that ensures adequate protection of workers, the public, and the environment."*

To implement its human health and safety responsibilities under the AEA, DOE has promulgated a series of regulations, as well as directives and guidance documents that further elaborate how regulations

[20] This regulation is carried out under 10 CFR 820, *Procedural Rules for DOE Nuclear Activities.*

should be implemented at DOE nuclear facilities and sites. They address nuclear safety management, worker health and safety, and radiation protection, including:

- 10 CFR 830, *Nuclear Safety Management*: governs the conduct of DOE personnel, contractors, subcontractors, and other persons conducting activities that affect, or may affect, the safety of DOE nuclear facilities. It is divided into two parts: Part A provides quality assurance requirements applicable to all activities/parties associated with work at DOE nuclear facilities, and Part B has safety basis requirements for DOE facilities that are Hazard Category 3 or higher. DOE facilities and activities are placed into Hazard Categories using quantitative limits for inventories of radioactive material stored/processed; facilities are ranked hazard categories 1 (highest) through 3 (lowest).[21] Then 10 CFR 830 Part B lists several recognized consensus standards for the assessment of safety in specific types of facilities and activities—such as, environmental restoration projects, decontamination and decommissioning activities, non-reactor nuclear facilities, transportation and others.
- 10 CFR 835, *Occupational Radiation Protection*: similar to the requirements imposed by the USNRC at 10 CFR 20, *Standards for Protection Against Radiation*, this rule and its attendant DOE Orders[22] and a number of subject-specific technical standards provide specific requirements for protection against ionizing radiation and the potential for spread of radiological contamination.
- 10 CFR 851, *Worker Safety and Health*: requires that work performed on DOE sites be the subject of an integrated program to protect worker health and safety; a program that has been specifically tailored to the work at that site, integrated with the nuclear and radiological safety requirements discussed above and approved by DOE. This worker safety and health rule is designed to be consistent with Occupational Safety and Health Administration (OSHA) requirements and guidance promulgated by the Department of Labor.
- 48 CFR 970 and 952, *Integrated Safety Management*: DOE has placed in the DOE Acquisition Regulation (known as the DEAR) requirements that contractors are required to implement concerning integrated safety management systems—designed to ensure that all work planned and conducted at DOE nuclear facilities is done so in a process that identifies the hazards associated with scopes of work, determines required safety controls for the work, implements those controls during the conduct of work, and evaluates the efficacy of those controls. Each DOE contract invokes a set of DOE Orders, Guides and Technical Standards necessary to ensure the safety of the public and workers, and be protective of the environment.
- 10 CFR 820, *Procedural Rules for DOE Nuclear Facilities*: This rule promulgates the responsibilities and authorities for independent safety oversight within the DOE. This responsibility is exercised by an organization that reports directly to the Deputy Secretary, with

[21] In accordance with detailed requirements stated in DOE Standard 1027, *Hazard Categorization and Accident Analysis*.

[22] For example, DOE Order 458.1, *Radiation Protection of the Public and the Environment*.

comprehensive oversight and regulatory authority for matters associated with nuclear safety, radiation protection, and worker safety and health (also safeguards and security). This group, the Office of Enterprise Assessment (DOE-EA), has authority to impose a full spectrum of penalties ranging from notices of violation to monetary fines. In exceptional cases, it has the responsibility for initiating criminal proceedings. DOE-EA complements the work of the Office of Health, Safety and Security (DOE-AU) which implements guides and technical standards important to safe performance of work at DOE sites.

The above DOE rules provide requirements important to the protection of human health and safety and ensure protection of the environment. They provide the framework within which work at DOE sites is planned and executed. The DOE provides implementation guidance for each of these rules in the form of "Guides", which discuss, in greater detail, the Department's expectations for performance in areas important to human and public health and safety.[23]

3.1.1.2 DOE Line Management of Safety

The system that DOE has in-place for executing its line management responsibilities for safety is embodied in an approach known as Integrated Safety Management (ISM), which was initially launched in response to DNFSB Recommendation 95-2, *Integrated Safety Management*. The policy is elaborated in DOE P 450.4, *Integrated Safety Management*: "It is the Department's policy that work be done safely and efficiently and in a manner that ensures protection of workers, the public, and the environment"; the Policy goes on to establish *guiding principles* for implementation of ISM, which include: line management's responsibility for safety, the concept of balanced priorities,[24] hazard controls tailored to the work being performed and clear responsibility for the authorization of operations (among several others). Further, it defines a top-level process for the planning and execution of work, which involves: definition of the scope of work, analysis of the hazards associated with the intended work scope, development and implementation of hazard controls based on hazard analysis, performing work within the controls derived, and developing feedback on work evolutions so that the conduct of work within the DOE can be continuously improved. DOE Order 450.2, *Integrated Safety Management*, provides the detailed requirements, roles and responsibilities for implementation of ISM in DOE facilities and projects. DOE G 450.4-1C, *Integrated Safety Management System Guide* provides more than 100 pages of detailed guidance on safe work planning and execution, incorporating safety into daily work planning,

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[23] Examples include: DOE G 414.1-2B, Quality Assurance Program Guide; DOE- G 420.1-1A, Non-Reactor Safety Design Guide; DOE G DOE G 413.3-Series, which includes 18 guidance documents on the management of major projects (including a volume of project risk management); deactivation and decommissioning are represented as well in DOE G 430.1-2, DOE G 430.1-3 and DOE G 430.1-4).

[24] In this use, "balanced priorities", is defined in DOE-G-450.4-1C as follows: "Resources are effectively allocated to address safety, programmatic, and operational goals. Protecting the workers, the public and the environment is a priority whenever activities are planned and performed."

enhancing safety-related behaviors, and instituting and maintaining a strong safety culture. This guide embodies the lessons that the DOE has learned since adopting ISM as its safety system in the mid-1990s and was revised and updated in 2011.

DOE-EM requires an annual review of the effectiveness of each contractor/site's implementation of ISM. The self-assessment process begins with a detailed letter of direction from EM Headquarters that establishes emphasis areas for the year, any special evaluations that are desired (for example, quality assurance and safety culture have been emphasis topics in the past), and headquarters' expectations for the conduct of the review. Each DOE-EM Field Office then provides directions to its contractors to conduct the self-assessment[25] and report the results. Contractors are required to provide a detailed report documenting any deficiencies identified and formally validate the continued effectiveness of their ISM system. DOE Field managers and their technical/safety staff, in concert with DOE-EM headquarters project and safety staff, review the results of each assessment to determine if site-specific actions are required and if program-wide changes are needed to continuously improve safety management at DOE's cleanup projects.

For planning day-to-day work, requirements are found in DOE Order 450.2, *Integrated Safety Management*. It states its purpose is to "ensure that [DOE] systematically integrates safety into its work practices at all levels, so that missions are accomplished efficiently while protecting the workers, the public and the environment." It provides requirements for: incorporation of ISM into contracts, safety oversight plans, contractor reports to DOE, and performance measures and analysis of operational information.[26] Requirements for integration of safety are also incorporated into DOE's direction for the planning and execution of major projects, DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, which provides DOE "program and project management direction for the acquisition of capital assets, with the goal of delivering projects…fully capable of meeting mission performance, safeguards and security, and environment, safety and health requirements…" and milestones for safety-related deliverables are established.[27]

10 CFR 830, *Nuclear Safety Management*, requires contractors that manage and operate DOE nuclear facilities to analyze the safety of DOE facilities and activities; this rule provides several industry standard methods for conduct of these safety analyses. The most frequently used is DOE-STD-3009, *Preparation*

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[25] Such self-assessments are a best-practice in the nuclear industry and governed within DOE by an authoritative directive, DOE-G-414.1-1C, Management and Independent Assessments Guide"; for example, under 10CFR835, each site is required to perform a self-assessment of the adequacy of its radiation protection program at least once every three years.

[26] Details of implementation are found in an associated guide DOE G 450.4-1C, Integrated Safety Management System Guide.

[27] For example, preliminary and final hazard assessments, preliminary and final documented safety analyses, and technical safety requirements. Detailed technical direction for integrating safety analysis into the design and construction of projects is found DOE-STD-1189, Integrating Safety into Design.

of Nonreactor Nuclear Facility Documented Safety Analysis.[28] ("safe harbor" for meeting 10CFR 830) DOE nuclear safety experts technically review all DSAs, and any changes, for adequacy and accuracy; DSAs and changes thereto are formally approved by DOE (normally at the Field Office level) and any issues are documented and resolved to DOE satisfaction.

Like the USNRC, DOE has established requirements that apply specifically to its review and approval of DSAs and other safety-related analysis, these requirements reside in DOE-STD-1104, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*.

The present DOE risk analysis process uses quantitative analysis of accident consequences, coupled with qualitative estimation of accident likelihood (based on subject matter expert judgment of probability); this process is consistent with past USNRC practice for *non-reactor* applications of nuclear energy (e.g., fuel cycle facilities, nuclear waste facilities, etc.); however, USNRC's policy on this front is in the process of evolving. In a recent letter, the USNRC Advisory Committee on Reactor Safety (ACRS) recommended to the Commission that "we see advantages in moving the [non-reactor risk analysis process] systematically in the direction of PRA", also in that letter the ACRS stated that in implementing probabilistic risk assessment (PRA) for non-reactor facilities, "the greatest benefit will be achieved for complex facilities with high consequence events."[29] More recently, a USNRC Task Force proposed a regulatory framework that would apply risk management methods to all USNRC-regulated activities[30]. DOE has not yet incorporated the use of probabilistic risk assessment (PRA) into its analyses of accident probabilities. In the commercial nuclear industry, the information available in the PRAs that have been conducted allows the USNRC and regulated reactor operators to make better, risk-informed decisions on maintenance enhancements to safety-related systems, along with system design and procedure changes.[31] Thus, DOE's present safety analysis process may not provide DOE all of the insight which would be valuable for managing the safety of its high-hazard nuclear facilities in the most efficient and effective manner.

It is further noted that Congress addressed the use of PRA in Section 3161 of the Fiscal Year 2013 National Defense Authorization Act, where it was required that DOE "ensure that the methods for assessing, certifying, and overseeing nuclear safety at [its facilities] use national standards and nuclear

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[28] 10 CFR 830 also requires that contractors maintain current the Documented Safety Analysis (DSA) for a facility or activity, with at least annual updates. Further, new information or questions regarding the adequacy of the DSA are resolved through the unreviewed safety determination process Requirements for this process are found in DOE G 424.1B, *Implementation Guide for Use in Addressing Unreviewed Safety Questions Requirements*.

[29] ACRS memo to USNRC Commissioners, Comparison of Integrated Safety Analysis (ISA) and Probabilistic Risk Assessment (PRA) for Fuel Cycle Facilities," February 17, 2011.

[30] USNRC, NUREG 2150, A Proposed Risk Management Regulatory Framework, April 2012

[31] Further details discussion of the advantages of PRA, for facilities similar to DOE nuclear facilities, can be found in a letter from the Advisory Committee on Reactor Safeguards (ACRS) to the USNRC.

industry best practices, including probabilistic or quantitative risk assessment if sufficient data exist"; in elaborating on this section, Congress expressed its concern that DOE risk assessment practices were inconsistent with industry practices at commercial nuclear power reactors—which use PRA. Although DOE has recently issued DOE-STD-1628, *Development of Probabilistic Risk Assessments for Nuclear Safety Applications*, the Department has yet to implement this standard in any pilot PRA studies needed to inform use of the new standard.[32]

Regular review of safety implementation is also important. Leadership focus is provided when the top leaders personally engage and lead by example, with their subordinate executive team. The Review Committee interviews with DOE-EM field and headquarters managers (conducted from August to October 2014) indicated that the EM-1 had not been conducting performance reviews with their subordinate headquarters executives, the site office managers, and senior contractor officials; rather, problematic major capital projects were the focus of senior management review (i.e., those projects that are behind schedule or encountering technical issues). Comprehensive reviews of EM project performance, integrating safety and mission accomplishment insights, are not regular, nor frequent. In the past, such performance reviews were conducted by EM-1 and included and integrated: safety, cost and schedule performance, quality, and risk management.[33] Upper level DOE management does conduct reviews, but not necessarily with EM-1 present. Absent the attention afforded by regularly scheduled line management reviews, it is possible that the focus on critical elements such as nuclear safety and industrial/operational safety could be reduced. Furthermore, the Review Committee understands that for the past several years the person acting as EM-1 has not been regularly and actively engaged in this process. Also noted, it has been a long period of time since there has been a Senate-confirmed Assistant Secretary of Energy with responsibility for the EM program. This absence of an accountable administration official may lead to a lack of continuity, and a perception of lack of authority, and such authority and accountability is essential for the execution of the important responsibilities of this complex nuclear cleanup program. Towards the end of the review, the Review Committee became aware of a project management improvement plan initiated by the Secretary of Energy; this plan focused primarily on additional external/peer review of capital projects[34]. EM should

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[32] However, it is noted that DOE has completed PRAs on its two major test reactors, the Advanced Test Reactor (Idaho National Laboratory) and the High Flux Isotope Reactor (Oak Ridge National Laboratory). These PRAs were accomplished consistent with USNRC requirements and guidance for test reactors. Also, PRA's for facilities similar to those operated by DOE-EM have been complete elsewhere; for example, for the low-level waste disposal facility at West Valley, NY and for the Mixed-Oxide Fuel Fabrication Facility (MFFF) at the Savannah River Site in Aiken, SC.

[33] The practice and benefits of regular project reviews in DOE-EM has been described in J. A. Rispoli, S. L. Krahn, and S. L. Ross, *How We* [DOE EM] *Manage and Process Nuclear Waste*, The Science and Culture Series: Nuclear Strategy and Peace Technology, 40th Session. World Scientific Publishing, 2010.

[34] DOE, Secretary of Energy Memo to Heads of All Department Elements, "Improving the Department's Management of Projects," December 1, 2014.

consider the above Committee discussion, which is focused on line management of all EM projects, as EM implements improvements to meet this new secretarial initiative.

EM's Site Offices have in place a structured process for oversight of operations and safety at nuclear facilities (and other high-hazard facilities). The Review Committee's interviews at EM sites demonstrated that Site Offices closely oversee operations at the facilities under their purview with a combination of: regular senior management meetings focused on operations and safety, oversight of facility operations by qualified DOE staff, and regular required reporting by DOE contractors of safety-related matters. The Site Offices maintain detailed oversight plans, in accordance with DOE Order 226.1B.[35], that include: operational awareness activities, e.g., facility walk-downs, and procedure reviews, direct oversight of operations; independent and self-assessments of facilities, operations and programs; and, evaluation of the contractor's assessment and performance measurement systems. Furthermore, Site Office oversight is supplemented by and evaluated by EM HQ oversight processes. Important operations and health and safety information is required to be reported to the DOE Site Office and HQ management in a timely manner; this information includes any off-normal operational incidents, environmental releases, personnel accidents, and other information necessary to evaluate the safety of facility and site operations.[36] Looking at the aggregate data from the second quarter FY2012 through the first quarter FY2015 shows that EM's rate of events that require medical treatment and/or lead to days away from work average between one-quarter to one-fifth of those for comparable industries (the U.S. construction industry and waste management and remediation service industries). And while the Review Committee elsewhere raises concerns about the overall strength of the Department's own technical oversight resources, we note that EM Site Offices and HQ are required to maintain an adequate cadre of technical and safety staff tailored to the challenges that exist at the facilities they oversee; this process is described in DOE's Federal Technical Capability Program[37], which requires quarterly review of personnel/qualification needs and capabilities.

In addition to the formal structure for safety management, DOE has a "boots on the ground" presence in its nuclear and other high-hazard facilities, the DOE Facility Representative, or "FR" as they are known in the field. The FR is a highly-trained and qualified (in accordance with DOE STD 1063-2011) DOE employee who has no other responsibilities than overseeing the safe operation of the facilities under their purview. They have unfettered access to DOE facilities, responsibilities for active safety oversight, authorization to stop work under unsafe circumstances, and access to senior DOE and contractor

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[35] DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, the basic tenets of DOE management and oversight of contractor performance are promulgated in DOE Policy 226.1B, *Department of Energy Oversight Policy*.

[36] Detailed requirements are found in DOE Order 231.1B, *Environment, Safety and health Reporting*, DOE Order 232.2, *Occurrence Reporting and Processing of Operations Information*, and DOE Order 225.1B, *Accident Investigation*, along with supporting guidance documents and technical standards.

[37] In accordance with DOE Order 426.1 (Change 1), *Federal Technical Capability*.

management.[38] They provide management's "eyes and ears" at DOE sites, providing daily onsite assessment of the safety of operations.

Finally, since about 2008, DOE has been working to integrate human performance and behavior insights into its ISM approach. The initial fruits of the process were a collaborative effort between DOE and its facility operating contractors, which was issued by the Deputy Secretary in 2009.[39] As discussed below, safety culture issues were identified by the DNFSB at the Waste Treatment and Immobilization Plant in Hanford, resulting in DNFSB Recommendation 2011-1, *Safety Culture at the Waste Treatment and Immobilization Plant (WTP)*. Recommendation 2011-1 urged specific actions regarding the culture at the WTP and also recommended that DOE evaluate safety culture more broadly throughout its nuclear facilities. DOE work to implement DNFSB Recommendation 2011-1 continues at present. A corrective action plan has been developed for the DNFSB recommendation and a number of its steps implemented for identified safety culture issues at WTP. Further, independent assessments of safety culture at DOE's major capital projects have been completed by outside experts, led by DOE's internal regulatory organization (DOE-EA). DOE noted to the Committee that a similar assessment process but performed by line management (i.e., self-assessment) is being followed on other projects and sites.

Further, DOE has in place programs to allow personnel who disagree with management decisions to formally document their concerns and have those concerns reviewed by an impartial person for resolution. Under the DOE Employee Concerns Program (ECP), DOE, contractor, or subcontractor employees may report concerns about any aspect of DOE-related operations without fear of reprisal.[40] More specific to technical and/safety-related concerns, DOE has in place a differing professional opinion process that supplements the ECP; it is aimed specifically at addressing detailed, technical issues associated with assuring adequate safety and environmental protection at DOE sites and facilities.[41]

In addition, sites with nuclear facilities have completed self-assessments of safety culture at their sites. Recently a consolidated report discussing what the Department has learned from the WTP assessments, independent assessments of major capital projects and self-assessment at other sites has been issued, along with DOE's plans to sustain department-wide progress in safety culture.[42] The Review Committee's discussions with DOE-EM managers, and review of recent information regarding the safety culture at WTP and preliminary information associated with the recent incidents at the Waste Isolation

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[38] These roles and responsibilities are documented in DOE G 226.1A, *Federal Line Management Oversight of Department of Energy Nuclear Facilities*.

[39] The document was entitled "Assessing Safety Culture in DOE Facilities."

[40] The Committee notes, however, employee concerns, for example at the Hanford WTP, suggesting that existing programs may not be achieving their intended purpose and that further DOE attention is needed.

[41] These programs are embodied in DOE Order 442.1A, Department of Energy Employee Concerns Program and DOE Order 442.2B, *Differing Professional opinions for Technical Issues Involving Environment, Safety and Health Technical Concerns*.

[42] The plan of action described here is embodied in DOE's implementation plan for the Board's recommendation, which was reviewed and approved by the DNFSB.

Pilot Plant (WIPP), lead the Review Committee to agree with DOE-EM management that safety culture improvement is a "work in progress" and that continued emphasis on implementing a safety culture in EM that meets DOE expectations (outlined in DOE-G-450.4-1C) and industry standards is an important and necessary step in continuous improvement of safety within EM.

3.1.1.3 Implementation of Safety Programs

The Review Committee had a series of discussions with DOE personnel from both Headquarters and the Field regarding how they implemented responsibilities for ensuring adequate protection of the workers, the public and the environment. For the purposes of summarizing, the conversations will be divided into technical and managerial sections below, although there is overlap between these two categories.

Technical Implementation

Implementation of requirements for human health and safety protection was discussed with safety analysis personnel, facility operations personnel and DOE Facility Representatives (who have federal responsibility for oversight of both areas). These conversations displayed the personnel's understanding of how the DOE safety system (described above) functioned to ensure that workers, the public and the environment are protected from the hazards associated with work at DOE's cleanup sites. Particular emphasis was placed on the role played by engineered and administrative control systems; these systems are analyzed for their safety roles in the Documented Safety Analysis and their continued functioning is ensured by Technical Safety Requirements, which dictate monitoring and preventive maintenance required to ensure that the safety functions are maintained. The operation of these safety-related systems and the maintenance required to keep them functional is provided the highest priority by facility management. DOE Facility Representatives indicated that they had unfettered access to both contractor and DOE facility and executive management to identify safety issues and ensure their proper resolution. DOE safety management and oversight is augmented by the independent review provided by DNFSB Site Representatives and technical staff reviews; the DNFSB provides graded levels of feedback to DOE, as discussed in the section on the DNFSB (below).

Maintenance of infrastructure directly and indirectly related to the safe operations of nuclear facilities and nuclear cleanup activities is important. Not all systems installed in nuclear facilities directly perform safety-related functions; there are also a number of site-wide systems that are required to be functional to support the safe operation of nuclear facilities and the conduct of nuclear cleanup activities, including emergency management. Site-wide systems essential to ensuring site safety can include: the site power system, for normal operations and extended operation of safety-related systems; service water systems, for fire-fighting and some cooling applications; and the site transportation and communication network, for emergency preparedness and waste management operations, to name a few. Sites with substantial cleanup missions were initially constructed during World War II (e.g., Hanford, Oak Ridge) or the Cold War (Savannah River, Idaho). At several sites, important infrastructure systems are operating past their design lives and are showing the stress of extended operations. For sites, or portions thereof, which were anticipated to have completed deactivation, decommissioning and environmental restoration by

now, some infrastructure systems are increasingly difficult to maintain and their maintenance has not been deemed a high priority (until recently, see below). Like PRA, quantitative analysis tools are available to assist in the analysis of maintenance program effectiveness (such tools include reliability-centered maintenance (RCM), failure modes and effects analysis (FMEA)); a more detailed, quantified understanding of the operation and maintenance of these important site infrastructure systems, as can be provided by RCM and FMEA, provides a rational basis for infrastructure planning—as opposed to the present approach, described by several interviewees as "run to failure." However, these tools have not yet been applied to the infrastructure maintenance challenges discussed.

Safety Culture

DOE has been working to enhance its approach to safety culture since 1995. This work has been accelerated and provided focus by DNFSB Recommendation 2011-1 and the associated DOE implementation plan (discussed above). DOE's actions to address DNFSB Recommendation 2011-1 included independent assessments of safety culture and DOE's major construction projects, independent assessments of the safety culture of major headquarters organizations (including EM), self-assessments of safety culture and DOE sites/facilities that have nuclear facilities, revision of the DOE Nuclear Safety Policy to recognize the role of safety culture, and senior management meetings with workers and training on safety culture topics and issues. During the development and implementation of these actions, DOE involved outside experts with safety culture expertise, along with representatives of other federal agencies that have active safety culture programs, notably NASA and the USNRC, in addition to participation by the DNFSB. Many actions of the DOE implementation plan have been completed and lessons learned in the process documented—most notably in the recently issued DOE consolidated report on safety culture[43]; this report identified four areas for near-term DOE focus: (1) demonstrated safety leadership, (2) open communication and fostering an environment free from retribution, (3) teamwork and mutual respect, and (4) credibility, trust and reporting errors and problems. DOE is now implementing actions recommended by the Consolidated Report, including a permanent Safety Culture Improvement Panel (SCIP) to monitor progress in safety culture, oversee DOE sustainment actions, and provide feedback to management on improvement actions needed. Recent events, such as the incidents that resulted in the shutdown of the Waste Isolation Pilot Plant (WIPP), along with continued specific employee concerns associated with the Waste Treatment Project at Hanford merit the attention of the SCIP; further, the SCIP should look to continue the practice of input from outside organizations like NASA, the NRC and others. This summary, along with the discussion in the DNFSB section below, is provided to describe actions in this important area. Time did not allow for a detailed review of safety culture in DOE.

[43] DOE, *Consolidated Report for DNFSB Recommendation 2011-1, Action 2-8 and 2-9*, dated May 2014

Management's Role in Safety Implementation

Management's priorities are most clearly demonstrated by the budget process (the details of which are discussed elsewhere) and what management pays attention to. To reflect the top priority placed upon safety-related matters, DOE sites have a "min-safe" budget category that encompasses operations, maintenance and activities necessary to maintain the safety-related systems associated with nuclear facilities; it also includes site-wide programs (such as radiation protection, nuclear safety analysis, etc.) important to both the operation of nuclear facilities and the conduct of cleanup projects. The Review Committee dialogue with the management teams clearly indicated their understanding of the importance of the min-safe budget development process and their plans to use this process to ensure that adequate funds were brought to bear to ensure that nuclear activities were conducted safely. However, the Review Committee dialogue with them did indicate that they were concerned about past under-funding of infrastructure maintenance and investment and they described several actions underway to try to address the past funding shortfalls in this area. These actions centered on providing a higher degree of attention to the category of infrastructure maintenance and investment and in planning for important infrastructure systems during budgeting activities. Also, the lack of regularly scheduled performance reviews for DOE-EM projects and operations, conducted by EM-1 periodically on the entire portfolio of projects and operations, can reduce the level of attention paid to critical elements such as nuclear safety and industrial/operational safety (as discussed in detail in section 3.1.1.2, above-Line management); in addition, senior management focus on operations and safety is a key tenet of a healthy safety culture.

Further, as discussed in more detail below, complex technical subjects which are the subject of dialogue between DOE-EM and the DNFSB often take an extended period of time to resolve. Examples discussed below include more than a decade spent evaluating mixing within the WTP Pre-Treatment Facility and eight years evaluating and discussing the use of PRA in the DOE-EM safety-related applications. Long-standing technical issues also include issues not under DNFSB purview, such as the on-going concerns regarding chemical vapors at the Hanford Tank Farms.[44] Further, it should be noted that none of these issues is fully resolved at present; testing of ability of the Pretreatment Facility systems to provide adequate mixing is on-going and will continue for several years, PRA has yet to be used to evaluate safety-related issues in a DOE-EM facility, and actions are still in-process to fully characterize and resolve concerns with chemical vapors at Hanford.[45] Such extended periods being required to evaluate complex

[44] SRNL-RP-2014-00791, "Hanford Tank Vapor Assessment Report," October 30, 2014 is the most recent report; the issue has been expressed and reviewed before, stretching back to at least 1992.

[45] Washington River Protection Solutions, "Implementation Plan for Hanford Tank Vapor Assessment Report Recommendations," (undated) Implementing all the Report's recommendations could take four to five years, according to the contractor. A. Carey, "State Notifies DOE of Possible Lawsuit Over Hanford Tank Vapors," (Nov. 19, 2014). The State of Washington and other parties have brought legal action against DOE and the contractor seeking resolution of the tank farm vapor issues and associated worker health complaints. Id.

technical issues could be indicative of problems with the capacity (i.e., numbers of technical personnel coupled with their skill set) of the technical organization within DOE-EM and warrant review.

3.1.1.4 Summary

DOE has promulgated a hierarchy of requirements (rules, guides, orders, technical standards) to ensure the health and safety of the workers and the public; the Review Committee interviews with DOE personnel demonstrated their understanding of proper implementation of these requirements. Further, Review Committee interviews with Field and Headquarters personnel indicated that systems required to provide for nuclear safety, and protection of workers, the public and environment are operated and maintained in a manner that continues to assure protection. However, ongoing operation and maintenance of DOE's nuclear facilities is not without its challenges, as demonstrated by the recent incidents at WIPP—which led to renewed attention by DOE to important infrastructure systems, a shutdown of waste management operations important to DOE's cleanup of nuclear sites, and a formal recommendation from the DNFSB.[46] Moreover, at DOE-EM sites, important infrastructure systems are operating past their design lives and are showing the stress of such extended operations. For these sites, some critical infrastructure systems are increasingly difficult to maintain and their maintenance has not been deemed a high priority until very recently. The Review Committee identified that potential enhancements to the DOE-EM protective system were available; these improvements included use of PRA in safety-related applications for high-hazard nuclear facilities, evaluation and improvement of the engineering/technical function within DOE-EM (including the tracking of technical and safety issues through to conclusion), and the implementation of more quantitative methods to assess the efficacy of maintenance programs for critical site infrastructure. Continued emphasis on safety culture in DOE-EM is on-going and necessary, close monitoring of ongoing sustainment actions will be important to the success of DOE's safety culture initiatives. The DOE Facility Representative program continues to provide a vital, "boots on the ground" assurance of the safety of the DOE-EM complex.

3.1.2 THE DEFENSE NUCLEAR FACILITIES SAFETY BOARD (DNFSB)

The following summarizes *how the DNFSB identifies and elevates threats to the public health and safety, and how DOE considers DNFSB concerns as part of program decisions*.[47]

The Defense Nuclear Facilities Safety Board (DNFSB or the Board) was established by Congress in 1988 to provide an expert body to act as an adviser to DOE on establishing and operating in accordance with standards comparable to those in the commercial nuclear power industry. The Board is an independent agency that oversees the development and implementation of DOE's human (public and worker) health and safety standards at defense nuclear facilities. The Board purview addresses facilities operated by DOE that are covered by the Atomic Energy Act and have a function related to national defense. Since

[46] DNFSB Recommendation 2014-1, *Emergency Preparedness and Response*, September 2014.

[47] The following information is extracted from the DNFSB website and references therein.

DOE is a self-regulating entity, the Board constitutes the only fully independent technical oversight of nuclear operations at the Nation's defense nuclear facilities. The Board's mission as defined in the Board's enabling statute "… shall be to provide independent analysis, advice, and recommendations to the Secretary of Energy to inform the Secretary, in the role of the Secretary as operator and regulator of the defense nuclear facilities of the Department of Energy, in providing adequate protection of public health and safety at such defense nuclear facilities." That mission includes the design, construction, operation, and decommissioning of DOE's defense nuclear facilities.

The Board's initial focus was on the safety at the nuclear weapons production and manufacturing complex; however, after the end of the Cold War, nuclear weapons production stopped. As a result, DOE's mission became the disassembly of a large fraction of the nuclear weapons stockpile, maintenance of the remainder of the stockpile, and cleanup of the former weapons production sites. The Board changed their focus accordingly, and a significant part of their activity became the safety at the DOE -EM sites. Recovering and stabilizing excess nuclear material into safe forms for interim and long-term storage is possibly the most significant and challenging safety issue being tracked by the Board. DOE stores a large inventory of radioactive waste in a number of operating facilities that are near or have exceeded their initial design lives. Tens of millions of gallons of high-level waste are contained in more than 200 aging tanks at the Savannah River and Hanford Sites, some of which have leaked. Aging nuclear facilities that are surplus to DOE's needs can still contain significant quantities of hazardous nuclear material and await decontamination and decommissioning (D&D). Additionally, several new facilities being designed to treat and immobilize the waste for disposal are behind schedule with some substantial unresolved technical and safety issues. The above-mentioned conditions can present a potential risk to human health and safety, and the Board has a history of pointing out these risks to DOE. The EM, in turn, has expended considerable effort to respond to the DNFSB's recommendations and deployed resources to mitigate those risks.

Formal written recommendations to the Secretary of Energy are the most powerful mechanism the Board has for advising DOE of risks that DOE-EM needs to address. For each recommendation, the Secretary must provide a response that accepts or rejects the recommendation and, if accepted, provide an implementation plan and resources necessary to resolve the acknowledged issues. To date, the Board has issued and the Secretary of Energy has accepted 48 recommendations. The third recommendation issued by the Board in 1990, Recommendation 90-3: *Safety at Single-Shell Hanford Waste Tanks*, is the first of a series of recommendations concerning safety at the EM cleanup sites. Notably, four of the most recent accepted recommendations are directly related to operations at DOE-EM sites: (1) Recommendation 2012-2: *Hanford Tank Farms Flammable Gas Safety Strategy;* (2) Recommendation 2012-1: *Savannah River Site Building 235-F Safety*; (3) Recommendation 2011-1: *Safety Culture at the Waste Treatment and Immobilization Plant; and (4)* Recommendation 2010-2: *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant.*

In addition to formal recommendations, the Board frequently issues letters, holds public hearings, and issues technical reports concerning safety issues. Letters to senior DOE management - that formally

establish reporting requirements - are often used; the Board and DOE told the Review Committee that they consider these to be a more efficient and expeditious way of resolving issues than the lengthy formal recommendation process. In addition, the Board and DOE have concluded that it is often easier to reach an agreed upon path forward by trying to resolve issues in interactions among the respective staffs. In this vein, the DNFSB enabling statute authorizes it to place Site Representatives at DOE facilities to provide day-to-day oversight. The Site Representatives attend DOE and contractor planning meetings, walk-down facilities and hold regular interactions with site management to provide quick-turnaround feedback to DOE and its contractors on safety-related matters. They also document their observations in weekly reports that are publicly available on the DNFSB website. The Board uses the site representative weekly reports to plan oversight actions and initiate specific formal reviews by DNFSB headquarters technical staff.

The Department and the Board share the common goal of ensuring adequate protection of public and worker health and safety and the environment at defense nuclear facilities. To accomplish this goal, the Department's policy has been to: fully cooperate with the Board; provide access to information necessary for the Board to accomplish its responsibilities; thoroughly consider the recommendations and other safety information provided by the Board; consistently meet commitments to the Board; and conduct frequent interactions with the Board technical staff. Experience has shown that the involvement and interaction of the Department's executive management with the Board Members is essential for resolving safety issues. In addition, DOE contractors cooperate with the Board by providing access to facilities, personnel, and information that the Board considers necessary to carry out its responsibilities.

In summary, the DNFSB has a clear mandate and authority to provide comprehensive oversight that provides assurance that DOE operates in a manner that ensures adequate protection of human health and safety. The Board's oversight functions and authorities are defined by its enabling statute and can be summarized as:

- Review and evaluate the content and implementation of the standards relating to the design, construction, operation, and decommissioning of defense nuclear facilities;
- Investigate any event or practice at a DOE defense nuclear facility which has adversely affected, or may adversely affect, public health and safety;
- Perform independent oversight of operational safety of DOE's defense nuclear facilities;
- Review the design and operation for new and modified defense nuclear facilities; and
- Make such recommendations to the Secretary of Energy as are necessary to ensure adequate protection of public health and safety.

The DOE has a rigorous process for responding to the Board's documented issues and implementing corrective actions as part of their program activities.[48]

The Board's jurisdiction is focused on nuclear facilities that are related to national defense. The Board does not oversee DOE's civilian nuclear projects, commercial nuclear facilities, nor the US Navy's nuclear propulsion program. In addition, there are a number of activities that while the Board does not directly perform, the DNFSB and staff do review, comment and have influence over (and such actions by the DNFSB are within their purview and act to reduce nuclear safety risks). For example:

1. The Board does not oversee environmental hazards regulated by other federal and state agencies. However, according the DNFSB Policy Statement (PS-3) on Board oversight of DOE decommissioning activities at defense nuclear facilities, the Board is concerned if the environment can be contaminated with radioactive materials originating from a DOE defense nuclear facility. In addition, the Board is prepared to work with federal or state agencies having statutory responsibility for forcing corrective or remedial measures. The Board's objective is to facilitate a smooth transition of oversight to state and federal regulation as a defense nuclear facility passes through operational and decommissioning phases to state and EPA regulation during final cleanup, demolition, and environmental restoration activities.

2. The Board does not regulate, issue requirements, or define standards for DOE's defense nuclear facilities. However, the Board does influence DOE standards that are required to assure or improve human health and safety. One of the Board's strategic objectives is to strengthen safety standards by recommending and promoting effective safety standards. A relevant example is DNFSB Recommendation 2009-1, *Risk Assessment Methodologies at Defense Nuclear Facilities*. The Board first identified a concern with the lack of formality in use of risk management tools at defense nuclear facilities in an April 2005 letter. DOE responded with a *draft* Risk Assessment Policy in January 2006 that reaffirmed DOE's position that traditional deterministic safety assessment methods are adequate to support many operational decisions, but did allow that in hazardous and complex operations, a risk assessment can enhance the deterministic approach. Subsequent DNFSB letters reiterated the concerns that DOE does not have standards to control the use of risk management tools such as those used by other federal agencies involved in high-risk activities.[49] The Board finally issued Recommendation 2009-1 that recommends DOE develop and issue a policy and guidance on the use of quantitative risk assessments for nuclear safety applications. The DOE accepted the DNFSB's recommendation in April 2010 and issued DOE Standard DOE-STD-1628-2013 *Development of Probabilistic Risk (PRA) Assessments for Nuclear Safety Applications* that provides a

[48] Guidance for interactions with the DNFSB is found in DOE Manual 140.1-1B, *Interface with the Defense Nuclear Facilities Safety Board*

[49] This technical background is described in detail in DNFSB Recommendation 2009-1.

consistent approach and process for planning, executing, and using PRAs in nuclear safety applications.

3. The Board does not calculate risks or identify the nature and consequences of potential threats, but rather uses the hazards, accident scenarios, and risks identified in facility specific Documented Safety Analyses, developed by DOE (described above), to identify threats to the public; however, in doing so, the Board may perform independent analyses. The ability of safety systems to protect the public are then judged by the DNFSB against DOE regulations and standards. The Board's enabling statute states, "In making its recommendations the Board shall consider, and *specifically assess risk* (whenever sufficient data exists)...." The Board's decisions and priorities are grounded in engineering experience and judgment - a deterministic approach, and are not probabilistic in nature. The DNFSB Staff has a planning process to develop an annual oversight strategy; this process uses a qualitative multi-variant risk analysis to prioritize staff activities that includes broad categories of probabilities and mitigating circumstances. The annual plan and priorities for DNFSB work are, therefore, influenced by this risk-informed data. The annual plan is reviewed and approved by the Board. The plan, however, cannot be rigid; it needs to be flexible, as emergent challenges occur that require the re-allocation of resources.

   The rapid response to recent events at WIPP illustrates the Board's flexibility; DNFSB personnel were deployed to WIPP within 48 hours of the incident, and full-time coverage of the DOE accident investigation has been provided. The root cause of the radioactive material release on February 14, 2014, is that Los Alamos (LANS) failed to understand and implement its Hazardous Waste Facility Permit and Carlsbad Field Office directed controls, which led to the use and shipment of a noncompliant ignitable waste form (Department of Energy 2015).

4. Throughout this process, the DNFSB remains respectful of DOE's responsibility to perform its own investigation, but will assess DOE's effectiveness in taking corrective actions. Board concerns with WIPP are not new; problems with fire protection and maintenance at WIPP had been identified in letters in 2010. The DNFSB noted that the shortcomings in the responses to a truck fire event and the radioactive material release at WIPP exist at other DOE sites with defense nuclear facilities. This extent of conditions prompted the Board to issue Recommendation 2014-1: *Emergency Preparedness and Response* on September 2, 2014. DOE responded with an implementation plan that the Board has accepted and is currently tracking the issue.

   The Board is focusing priority attention on WIPP not only in consideration of potential human health and safety risk indicated from the current incidents, but also because WIPP is a key piece in the whole waste cleanup process. The process of getting transuranic (TRU) wastes disposed from various DOE sites has stopped while WIPP operations are in stand-down. Without WIPP, risks at cleanup sites increase because they will have to continue storing their TRU in temporary storage rather than in the protection provided by geologic disposal.

5. The Board does not direct DOE priorities or define alternative approaches; it is not within DNFSB's mandate to identify and raise to DOE's attention high-cost remedies or proposed remedies at DOE sites that appear to be unjustified by risk reduction and accordingly, are not cost-effective. However, the Board does take action on cleanup projects, when necessary to emphasize human health and safety. For example, Building 235-F, a former plutonium processing facility at the Savannah River Site has not been in operation for years, the building is deteriorating, and contains amounts of Pu-238, a particularly hazardous isotope of Pu, that present an potential hazard to workers in the facility and those in nearby facilities. Even though Building 235-F has an approved safety basis and DOE has retrofitted upgrades, as required to mitigate potential accidents, the building has the potential for a sizeable Pu-238 release that poses a health risk to nearby workers. The Board first identified the need to address the residual contamination in Building 235-F in a June 2003 letter. The letter noted that the risk associated from residual Pu-238 contamination had been accepted rather than eliminated. DOE continued to update the Building 235-F safety analysis and make incremental safety modifications; however the Pu-238 source term remained in the facility. As a result, DNFSB issued Recommendation 2012-1, *Savannah River Site Building 235-F Safety,* which recommends DOE take action to immobilize and/or remove the Pu-238 that remains as residual contamination within Building 235-F. In July 2012, DOE accepted Recommendation 2012-1. Although several actions to reduce risks in Building 235-F have been completed, the residual Pu-238 contamination remains a hazard.

6. The Board does not formally factor in costs when making recommendations to DOE. The Board's enabling statute states, "In making its recommendations the Board shall consider, ….. the technical and *economic feasibility* of implementing the recommended measures." The Board considers technical feasibility; however, it is not obvious how the Board takes economic feasibility into account. In addressing nuclear safety matters applicable to commercial nuclear power, courts have previously found that cost consequences need not be considered when an issue involves the adequate protection of public health and safety.[50] The USNRC does distinguish between adequate protection measures and safety enhancement. On the other hand, the Review Committee believes when the issue involved represents a safety enhancement, cost-to-benefit analysis should be considered. The Board has issued recommendations that have directed DOE to consider alternative, approaches to enhance the safety of its facilities. For example: Recommendation 2004-2 *Active Confinement Systems*, Recommendation 2005-1 *Nuclear Material Packaging*, and Recommendation 2010-2 *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant* propose alternative

[50] Ruling on the authority of the Nuclear Regulatory Commission, the Court of Appeals for the D.C. Circuit (Union of Concerned Scientists v. NRC, 824 F.2d 108, 120 (D.C. Cir. 1987)) distinguished between adequate protection and safety enhancement. "…under the adequate-protection standard of section 182(a), the NRC need ensure only an acceptable or adequate level of protection to public health and safety….. If it so desires, however, the Commission may impose safety measures on licensees or applicants over and above those required by section 182(a)'s adequate-protection standard…. If the Commission wishes to do so, it may order power plants already satisfying the standard of adequate protection to take additional safety precautions. When the Commission determines whether and to what extent to exercise this power, it may consider economic costs or any other factors."

approaches to DOE work and cleanup sites that are based on safety considerations and the Review Committee believes these may have benefitted from cost-to-benefit analysis.

7. The Board has demonstrated an on-going interest in safety culture starting in 1995 with Recommendation 95-2: *Integrated Safety Management* (ISM) that helped DOE establish a revised approach for doing work safely in defense nuclear facilities. A technical report issued in 2005, DNFSB/TECH-36, *Integrated Safety Management; The Foundation for a Safety Culture*, noted that the potential to achieve operational excellence and instill a sustainable safety culture had not been realized. More recently the Board issued Recommendation 2011-1, *Safety Culture at the Waste Treatment and Immobilization Plant*, and has held two public hearings to establish how organizations with hazardous operations (commercial nuclear, space exploration, nuclear propulsion, chemical, and medical) approach safety culture. A third public hearing was held to address safety culture at DOE defense nuclear facilities and the Waste Treatment Plant at Hanford; Secretary Moniz and Mark Whitney (Acting EM-1) both testified, articulating DOE's commitment to improve safety culture at the plant. While the safety culture issues at DOE facilities continue to be a "work in progress," and another public hearing will be held in August 2015, the Board's interest has clearly prompted DOE to further implementation of a safety conscious workforce at DOE-EM's nuclear facilities and thereby reduce risks to human health and safety. Recently a DOE inspector general's report on safety culture at the DNFSB, requested by the Board, identified on-going challenges in the implementation of safety culture.[51] The Review Committee supports DOE and the DNFSB in their efforts to enhance safety culture.

8. The Review Committee supports DOE in its efforts to implement and improve safety culture.

In summary the above examples demonstrate that: (1) the DNFSB can and does directly influence the development and issuance of new DOE standards, priorities, and approaches to managing human health and safety risks; (2) both the DNFSB and DOE maintain a traditional risk management decision-making process grounded in expert judgment and conservative engineering to nuclear facility analysis; (3) the Board places Site Representatives at high priority DOE sites to provide day-to-day safety oversight; (4) depending upon the complexity of the issue, DOE can take a long time to respond to the DNFSB recommendations and letters, further the Board, in turn, can take quite a while to respond back to DOE, and multiple rounds of negotiations may be required to resolve an issue; as examples discussed above demonstrate, (5) the Board is aware of costs and the environmental issues at EM sites, but does not explicitly consider economic feasibility or environmental issues in their communications and recommendations to DOE; (6) the DNFSB is not afraid to criticize DOE or issue an extent of condition in order to address potential human health and safety risks, and can quickly redirect its attention to help DOE resolve a major unanticipated problem; and (7) the Board's recommendations to DOE and current

[51] NRC Inspector General, "Assessment of the Defense Nuclear Facilities Safety Board Workforce and Safety Culture", Report DNF40TI, January 2015

series of public hearings on safety culture indicate DNFSB's longstanding and continued commitment to DOE safety culture improvement, which remains a "work in progress."

The following addresses: "*how effectively the DNFSB identifies and elevates the nature and consequences of potential threats to public health and safety at the defense environmental cleanup sites*"

In response to the overarching direction from Congress to the Review Committee "…how *effectively* the DNFSB identifies and elevates the nature and consequences of potential threats to public health and safety EM sites…;" the Review Committee finds that the Board has been effective in providing recommendations and other action-forcing feedback to DOE that materially assists DOE in its responsibility to ensure that its defense nuclear facilities are designed, constructed, and operated in a manner that protects the public health and safety. The Board's processes have identified weaknesses in some nuclear facility safety analyses and issued recommendations, reporting requirements and letters that help mitigate those weaknesses. In addition, the Board has identified needed improvements with DOE standards and worked with DOE staff to strengthen the standards and safety practices at DOE-EM sites. The Board has a relatively small technical staff with a depth of experience and technical competence that has been the foundation for many safety improvements at DOE-EM sites. The Board staff uses a semi-quantitative and qualitative risk prioritization processes, and their risk assessment procedures and resultant priorities seem rational and flexible; however, a recent General Accountability Office (2015c) report[52] has questioned the efficacy of the Board's implementation of this prioritization process; the Review Committee has taken notice of this report, but it was received too late to be included in the Committee's deliberations. DNFSB site representatives and cognizant engineers maintain a proactive presence at the EM sites, and DOE staff respects their technical advice. Overall, the Review Committee believes that DOE values the safety improvement and risk reduction advice provided by the DNFSB.

DOE endeavors to make human health and safety a top priority at the EM sites, however, there are some remaining risks that should be reduced, especially to workers at the sites. The DNFSB considers the following to be risks to human health and safety at DOE/EM sites:

- Design and construction projects of nuclear facilities containing immature technologies that are introducing unexpected safety risks;
- The vast inventory of high-level radioactive waste stored in deteriorating tanks and containers at the Savannah River, Hanford, and other EM Sites with unresolved safety issues; and
- Performance of programmatic work in defense nuclear facilities that are beyond their design life and were not designed for the mission activities conducted today.

[52] GAO, *Defense Nuclear Facility Safety Board: Improvements Needed to Strengthen Internal Control and Promote Transparency*, January 2015.

These issues are not new and have been the subject of DNFSB-DOE dialogue for more than a decade. For example, technical and safety problems with pulse jet mixing at the Waste Treatment Plant were being raised in 2002, yet the 2014 DNFSB Report to Congress on Safety Issues in Design and Construction of Defense Nuclear Facilities states: "the underlying safety issues with pulse-jet mixing remain unresolved." Because of these issues, construction of the Pretreatment Facility within the WTP is on hold. Delay in the startup of the WTP is of concern since some of the Hanford tanks have degraded to the point that small quantities of liquid waste have leaked out. DNFSB Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant* motivated DOE and the contractor to undertake full-scale demonstration of pulse jet mixing with non-radioactive simulants. However, potential safety concerns such as the erosion and corrosion of piping and vessels, nuclear criticality, and hydrogen generation safety issues still exist and are being actively addressed by DOE.

The DOE-EM defense cleanup sites are remnants from the Cold War and the supporting infrastructure is aging and in need of upkeep. The operating nuclear facilities have approved safety bases that are routinely updated and have safety-significant systems that are routinely upgraded and maintained; however, facility managers have to be concerned about the possibility of other critical system failures, including loss of water, breakdown of electrical components, etc., that could result in fires result in potential threats to nuclear facilities. Furthermore, the projected operating lifetimes of the infrastructure and systems at some sites have increased by 20 to 30 years primarily because of schedule extension and resource limitations. The Board remains vigilant to ensure that vital safety systems are maintained, and has expressed concern that failure likelihood data are not analyzed. In addition, the DNFSB staff are considering ways to utilize reliability-engineering analysis of aging facilities more than in the past. Because DOE does not presently use reliability and maintainability engineering principles to maintain and upgrade critical infrastructure and facilities, the likelihood of an unanticipated failure of an old safety system or component could be higher than necessary. An example is the Waste Encapsulation and Storage Facility (WESF), which holds approximately one third of the radioactivity at the Hanford site in the form of cesium and strontium fission products. The waste is contained in robust, double shelled stainless steel capsules and held in a spent fuel type pool. However, the facility is over 40 years old and the ventilation system and concrete structures are aging. Furthermore, the waste has no clear disposition path so WESF will have to operate for an undetermined period of time. A risk-based analysis would likely put refurbishment of WESF at a very high priority.

The problems with competing stakeholder expectations were repeated by the site managers, DOE EM/HQ, and the DNFSB. The integration of multiple layers of requirements – environmental regulations, nuclear facility safety, and worker health and safety, for example – is clearly a management challenge, particularly in times of shrinking budgets and the apparent lack of flexibility to transfer funds at the site level. Site management believes that compliance with court-directed requirements is not necessarily risk driven or flexible enough to react to changing risks or aging infrastructure issues, and as a result, lower risk activities are sometimes done first. For example, retrieval activities at the Tank Farms continue under the environmental regulatory requirement for volume reduction, which does not necessarily reduce human health and safety risks; in fact, this procedure could cause risks to workers.

Waste transfer is a safely controlled but involves the movement of high-hazard radioactive materials, and volume reduction commitments can result in more frequent transfers without clear benefits in risk reduction and may increase worker risks. On the other hand, the overall Tank Farm safety record as presented in DOE data provided to the Committee is excellent, and activities are considered safe based on the approved safety analysis, training, and safe work practices; nonetheless, there are recurring concerns raised about the Hanford tanks farm vapors (and their potential implications for worker health) that have yet to be fully characterized and resolved.

3.1.3 HUMAN HEALTH AND SAFETY - FINDINGS AND RECOMMENDATIONS

3.1.3.1 Findings for DOE and DNFSB

- DOE has implemented a hierarchy of requirements (rules, guides, orders, technical standards) to ensure the health and safety of the workers and the public. Interviews with Field and Headquarters personnel indicated that these requirements are being implemented and that the systems required to provide protection are operated and maintained in a manner that continues to assure such protection. DOE's accident rates, which are substantially lower than similar industries (less than one-quarter of the rates in similar commercial industries), combined with other data on maintenance of facility safety and safety program implementation, support the conclusion that DOE has maintained a strong safety record.
- The slow progress in addressing technical issues associated with stabilizing high hazard nuclear materials, addressing chemical vapor concerns at the Hanford Tank Farms, and implementing PRA suggest that DOE-EM needs still stronger engineering and technical capabilities to guide contractor actions and advise DOE management. A strong engineering capability should be built into the DOE-EM organization, taking into consideration the role of the applicable DOE national laboratories, along with appropriate roles for site deployed and centralized technical staffs (see Crawford, Krahn 1998).
- Important infrastructure systems are operating past their design lives and are showing the stress of extended operations. For sites like Savannah River and Hanford, some critical infrastructure systems are increasingly difficult to maintain and their maintenance has not been deemed a high priority until very recently.
- Potential enhancements to DOE's safety management system are available; these improvements include use of PRA in safety-related applications for high-hazard nuclear facilities, evaluation and improvement of the engineering function within DOE-EM, and the implementation of more quantitative methods to assess the efficacy of maintenance programs for critical site infrastructure.
- EM-1 does not regularly carry out and personally lead a comprehensive set of performance reviews of its portfolio of projects and operations that include headquarters executives, the line leadership, and site office managers. Such performance reviews have in the past included an integrated review of safety, cost and schedule performance, quality, and risk management. It is

believed that such regular reviews would enhance focus on critical elements such as nuclear safety and industrial/operational safety.

- There has not been a Senate-confirmed Assistant Secretary of Energy with responsibility for the EM program since the summer of 2011, a period of nearly four years. This absence of an accountable administration official presents the opportunity for a lack of continuity, and a perception of lack of authority, and such authority and accountability is essential for the execution of the important responsibilities of this complex nuclear cleanup program.
- DOE has put in-place a set of actions for sustainment of its safety culture initiative. The basis for the priorities outlined and a method for continued leadership on safety culture matters, from line management and the newly formed Safety Culture Improvement Panel, have been explained and discussed with the DNFSB. Continued senior management attention and focus will be needed to ensure progress and address presently identified shortcomings.
- The DOE Facility Representative program provides a vital, "boots on the ground" assurance of the safety of the DOE-EM complex.
- Overall, the DNFSB has been effective in providing recommendations and other action-forcing feedback to DOE that materially assists DOE in its responsibility to ensure that its defense nuclear facilities are designed, constructed and operated in a manner that protects the public health and safety.
- DNFSB recommendations have led to important human health and safety risk reduction projects and the DOE staff, by and large, acknowledge the positive role of the DNFSB; this is particularly true at the site level where DOE and the DNFSB Site Representatives work closely together.
- Some human health and safety issues first identified by the DNFSB in letters to DOE evolve slowly to formal recommendations. When possible, the DNFSB seeks to resolve identified issues at the lowest possible working level. Protracted interchanges sometimes take place because of funding priorities and differing technical opinions and approaches to reducing risk. As a result, some clearly recognized issues remain unresolved for extended periods of time.
- The DNFSB is aware of costs and the environmental issues at EM sites, but does not explicitly consider economic feasibility or environmental issues in their communications and recommendations to DOE.

3.1.3.2 Recommendations for DOE

- DOE-EM should review its technical capacity to address technical issues, and propose innovative ways to ensure that important technical and safety issues are tracked through to resolution and to retain key technical experts to advise senior decision makers. A strong engineering capability should be built into the DOE-EM organization, taking into consideration the role of the applicable DOE national laboratories, along with appropriate roles for site deployed and centralized technical staffs.

- DOE-EM should move ahead in a timely manner to evaluate the benefits that could be derived from implementing PRA and risk-informed decision-making for its high-hazard non-reactor nuclear facilities; this should include near-term identification of high-leverage pilot PRA studies, funding for such studies, and planning to incorporate the results of these pilots into a DOE-EM risk-informed decision-making process.
- DOE should develop and issue reliability, maintainability, and availability analysis expectations—taking advantage of available industry standard practices—and implement an engineering analysis of aging critical facilities and infrastructure at major EM sites (Hanford and Savannah River on a priority basis) to identify urgently needed repair and maintenance needs for systems, components and infrastructure that are vitally necessary to support safety systems and emergency management.
- EM-1 should personally conduct and lead periodic performance reviews of major EM projects and operations, to include safety, cost and schedule performance, quality, and risk management, among other elements of the applicable project.

3.1.3.3 Recommendations for DNFSB

- The Board should consider holding a series of public hearings to investigate potential worker safety impacts and concerns arising from implementation of remediation and environmental regulatory requirements.
- The DNFSB and DOE should collaborate to develop an efficient process that reduces the time it takes to resolve a safety issue identified by the Board, from its initial identification to DOE-EM through letters, subsequent elevation to a formal DNFSB Recommendation, DOE response and development of an effective implementation plan and DOE follow-through to expeditiously carry out all steps in the plan.
- The Board should state in its letters to DOE whether a particular recommendation refers to an adequate protection issue, in which case cost should not be a consideration, or is a safety enhancement, in which case cost and other considerations should be part of the decision-making process.

3.2 MAJOR THEME: INCONSISTENCIES IN CLEANUP REQUIREMENTS AND POLICIES AMONG SITES

3.2.1 CONTEXT

The Review Committee's evaluation has found major inconsistencies in remedial requirements, policies and practices to deal with similar hazards and risks at different DOE legacy waste sites. In a number of instances, these inconsistencies take the form of extremely costly measures to deal with minor or speculative risks, or to derive marginal incremental risk reduction. Such inconsistencies are troubling in federal cleanup programs designed to achieve a consistent approach to remediation across the country. These inconsistencies are especially troubling in the context of federal facility cleanups funded by federal taxpayers. Given funding constraints, devoting very large resources to address unproven problems or lower priority issues at some sites deprives other sites and their communities of resources that could achieve greater reductions in risk. Overall protection of health and the environment would be increased if more consistent policies and measures for remediation were followed across the DOE complex.

These inconsistencies have various sources, including inconsistencies in the application of different remedial statutory schemes that are supposed to be functionally equivalent; different legal requirements for treatment of the same or similar hazards; different processes for remedy selection at different sites leading in some instances to selection of very costly remedies through processes that are not transparent, not based on an adequate assessment of the risks to be remediated, and do not adequately consider risks that remedies pose to workers and the environment; opaque and questionable designations by Federal staff officials of very costly state requirements as ARARs; inconsistencies in assumptions about future land uses at different sites; insufficient DOE/EPA headquarters review of site-level remedial decisions with major budgetary consequences; budgetary processes that inhibit risk-informed allocation of resources among sites; and dispute settlement processes that enable states to resort to litigation in local federal courts to dictate cleanup priorities. The Committee believes that resource and remediation priorities in a national, federally funded program for federal facility cleanups should reflect a national perspective.

Moreover, many of the practices described above, especially the nontransparent processes of local remedial decision-making that can undermine accountability are problematic in themselves, quite apart from the remedial inconsistencies they produce. A separate, but related issue was raised in the course of the Review Committee's evaluation, but that the Committee was not able to fully examine: some members expressed unease with the lack of clarity about the potential role of contractors in providing support to DOE in establishing site priorities and providing budget estimates, and federal oversight of this form of contractor involvement at individual DOE sites. The role of contractors in budget

preparations is defined in DOE orders, but the orders are silent on the issue of contractor involvement in prioritization.[53]

The Review Committee was charged with identifying and reviewing how specific federal policies and guidance shape DOE's evaluation and use of risks to human health and safety as part of program decisions. The Review Committee was also requested to assess how risks to public health and safety are considered as part of state and federal regulatory compliance and priority-setting of cleanup activities at DOE sites. DOE, as lead agency at its sites under Executive Order 12580, is in charge of planning and executing the cleanup effort, in accordance with all applicable laws, regulations, policies and guidance. Cleanup at DOE legacy sites typically takes place primarily under two federal laws, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the federal hazardous substance cleanup program, and the Resource Conservation and Recovery Act (RCRA), the federal program regulating hazardous waste "from cradle to grave." Under CERCLA, EPA is in charge of overseeing the Department's cleanup actions. States are not delegated authority for oversight of DOE site cleanup under CERCLA, although they are active participants in the CERCLA process. Section 120(a)(2) provides that EPA's guidelines, rules, regulations, and criteria for the CERCLA remediation program, including those for risk assessment and remedy selection, are applicable to Federal facilities to the same extent as they are applicable to other facilities.[54] State requirements that are more stringent than federal requirements—and, among other provisos, are consistently applied by the state-- can be "applicable" or "relevant and appropriate" requirements (ARARs) that apply to cleanup at DOE sites; however, pursuant to CERCLA Section 120(a)(4), federal facilities are only subject to more stringent substantive and procedural state remedial requirements to the same extent as non-federal parties in the state. To expedite federal facility cleanup, CERCLA Section 121(e) provides that where a CERCLA remedial activity is being conducted entirely "onsite", federal facilities do not have to obtain any federal, state or local permits that might otherwise be required; this includes permits under RCRA.

Although cleanup of DOE sites could be accomplished under CERCLA authority alone, such cleanup is also being conducted under the "corrective action" provisions of RCRA, as well as under other RCRA provisions that regulate waste storage, treatment and disposal actions, including requirements for

[53] DOE Order 130.1 defines the roles and responsibilities of the DOE heads of field offices and contractors.

[54] Section 120(a)(2) of CERCLA provides that: "No department, agency or instrumentality of the United States may adopt or utilize any such guidelines, rules, regulations, or criteria which are inconsistent with the guidelines, rules, regulations, and criteria established by the [EPA] Administrator under [CERCLA]."

underground storage tank (UST) closure and cleanup.[55] At large DOE sites, some portions of the site may be undergoing remediation pursuant to CERCLA, while other areas—sometimes as "islands" within a larger CERCLA cleanup area—are being cleaned up under RCRA. RCRA generally requires that permits be issued for hazardous waste treatment, storage and disposal facilities, as well as for corrective action. Because radionuclides do not fall within the purview of RCRA, however, where DOE wastes containing both hazardous constituents and radionuclides are involved (i.e., so-called "mixed wastes"), closure and corrective action permitting are complicated by further dual-regulation: "hazardous" components of the waste are regulated by EPA (or authorized states) under RCRA, while "radioactive" components are regulated by DOE under the Atomic Energy Act. The CERCLA Section 121(e) permit exemption has not been interpreted by EPA to allow an exemption from permitting procedures where solely-onsite remediation is being conducted under RCRA, however; DOE believes that state RCRA permitting procedures at some sites have added significantly to the time required to develop remedies and increased site remediation costs.

Unlike CERCLA, RCRA authorizes EPA to delegate implementation and enforcement of the Agency's RCRA program to "authorized states," i.e., states with equivalent programs that are not inconsistent with EPA's RCRA program and which are approved by EPA; authorized state programs can be more stringent (but not less stringent) than EPA's. States with RCRA authorization, rather than EPA, are the principal remedial decision makers for those portions of a DOE site that are being cleaned up under state RCRA programs.[56] Pursuant to the Federal Facilities Compliance Act, RCRA-authorized states are specifically authorized to take the lead in addressing mixed wastes (wastes that contain both RCRA-hazardous and radioactive waste) at DOE sites using their state RCRA authority.

Accordingly, RCRA permits are being required for some but not other facilities undergoing remediation at DOE sites, largely depending on whether the parties have agreed in an FFA that RCRA or CERCLA will be used as the authority for cleanup at the site area in question and/or whether and how a state chooses to assert its RCRA authority. One example is at Hanford, where a permit has not been required for ERDF, the onsite disposal facility for much of the site's waste, including RCRA hazardous waste, based at least in part on the rationale that the facility is a remedy under CERCLA and accordingly is

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[55] As further described, *infra*, other federal, as well as state, requirements may also apply to DOE site cleanups conducted under CERCLA as "Applicable or Relevant and Appropriate Requirements" (ARARs). Additionally, certain cleanup activities at DOE sites are conducted under DOE's general authority to manage radioactive wastes under the Atomic Energy Act, which DOE itself is in charge of implementing, as well as under other federal statutes (e.g., Uranium Mill Tailings Radiation Control Act (UMTRCA)). Further, DOE has issued numerous directives, guidance and policies to guide the Department's implementation of its cleanup responsibilities at DOE sites, many of them designed to ensure that DOE complies with EPA's CERCLA and RCRA cleanup requirements, policies and guidance. For further detail on the intricacies and interactions of the legislative and regulatory schemes governing nuclear waste cleanup and disposition, see R. Stewart and J. Stewart, Fuel Cycle to Nowhere, Vanderbilt University Press, 2011.

[56] States with major DOE sites, including Washington (Hanford), Idaho (INL), South Carolina (SRS), and Tennessee (Oak Ridge), Kentucky (Paducah) and Ohio (Portsmouth), all have received authorization from EPA to conduct the RCRA corrective action program. However, an authorized state may also have the authority to conduct certain DOE site cleanup activities under other laws. For instance, South Carolina, although a RCRA authorized state, has elected, at least for now, to regulate HLW tank closure at SRS under the Clean Water Act, rather than RCRA.

subject to the CERCLA Section 121(e) exemption from permitting. Yet under the state RCRA-authorized program, permitting is being required for many other facilities undergoing remediation at Hanford. This has complicated remedial decision making, caused delays in addressing deteriorating HLW tanks, and increased costs, according to DOE, raising the question whether the exemption from permitting for onsite remediation under CERCLA Sec. 121(e) does, or as a matter of policy, should apply to cleanup under RCRA at DOE sites.

Important roles of EPA are to establish and oversee compliance with federal cleanup requirements, guidance and policies, and to ensure that cleanup decision-making is consistent, both procedurally and substantively, within and across DOE sites, as well as with cleanup decisions at non-DOE private sites across the country. Given the overlap of CERCLA and RCRA, EPA has issued numerous guidance documents and policies designed to ensure that cleanup under CERCLA and RCRA is carried out in a coordinated and nationally consistent fashion and that the remedy selection process yields equivalent results nationally, regardless whether cleanup takes place under CERCLA or RCRA. As described below, however, for a variety of reasons—including because state RCRA programs can be more stringent than EPA's and who the lead decision maker is depends on whether CERCLA or RCRA is the governing authority for cleanup—the intended RCRA-CERCLA program equivalence is not being achieved in practice at some DOE sites.

CERCLA, section 120, provides the statutory basis for Interagency Agreements (also known as Federal Facility Agreements (FFAs)), which set forth the responsibilities of DOE, EPA and, if they choose to join, state regulators (the "Tri-parties") with respect to cleanup activities at DOE sites on the National Priority List (NPL). In FFAs for the vast and complex major DOE sites, the parties may have agreed to assign lead responsibility somewhat differently than is described above. For instance, at Hanford, Washington state has lead responsibility for certain portions of the site being remediated under CERCLA, as well as for portions of the site being cleaned up under RCRA; the determination made by agreement of the parties as to which authority, CERCLA or RCRA, will apply to which portion of the site, is also specified in the FFA.

Within the framework of an FFA, DOE, EPA, and states work together to determine site priorities, evaluate cleanup approaches, develop a schedule for cleanup activities, and specify the requirements that site cleanup actions and activities must meet;[57] these jointly-arrived-at decisions are typically memorialized as binding commitments in the FFA. Accordingly, the FFA details the cleanup tasks that the parties have agreed DOE will undertake at the site and contains "milestones" (activity completion

[57] FFAs are also intended to promote successful interactions among the Tri-parties regarding cleanup by providing for early, frequent communication, and full disclosure of relevant information. Input from Tribes and stakeholders, including site citizen advisory boards, organizations and members of the public, often plays an important role in the parties' deliberations.

deadlines) by which DOE must complete specific steps in the cleanup process. According to the DOE IG: remediation "program costs are largely 'driven' by 37 individually negotiated Federal Facility Agreements (FFA) at key Department sites across the Nation. The FFAs involve no less than 350 milestones at these sites. The FFAs are augmented by numerous other local agreements with their own set of actions, requirements, milestones and due dates…. However, the current strategy may not be sustainable if the Department's remediation budget suffers major reductions."[58] However, milestones are not automatically adjusted to reflect budget constraints and therefore need to be renegotiated amongst all the parties to the FFA whenever budget constraints impede timely completion of milestones.[59]

Milestones and other provisions of the FFA are judicially enforceable; however, FFAs contain procedures for resolving disputes that arise among the parties, without resorting to litigation in court in the first instance, and even though the cases rarely reach the courts, they have in the case of Hanford, and the courts could be used more frequently as DOE-EM's budget tightens. FFAs are also intended to promote successful interactions among the Tri-parties regarding cleanup by providing for early, frequent communication, and full disclosure of relevant information. The National Contingency Plan, the central set of CERCLA regulations promulgated by EPA, establishes a detailed, sequential national process for assessing and remediating sites where there has been a release of a hazardous substance, including at federal facilities. The DOE facilities remediation process, under CERCLA, the NCP, and existing CERCLA policy and guidance, includes a number of opportunities for evaluating actual and potential risks to public health and the environment, and for adopting the most appropriate cleanup approach for addressing those risks. For more than two decades, EPA policy and guidance for cleanup of federal facilities (as well as cleanup at other sites) has strongly emphasized the need to ensure national consistency in program implementation in order to ensure cost-effectiveness. A series of EPA "Superfund Reforms" in the mid-1990's purposefully underscored this objective through, among other things, issuance of a policy for national consistency in remedy selection and establishment of the National Remedy Review Board (NRRB) to evaluate proposals for high-cost site remedies to ensure their cost-effectiveness and consistency. A further EPA policy expressly established that regardless of whether cleanup is conducted under CERCLA or RCRA, the process is intended to yield equivalent results. This 1996 EPA RCRA/CERCLA equivalence policy was built on the principle that both programs should yield similar remedies under similar circumstances and was intended to avoid substantial discrepancies in what is done to address contamination under one of these laws versus another. This is

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[58] Department of Energy, Office of the Inspector General, Special Report: Management Challenges at the Department of Energy, DOE/IG 0858, November, 2011.

[59] The Department's current unfunded environmental remediation liability is approximately $300-335 billion. DOE, Secretary of Energy Advisory Board, "Report of the Task Force on Technology Development for Environmental Management," 1 (Dec. 2014). The result of more than 50 years of nuclear defense and energy research work, as of 2011 DOE's Inspector General reported that this effort involved 2 million acres of land located in 35 states and employed more than 30,000 Federal and contractor employees. The Department then spent about $6 billion per year on its environmental remediation activities. (More recent budgets have been about 10 percent smaller.) Department of Energy, Office of the Inspector General, Special Report: Management Challenges at the Department of Energy, DOE/IG 0858, November, 2011.

because CERCLA and RCRA both require that cleanup achieve a common goal: ensuring protection of human health and the environment. While site-specific circumstances play an important role in cleanup decision making at DOE and other federal facility sites, and remedies selected at one site may differ from those at another, implementation of federal cleanup laws, regulations, policies and guidance is intended to be done consistently, both within and across all sites, nationally. Accordingly, the approaches used to evaluate risks and select remedies are expected to be comparable at all sites, and similar contaminants under similar site conditions are expected to be addressed in a comparable manner across sites.

Consistent with the CERCLA, the NCP establishes a stepwise process as a foundation for the selection of remedies to address risks to human health and the environment. The NCP calls for consideration of nine criteria when evaluating alternative remedies, a key remedy selection activity that occurs during the final step of the "Remedial Investigation/Feasibility Study" stage of remedy selection.[60] The two "threshold criteria" that all response actions selected under CERCLA must meet in order to be considered for selection are that the remedy (1) provides overall protection of human health and the environment, and (2) complies with "applicable or relevant and appropriate requirements" (ARARs). Other remedy selection criteria, used to analyze and compare alternative remedies that have met the threshold criteria, are the five "primary balancing criteria," long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost effectiveness. Notably, "short-term effectiveness" includes consideration of adverse impacts to workers, the public and the environment that may occur during conduct of the remedial alternative and before cleanup is complete. Two final "modifying criteria" to be considered are state and community acceptance; the modifying criteria may be considered along with the balancing criteria, but are not required to be considered until after public comments have been received on the Proposed Plan setting forth the "preferred alternative" remedy proposed for the site. The threshold criteria are requirements that any remedial alternative must meet to be eligible for selection. The primary balancing criteria are used to weigh major trade-offs among alternatives. The modifying criteria are used to ensure that community and State perspectives are considered in the final remedy decision. CERCLA also has separate provisions addressing natural resource damages, to be used for restoring injured natural resources, which are distinct from the statute's broad response authorities for ensuring protection of human health and the environment now and in the future.

Federal environmental laws and regulations that constitute applicable, or relevant and appropriate requirements (ARARs) need to be met or a waiver justified. State requirements that are more stringent than federal requirements also may need to be met as ARARs (provided the statutory preconditions for adoption of state requirements as ARARs have been met), or a waiver justified. For a state requirement

[60] These apply to federal facility sites on the NPL. Of the 16 remaining DOE sites, the following are currently on the NPL: Hanford, Idaho, Los Alamos (Site 300), Oak Ridge, Paducah, and Savannah River.

to be an ARAR, the requirement must be: under a state environmental law or facility siting law; promulgated; more stringent than the Federal requirement; identified in a timely manner; and consistently applied.[61] DOE, EPA, and States regularly evaluate and consider ARARs at all stages of cleanup. Additionally, Section 120 of CERCLA provides that federal facilities must comply with the substantive and procedural requirements of CERCLA to the same extent as private parties; accordingly, DOE cleanup sites cannot be held to lower—or higher—federal or state standards than those that are being applied to private party sites.

The Review Committee's discussions with DOE HQ and site level personnel led to the observation that, of the many inputs to remedial decision making and remedy selection, the following stand out as major drivers of site cleanup costs and play a central role in DOE-EM resource allocation decisions: (1) the presence of HLW; (2) the choice of cleanup technologies/approaches in selected remedies and waste treatment and disposal requirements; (3) state RCRA requirements and state requirements identified as ARARs that must be met as a threshold matter by site remedies; (4) designations/assumptions regarding "reasonably anticipated future land use" at the site; and (5) FFA milestones and judicial consent decrees resulting from state FFA enforcement litigation. In many cases, the more stringent the requirements identified as ARARs and/or the more "unrestricted" the anticipated future land use, the more costly a site remedy will be. And inconsistent application of rules and policies in decision-making relating to the above cost-drivers can lead to higher expenditure of increasingly limited cleanup funds at one site, making less funding available for cleanup at others. This would occur, for example, when a much more expensive treatment remedy is used at one site, whereas a containment remedy is used at another, to solve essentially the same problem under similar circumstances at both sites.

To address the issues relevant to its charge, the Review Committee conducted: meetings and phone calls with DOE officials at Headquarters; site visits to the Hanford, Savannah River, and Oak Ridge sites and onsite discussions with DOE and state representatives; and a meeting and follow-up call with EPA officials from Headquarters, Region 4, and Region 10. (EPA also provided written answers to the Review Committee's interview questions, found at Appendix C.). From these discussions and follow-up review of pertinent documents, the Review Committee learned that there are significant inconsistencies in the application of EPA and other federal cleanup policies and guidance at DOE sites, and in implementation of cleanup program requirements. These inconsistencies can have significant adverse impacts on priority-setting and resource allocation at DOE sites, and Appendix C, especially responses to question 4, highlights several of these through the eyes of site managers.

[61] EPA, OSWER, Fact Sheet, "CERCLA Compliance with State Requirements" (Dec. 1989).

3.2.2 MAJOR INCONSISTENCIES

This section lays out the Review Committee's findings regarding these issues, and recommendations for future improvements. The Review Committee found inconsistencies with significant implications for priority setting and resource allocation at DOE sites with respect to the following:

- Selection of Legislative and Regulatory Regimes;
- Implementation of National Contingency Plan (NCP) Cleanup Requirements for Remedy Selection;
- Determination of State Standards as Applicable or Relevant and Appropriate Requirements (ARARs);
- Future Land Use Determinations and their Use in Establishing Cleanup Requirements;
- Application of Cleanup Technologies/Approaches;
- Role of the EPA Remedy Review Board; and
- Dispute Resolution.

3.2.2.1 Selection of Legislative and Regulatory Regimes

There appear to be substantial differences in requirements (discussed later in this section) applicable to certain significant categories of cleanup activity at DOE sites, including importantly, tanks and tank wastes. These differences cause confusion, have very large cost implications, and have potential human health and safety implications, especially for workers (depending on the strategy selected for tank management) and nearby populations.

The main example raised in the Review Committee's interviews at DOE HQ, Hanford, SRS, and OR was differences in the regulatory scheme selected, remedial action required or available under that regulatory scheme and, ultimately, in the costs of conducting essentially the same activity at the three different sites: emptying and closure of tanks containing mixed radioactive waste, and disposition of the tank contents. These inconsistencies are apparently the result of a number of intersecting factors, including: (1) differences in the exercise of state regulatory discretion; (2) problems inherent in the definition of high-level waste (HLW) that classify materials primarily by origin rather than hazard; (3) differing requirements in site FFAs; and (4) the applicability at some, but not all, DOE sites of Section 3116 of the National Defense Authorization Act for 2005 (NDDA) authorizing DOE to manage and dispose of certain low-activity fractions of HLW in tanks at some sites as LLW.

As the result of differences in how regulators exercised discretion at DOE sites with respect to tanks, closure of the Hanford Site HLW tanks is being conducted under the state's EPA-approved RCRA program, whereas the Savannah River Site HLW tank closure is being regulated under the Clean Water Act (CWA), even though relevant portions of the RCRA program have been delegated to the State of South Carolina, and the tanks at SRS are covered by a RCRA permit. At Oak Ridge, tanks that the Review Committee was told contained materials similar in characteristics and hazard to those at SRS and

Hanford, but not falling within the origins-based definition of HLW, had been addressed as LLW tanks and closed by simpler and less costly measures under CERCLA.

Tank contents are also regulated under different rules at different sites. DOE wastes are, as a general matter, categorized as HLW based on the process (i.e., reprocessing of spent nuclear fuel) by which they were originally generated, rather than by their hazard characteristics. As a result, tank contents at OR, which were a byproduct of R & D, rather than large-scale reprocessing *per se*, have been managed as Transuranic Waste (TRU) and LLW[62], even though site personnel described the tank wastes at OR as similar (in characteristics and hazard) to tank wastes classified as HLW at Hanford and SRS. The regulatory requirements applicable to HLW, as well as technologies required to treat HLW, are far more elaborate and costly to implement than those for TRU and LLW.

Further, in accordance with a 2005 Congressional statute applicable to SRS and Idaho but not to Hanford, certain low-activity fractions of the tank wastes are able to be disposed, more simply and cheaply as low level waste, if they meet certain requirements under relevant provisions of the appropriations legislation (Section 3116 of the National Defense Authorization Act of 2005).

Prior to enactment of Section 3116, DOE, through its self-regulating directives process per the Atomic Energy Act, developed a process to allow low-activity fractions of reprocessing wastes, termed Waste Incidental to Reprocessing (WIR), to be managed and disposed as LLW or transuranic waste. The WIR provisions were challenged in litigation brought by NRDC; Section 3116 was a response to the resulting legal uncertainty.[63] The DOE WIR regulation is still in place, but its use at Hanford, which is not covered by Section 3116, could well invite legal challenge. It has not been used as the basis for a final decision to manage and dispose of low-activity fractions of reprocessing wastes as LLW at Hanford.

Congressional action to extend the National Defense Authorization Act for 2005, Section 3116 provision to Hanford and West Valley could help DOE to more efficiently reclassify low activity fractions of tank wastes meeting the criteria in 3116 and manage them as LLW. DOE annual environmental lifecycle cost estimates to treat tank wastes at Hanford are roughly *twice* that for treating tank wastes at SRS. Note that these are estimates and in the case of Hanford are not based on actual treatment, hence the actual costs could change. DOE officials attribute these differences in cost to the regulation of these projects in Hanford under RCRA compared to the Clean Water Act at Savannah River, different labor arrangements at the two sites, and differences in the regional interests between the two areas. The Committee, nevertheless is of the view that it would be beneficial to have the WIR provision applied to the Hanford Site by law, to preclude third party action should the DOE and its regulators determine

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[62] Oak Ridge National Laboratory, "The Gunite and Associated Tanks Remediation Project Tank Waste Retrieval Performance and Lessons Learned," ORNL/TM-2001/142.

[63] The federal district court held that the DOE's then applicable WIR regulation was invalid; the court of appeals vacated its judgment on the ground that the case was not ripe for decision. NRDC v. Abraham, 388 F.3d 701(9th Cir. 2004). Congress enacted Section 3116 to establish specific criteria as well as a process by which DOE might classify certain low-activity fractions of HLW as LLW for wastes remaining at the Idaho and Savannah River sites.

another method rather than vitrification by which to treat the (roughly) 50 percent of the Low Activity Waste (by volume, from the underground tanks).

Federal legislation to allow the flexibility to handle qualifying low-activity fractions at Hanford the way they are safely handled at other sites, could promote substantial cost savings at Hanford. Furthermore, DOE believes that Washington State's most recent proposal to add approximately 100 new milestones and further tank waste requirements to the 2010 Hanford consent decree have the potential to add significant life cycle cost increases. Already costs for the vitrification plant project and tank waste management consume one-fifth of DOE-EM's entire cleanup budget. Given budget constraints, the government opposed adding the further costs of additional milestones, estimated at $18 billion, saying that, "The result would be devastating", with operations at other cleanup sites severely curtailed, creating potential risks to human health and the environment.[64]

The inconsistencies between tank waste management at Hanford (under RCRA) and at SRS (under CWA) and OR (under CERCLA), illustrate, among other things, that the CERCLA/RCRA equivalence policy is not always being carried out in practice. For instance, because Washington state, as a state delegated by EPA to run the RCRA program, elected that the Hanford tanks remediation/closure be conducted as a RCRA corrective action, the federal RCRA requirement applies that each of the tanks should be emptied 99% before it can be closed[65] ; whereas, tanks at OR that were emptied under CERCLA were not required to achieve that level of emptiness prior to closure, as well as additional requirements for treatment and disposal of the low activity fraction of the tank waste. There is no apparent risk-based performance rationale for this difference in remediation practices, yet the cost of emptying tanks and treatment and disposal of their retrieved waste at Hanford is very large. Because of a consent decree enforcing this obligation, tank closure activities have had to take priority (and, accordingly, funding) over addressing other, potentially riskier, operable units at the site, and achieving more cost-effective risk reduction.

[64] U.S. Department of Justice in US District Court, Eastern District of Washington, State of Washington, Department of Ecology v. Ernest Moniz, Secretary of the United States Department of Energy and the United States Department of Energy, No. 08-5085-RMP, United States' Response to the State of Washington's Petition to Modify Consent Decree, filed December 5, 2014.

[65] The requirement applicable to the Hanford tanks is specified in the TPA as 99% or what is technically and economically practical in accordance with app H of the TPA.

3.2.2.2 Implementation of National Contingency Plan (NCP) Requirements for Risk Assessment and Remedy Selection

The NCP requires a remedy selection process that begins with conducting a remedial investigation (including a baseline risk assessment),[66] followed by a feasibility study evaluating and comparing a range of remedial options against the nine statutory criteria, a Proposed Plan identifying the preferred remedial option for public comment,[67] Record of Decision (ROD) selecting the final remedy, and a detailed remedial design, followed by remedial construction. This step-wise, in-depth and rigorous NCP process, which is designed to ensure that remedies are appropriately related to and designed to remedy the risks to human health and the environment actually posed by wastes, is not being adhered to for remedy selection at certain, very extensive DOE site cleanups. Instead, at some sites, including Hanford, extensive cleanup of large areas lasting decades has been conducted as "interim action" using "interim remedies" selected many years ago based on limited information and analysis. Since at Hanford this cleanup has been virtually completed through interim action by the time selection of final remedial action takes place, interim remedies have become the de facto *final* remedies at some major areas of the site.

However, under the NCP, interim action was intended to be a short-term-- able to be completed in less than five years-- relatively low cost, risk-reduction intervention to be followed later by a final remedy that would address the full scope of a given site contamination problem. EPA guidance states that "an 'interim' remedial action is generally intended to address a threat in the short term, while a permanent remedial solution is being developed."[68] Equally important, interim action was not meant to displace

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[66] The baseline risk assessment is used to determine whether contamination at the site poses current or potential risks to human health and the environment, in the absence of remedial action. The assessment consists of an exposure assessment component and a toxicity assessment component, the results of which are combined to develop an overall characterization of site risks. EPA, Proposed Rule, 53 Fed. Reg. 51525 (Dec. 21, 1988)(Preamble to Proposed Rule amending the National Contingency Plan following enactment of the 1986 SARA amendments to CERCLA). The central importance of the baseline risk assessment in remedy determinations is succinctly explained in EPA's 1991 guidance, "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions" (OSWER Directive 9355.0-30, April 22, 1991):

" The NCP preamble states, "The results of the baseline risk assessment are used to determine whether remediation is necessary, to help provide justification for performing remedial action, and to assist in determining what exposure pathways need to be remediated. "

[67] The Proposed Plan identifies "the alternative that appears to offer the best balance of trade-offs among alternatives in terms of the [nine statutory] criteria…." 53 Fed. Reg. 51429 (Dec. 21, 1988).

[68] EPA, Guidance on Implementation of the Superfund Accelerated Cleanup Model (SACM) under CERCLA and the NCP, at 8 (1992). The target of interim actions is "rapid risk reduction." See id. at 6. The EPA guidance makes clear that "the Agency will continue to use [long-term] remedial action authorities to respond to most contamination problems that are expected to require more than five years to complete ("long-term actions"), such as groundwater restoration projects, large wetland/estuary sites…and sites requiring significant long-term operation and maintenance activities." Id. EPA also emphasizes that interim actions must comply with CERCLA and the NCP. Id at 2. See also EPA, "Early Action and Long Term Action Under SACM--Interim Guidance" (1992). Accordingly, EPA guidance does not envision or authorize that clean-up of massive portions of DOE sites-- lasting for decades—will take place principally under interim remedies.

the NCP process for selection of a final remedy, which envisions that cleanup will take place after issuance of, and based on, key CERCLA inputs (such as a completed baseline risk assessment) and decision documents, including a final RI/FS, Proposed Plan and final ROD.

Departures from the NCP cleanup decision making process are most apparent at the River Corridor of the Hanford Site, where remediation of this 220 square mile portion of the site—a still-ongoing cleanup that has lasted for almost 2 decades and already cost $3.8 billion—has been conducted almost entirely as an "interim action", under interim RODs, without completion: (until 2012) of a final baseline risk assessment; (until 2013) of a final RI/FS and Proposed Plan; and (until 2014) of a final ROD. By the time these CERCLA decisional documents were issued and the final remedy selected, a great majority of the cleanup at the 100 Area portion of the River Corridor had already been completed. The interim action process used at the River Corridor, which comprises an enormous portion (over one-third) of the Hanford Site, makes it difficult to: (1) to ensure that risks are appropriately characterized and addressed; (2) assure that all of the considerations embodied in the 9 CERCLA remedy selection criteria are evaluated rigorously and in-depth prior to remedy selection and implementation; (3) rationally allocate funds on a risk-informed basis; (4) determine whether remedial alternatives are cost-effective; and (5) ensure that remediation risks to workers and the environment do not outweigh the risk reduction benefits of cleanup). (See Appendix C, especially Question 4 for discussion of balancing among risk-informed decisions.)

The Committee agrees that while use of early or interim actions at a given site, for a particular operable unit or contaminated medium may be consistent with national program guidance (see U.S. EPA, 1999, ROD guidance Chapter; http://www.epa.gov/superfund/policy/remedy/rods/pdfs/guide_decision_documents_071999.pdf).

A national strategy for DOE sites that relies ***primarily*** on these tools (where use of the RI/FS process is the exception) is not consistent with the spirit and volume of national RI/FS/remedy selection guidance developed over the last 35 years.

3.2.2.3 Determination of Applicable or Relevant and Appropriate Requirements (ARARs)

ARARs are federal, or more stringent state requirements that a remedy must meet in order to be selected under CERCLA for implementation at a site, pursuant to CERCLA Section 121(d). Where a state requirement is asserted to be an ARAR, as has been the case at Hanford and other DOE complex sites, CERCLA requires that the state requirement must be: (1) under a state environmental law or facility siting law; (2) promulgated; (3) more stringent than the Federal requirement; and (4) identified by the state in a timely manner; state requirements also must be substantive (not procedural or administrative) and consistently applied by the state.[69] DOE, EPA, and states regularly evaluate and consider ARARs at all stages of cleanup. Additionally, Section 120(a)(4) of CERCLA provides that federal facilities must comply with the substantive and procedural requirements of CERCLA to the same extent as private parties;

[69] 40 CFR § 300.400(g)(4). See also EPA, OSWER, Fact Sheet, "CERCLA Compliance with State Requirements" (Dec. 1989).

accordingly, DOE cleanup sites cannot be held to higher state standards than those being applied to private party sites in the state.

If found to be an ARAR, a state requirement nonetheless can be waived if it is determined that the state has not consistently applied the requirement in similar circumstances at other cleanup sites within the state. Waivers of state and federal ARARs under CERCLA 121(d)(4) are also available at a federal facility when: (1) the preferred alternative is an interim measure and will become part of a total remedial action that will attain the ARAR; (2) compliance with the requirement will result in greater risk to human health and the environment; (3) compliance is technically impracticable from an engineering perspective; or (4) the alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation.[70]

It is important to note that CERCLA provides an additional ground for waiver of an ARAR at non-federal facility sites being cleaned up using resources made available through the federally-administered "Fund."[71] The so-called "fund balancing waiver" applies where an alternative remedy that attains the ARAR will not provide a balance between the need for protection of human health and the environment at the site and the availability of Fund monies to respond to other sites. No analogue to this sensible ground for an ARAR waiver--based on balancing cleanup responsibilities with the availability of cleanup resources-- currently applies at federal facility sites, even though they too are federally-financed (out of taxpayer receipts). If CERCLA were amended to make an analogous waiver available for federal facilities (or DOE sites), this would enable cleanup decision makers at DOE sites to make more effective use of limited cleanup resources.

Because compliance with ARARs is one of the two threshold criteria for selection of a remedy under CERCLA, and because, properly identified state ARARs are by definition standards that are more stringent than federal requirements, misidentification of state ARARs can have serious adverse impacts on prioritization of risks, budget allocation and overall remedial costs. For example, the adoption of the Washington Model Toxics Control Act (and with it the state chromium standard) as an ARAR--which was a primary basis for selection of a very extensive excavation remedy to remove chromium,[72] carried out

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[70]EPA, OSWER, Fact Sheet, "CERCLA Compliance with State Requirements" (Dec. 1989).

[71] The Fund established under CERCLA, was derived from a tax on petroleum feedstocks; the tax is no longer being collected.

[72] A recent conference paper presented by DOE Hanford site officials explains the rationale for the 100-C-7 excavation project and the role of the state ARAR as follows: "RL, EPA and WCH determined that because [chromium] contamination was so widespread at 100-C-7 and extended all the way to groundwater that the project should remove the source of contamination. The 100 B/C Reactor Area has a low level groundwater plume of hexavalent chromium and parties believed it would be prudent to remove the source of contamination before the groundwater became worse….There is currently no groundwater Record of Decision for the 100 B/C Area, however groundwater exceeds both the Washington State MCL and the AWQC. In general, the hexavalent chromium plume is a large, fairly dilute plume. The remediation goal for the 100-C-7 waste site is to clean up soil contaminated with hexavalent chromium before more of the chromium could be spread to the underlying groundwater and eventually drain into the Columbia River less than one mile away." T. Post, DOE Richland, et al., "The 100-C-7 Remediation Project: An Overview of One of DOE's Largest Remediation Projects," presented at WM2013

in the 100-Area of the Hanford River Corridor, assertedly to protect salmon in the Columbia River[73]-- was questioned by the NRRB.[74] The "RTD" remedy selected for the 100-Area eventually led to a "pit mine" style excavation project, conducted from 2010-2013, to remove chromium from the 100-C-7 waste site, a 15-football-field-sized area described as "one of the largest waste sites in the [U.S. DOE] complex." This remediation project involved removal of 2.3 million tons of "clean and contaminated soil, concrete debris and scrap metal"-- to a depth of 85 feet (groundwater)-- followed by soil treatment and onsite landfill disposal.[75] Considering the role of cost effectiveness in the CERCLA remedy selection process, the justification for this project is questionable as a cost-effective risk reduction measure at the site. This highlights the need for careful review of ARARs and adherence to the requirements of the NCP remedy selection process detailed earlier in this section.

Despite the potential cost implications at huge DOE sites, the NCP does not require, as a prerequisite for state ARAR identification at federal facilities, that there be prepared, detailed, publicly available, formal

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Conference, Arizona, Feb. 24-28, 2013, available at http://www.wmsym.org/archives/2013/papers/13260.pdf. The presentation describes the threat to the river posed by chromium contamination of soils in the 100-C-7 area: "Hexavalent chromium is particularly toxic to young salmon and other aquatic life. The cleanup requirement for hexavalent chromium at Hanford is to reduce ground water contamination to 20 ppb hexavalent chromium before it reaches the Columbia River to meet Ambient Water Quality Criteria of 10 ppb. Federal and state groundwater and surface water protection requirements have resulted in a soil protection cleanup level of 2.0 mg/kg for hexavalent chromium at the 100-C-7 waste site. Removing the source of contamination before it migrates to the aquifer is a more conservative and more cost effective alternative than pumping and treating groundwater." *Id*.

[73] For example, Hanford's Third CERCLA Five-Year Review Report, citing an interim action ROD for the "100 and 200 Area Remaining sites": (EPA/ROD/R10-99/039) explains the 100-KR Operable Unit Remedial Action Objective 2 and the methods to be employed as being for the protection **"of receptors (aquatic species, with the emphasis on salmon) in surface waters".** (bold-face added here to highlight text) DOE/RL-2011-56, rev. 1, March 2012. In fact, the Washington State Department of Ecology has for years described the waters of the Columbia River in the Hanford Reach as being a Class A water body and "Research to date shows no negative impact to salmon from chromium concentrations in the river gravels". See http://www.ecy.wa.gov/programs/nwp/salmon.html, accessed January 31, 2015.

[74] As early as 2000, the NRRB, discussing then current and planned remediation in the 100 and 300 Areas of the Hanford site, had written:

> "The information provided to the board did not identify the cleanup goals that would address direct exposure risk in the upper 15 feet of contaminated soil, or the groundwater risks associated with contaminants at any depth. The board recommends that DOE identify these cleanup goals and describe its excavation plans, including the strategy that will guide excavation below 15 feet.
>
> The information presented to the board did not identify clearly the potential federal and state ARARs that address cleanup levels, e.g., statutes and regulations regarding the depth and levels for cleanup in residential and industrial use scenarios. The board recommends that DOE identify all potential ARARs in its decision documents for the site and explain how they affect the proposed cleanup."

If a response to this recommendation was ever made to the NRRB, or implemented, the Committee has been unable to find it.

[75] T. Post, DOE Richland, et al., "The 100-C-7 Remediation Project: An Overview of One of DOE's Largest Remediation Projects," presented at WM2013 Conference, Arizona, Feb. 24-28, 2013, available at http://www.wmsym.org/archives/2013/papers/13260.pdf. The authors assert that the 100-C-7 project "now serves as a model for remediating extensive deep zone contamination sites at Hanford." *Id*.

ARAR analysis demonstrating how a given state standard or requirement qualifies as an ARAR for cleanup under CERCLA and EPA's implementing regulations and guidance. Apart from terse ARAR charts, brief explanations, or conclusory statements in other CERCLA decisional documents, no detailed ARAR analysis or formal ARAR decision document is published. Although EPA had originally announced that it would do so, and a section of EPA's CERCLA NCP regulations ("Subpart K")) is still reserved for "federal facilities," EPA never followed through on developing a set of remedial requirements tailored to the unique circumstances of federal facilities, in the NCP.[76] These circumstances, at DOE sites, include the vast size of some facilities (e.g., Savannah River 310 square miles, Hanford 550 square miles and Idaho 890 square miles), the extremely complex and often unique problems presented at most of them, and the fact that the access is controlled to prevent or mitigate risk, unlike the typical sites that Superfund was designed to address, where members of the public were being exposed at contaminant levels above reasonable risk thresholds. Hence, enormous resources are estimated to be required to completely remediate the complex; current estimates put the total remediation cost for the complex at $300-335 billion (see Table 1) and potentially much more[77]; the EM budget for DOE sites for FY2013, after revisions was $5.3 billion (Table 1). By comparison, the total annual budget for the entire non-Federal, nationwide EPA Superfund cleanup program is approximately $1.1 billion. In general, existing regulations and guidance on ARARs was developed on the basis of conditions encountered at typical private and municipal sites undergoing cleanup under CERCLA, much of it long before federal facilities became subject to these requirements.

As discussed below, based on the Review Committee's discussions with EPA and DOE officials, it is clear that the decision as to whether a state standard qualifies as an ARAR at a DOE site is almost always made exclusively by site-level officials, without formal HQ review or approval specifically of the ARAR decision, by either EPA or DOE.

Further, a lack of transparency and inadequate or non-existent analysis in RI/FSs and RODs have been characteristics of the process of identifying ARARs for at least some DOE sites. RI/FSs and RODs at Hanford, for example as indicated earlier, contain ARAR charts listing ARARs with little explanation or analysis and provide only brief, conclusory statements about the applicability of state and other ARARs.

The Committee was told by EPA officials that identification of ARARs follows a more rigorous analysis at some DOE sites. However, although the Review Committee requested it, EPA provided only one example

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[76] See, 40 C.F.R. § 300.400(g)(4). (National Oil and Hazardous Substances Pollution Contingency Plan), p. 568 found at http://www.epa.gov/superfund/policy/remedy/sfremedy/pdfs/ncpfinalrule61.pdf. EPA did, however, issue some guidance on remediation of federal facilities. See U.S. EPA, 1994, Guidance on Accelerating CERCLA Environmental Restoration at Federal Facilities, August 22, 1994, available at http://www2.epa.gov/fedfac/guidance-accelerating-cercla-environmental-restoration-federal-facilities. [16 July 2015].

[77] Department of Energy, Report of the Task Force on Technology Development for Environmental Management, Secretary of Energy Advisory Board, December 2014. Available at: http://energy.gov/sites/prod/files/2015/01/f19/Report%20of%20the%20SEAB%20Task%20Force%20on%20Tech%20Dev%20for%20EM_FINAL.pdf. [30 March 2015].

—said to be a very rare instance of HQ review of a state ARAR dispute—indicating that such analysis takes place. This, however, does not support the assertion that such analysis is going on as a routine matter at sites. The Review Committee was unable to explore this issue in further depth to determine additional examples.

For a regulatory determination with such substantial implications for priority-setting and resource allocation, the ARAR decision process is remarkably opaque, internal, and lacking in publicly-available analysis and substantiation, albeit that ARARs are identified (mainly in charts, with very brief explanations) in draft decision documents issued for public comment, such as the draft RI/FS and Proposed Plan, as well as final decision documents, such as the final RI/FS and ROD. According to the EPA HQ, regional and site personnel the Committee interviewed, identification of ARARs occurs almost exclusively through dialogue among site-level personnel, email correspondence and other informal means. The contents of such deliberations, to the extent that they are written down, are not readily available, if available at all, to the public, and the Review Committee was told that it could not review existing written deliberative materials unless a final ARAR decision had already been made.

EPA officials also stated that when agreement is reached at the site level that a standard constitutes an ARAR, the matter is considered to be resolved, and no further analysis or confirmation is required from Regional EPA or EPA HQ. In the rare event that site level officials do not agree, the matter is regarded as a dispute under the Tri-party agreement and goes to senior regional personnel to help find resolution. In the very rare case that the issue cannot be solved with help from the Region, an ARAR issue would be referred to EPA HQ for an opinion. Committee members were told that this had occurred perhaps 6-8 times in the history of the CERCLA program. Given that deliberations on ARARs are not made public, it is difficult to know whether the usual case, i.e., site level agreement as the means for deciding on ARARs, is founded on appropriate and adequate legal or technical bases.[78] A thorough, well substantiated, and publicly-available ARAR analysis, would help ensure that there is a strong rationale for applying a high-cost ARAR to achieve needed risk reduction under the particular circumstances presented at a site.

Given the potential cost implications and risks to national consistency of selecting a stricter-than-federal state requirement as an ARAR at a DOE site, it is also surprising that the availability of a waiver from state ARARs is also not evaluated, upfront and as a routine matter, where a state ARAR is likely to be a substantial cost-driver. EPA could, but does not, recommend through its guidance that this be done as a routine matter when application of a state ARAR could have potentially large implications for resource allocation at a site.[79] Even without EPA guidance to this effect, DOE, on its own initiative, could conduct its own ARAR waiver evaluation prior to agreeing with other parties to apply a state ARAR at a site; this

[78] For a recent illustration see U.S. EPA 2015, National Remedy Review Board Recommendations for the 1 00-DR-1, 1 00-DR-2, 100- HR-1 and 100-HR-2 Operable Units at the Hanford Superfund Site, USEPA, Washington DC.

[79] There is precedent for this approach in EPA's guidance on DNAPLs, which essentially adopts the presumption that ARARs requiring cleaning up DNAPLs in groundwater are waived on the basis of "Technical Impracticability," one of the grounds for an ARAR waiver under CERCLA.

can even be done following an initial agreement on ARARs if appropriate grounds arise, because ARAR determinations are supposed to be reviewed and adjusted throughout the remedial process. Another basis for waivers, discussed further below, that should be targeted for inquiry, is whether the state standard in question has been consistently applied at cleanups throughout the state; if it has not, the state ARAR may be waived. Unless this issue is specifically investigated and evidence is found to indicate inconsistent application, the state standard is *presumed* to have been consistently applied, according to EPA guidance.[80]

EPA could address the situation described above by requiring preparation and publication of state ARAR analyses at DOE sites where imposition of a proposed state ARAR is likely to be a significant remedial cost-driver; this analysis should also examine whether an ARAR waiver might be justified on the basis of inconsistent application of the requirement by the state to other cleanup sites. The analysis should also review whether private party sites are consistently being subjected to the potential state ARAR under similar circumstances. Consistent with its long-standing role in reviewing remedies that are potentially excessively costly, the EPA National Remedy Review Board could be enlisted to help identify circumstances where state ARARs, if selected for cleanup at a DOE site, are likely to escalate remedial costs substantially and accordingly, that a state ARAR analysis should be prepared. The Committee believes that in such circumstances, ARAR analyses should be reviewed by EPA HQ and DOE HQ prior to implementation of the state ARAR in remedy selection at the site, and such analysis should be made publicly available.

For sites being remediated under CERCLA, CERCLA Section 120(a) provides that federal facilities cleanups are required to meet procedural and substantive cleanup standards, including more stringent state standards, to the same extent as sites remediated by private responsible parties. Accordingly, DOE sites are not required to meet state ARARs that are not being applied at other remediation sites in the state. Additionally, CERCLA provides for an ARAR waiver where there is evidence that a state requirement is not being consistently applied at other sites in the state. However, the Committee found at least one example, regarding groundwater cleanup, where a Washington state groundwater restoration requirement being applied as an ARAR at Hanford appeared to be more onerous than cleanup requirements being applied to groundwater at a site being remediated by private parties. At Hanford, a state requirement deemed to be an ARAR--that virtually all groundwater, no matter how contaminated, be restored to drinking water quality-- is one of the rationales for requiring that contaminated groundwater at the 100 Area be cleaned up to achieve drinking water standards. However, this state groundwater restoration requirement has not been applied to contaminated

[80] EPA's guidance states: "This waiver may be invoked when evidence exists that a State standard has not been or will not be consistently applied to both non-NPL and NPL sites within the State. The waiver may be used, for example, for a State standard that was promulgated but never applied, or for a standard that has been variably applied and enforced. A State standard is presumed to have been consistently applied unless there is evidence to the contrary." EPA, OSWER, Fact Sheet, "CERCLA Compliance with State Requirements" 5 (Dec. 1989).

groundwater under waste piles (in a "waste management area") at the private party-financed cleanup of the Holden Mine federal facility site, where a recent ROD decided not to require cleanup of such groundwater at all.[81]

This suggests that the state groundwater restoration requirement may not be applicable under CERCLA Section 120 at Hanford and/or that a waiver from the state requirement may be justified. We would urge the Task Force, if it is established, to look further into the matter and evaluate whether other high-cost state requirements being applied at Hanford are being similarly applied at other sites; EPA and DOE can do so in any event. Indeed, the Committee believes that where high-cost state ARARs are being urged for adoption at DOE sites, DOE and EPA should, should as a matter of course, investigate whether the more stringent state requirement asserted to be an ARAR is being applied to cleanups elsewhere in the state and take appropriate action based on what it finds.

3.2.2.4 Land Use Designations

Determinations of reasonably anticipated future land use(s) at a DOE site directly impact almost every step in the CERCLA NCP remedy selection process (and decision making under the RCRA counterpart, corrective action)--including assessment of risks to human health and the environment in risk assessments, identification of remedial action objectives and cleanup objectives and standards in the RI/FS, and ultimate selection of a final remedy for the site in the ROD—as well as directly impacting the cost of remedial action. For example, the assumption that future land use at substantial portions of a currently highly-contaminated DOE NPL site will be residential or "unrestricted", (or "unrestricted – surface use") as opposed to industrial, can result in remedial action requirements that are significantly more extensive, and more costly, than those that would be required were the assumption made that the future land use will be industrial. Where a form of unrestricted use is determined to be the reasonably anticipated future use for highly-contaminated areas, regulators must design remedies that will clean up to standards that would make it safe for people to live as full-time residents on the site, limiting funds available for cleanup elsewhere.

In light of the magnitude of the projected cleanup task, the expense involved, funding limitations, the extent and degree of contamination at EM sites, and other factors, it has been recognized that unrestricted use, although not impossible to achieve for certain areas, is not a likely or cost-effective scenario for the majority of lands across the former weapons complex.[82] Other valuable uses, such as conservation, wildlife protection, recreation, education, environmental and other research, and industrial use, are often more appropriate. Tribal nations often refer to their uses as more intensive

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[81] USDA Forest Service, *Record of Decision: Holden Mine Site, Chelan County, Washington* 2-48, 49, 116 (2012), available at http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5350463.pdf.

[82] In an August 1994, GAO report on "Nuclear Cleanup", GAO concluded that taxpayers cannot afford to pay for DOE site cleanups appropriate for residential use.

than other nearby populations and their interests in accessing usual and accustomed places for subsistence hunting, fishing and gathering, as well accessing areas used for religious ceremonies or other traditional practices must be given careful consideration in land use determinations. Non-residential land uses often are consistent with less stringent cleanup requirements, yet cleanups to support these uses—while not leaving lands or groundwater pristine-- have achieved the overarching CERCLA goal of being protective of human health and the environment.[83]

Notwithstanding the critical role of land use decisions for the future role of DOE legacy sites and in cleanup decisions and costs, land use determinations at sites across the DOE complex vary substantially from site to site, and there is evidence that such designations are not being made using a consistent set of procedures and criteria across the DOE complex (examples are discussed below). There also appears to be ambiguity, at least at Hanford, about DOE's authority to make land use determinations and EPA's role in the process. Further, the job of assuring that land use determinations are appropriately used as the basis for setting cleanup objectives and selecting remedies at DOE sites appears to have been delegated to site-level and/or Regional officials, with limited oversight from DOE and EPA Headquarters. Precisely when and under what conditions the review and approval of key EM decisions and decision documents is delegated by DOE-EM headquarters to field office managers has been evolving, particularly since April 2013.[84] A more consistent approach to establishing (and if necessary, modifying) land use determinations, and greater coordination between, and oversight by, DOE and EPA

[83] The Committee notes that in order to assure complex-wide consistency in remedy selection for DOE sites for which future land use is determined to be non-residential and non-industrial, appropriate exposure scenarios designed to evaluate risks and determine cleanup standards need to be developed and used across DOE sites. These should include exposure scenarios for human health as well as ecological exposure scenarios; the former may need to be tailored at sites where Tribal use is involved, as stipulated under CERCLA and RCRA, which have specific provisions for Tribal nations, and site-specific ecological exposure scenarios may need to be tailored to particular species found at individual DOE sites. Although some such exposure scenarios have been developed, more work needs to be done to address this set of issues.

[84] Revision 9 of Standard Operating Procedures governing the Delegation of Authority process had been in effect since April 2008, but was rescinded on April 9, 2013 and replaced on April 10, 2013 by a more restrictive SOPP Revision 10 governing the Review and Approval of Regulatory Agreements, Milestones and Decision Documents. About a month and a half later, on May 24, 2013 David Huizenga then Senior Advisor for Environmental Management who was functioning at EM-1 sent a memo to the field transmitting these SOPP changes and explaining their intent and purpose specifically noting that the Department's Internal Remedy Review process at Headquarters that had operated since between 1999 and 2006 had been phased out but then reconstituted in May 2012. This initial Huizenga memo described how the delegation might differ depending on the circumstances. Yet only 3 months after this May 2013 memo, Huizenga issued a second memo entitled Headquarters Concurrence for Regulatory agreements and Decision Documents in which he described a far more prescriptive process of concurrence not simply consultation for these decisions. Refer to the following for more information: U. S. DOE. Environmental Management Agreements, Milestones, and Decision Documents Review and Approval and Delegation of Environmental Authorities, Memorandum for distribution from David Huizenga, Senior Advisor for Environmental Management, May 24 2013; U.S. DOE Office of Environmental Management. Delegation of Authority Process (Environmental), Standing Operating Policies and Procedures (SOPP) #9, Revision #1, April 10, 2013; U.S. DOE Office of Environmental Management. Review and Approval of Regulatory Agreements, Milestones and Decision Documents, Standing Operating Policies and Procedures (SOPP) #10, Revision #1, April 10, 2013; and, U. S. DOE. Headquarters Concurrence for Regulatory Agreements and Decision Documents, Memorandum for distribution from David Huizenga, Senior Advisor for Environmental Management, August 30 2013.

Headquarters would enable the DOE legacy sites to be used in the most appropriate way and target scarce cleanup resources more efficiently and effectively.

Congress in 1997 expressly charged DOE with making land use determinations for former weapons complex sites in the EM remediation program, following issuance of the 1996 FFERDC report adopting a "risk plus" approach to priority-setting at federal facilities and DOE's commitment several years earlier to incorporate realistic land use assumptions in remedy selection and thereby effectuate cost savings and more efficient cleanup at DOE sites.[85] Section 3153 of 1997 Congressional appropriations legislation required DOE to establish anticipated future land use plans to guide cleanup decisions with respect to its Hanford, SRS, Oak Ridge and Idaho facilities and strongly encouraged the Department to establish such land use plans in connection with cleanup decision making at all its other sites.[86] The purpose of this provision was to support cleanup priority setting at DOE sites and to ensure that cleanup goals (and by implication, remediation costs) were tailored to the anticipated future land uses at DOE sites.[87] In light of the clear Congressional mandate that DOE determine future land uses at its remediation sites, it is not evident to the Review Committee that EPA, states, or any other regulatory authority has authority to

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[85] See GAO, "Nuclear Cleanup," at pp. 10-13. The report noted that at the time (1994), "EPA's current practice is to generally assume one land use--residential." Id. at 13. The FFERDC report made clear that, in using the "risk plus" approach, the principal factor to be considered for purposes of priority setting at federal facilities should be risks to human health. See Introduction, supra.

[86] PL 104-201, Sec. 3153, 42 U.S.C. 7274k (National Defense Authorization Act for Fiscal Year 1997).

[87] H.R. Rep. 104-563, 104th Cong. 2d Sess. (May 7, 1996). The House Report explains that the provision:

> "would permit the Secretary of Energy to develop and implement as part of the Defense Environmental Restoration and Waste Management Program, a future land use plan at sites where the Secretary is planning or implementing environmental restoration activities. Although the Secretary would be encouraged to use this authority at all defense sites where remedial activities are occurring, the Secretary would be required to develop these plans at specific selected defense sites. In developing these plans, the Secretary would be required to consult with local advisory boards, local land use redevelopment authorities, or other appropriate state agencies. The Federal Facilities Environmental Restoration Dialogue Committee recently issued its final report entitled ''Consensus Principles and Recommendations for Improving Federal Facilities Cleanup''. The recommendations contained in this report are aimed at improving the process of making decisions and setting priorities for cleanup efforts at federal facilities. The committee supports the expansive role of future use/site advisory boards as described in that report and recommends that future use planning, as required by this section follow, to the extent practicable, the recommendations contained in that report. The committee expects that reaching agreement with local authorities about anticipated future land use associated with contaminated former defense sites once they are remediated should result in cleanup activities that are appropriate to that anticipated future use. This should also result in a more expeditious transfer of the property upon the completion of the remediation activity. This section would recognize that certain sites, in conjunction with local advisory groups, have developed or are in the process of developing future use land use plans. This section would not overturn or require changes to those plans or the appointment of new advisory groups. This section would also require the submission of a report to Congress on the future land use plans at these former defense facilities. Finally, this section would require that all future land use plans developed under this section be in strict compliance with all existing statutory and regulatory requirements."

otherwise determine "reasonably anticipated future land uses" for cleanup decisional purposes at DOE sites.[88]

With a few exceptions, DOE former weapons complex sites are comprised of lands owned by the federal government, many have continuing missions, and most are expected to remain in federal hands and under federal control for the foreseeable future. Accordingly, future land use determinations made by DOE for its own sites, developed using appropriately participatory procedures, form a reliable basis for establishment of cleanup standards that will support reasonably anticipated future land uses at DOE sites.

The major DOE sites are generally large (e.g., Hanford covers over 550 square miles, Savannah River 310 square miles, and Idaho 890 square miles), and consist of highly-contaminated core areas where weapons production activities were concentrated, surrounded by relatively uncontaminated and often ecologically valuable buffer zones that DOE has long kept undisturbed and protected from development. At these and some other smaller sites, sizable areas of the surrounding buffer zone (or in some cases, the entire site) are state or federally protected as wildlife refuges or may be suitable for such protection. The Rocky Flats Site was remediated to non-residential standards and designated by Congress as a National Wildlife Refuge. At the Fernald Site, DOE, working closely with a committed citizen advisory board, determined to cleanup almost the entire site for use as a nature preserve and education center; primarily for this reason, the Fernald cleanup, originally estimated to cost $8 billion (assuming cleanup to residential standards), ended up costing only $4.4 billion. DOE site cleanup to standards suitable for

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[88] Although 100 Area and 300 Area CERCLA decisional documents do not provide the legal basis on which EPA site or regional personnel assert authority to dispute determinations of future land use at Hanford and depart from land use designations in the DOE Hanford Land Use EIS and ROD, a possible basis might be CERCLA Section 120(e)(4)(a), which pertains to disagreements between EPA and the federal facility owner over the selection of remedy for cleanup. Section 120(e)(4)((a) provides that under a federal facility agreement the federal agency conducting a cleanup and EPA shall review alternative remedial actions and select a remedial action, and that if they disagree, EPA shall select the remedial action. The Preamble to the Federal Register explaining EPA's interpretation of this provision makes clear EPA's understanding that its authority in the event of a dispute with the federal facility owner is to select the *final* remedy: "[T]he final remedy selection decision shall be reserved for the EPA Administrator." See 55 Fed. Reg. 8731 (1990). It does not necessarily follow from this provision – relating to selection of final remedial action from among alternatives - -that EPA is empowered to decide every issue and element leading up to the development of remedial alternatives, issues relating to risk assessments, evaluation of remedies, and determinations on reasonably anticipated future land uses. In any event, it is highly questionable that EPA can determine that the future use of federal lands, for example, at Hanford, should be residential when, pursuant to Congressional mandate, DOE, as the owner and manager of the land, has decided--after conducting an elaborate NEPA EIS process involving voluminous public input and deliberation with other federal agencies including FWS--that the lands should be managed for industrial or recreational use. Having followed a consultative process involving a wide range of stakeholders and met other EPA criteria, DOE's determination of land use at Hanford appears quite consistent with EPA Headquarters guidance on land use in the CERCLA remedy selection process. See, e.g., EPA, OSWER, "Land Use in the CERCLA Remedy Selection Process," (1995). The EPA 1995 land use guidance makes clear that when future land use is reasonably certain,--as is the case where DOE has carried out a Congressional mandate to plan for future uses at lands under the Department's exclusive, long-term control—remedial action objectives should generally reflect this land use. Id. Even assuming EPA might have such land use authority, it must be exercised, consistent with the Administrative Procedure Act strictures against "arbitrary and capricious" agency action, on the basis of reasoned justification with support in the decision-making record.

ecological protection at suitable sites, rather than residential or other uses that would require far more intensive remediation, can save money while at the same time protecting unique or valuable ecosystems and affording recreation opportunities for members of the public.[89]

That land use designations for restricted uses are appropriate at sites in the DOE complex seems to be well accepted by parties and stakeholders at many DOE sites, including large sites such as SRS, OR and the smaller Portsmouth site; at these three sites, the Committee learned, no lands have been designated for unrestricted use.[90] Similarly, DOE sites at Fernald, Rocky Flats and the Mound have all been cleaned up to non-residential standards for other important uses: Fernald is now a nature preserve, education center and Tribal burial ground; most of Rocky Flats is a National Wildlife Refuge; and the Mound was remediated for future industrial use. For the most part, these uses and the corresponding remedies were determined and implemented through open and inclusive processes.[91] For example, at Fernald, land use determinations were the result of a collaborative, multi-year process conducted by DOE and a carefully selected advisory committee which established clear criteria and evaluated a very wide range of possible land use scenarios, the various remedial alternatives that would be needed to make each scenario a reality at the site, and the costs of implementing each potential land use/remedy combination; over 200 alternatives were systematically evaluated and compared, and the final consensus reached through the process became the blueprint for the selected remedy implemented by DOE for the site. At SRS, agreement early in the process among DOE, regulators and the public that future land use for major areas of the site would be industrial, which was achieved through a public participatory process, formed the basis for an innovative site-wide "area" cleanup strategy that has greatly expedited cleanup of the site.[92]

By contrast, at Hanford, large areas of the site are being remediated to unrestricted surface land use standards (which means that contaminants may remain below 15 feet in some cases for a long period of time), despite a DOE future land use plan providing for non-residential uses throughout the site.[93] In response to Section 3153 of the appropriations legislation, DOE conducted an extensive, public EIS/ROD

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[89] See, e.g., J. Burger, et al., "Integrating Long-Term Stewardship Goals into the Remediation Process: Natural Resource Damages and the Department of Energy," Journal of Environmental Management 82 (2007), pp. 189-199.

[90] EPA officials provided this information during a phone call with members of the Committee.

[91] See M. Jewett and M. Jaraysi, "The Role of Land Use in Environmental Decision Making at Three DOE Mega-Cleanup Sites," presented at WM2011 (Feb. 27-Mar. 3, 2011, Arizona), at http://www.wmsym.org/archives/2011/papers/11595.pdf.

[92] See C. Guevara and D. Brett, "SRS—Incorporating Risk and Land Use into Site "Area Completion" Remedial Decisions at the Savannah River Site," presented at WM2011 (Feb. 27-Mar. 3, 2011), at http://www.wmsym.org/archives/2011/papers/11409.pdf.

[93] DOE's Idaho site (INL) is expected to be largely limited to restricted industrial use for the next 100 years (on the assumption that the federal government will control and manage the site for at least 100 years) and afterwards suitable for residential use. Accordingly, INL need not be suitable for unrestricted use until 2095, when natural processes are expected to have broken down site contaminants to less hazardous forms.

process with substantial stakeholder involvement, to determine future land uses throughout the site. The process generated the Hanford Comprehensive Land Use Plan Environmental Impact Statement and Record of Decision (Hanford Land Use EIS and ROD)[94], which DOE formally adopted in 1999 and reaffirmed in 2008. The Hanford Land Use EIS and ROD provide that most areas of the Hanford site are to be managed for conservation and preservation uses; it designates all of the 100 Area for conservation/preservation use and almost all of the 300 Area for industrial use.[95] In 2000, Congress declared a substantial portion of the preservation/conservation Hanford Reservation (including part of the 100 Area) a National Monument, a use consistent with the designations in DOE's Hanford Land Use EIS and ROD.

DOE's determinations of land use through the Hanford Land Use EIS and ROD, appears consistent with CERCLA land use guidance issued by EPA headquarters. The EPA 1995 land use guidance makes clear that when future land use is reasonably certain,--as is the case where DOE has carried out a Congressional mandate to plan for future uses at lands under the Department's exclusive, long-term control—such land use plans should be given substantial weight in the determination, and remedial action objectives should generally reflect this land use.[96] Further, EPA headquarters guidance urges that land use determinations be made through a process involving extensive consultation with stakeholders.[97] In developing the Hanford Land Use EIS and ROD, DOE held numerous public hearings, made draft EIS and draft ROD documents available for public comment, and consulted with a wide variety of stakeholders. The conservation/preservation use designated for the River Corridor in the final EIS and ROD is also consistent with the solely non-residential uses identified as likely for both the 100 and 300 Areas a few years earlier by the Hanford Future Site Uses Working Group.[98] By contrast, as described below, both the rationale and procedure used to effectively set aside the land use determinations made in the final Hanford Land Use EIS and ROD for the River Corridor (100 and 300 Areas) are questionable.

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[94] DOE, Final Hanford Comprehensive Land Use Plan Environmental Impact Statement (Sept. 1999); (DOE, Record of Decision: Hanford Comprehensive Land Use Plan Environmental Impact Statement, 64 Fed. Reg. 61615 (Nov. 12, 1999); and, Amended Record of Decision for the Hanford Comprehensive Land Use Plan Environmental Impact Statement, 73 Fed. Reg. 55824 (Sept. 26, 2008).

[95] DOE, Final Hanford Comprehensive Land Use Plan Environmental Impact Statement (Sept. 1999); (DOE, Record of Decision: Hanford Comprehensive Land Use Plan Environmental Impact Statement, 64 Fed. Reg. 61615 (Nov. 12, 1999). An earlier, 1992 working group had also identified only non-residential uses as likely future uses for both the 100 and 300 Areas. Hanford Future Site Uses Working Group, "The Future for Hanford: Uses and Cleanup," (Dec. 1992).

[96] EPA, OSWER, "Land Use in the CERCLA Remedy Selection Process," (1995).

[97] Id.

[98] Hanford Future Site Uses Working Group, "The Future for Hanford: Uses and Cleanup," (Dec. 1992).

The interim ROD for cleanup of the 100 Area, issued in 1995[99] and in effect until November 2013, prescribed cleanup to residential standards. Despite the urging by the DOE-IG in 1999 to correct the interim ROD to match the conservation/preservation land use designation made for the 100 Area in the Hanford Land Use EIS and ROD (also issued in 1999), [100] the interim ROD was never amended to reflect the new designation. As to the 300 Area, its designation in the Hanford Land Use EIS and ROD for exclusively industrial use was largely undisputed until recently, when EPA asserted that residential use was a possible use for most of the 300 area.[101]

Five Year Reviews for Hanford, including the most recent one in 2011, have clearly articulated that final remedies would be based on land uses in the Hanford Land Use EIS and ROD.[102] Today, however, by agreement of the tri-parties, the 100 and 300 Areas are being cleaned up, at greater cost, to unrestricted (surface) use standards notwithstanding the non-residential uses determined in the Hanford Land Use EIS and ROD and statements in Five Year Reviews affirming that cleanup specified in final RODs would be consistent with land uses in the Hanford Land Use EIS and ROD.[103] Not counting the investment made in the River Corridor groundwater treatment during the period from 2007 to 2014,

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[99] Document For Accession: D195066674. Declaration of Record of Decision for the 100-BC OF RECORD OF DECISION FOR 100-BC-1 100-DR-1 AND 100-HR-1 OU USDOE HANFORD 100 AREA found at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D195066674 Accessed March 30, 2015

[100] A 1999 DOE Inspector General Report warned that cleanup costs of the Hanford River Corridor would increase significantly due to designation of the 100 Area of Hanford, an area that is included in the Hanford NPL Site, for cleanup to unrestricted use instead of for the conservation/preservation uses determined for that area in DOE's 1999 Hanford Land Use EIS and ROD. The report strongly urged Hanford site officials to change to land use and cleanup objectives for the 100 Area to those consistent with the then-newly-issued Hanford Land Use EIS and ROD. DOE IG, "Audit Report: Hanford Site Cleanup Objectives Inconsistent with Projected Land Uses," 4-5 (1999). The DOE IG's report did not examine costs of cleanup for unrestricted use versus industrial use for the 300 Area of the River Corridor at Hanford because at that time there was no question that the 300 area would be cleaned up for industrial, rather than unrestricted, use. See id. at 1.

[101] Document For Accession: 0088359. DOE/RL-2010-99 REV 0: Remedial Investigation/Feasibility Study for the 300-FF-1 300 FF-1 300FF-2 and 300 FF-5 Operable Units, approved for public release, July 2, 2013. Available at: <http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0088359> [30 March 2015].

[102] DOE, Hanford Site: Third CERCLA Five Year Review Report, 20 (May 2012)(stating that although interim ROD for 100 Area, issued before Hanford Land Use EIS and ROD was promulgated, bases cleanup levels on unrestricted land use, DOE expects final cleanup levels to be based on future land use as described in DOE Hanford Land Use EIS and ROD).

[103] A 1995 ROD for the 100 Area, issued a few years before finalization of the Hanford Land Use EIS and ROD, aimed cleanup standards for the 100 Area at unrestricted use; DOE site personnel apparently decided not to adjust the cleanup standards following its issuance, despite the urging of DOE's Inspector General in 1999. A 2004 DOE Explanation of Significant Difference (ESD) for the Hanford 300 Area states that the Tri-Parties agreed to change the future land use designation from industrial to unrestricted use, and altered cleanup levels accordingly, for eight discrete "outlying" areas of the 300 Area. DOE, "Explanation of Significant Differences for the 300-FF-2 Operable Unit Record of Decision," 5 (May 2004) (decision based on evaluation of "the *additional cleanup necessary to achieve unrestricted cleanup levels* for 300 Area waste sites "outside the industrial core," as well as reduction in cost of long-term institutional controls and desire "to allow other beneficial uses.") (emphasis added.) The ESD reaffirmed the reasonably anticipated future land use for the rest of the 300 Area to be industrial due to remaining waste sites' proximity to the industrial core or the Energy Northwest Complex. Id. at 5. The Hanford Land Use EIS and ROD was not mentioned anywhere in the ESD.

nearly $3.8B has been spent on cleanup of the River Corridor, and the Department estimates that another $1B+ will be required to complete remediation of just this portion of the Hanford site.[104]

Recently issued final RODs characterize this reversal in land use assumptions as the resolution to a disagreement between DOE and EPA: the ROD states that while DOE continues to believe that the reasonably anticipated land uses for these areas are those specified in the Hanford Land Use EIS and ROD, EPA now believes that residential uses are possible. According to the RODs, DOE and EPA have agreed (with the support of Washington State Department of Ecology) to clean up the site to unrestricted use standards, which they assert will support both DOE's and EPA's predicted future uses. The RODs further assert that this change in land use assumptions will result in savings on the costs of monitoring and land use controls. It is unclear by what process at the site level this decision was made for the 300 Area. However, it appears that the decision to cleanup of the 300 Area to a new land use assumption, unrestricted use, was made by site officials without substantial review, oversight and approval by EPA Headquarters.[105]

In the Committee's view, the rationale for disregarding a longstanding Hanford Land Use EIS and ROD land use determination that DOE and EPA jointly give in site decisional documents –namely, that requiring cleanup to meet unrestricted use standards will support both unrestricted and industrial uses and yield savings on monitoring and land use control costs—is unlikely to constitute a reasoned basis for a decision to adopt a more costly remedy than would be called for to support the non-residential uses envisioned in the Congressionally-mandated land use plan for the site. While changes in land uses and corresponding remedies can certainly be made where there is appropriate supporting evidence and reasons, this should be done by DOE, in a manner consistent with the Hanford Land Use EIS and ROD amendment process that the Department had announced it would use when it considered this issue in its 2008 review of the Hanford Land Use EIS and ROD.[106] Both DOE and EPA Headquarters should play a stronger oversight role going forward to assure that remedy decisions at DOE sites adhere to legal

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[104] Department of Energy, 2014. Department of Energy, FY 2015 Congressional Budget request, Environmental Management. p. 66. See tabular accounts of to-date and anticipated RL expenditures for PBS RL-0041, a PBS which does not include a portion of RL-0030 that has been expended on River Corridor groundwater treatment during the same period. Available at <www.energy.gov/sites/prod/files/2014/04/f14/volume5> [30 March 2015].

[105] This conclusion is based on the representations of EPA Headquarters officials that site remedial decision making is generally conducted at the site level without substantial Headquarters involvement. According to the 2013 Record of Decision for the Hanford 300 Area, unrestricted use (based on the rural residential exposure scenario used for the 100 Area) now applies to 39 out of 40 square miles of the 300 Area. [Document For Accession: 0087180. Hanford Site 300 Area Record of Decision for 300-FF2 and 300-FF5 and Record of Decision Amendment for 300-FF-1, Appendix B, p. 105. Available at: <http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0088305> [30 March 2015].

[106] DOE in 2008 determined that although no changes in land uses prescribed by the Hanford Land Use EIS and ROD were then needed, the Department would review the Hanford Land Use EIS and ROD every five years; if changes in land uses specified in the Hanford Land Use EIS and ROD were found to be required at some point, DOE announced it would undertake procedures to formally amend the Hanford Land Use EIS and ROD. DOE, Amended Record of Decision for the Hanford Comprehensive Land Use Plan Environmental Impact Statement, 73 Fed. Reg. 55824 (Sept. 26, 2008).

requirements, policies and agency guidance, with appropriate consideration of any pertinent DOE-IG, NRRB or other expert reports. A remedy decision that requires cleanup in excess of reasonably anticipated future land uses, at greater cost, apparently in order to resolve a disagreement among local site officials is, in the Committee's view, not cost-effective nor consistent with applicable requirements (cited above) and can cause limited cleanup resources to be used for projects that would not otherwise be justified based on comparative risks to human health and the environment.

Considering the significance of land use determinations in cleanup decision making generally, and remedy selection in particular, DOE HQ and EPA HQ should be tasked with arriving at a clear and consistent process--and set of criteria-- for arriving at reasonably anticipated future land use designations, assuring that cleanup goals and selected remedies are matched to (and do not exceed) designated land uses and that such uses are appropriately factored in at each stage of the cleanup decision making, at all sites within the DOE complex.

3.2.2.5 Application of Cleanup Technologies/Approaches

Selection of the appropriate technologies and approaches to remediate sites is critical to achieving the CERCLA mandate to protect public health and the environment. Most contamination at sites in the DOE complex was produced over a period of decades. Thorough investigations and analyses must be conducted in order to determine the best technologies and approaches to address this contamination, based on land use assumptions, the baseline risk assessment, and other factors. These technologies and approaches must also allow the remedy selected for site cleanup to satisfy the nine remedy selection criteria under the NCP (discussed earlier). These technologies and approaches to remediation have been defined due to many years of research and development by EPA, DOE, other government agencies, and the private sector.

Remediation technologies are designed to remove, treat, and reduce the ability of contaminants to migrate. There appear to be significant differences in how similar waste materials under similar site situations are remediated at some DOE sites. For example, low activity fractions of HLW at the Hanford Site are to be treated by vitrification and when emplaced in a permanent disposition location on the site, even though there is very limited infiltration and no near-surface water table that would cause migration of the radioactive waste from its disposition form. In contrast, the low activity fraction of the tank wastes at the Hanford Site are planned to be vitrified on the basis of protection of human health and the environment.[107] At the Savannah River Site, similar low activity waste is being transformed into

[107] Prior to 1996, the Hanford Waste Vitrification Plant (HWVP) was being defunded by DOE-HQ with the claim that DOE complex could not build two one-of-a kind vitrification facilities at the same time: one in WA and one in SC. At the same time, as noted above, the citizens of Northwest and the State of Washington were having problems approving the disposal of LAW Grout in Washington soils based on the then current understanding of the state of technology. A trade was brokered between DOE-HQ and Washington State: Washington State would take a delay on the HWVP and DOE-HQ would agree to vitrify the LAW. This agreement was documented in the Hanford Federal Facility Agreement and Consent Order modification

"saltstone", which is a solid cementitious grout material, and will be permanently disposed in vaults and tanks, ultimately planned to be buried below grade, resulting in waste being close to the water table but demonstrated to provide adequate protection through an approved performance assessment, which involved NRC technical comment.

The Review Committee believes that there should be consistency across the DOE complex in terms of the technologies or approaches utilized to remediate similar types of site wastes under similar site circumstances, as is contemplated by under long-prevailing equivalence policies for the CERCLA and RCRA program.

3.2.2.6 Role of the EPA National Remedy Review Board

The National Remedy Review Board (NRRB), an entity established in 1996 by EPA (as a function coordinated by its HQ Superfund office), serves a purpose that is, in many (although not all) respects, a book-end to that performed by the DNFSB. While DNFSB's job is to identify areas where DOE has not done enough to address worker and public health associated with nuclear safety at a site and urge DOE to give these greater attention, NRRB identifies high-cost site remedy proposals that may not be cost-effective. However, unlike those made by DNFSB, NRRB's advice and recommendations are not directed at DOE, and DOE is not statutorily bound to make a determination whether or not to adopt NRRB's recommendations nor to develop and carry out an implementation plan for NRRB recommendations with which it agrees. Instead, NRRB's reviews are directed at the EPA Regions, which oversee DOE response actions, rather than at DOE itself; and the Committee was told that NRRB does not routinely consult with or directly engage DOE in its deliberations to develop the Board's recommendations; whereas, by law, DNFSB's recommendations are developed in dialogue with DOE, are targeted at DOE, and require a specific response and implementation plan from DOE. Further, unlike DNFSB, NRRB only reviews DOE remedies under CERCLA and does not address comparable health, safety and environmental activities that DOE carries out at sites under RCRA authority. Despite the less direct aim at DOE and lack of a statutorily prescribed mandate, however, by identifying proposed remedies that

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(the TPA), resulting in the following: delays in the dates on the operation of the Vitrification Plant and agreement to vitrify the HLW and LAW. The TPA milestones at the time in the TPA specifically spelled out vitrification for both HLW and LAW. Further documentation of this is found in the Tank Closure and Waste Management EIS (DOE/EIS-0391). Thus, selection of treatment approaches for low activity fractions of high level waste (i.e., LAW) at Hanford has been largely technology based, rather than risk or cost effectiveness based, but emphasizing vitrification (i.e., producing a glass waste form). Subsequent risk and comparative evaluations of potential alternative technologies have incorporated simplifying assumptions and additional requirements that make an unbiased and meaningful assessment of what constitutes adequate treatment of LAW, from perspectives of human health protection and environmental risk, as well as cost and schedule (including consideration of uncertainties) difficult. Progress on WTP, associated operational improvements and challenges, and improved understanding of alternate waste forms, suggests that a comparative evaluation of low activity waste treatment alternatives merits consideration -with higher fidelity—that includes a combination of LAW treatment approaches and waste forms, selectively applied to specific groups of tank wastes.

are not cost-effective, NRRB reviews, if heeded by decision makers and informed by dialogue with DOE, can perform a very important function.

The NRRB's mission is to help control remedy costs under CERCLA and to promote both consistent and cost-effective remedy decisions at Superfund sites, including federal facilities. NRRB is chaired by the EPA HQ Superfund office, and includes representatives from each of the ten EPA Regions. NRRB reviews site remedies at DOE sites where the following criteria have been met: (1) the primary contaminant is radioactive; and (2) the proposed remedial action exceeds $75 million.

Since its inception, NRRB has issued reviews of remedies at several DOE sites, including Hanford, OR, and SRS. The four most recent DOE site reviews by the NRRB were for the Hanford Site in 2008, 2011, and 2012 and as recently as March in 2015.

With respect to ARARs, of note, NRRB has expressly questioned whether, and if so how and why, Hanford was using Washington's Model Toxics Control Act (MTCA) as an ARAR for development of remedies for various portions of the site.[108] The response to NRRB's concern from the Region was: "they will continue to work with DOE and the state to evaluate the appropriate role of MTCA in CERCLA response actions."[109] Beyond providing this reply, it appears the Region did not feel compelled—nor did this exchange apparently result in EPA HQ requiring the Region—to further elaborate on the legal basis on which the MTCA was selected as an ARAR at Hanford. Having asked a very important question and received what is at best, a vague answer, it appears NRRB's concern—namely, that the MTCA might not have been justifiably adopted as a CERCLA ARAR, a "threshold criteria" with which any and all site remedies must comply (as opposed to being "to be considered" information)—was not pursued further. (It is noteworthy that the NRRB again asks essentially the same question in its review of another Hanford River Corridor site in the Spring of 2015. No Regional response to this latest NRRB review has been made available.)

The Review Committee regards NRRB's central function—that of assuring national consistency in high-cost remedy selection by reviewing potentially inconsistent and excessively costly remedies being proposed for adoption at Superfund sites, including DOE sites—as a very important one that

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[108] "The Board did not have sufficient information to evaluate the role of the Washington Model Toxics Control Act (MTCA) for these areas and whether MTCA Method B is an applicable or relevant and appropriate requirement (ARAR) for these areas. To the extent MTCA might be considered as an ARAR, the Board notes that the stringent cleanup levels identified by the State of Washington may not be achievable with current technology. The Board recommends that the Region, DOE, and the State work together in evaluating the appropriate role of MTCA in designing a remedial action that will protect human health and the environment."] U.S. EPA 2012, National Remedy Review Board Recommendations for the 110-k, 200-UP-1, and 300 Areas of the Hanford Superfund Sites. Washington DC: USEPA, June 26, 2012. All NRRB site reports can be accessed at http://www.epa.gov/oerrpage/superfund/programs/nrrb/siterevs.htm.

[109] Opalski, D., PA Memorandum (September 18,2O12) to Amy R. Legare, Responses to National Remedy Review Board ecommendations for the 1OO-K, 2OO-UP-1, and 3OO Areas of the Hanford Superfund Site". The cited review at the bottom of the paragraph is U.S. EPA 2015, National Remedy Review Board Recommendations for the 1 00-DR-1, 1 00-DR-2, 100- HR-1 and 100-HR-2 Operable Units at the Hanford Superfund Site, USEPA, Washington DC.

complements that of DNFSB, and which could be employed to greater benefit than now appears to be the case at DOE sites. Optimizing NRRB's role in promoting national consistency at DOE sites could entail:

1. Directing NRRB reviews to DOE HQ and site level officials and soliciting DOE's views and input on potential recommendations;
2. Establishing an analogous and coordinated review board for RCRA remedies that identifies and reviews high-cost remedies at all DOE sites;
3. Having NRRB and the proposed RCRA review board work with an Interagency Task Force to identify ways to resolve regulatory inconsistencies at DOE sites; and
4. Examining the outcomes to assure that recommended action represents a coordinated response to insure consistency through the two boards.

In calling for this expansion of the scope and activity level of the NRRB the Review Committee is cognizant that to be implemented, the NRRB will need additional resources. In fact, the Committee did observe during its discussions with EPA officials that there are significant resource constraints associated with the ability of the Headquarters Federal Facilities program to provide oversight of DOE site cleanup activities. The EPA Federal Facilities Restoration and Reuse Office, and the Federal Facilities Enforcement Office have 15 staff personnel each to provide oversight of assessment, remediation, and compliance matters at DOE, DOD, DOI, NASA, and other Federal Facility sites across the nation. Thus, while the Review Committee recognizes the constraints upon EPA staff in ensuring consistent application of its policies at DOE sites, devoting more resources to headquarters review and promoting consistency in remedial approaches among sites could, however, yield cost savings and enhance protection. EPA and DOE should work together, as part of the Interagency Task Force, to address the resources required for the suggested NRRB expansion.

3.2.2.7 Dispute Resolution Mechanisms

FFAs have been agreed to for every DOE cleanup site within the complex. Over the years, the FFAs for DOE sites across the complex have accrued a multitude of cleanup obligations and compliance milestones, many of which were characterized by the GAO as not realistic when they were agreed to and cannot be accomplished within current budget limitations.[110] This situation has led to friction between the regulators (EPA and states) and DOE when FFA milestones are missed and controversy over whether or not the cleanup obligations/milestones are feasible and appropriate.

In notable instances, following unsuccessful efforts to resolve matters through the dispute resolution process prescribed in FFA, states have acted by initiating litigation in the local federal court to obtain

[110] General Accounting Office, "Department of Energy: National Priorities Needed for Meeting Environmental Agreements," 2-5 (March 1995). Also, DOE, "Report of the Secretary's Environmental Advisory Board Task Force," at p. 1.

decrees to enforce missed cleanup milestones. Typically, this eventually results in negotiation of a consent decree between the state and DOE, which is entered by and enforceable by the court. This has already happened at Hanford, where Washington State secured a consent decree to redress missed milestones for tank closure and tank waste treatment; the state is now seeking to have the court enforce milestones in the Hanford FFA Consent Decree and enlarge the scope of the decree to include additional cleanup obligations and milestones. The litigation route is also being actively considered at SRS, where, also due to missed tank closure milestones, South Carolina is evaluating whether to seek a court order enforcing tank closure milestones and imposing up to $200 million in penalties on DOE.

Allowing states to obtain court decrees to enforce milestones in FFAs and FFA consent decrees enables a state to use litigation in a local federal District Court to commandeer the limited available federal facility cleanup budget to require DOE to spend more of that budget on sites within the state. There are a number of troubling consequences of this practice. One is that site problems addressed by a consent decree are elevated to top-priority—regardless of the degree of risks the problems pose or the impacts diverting resources will have on DOE's ability to address other problems at the same or another site. There is accordingly considerable pressure in the DOE funds allocation process to fully fund cleanup obligations enshrined in a consent decree, even where risks to human health elsewhere at the site (or at another DOE site) may be of greater magnitude or urgency. A further consequence is that it, in effect, delegates national priority setting for cleanup of DOE sites to local federal courts, each deciding independently without any mechanism for assessing and setting priorities for allocating limited federal facility cleanup funds from a national perspective.

These three consequences can skew DOE priority-setting and funds allocation, and in a national, federally-funded program with a limited budget, undermine processes for determining cleanup priorities.

3.2.3 INCONSISTENCIES IN CLEANUP REQUIREMENTS AND POLICIES AMONG SITES - FINDINGS AND RECOMMENDATIONS

3.2.3.1 Inconsistencies in Legislative and Regulatory Regimes

Findings

- The Tri-parties at different sites have used regulatory discretion to select different regulatory regimes and impose different cleanup expectations to address the same or similar site problems, resulting in imposition of different cleanup, waste treatment and final disposition requirements across the complex. For example, there are different requirements for tank waste retrieval and treatment at Hanford and Savannah River sites. Requirements are not consistently risk-informed and performance based, resulting in different cost and risk profiles at each site. It does not appear that EPA and DOE have been able to provide consistency across the sites, because each situation is placed in a particular regulatory regime, such as CERCLA, RCRA or the Clean Water Act and subject to different expectations. Further these inconsistencies undermine

federal policies, such as EPA's policy on "Coordination between RCRA Corrective Actions and Closure and CERCLA Site Activities" (9/24/96) and EPA's Integrated Cleanup Initiative, which are intended to ensure similar cleanup results under similar circumstances, regardless of which cleanup authority is used. Greater consistency in remedies, avoiding disproportionately costly measures and promoting more cost-effective remedies targeted at priority risks, would enhance overall protection and save resources.

- Application of the Section 3116 of the National Defense Authorization Act of 2005 that now only applies to HLWs at DOE's SRS and Idaho sites may facilitate more efficient waste treatment and tank closure at the Hanford and the West Valley sites, while still providing protection of human health and the environment.
- Existing federal statutory and regulatory classifications for radioactive wastes, based primarily on waste origin, can result in wastes with similar hazards and characteristics being managed differently (and at different costs) as is the case in Oak Ridge compared to Hanford and Savannah River.

Recommendations for Congress

- **Congress should establish a standing Interagency Task Force**, comprised of senior officials of DOE, EPA, DNFSB, and independent experts, and co-chaired by DOE and EPA. The mission of the Task Force would be to advise and assist DOE in taking actions, with EPA cooperation, to promote consistency and risk-informed decision-making and results, both within DOE sites and across the DOE complex, with respect to site cleanup priority-setting, resource allocation, integration of regulatory authorities and standards, regulatory compliance, cleanup technology and approaches, dispute resolution and other activities that impact the cost-effectiveness of, and risk-informed decisional basis for, cleanup decisions at individual sites and across the DOE complex. The Task Force should be appropriately staffed, supported by technical staff and have a budget line. It should prepare an annual report for Congress, the Secretary of the DOE, and the Administrator of EPA.
- Congress should extend the Section 3116 process for HLW to DOE's Hanford and West Valley sites, in order to more efficiently enable low-level fractions of tank waste at Hanford to be managed as LLW and to enable empty HLW tanks at the West Valley site to be closed.
- Congress should authorize DOE to reclassify, on a sound scientific basis, defense HLW, based on their degree of hazard and intrinsic characteristics, instead of based on their origins as is presently the case.

3.2.3.2 Implementation of National Contingency Plan (NCP) Cleanup Requirements for Remedy Selection

Finding

- Conducting decades-long "interim action" as the dominant mode of CERCLA cleanup of large portions of some DOE sites has displaced the NCP remedy selection process, which places great emphasis on following a carefully-designed sequence of remedial steps, development of remedial alternatives and systematic consideration and comparison of alternatives against nine criteria, including worker risk and cost-effectiveness. As a result, these interim remedies have become the final remedies by default. This nontransparent "shortcut" approach has resulted in selection of remedies —and near-completion of cleanup--without the level of analysis expected in key CERCLA final decisional documents and before these documents have been issued. Thus, the extensive and extended use of "interim action" cleanup makes it difficult to: (1) ensure that risks are appropriately characterized and addressed; (2) assure that all of the considerations embodied in the 9 CERCLA remedy selection criteria are evaluated prior to remedy selection and implementation; (3) rationally allocate funds on a risk-informed basis; (4) determine whether proposed remedies will be cost-effective (because cost effectiveness is not considered in selection of "interim" remedies); and (5) assure that remediation risks to workers or sensitive ecological resources are minimized and that such risks do not outweigh the risk reduction benefits of cleanup (because short-term effectiveness is not considered in selection of "interim" remedies).

Recommendation for DOE

- The NCP remedy selection process should be reinstated at all DOE sites, as soon as possible, including remedy selection considering, rigorously and in depth, all nine CERCLA remedy selection criteria and designated land uses. Final RI/FSs, Proposed Plans and final RODs should be completed before cleanup takes place. Interim actions at DOE sites should be limited, going forward, to short-term risk reduction interventions in compliance with the NCP with clear guidelines to be established by the Interagency Task Force.

3.2.3.3 Determination of Applicable or Relevant and Appropriate Requirements (ARARs)

Findings

- CERCLA Sec. 120 (a)(4) provides that cleanup of federal facilities is to be conducted according to the same cleanup standards and procedures as those being applied to sites that are remedied by private site owners or operators.
- There is evidence that, through adoption of state standards as ARARs, higher standards are being required of DOE than are being required of cleanup by private parties at other sites in the same state.

- CERCLA provides for a "fund-balancing waiver" of ARARs at non-federal facilities, but does not currently provide for an analogous waiver at federal facility sites; if such a waiver were available, it would enable cleanup decision makers at DOE sites to more effectively allocate limited resources to priority needs throughout the complex by balancing the need for protection of human health and the environment at a given site against the availability of federal monies to respond to other sites.
- Under CERCLA, state ARARs must be more stringent than federal requirements in order to be adopted as requirements for cleanup. However, state ARARs may be costly and not obtain appreciably greater risk reduction than alternative measures. The cost impact of adopting some state ARARs can be substantial. State ARAR determination decisions in RODs for CERCLA sites are typically conclusory and no detailed analysis is provided to explain the decision basis and how the CERCLA criteria for state ARARs have been met. The Committee is troubled that the decision process for determining state ARARs is very informal, internal undocumented, non-public and made without HQ review or approval at either DOE or EPA. Furthermore, waivers of state ARARs are rarely considered on grounds of inconsistent application of a standard within a state. Given the importance of ARARs on remedial decisions, it would be prudent to evaluate whether grounds exist for a waiver of a high-cost state ARAR upfront, at the same time as the state ARAR determination is being considered or reassessed.

Recommendation for the Interagency Task Force

- The Interagency Task Force should direct DOE and EPA to work together to ensure that potentially "high-cost" state ARAR decisions are made on the basis of a rigorous analysis of the grounds for the decision and through a transparent, well-documented process (e.g., when the cost exceeds $75 million, consistent with NRRB review threshold). The Review Committee recommends requiring preparation by EPA of a detailed, written analysis of state ARAR applicability or relevance and appropriateness, begun early in the remedial process, for any potential state ARAR that is a potential major remedial cost driver at a DOE site. The analysis should assess the grounds on which applicability of the State ARAR is asserted by the state and provide a detailed analysis of whether and how statutory preconditions for applicability or relevance and appropriateness of the State ARAR have been met and assess whether there may any potential grounds for a waiver. The Review Committee also recommends that all such analyses should be required to be reviewed and approved by DOE and EPA headquarters-level officials and made publicly available prior to use of a high-cost state ARAR in the remedy development process.

3.2.3.4 Land Use Determinations

Findings

- Determinations about future land uses are important drivers of remediation technology and cost. There is not a consistent process and criteria in use across the DOE complex for decisions

about future land uses and the use of future land use determinations in risk assessments and cleanup decisions.

- DOE was charged by Congress to determine reasonably anticipated future land uses at its Hanford, SRS, Idaho, and Rocky Flats sites and encouraged to do so at all other DOE sites that are part of the EM remediation program; cleanup levels at DOE sites were expected by Congress to match reasonably anticipated future uses.
- DOE at many of its major DOE former weapons production sites has determined cost-effective and appropriate future uses, including conservation, wildlife refuge, recreation, education, research and industry, rather than unrestricted use, and most sites have geared cleanup and remedy selection to such future uses.
- At Hanford DOE promulgated a Comprehensive Land Use Plan (Hanford Land Use EIS and ROD) designating the 220-square-mile River Corridor almost entirely for conservation/preservation use, through an extensive, consultative process involving a wide range of stakeholders and a formal EIS and ROD; however, the River Corridor is being cleaned up for unrestricted surface use—not the uses designated in the Hanford Land Use EIS and ROD—based on agreements among triparties at the site, and without adequate review and oversight by DOE and EPA Headquarters. The cost of River Corridor cleanup to date is more than $3.8 billion, and additional substantial costs are expected to be incurred before the job is done.

Recommendation for the Interagency Task Force

- The Interagency Task Force should develop a consistent process and criteria for making—and, when necessary, revising-- land use determinations and devise ways to ensure that these land use determinations are used appropriately in risk assessments and other remedy selection steps at all sites in the DOE complex.

Recommendations for DOE and EPA

- DOE Headquarters and EPA Headquarters should work together to provide effective oversight and ensure that site cleanup levels and remedies at all DOE sites are selected to match DOE land use determinations that have been made in accordance with Congressional land use planning mandates to DOE and consistent with relevant EPA Headquarters CERCLA Land Use guidance.

3.2.3.5 Application of Cleanup Technologies/Approaches

Finding

- Remediation technologies are designed to remove, treat, and reduce the ability of contaminants to migrate. There appear to be significant differences that are not risk-informed in how similar waste materials under similar site conditions are remediated, treated and disposed at some DOE sites. For example, low activity wastes at the Hanford Site are planned to be treated by vitrification when placed in its permanent disposition location on the site. At the Savannah River Site, similar low activity waste is being transformed into “saltstone”, which is a cementitious

grout material, and will be permanently disposed in vaults and on site. At the Hanford site, the State of Washington is the lead regulator for the tanks using RCRA authority. At SRS, the tanks are operating under a Clean Water Act permit, although RCRA does also apply. The State of South Carolina has chosen not to apply RCRA clean closure standards to the tanks. The cost differential between the various cleanup strategies for tank wastes at the Hanford Site versus SRS is potentially very large.

Recommendation for DOE

- DOE should commission independent, site-specific risk reviews, for major DOE sites (i.e., those with cumulative expenditures of greater than $250 million) to help assure risk-informed prioritization and resource allocation within and across the complex. The reviews should be performed by a well-qualified, non-conflicted entity that is independent of the cleanup contractors performing work at that, or other DOE sites.

Recommendation for the Interagency Task Force

- The Interagency Task Force should develop guidance to ensure consistency in implementation of appropriate legislative authority, national regulations, and policies at DOE sites when selecting cleanup technologies and approaches addressing similar categories of site activity.

3.2.3.6 Dispute Resolution Method

Findings

- In a constrained budget environment, state use of judicial consent decrees to enforce milestones in FFAs (e.g., at Hanford and SRS) can skew priority-setting and resource allocation at individual DOE sites and across the complex. This is because once site milestones are covered by a court-approved consent decree, accomplishing those milestones necessarily becomes a top DOE remediation priority -whether or not the problems being addressed by the milestones represent high-priorities from a risk perspective. This can decrease funds available for other, potentially higher priority cleanup tasks at the same or another DOE site, and inappropriately remove these DOE decision functions to individual federal courts in diverse states.
- The effectiveness of federal district court decrees in attracting increasingly scarce DOE cleanup funds is promoting greater use of this mechanism to resolve state-DOE disputes over missed cleanup milestones and may financially disadvantage sites that do not have consent decrees. For example, having secured a consent decree enforcing milestones for its tanks, Washington now seeks to include other FFA milestones in a decree as well as enforce milestones and other obligations in the existing decree. South Carolina is evaluating regulatory penalties and court action to enforce missed milestones, something that in the past the state has worked out informally with DOE under the FFA. One important consequence of this is that decisions on national cleanup priority setting and resource allocation at DOE sites are in effect being made by local federal courts.

- Less extensive "exhaustion of administrative remedies" requirements agreed to in FFAs by states at some sites make it easier and faster for those states to pursue the judicial enforcement route than other states that agreed to go through more extensive procedures to resolve their dispute directly with DOE before doing so. This in effect creates unequal access to a judicial remedy among DOE sites, further skewing the DOE priority setting and resource allocation equation.

Recommendation for Congress

- Congress should establish an alternative dispute resolution process to which parties to an FFA or FFA consent decree would be required to resort if exhaustion of FFA dispute resolution procedures does not result in a satisfactory resolution of the matter under dispute. This process would involve resolution of disputes by an expert national panel whose decision would be binding, subject to opportunity for judicial review of its decision in the Court of Appeals for the D.C. Circuit. It would be in lieu of a consent decree or resort to litigation in a local federal court and would result in a binding decision applicable to all the parties to the FFA.

3.2.3.7 National Remedy Review Board:

Findings

- NRRB plays a valuable role in improving the cost-effectiveness of CERCLA site remedies by identifying, raising concerns about, and reporting on high-cost proposed remedies prior to their selection, including with respect to DOE sites. The Review Committee has confirmed that NRRB has in the past issued useful reports on high-cost remedies at several major DOE sites, including Hanford, SRS and Oak Ridge, although in its deliberations to develop recommendations NRRB has not made it a general practice to consult or directly engage DOE . NRRB's expertise and experience evaluating remedies at DOE sites, and its recommendations especially if informed by input from and dialogue with DOE, could be harnessed to help address the cleanup inconsistencies identified.
- Systematic, complex-wide information on high-cost remedy proposals of the kind provided in NRRB reports—if expanded to include remedies developed under RCRA, as well as CERCLA--could help DOE avoid unnecessary expenditures of limited DOE-EM cleanup funds at its sites, freeing up funding for other priority site cleanup activities.

Recommendation for the Interagency Task Force

- The Interagency Task Force should: (1) evaluate the feasibility of creating an EPA RCRA team analogous to the National Remedy Review Board (NRRB) (with the provision of adequate resources) to expeditiously review all high cost RCRA corrective action remedies at DOE sites; and (2) develop effective procedures for assuring appropriate DOE input to NRRB and RCRA team deliberations and ensuring action by EPA, DOE, and applicable state officials in response to NRRB and RCRA team recommendations.

3.3 MAJOR THEME: DOE RISK INFORMED PRIORITIZATION AND RESOURCE ALLOCATION

3.3.1 RISK INFORMED PRIORITIZATION

3.3.1.1 Context

The Review Committee visited with Office of Environmental Management officials at both the headquarters in Washington, DC, and at four EM cleanup sites across the complex during the period July to October 2014. The sites visited were the Office of River Protection at the Hanford Site, the Richland Site Office, also at the Hanford Site, the Savannah River Site, and the Oak Ridge Operations Office. Additionally interviewed were three contractor executives with extensive experience supporting EM cleanup across a number of sites. During the Committee's visits, numerous personnel on-site were interviewed in person, and additional personnel were interviewed by telephone. The notes from these meetings are included in Appendix C and D.

Interviewees included a wide range of personnel, including EM site managers, their deputy managers, assistant managers for specific portfolios, Federal Project Directors, Facilities Representatives, personnel involved in planning and budgeting, on-site Defense Nuclear Facilities Safety Board (DNFSB) personnel, and personnel from state regulatory agencies for those sites. Additionally, the Committee was provided a tour of facilities at two of the sites, and during those tours, information was elicited from the personnel, both EM Federal employees, and in some instances, contractor personnel. Additional interviewees included state regulatory personnel, and EPA headquarters personnel in Crystal City (Arlington, VA), with telephone links to EPA regional staff for Washington State, South Carolina, and Tennessee.

Through interviews with officials at DOE Headquarters, the Review Committee learned that DOE delegates prioritization and budgeting for the sites to site personnel, with general guidance and review from HQ. Guidance from EM HQ is provided in a letter prioritizing seven activities and asking sites to build budgets around three scenarios: the prior year's budget, and that budget plus and minus ten percent.

During discussions at the sites, the Review Committee visited, site personnel described their procedure for prioritization and budgeting of all needed work. This includes operations and management of nuclear facilities and systems maintaining the required "min-safe" conditions (ability to safely operate the facilities), and the reduction of risk imposed by nuclear contamination and nuclear materials on site. Operations and management maintaining "min-safe" conditions, is performed under the Department's self-regulated authority for nuclear operations (with oversight, by the DNFSB and regulation by DOE's Office of Independent Oversight), along with meeting requirements for safeguarding and securing special nuclear material (SNM). In contrast, reduction of risk associated with environmental contamination is generally done to comply with environmental laws, regulations, and agreements.

The challenge at each site, however, is far more complex than this simple description implies. Concerns are driven by risk to the public, and to on-site personnel. Issues are voiced by citizen advisory boards, Tribal Nations and pueblos, local chambers and officials, and worker groups. Communities are interested in work force stability and maintenance of specialized nuclear expertise. The site must focus on min-safe operations for all nuclear facilities, resources required for security of nuclear materials and facilities; recently identified concerns with the reliability and operability of critical infrastructure; social justice issues and DOE's overall commitment to assure some measure of support to all its remediation sites. In short, there are a myriad set of important pushes and pulls for resources at DOE's major sites.

Additionally, in response to the "beyond design basis" risks highlighted by the incident at the Fukushima-Daiichi nuclear power plant in northeastern Japan, the Department of Energy has re-evaluated its operations and facilities and re-considered the potential for similar circumstances.[111] For example, a facility housing nuclear material that would be propagated if the facility containment were breached, is now evaluated considering a seismic event, which could breach containment, followed by a fire, which would further propagate the material housed within (Building 235F at the Savannah River Site, containing Plutonium "holdup" in disused hot cells). No longer is the evaluation against a single-event criterion, but it now considers such multiple, but related, causes (See discussion of DNFSB, theme 1 above and notes in Appendix C).

Unique and emerging situations further compound the difficulty of compiling a risk-informed priority list founded upon the factors as stated above. For example, at the Hanford Site, the Waste Encapsulation and Storage Facility (WESF) houses cesium and strontium which were extracted from the high level liquid waste in the underground tanks; these materials represent over one-third of the radioactivity at Hanford. This nuclear material is now stored within containers, and arrayed within a pool of water, for cooling and radiation shielding. A recent report by the DOE IG states: WESF is beyond its design life and the Office of Environmental Management considers it to be the largest "beyond design basis" facility, that is WESF is at the greatest risk of any facility to the threat of a natural event occurring that is beyond its design capacity to sustain (DOE IG OAS-L-14-04, March 2014). While the WESF facility is a priority for the DOE, the DOE faces a challenge in obtaining the resources needed. A March 2014 report by the Office of Inspector General of the DOE (2014) observed:

> "Accordingly, we suggested that the Department consider revising its current remediation strategy and instead address environmental concerns on a national, complex-wide risk basis. This would result in a form of environmental risk triage. Looking at the program holistically, funds would be provided to high risk activities that threaten health and safety or further environmental degradation. As previously discussed, WESF is beyond its design life and the Office of Environmental management considers it to be the largest "beyond design threat"

[111] DOE, *Review of Requirements and Capabilities for Analyzing and Responding to Beyond Design Basis Events*, Report to the Secretary of Energy (August 2011).

facility, that is WESF is at the greatest risk of any facility to the threat of a natural event occurring that is beyond its design capacity to sustain." (U.S. DOE 2014, p. 3)

Near-term procedural revisions have been made and an interim stabilization project is set to start in the next fiscal year. The significance of the material stored within, and the now-extended term of storage (due to the loss of the disposition path to the formerly planned repository at Yucca Mountain), coupled with the "beyond design basis" risk considerations, result in an increased imperative to improve the safety and reduce the risk in its present storage location, as well as planning to store it differently, in interim dry storage, in the near term. This has resulted in near-term corrective actions, a medium-term facility modification program, and finally, a long-term conceptual project to move the cesium and strontium capsules to dry storage canisters—similar to those used for commercial spent nuclear fuel. How these projects will fare in the continued constrained budget environment is unclear.

Additionally, it is becoming increasingly apparent, based upon anecdotal experience related by the on-site personnel, that decay of critical infrastructure elements is adding additional risk. For example, one site has reported seven failures of a water main providing fire protection within a year. This rapid rate of failure would indicate that reactionary repair for each incident does not always provide the assurance necessary for fire protection at a nuclear site. There were examples provided, including one involving the pressurized air switches at electrical breaker locations, where the metal is so thin that welded repairs can no longer be accomplished. In this instance, institutional controls have been implemented to keep workers away until the switches are de-pressurized; however, this does not address the risk of failure of the breaker system itself, and the potential threat to a nuclear operation dependent upon the electrical power reliability.

3.3.1.2 Risk Prioritization (utilizing the "risk-plus" approach)

DOE EM Sites

The sites visited indicated that they are endeavoring to use the "risk plus" approach, incorporating risks to human health and safety as the primary criterion, but also including other factors, into their prioritization process. This is further complicated because, as illustrated above, many of these risks are not addressed by regulatory milestones. The Department is required to fund requirements to meet regulatory milestones, in accordance with Executive Order 12088. (See Appendix E for a broader context of the deliberative process).

Generally, the process described to the Review Committee during visits to the sites considers the following in development of the "risk-plus" priority list at site level:

- Input from facility representatives, operations managers, and other staff working in the field;
- Identification of min-safe activities with the participation from contractors responsible for facilities operations.

The Integrated Priority List for the site is built around human health and safety in the following order:

1. Safety and security, including the DOE self-regulated nuclear safety requirements
2. Capital projects
3. Progress on regulatory commitments and compliance
4. DNFSB requirements

Several Review Committee members believe that DNFSB recommendations should at times be higher ranked than progress on the regulatory commitments and compliance, but the relative importance of DNFSB recommendations has not been clear from input received. The Review Committee deems that it is essential for headquarters to see the full and unconstrained (without regard to funding targets) priority list from each site, so that critical needs, even if "over target" can be evaluated and prioritized within the budget for all of EM. It is the Review Committee's understanding that this is the current practice, and the Review Committee endorses this approach.

The Review Committee also notes that there are two EM site offices that manage distinct work elements at the Hanford Site. The Office of River Protection prioritizes, submits budgets for, and manages all work in the tank farms, including operations, and also for the construction project for the Waste Treatment Plant which, when built, will process and vitrify the radioactive waste presently stored in the HLW tank farms. The Richland Site Office essentially prioritizes, submits budgets for, and manages all other work, including environmental remediation and common support functions, at the Hanford Site. These two offices do not integrate the priority lists they develop and submit to headquarters for the budget process; rather, EM officials at headquarters consider these as two distinct site offices as the budget is developed.

DOE EM Headquarters

Based upon several visits and phone calls between the Review Committee and officials at EM headquarters, it is apparent that the analytical methodology by which headquarters integrates the priorities across all the sites in the complex is not adequately defined to provide clarity for the full range of issues that DOE must prioritize, at least for as some the members of this Committee. The process that HQ uses is clear, that is, HQ managers can articulate exactly what they do, but the tools that they use to prioritize are not. The Review Committee believes that it is essential for officials at DOE headquarters, both those in EM and others involved in the Department-wide budget process, to allow sites to make budget requests for priority problems whether or not those request fall within arbitrary budget "targets" assigned to the EM program by DOE.[112]

The Review Committee notes, for example, that the President's budget for FY2015 included a reduction in proposed EM budget of approximately 3.6 percent from FY2014. (FY2014 enacted was $5,830K, FY2015 President's budget was $5,621.7K.) (Congress enacted, however, a total of $5.861K for FY2015, slightly more than the FY2014 appropriation for EM.) As part of the same President's budget, however,

[112] Currently EM allows sites to report site needs as requiring site budget allotments ("targets") which vary from the prior year's budgeted allotment by only 10% (more or less).

other programs were granted significant increases, such as approximately 6.9 percent for the Weapons Programs, approximately 22 percent for the Energy Efficiency and Renewable Energy Programs, and approximately 16 percent for ARPA-E.

The President's budget for FY2016 follows this same trend: an 8.1 percent increase for Weapons Programs over FY2015, a 42.3 percent increase for the Energy Efficiency and Renewable Energy Programs, and a 16 percent increase for ARPA-E. Additionally, the Department's Science programs funding has grown from $4.681 K in FY2013, to $5.06 billion in 2014, to $5,067.7K in FY2015, to $5,339.8K in the FY2016 President's budget, a cumulative increase of over 14 percent.

While the overall request for DOE in the FY2016 President's budget has increased by 9.2 percent over the FY2015 enacted budget, the President's budget has essentially held EM's cleanup funding flat. The Department and the President's budget should fully recognize EM's unique nuclear safety and security, min-safe, and regulatory requirements as well as its obligation to address the situations resulting across its sites from years of nuclear weapons work, and reflect this recognition in EM's budgets.

The Department can only have visibility for all its cleanup program requirements if each site submits a budget comprised of funding needed for the budget year, both "in target" and "over target " along with the consequences of not funding those requirements that are "over target."

The Review Committee was informed, during discussions with budget personnel at EM headquarters, that the budget guidance provided by headquarters to the sites generally gives each site a target budget, and asks the site to prioritize their requirements within that target budget. Additionally, headquarters then asks the sites to provide a variant of that requirements list if the budget were 10 percent higher, and another variant if the budget were 10 percent lower.

Interestingly, during the time frame of the Review Committee deliberations, the FY2015 Congressional omnibus appropriations resolution was released. It demonstrates that while the President's FY2015 budget for EM cleanup was approximately 3.6 percent lower than FY 2014 actual, the Congressional omnibus FY 2015 budget was approximately 4.3 percent higher than the President's FY2015 budget, and slightly more than the FY2014 enacted budget. This example illustrates the wisdom of the EM headquarters methodology of asking for a target budget, and then a plus 10 percent variant, and a minus 10 percent variant, given budget uncertainties. This approach enables the sites and the EM headquarters, program-wide, to build in consideration of options for such budget scenarios.

The Review Committee also notes that EM headquarters then operates with 16 different site budget prioritization lists, one for each cleanup site, not one integrated list. However, as is obvious, EM headquarters uses these 16 lists to create one budget request to encompass all its sites.

The Review Committee, as stated above, interviewed several experienced contractor executives. The contractors indicated that project priority is driven by three factors: (1) technical; (2) regulatory; and (3) "others" to include political, stability and preservation of skilled work force, consistency of support to a particular site, "social justice," etc. Reinforcing this view, an EM headquarters official said that if a strict

risk-based budget were to be developed, the requirements at some sites might fall very low on any risk-based list. This is despite the fact that the Department of Energy, over the years of weapons and national security programs, performed activities at each that resulted in some level of degradation of the environment, and nuclear safety risks. The approach used by EM headquarters provides that there will be continued risk reduction, within available budget, at all such sites, which might otherwise be placed at a low priority. In other words, every site will receive a degree of funding for its EM mission, even if that funding is less than management at that site believes it needs and can effectively spend on an annual basis. During budget formulation process, expected carryover into the budget year is important. If a site cannot expect to spend its funds, its request for the budget will be considered for reduction, in light of its spend rate.

The Committee has also learned, during the course of meetings with DOE and EPA officials, that the original intent of Executive Order (EO) 12088, and the OMB A-106 report, has been compromised in the years since the order and report were first put into place. EO 12088, entitled *Federal Compliance with Pollution Control Standards*, was issued on Oct. 13, 1978 by President Jimmy Carter, and appears at 43 FR 47707, 3 CFR, 1978 Comp., p. 243. The EO, as originally issued, had a number of significant requirements to insure that each agency, such as the DOE, coordinated their planning and budget process with the Environmental Protection Agency (EPA). Pertinent to this discussion, certain parts of Sections 1-4 and 1-5 are excerpted here:

> 1-401. Each Executive agency shall submit to the Director of the Office of Management and Budget, through the Administrator [EPA Administrator], an annual plan for the control of environmental pollution. The plan shall provide for any necessary improvement in the design, construction, management, operation, and maintenance of Federal facilities and activities, and shall include annual cost estimates. The Administrator shall establish guidelines for developing such plans.
>
> 1-402. In preparing its plan, each Executive agency shall ensure that the plan provides for compliance with all applicable pollution control standards.
>
> 1-403. The plan shall be submitted in accordance with any other instructions that the Director of the Office of Management and Budget may issue.
>
> 1-5. *Funding.*
>
> 1-501. The head of each Executive agency shall ensure that sufficient funds for compliance with applicable pollution control standards are requested in the agency budget.

While EM maintains that it budgets to meet all regulatory milestones, the requirement in Section 1-401 above, which required each agency to submit their plan to OMB through the EPA Administrator is no longer in effect.

Executive Order (EO) 13148 entitled *Greening the Government Through Leadership in Environmental Management* was issued by President Bill Clinton on April 21, 2000. Pertinent to the discussion in this section of the Review Committee report, it is noted that EO 13148, Section. 901. *Revocation,* revoked, among other provisions in three other Executive Orders, Section 1–4. ‘‘Pollution Control Plan’’ of Executive Order 12088 of October 13, 1978. Specifically, the provision whereby each agency would submit its plan (and thus budget) through the EPA Administrator to OMB, was removed.

This is particularly interesting, in that the OMB implementation of Section 1-4 of EO 12088, called OMB circular A-106, had required reporting of the agencies’ plans. In January 1996, prior to the revocation of Section 1-4 of EO 12088, it was announced in the Federal Register that:

> OMB intends to rescind Circular No. A-106, ``Reporting Requirements in Connection With the Prevention, Control, and Abatement of Environmental Pollution at Existing Federal Facilities.'' The circular provides reporting procedures for Federal agencies to prepare and submit semi-annual plans to OMB for the control of environmental pollution at Federal facilities. The plans, prepared under Environmental Protection Agency (EPA) guidelines, identify environmental pollution improvements and associated costs for Federally owned or leased facilities. Circular A-106 is being proposed for rescission because its requirements are duplicative and inconsistent with the reporting requirements of Executive Order ***12088, ``Federal Compliance With Pollution Control Standards,'' which will remain in effect*** after the Circular is rescinded. Terminating the circular was recommended in the Vice President's National Performance Review to eliminate duplicative reporting requirements and to allow agencies to report under Executive Order 12088 using their own in-house data systems or an inter-agency system provided by EPA.

As can be seen in this sequence of events, when OMB Circular A-106 was rescinded as part of the Clinton Administration’s “Reinventing Government” initiative, the intent was to keep EO 12088 “in effect.” This can be seen in the sections bolded and italicized immediately above. However, a few years later, the same administration revoked the operative section of EO 12088 that required the reporting and coordination through the EPA Administrator.

At this point in time, the EPA, although a significant participant in the risk prioritization efforts at DOE sites, does not have an opportunity to review the President’s Budget during its formulation stages, based on the above changes to executive orders. Thus DOE’s perspectives on relative risk, and the risk-informed priorities that drive the DOE-EM budget, are not visible to the EPA prior to the budget being finalized. The EPA, as a sister federal agency with technical competence and shared safety and health responsibilities with DOE, could be of significant value in the process of describing the integrated, risk-informed priority that drives the President’s Budget.

During June 2015, after a prior draft of this report was sent to all entities interviewed by the Committee, information was presented at a forum, attended by DOE government and contractor personnel, and the

trade press. The substance of the information was that while EM typically has a budget of about $5.8 billion per year, $8 billion per year would be required to maintain progress to meet both current year and future year regulatory milestones. This information leads to several pertinent considerations:

- In order to meet near term milestones, is it possible that activities to address higher risks are deferred to the outyears?
- Is it likely that as each year approaches, there will be a perpetual process of re-negotiating milestones which will be missed, and is it possible that those projected missed milestones are known far in advance?

It is known to the Review Committee that a multi-year budget constrained projection was provided to the various EM cleanup sites nearly ten years ago, following a "re-baseline" of all future work that would be required to address the milestones in effect at that time. The intent then, was that the milestones, both near term and outyear, be renegotiated with the appropriate regulators so that there would be a reconciliation, of sorts, to align projected budgets with milestones. It was recently (June 2015) made known to the Review Committee that this second step, that of reconciling the projected budgets, with cleanup activities and milestones, was not completed. The Review Committee believes that the intent of the re-baselining activities of nearly ten years ago was a valid one that would have resulted in more realistic expectations by the communities surrounding the DOE cleanup sites, as well as a valid position to renegotiate the outyear milestones in good faith with the regulators.

The Review Committee believes that EM should utilize current cost and time-phased projections of cleanup work, based upon a realistic near and outyear budget projection, align that work with regulatory milestones, and renegotiate milestones as applicable with the regulators. If such budget-constrained cleanup schedules at that level of detail are not available to EM, then an independent development of such a timeline should be accomplished. By doing this, the various regulators, as well as the EPA HQ, will be able to see realistic projections of milestone accomplishment, and also be able to evaluate whether a re-prioritization of activities need to be considered in the risk-informed environment.

3.3.1.3 Risk-Informed Prioritization - Findings and Recommendations

General Finding

- The Review Committee **finds** concern for human health and safety play a significant role in prioritization and budgeting at the sites the Review Committee visited; however, as a practical matter, a host of other factors also come into play that often prevent or undermine the most cost-effective targeting of available resources on the most important risks. These factors can include: consent decrees (which give priority to activities where DOE has missed milestones, even if those activities would not otherwise be given priority); regulatory requirements (that may not directly correlate with significant risk to human health and safety); often opaque remedial decision-making procedures, including "shortcut" methods that do not follow NCP procedures: stakeholder inputs; work force stability considerations; and DOE's commitment to

assure some measure of support to all its remediation sites. The process of weighing risk and non-risk factors may vary from site to site and the extent to which allocation of resources is risk driven and the relative weight that is given to other factors at individual DOE sites −and nationally− is unclear.

- The Committee further **finds** that the Department, in cooperation with its regulators and overseers, has developed a process that provides strong nuclear safety protection though there are initiatives on-going in safety enhancement, including safety culture, which remain a 'work in progress'; by contrast those cleanup processes and practices which are governed by environmental laws, and designed to achieve cost-effective protection of human health and the environment, have not been consistently implemented at sites according to specified procedural steps and have not obtained the level of nation-wide consistency and cost-effectiveness expected. Nevertheless, the Review Committee is of the view that given the various factors that contribute to the prioritization process, EM is, at both the sites and nationally, endeavoring to place the safety of the workers, the public and the environment first and endeavoring appropriately to consider other relevant factors.

DOE Findings

- Some sites receive far larger budgets than others, and this disparity in resource allocation tends to persist from year to year. Hanford, for example, garnered approximately 40% of the total EM remediation budget request for FY 2016, whereas budgets for two of DOE's other largest sites, SRS and OR represented 21% and 6% of the total, respectively. Budgeting scenarios used by sites are based on the prior year's budget, which at least in the past, has more or less assured sites of level budgets from year-to-year. In recent years, however, as EM's share of the total DOE budget has diminished (while budgets for other DOE programs have increased, some significantly). EM HQ has had difficult decisions to make about how to balance past commitments to states, Tribal Nations, and communities, embodied in FFAs, against constrained budget realities and other factors. HQ has cut or limited the cleanup budgets at some sites while increasing them at others.
- DOE EM does not have a transparent approach for integration of individual site priorities into an integrated EM risk-informed priority list and how the resulting list then informs budget allocations. The Committee recognizes that several factors drive the HQ budget allocations. It is not evident to the Review Committee: (1) exactly what criteria and what process DOE EM HQ uses to integrate the various site priority lists into the overall EM priority list and how the results are used to inform the budget; (2) the extent to which human health and safety considerations have been factored into HQ's decisions to make uneven budget cuts among sites; and (3) that HQ current budget allocations among DOE sites are aligned with the relative risks at one site versus another.
- The Review Committee is concerned with information it received on the state of EM's critical infrastructure at the sites it visited. It was informed of several instances of significant risk posed

by failures of water mains, and hazardous compressed-air actuated breakers at electrical stations. The Review Committee also observed deteriorating conditions of visible infrastructure components. Sites and EM headquarters have recently recognized the significance of this issue, and are taking steps to provide visibility. Of note, the Savannah River Site has developed a Critical Infrastructure Integrated Priority List (CIIPL) which they then use as they develop the overall priorities and budget input to EM headquarters. The Committee considers this to be a logical, transparent and auditable approach, but there may be even better ideas to deal with this issue.

- Risk-informed prioritization and allocation of increasingly scarce EM resources is being skewed by substantial regulatory inconsistencies among the sites with respect to cleanup decision-making, as well as inconsistent measures for enforcement of FFA milestones.
- It is possible, in the absence of a resource constrained schedule of cleanup activities linked to milestones, that out year regulatory milestones will be missed, and further, that in an effort to meet near term milestones, there may be an inversion wherein issues of higher risk will be further extended in order to meet near term milestones.
- Prioritization and budgeting at the site level was described to the Review Committee as a collaborative process, in which the predominant role is played by the sites, with general guidance and meetings between the sites and HQ and oversight with regard to following required steps and coordinating the process by Headquarters.
- Current HQ guidance to sites, which provides seven categories of activity (e.g., min-safe, tanks, HLW, other radioactive waste, on-site groundwater and soil, off-site groundwater, D&D and other priorities enumerated in HQ guidance to sites that are intended to guide site priority-setting and budgeting are too general to act as sufficient direction to sites (See Appendix C for more). Further detailed guidance from HQ, for use by the sites with respect to cleanup activities, is needed to ensure that human health and environmental risks play the major role in prioritization and resource allocation for cleanup activities, including through performance of risk evaluations, risk review results and other key information.

Recommendations for DOE

- DOE HQ, with advice from the Task Force described above, should provide more detailed guidance to DOE sites to inform site priority-setting and budgeting. DOE HQ should work with the sites to ensure that HQ guidance is implemented consistently at all sites and that prioritization and budgeting are fully risk-informed. DOE EM and EPA headquarters need to play a more active role in the process in order to provide a national perspective and better match resources to risks.
- DOE HQ should compare priorities across sites on the basis of risk and use this risk comparison as the primary basis for risk-informed cleanup resource allocation in an integrated national EM budget. HQ should further develop clear criteria for, and document its decisions regarding,

integration of site criteria into a unified national EM remediation risk-informed priority list. The ultimate objective should be to assure best use of limited budgets.

- DOE: Prioritization and budgeting at the site and HQ level should be informed by risk reviews conducted at all major DOE sites. The Committee recommends, consistent with the Secretary's approach in his December 1, 2014 Memorandum on Improving the Department's Management of Projects, that these reviews be performed by a well-qualified, non-conflicted entity that is independent of the cleanup contractors performing work at that, and other sites.
- EM should utilize current cost and time-phased projections of cleanup work, based upon a realistic near and out year budget projection, align that work with regulatory milestones, and renegotiate milestones as applicable with the regulators. If such budget-constrained cleanup schedules at that level of detail are not available to EM, then an independent development of such a timeline should be accomplished across the complex. By doing this, the various regulators, as well as the EPA HQ, will be able to see realistic projections of milestone accomplishment, and also be able to evaluate whether a re-prioritization of activities should be considered in the resource-constrained and risk-informed environment.
- DOE HQ should create a separate budget category for maintenance and renewal of infrastructure, and should implement a consistent infrastructure prioritization process complex-wide, such as is done at the Savannah River Site using their Critical Infrastructure Integrated Priority List (CIIPL) process. EM should provide guidance on how to integrate such CIIPL requirements into each site's annual budget scenario input to EM headquarters.

3.3.2 DOE SITE FLEXIBILITY TO ADDRESS EMERGING RISKS

3.3.2.1 Context

The DOE budgeting process is outlined in DOE Order 130.1, *Budget Formulation* and Order 135.1, *Budget Execution*. The basic information in these DOE Orders is supplemented by direction from program offices (e.g., DOE-EM) and the Office of the Chief Financial Officer (CFO) as the budget development and review process progresses. These directives require that budget formulation begin where DOE's mission is executed, in the field. The field budget process "is the first phase of the Department's annual budget formulation process…" (DOE Order 130.1, Section 4.a). Due to the off-set between the beginning of the government's fiscal year (FY) in October, and the beginning of congressional sessions in January, the Department will often have, at various stages of development, three budgets in process. The budget guiding current operations and expenditures is the execution year budget, this is the budget that the Department is authorized to execute (in accordance with the requirements of DOE Order 135. 1 and guidance available from DOE Manual 135.1-1, *DOE Budget Execution—Funds Distribution and Control Manual*)— from October 1st to September 30th each year, in this year's case FY2015.

The planning for FY2015 would have commenced back in the Spring of 2013, approximately 18 months prior to the time period covered by the budget; this planning would have culminated in the presentation of the President's Budget to Congress, which occurs after Congress comes into session, and is timed to

align (approximately) with the President's State of the Union address to Congress. Depending on the schedule of the President and Congress, this date is somewhat fluid, occurring between late January and early March. However, the authorization (approval) and appropriations (funding allocation) processes in Congress involve testimony, give-and-take between Congress, the Departments and OMB, and can take an extended time period. Thus, the planning process for a new budget will have started while the details of the President's 2016 Budget are being finalized. Therefore, by about April of this fiscal year, DOE will have *three* budgets the Department is dealing with: (1) executing the present FY budget, along with making any funding adjustments that emerging circumstances warrant; (2) negotiating the details of the next year's budget (FY2016), involving OMB, Congress and the DOE; (3) starting the planning process for the out-year, or planning year budget, in this case, FY2017.

At the site level, there are effectively two sets of boundaries on appropriated funds during the year of execution. One is structured by the PBSs (Program Baseline Summaries) and the other by control points. Program Baseline Summaries are essentially compilations of similar work at a particular site. For example, all tank farm operations at a site would be in one PBS; all soil and groundwater in another PBS. A very large PBS is the project to design and construct the Waste Treatment and Immobilization Plant, commonly called the WTP project, at the Hanford Site, under the purview of the Office of River Protection (ORP). The Committee understands that over the course of time, this one PBS has been broken into several control points. The Committee has been told that these control points were added to help ensure that funds are spent for the purposes for which they are budgeted and appropriated.

Generally, the control points are aligned with the PBSs, and that it is not uncommon for each PBS at a site to contain multiple control points. Some of these control points are derived from the Congressional Budget documents themselves. The Committee has been informed by DOE HQ and the sites that additional control points may be added by the Office of Management and Budget.

While the Committee understands the purpose of control points, it also recognizes that this regime affects the site's ability to be agile as issues emerge, whether from new requirements or cost overruns in a PBS. Given the long period of time required to formulate and approve the budget, and that a continuing resolution can extend the budget priorities even further, DOE site managers called for more flexibility.

Congress allows DOE to transfer appropriated funds between congressional control points up to $5 million or 10 percent, whichever is less, for human health and safety, or project-completion reasons, without first notifying and obtaining approval from Congress (referred to as an "internal reprogramming").

Furthermore, the Review Committee learned from discussions with DOE and from Review Committee members' own experience, that other federal departments, such as the DOD have much greater flexibility in the use of their resources.

If a regulatory conflict arises, there is no additional budget authority to address it during the year of execution, so the site management must work with the regulators and the stakeholders to propose a

shift of funds from one cleanup task to another. Or, if a significant nuclear safety issue should arise, such as at the WESF facility at the Hanford Site, wherein there is a compelling need to add such a requirement during the year of execution (rather than budget for action two years hence), the site and EM headquarters must deal with the constraints on shifting funds to address the issue. In each such instance, the sites, and the headquarters, must go through a "reprogramming" exercise to shift funds from one control point (account) to the one with the emerging/emerged requirement. The Review Committee was given examples that enumerated the number, and granularity, of these control points at the sites it visited. The Review Committee believes that the rigidity resulting from this practice has had the effect, and the potential in the future, to inhibit the timely addressing of emerging risks, prevention of events that would increase risk, and adjustment of priorities at a specific site. The Review Committee believes that the Site Managers, who are responsible and accountable for the safety and operations at a complex nuclear site, need the flexibility and responsiveness to deal with such issues at their site, and thus they should be held accountable for such decisions, rather than the rigidity currently provided in the application of control points.

All the sites where the Review Committee had discussions with EM managers, have suggested fewer control points, so that they can be more agile in addressing changing or emerging needs during the year of execution. For example, one site proposed one control point for all soil and ground water remediation activities; one for all nuclear materials facilities; one for each line item capital project (or groupings of projects), one for all other "min-safe" requirements, etc.

The Review Committee sees this suggestion as helpful to the sites in addressing emerging risks, even if EM headquarters approval would be necessary for the site manager to shift funds. The present regime of having to attain OMB approval to shift from one control point to another, and then (if Congressional control points are applicable to the situation) Congressional committee approval, appears to be a cumbersome process which may not be responsive to address emerging risks. The Review Committee reiterates that an attempt was made to discuss this issue with the relevant OMB representative. He declined the invitation to meet with the Committee.

3.3.2.2 Site Flexibility Finding and Recommendation

Finding

- Control points are required by the Congressional Budget and in some cases, by the Executive Branch's Office of Management and Budget. To address needs that require the shift of funds from one control point to another, there is a process that requires a formal request from the Department of Energy to the Office of Management and Budget, and then (if required), to the Congressional Appropriations Committees, to "reprogram" funds.

Recommendation for Congress

- Congress along with DOE HQ should provide a mechanism that will permit site managers with more flexibility in moving funds within and among PBSs' and control points in order to address

emerging issues. This will permit the Site Managers, who are charged with, and accountable for, operations and safety at complex nuclear sites, to be responsive to emerging situations that could impose significant risk, as well as the flexibility to address risk reduction as may be required. The Committee is not recommending the elimination of control points, it is recommending that Congress review the process that constrains the reallocation of funds insofar as they may impact site management ability to respond to an emerging threat.

4. COMMITTEE RECOMMENDATIONS

The following is a compilation of recommendations by the Review Committee from throughout this report.

4.1 NUCLEAR SAFETY AND HUMAN HEALTH

- DOE-EM should review its technical capacity to address technical issues, and propose innovative ways to ensure that important technical and safety issues are tracked through to resolution and to retain key technical experts to advise senior decision makers. A strong engineering capability should be built into the DOE-EM organization, taking into consideration the role of the applicable DOE national laboratories, along with appropriate roles for site deployed and centralized technical staffs.
- DOE-EM should move ahead in a timely manner to evaluate the benefits that could be derived from implementing PRA and risk-informed decision-making for its high-hazard non-reactor nuclear facilities; this should include near-term identification of high-leverage pilot PRA studies, funding for such studies, and planning to incorporate the results of these pilots into a DOE-EM risk-informed decision-making process.
- DOE should develop and issue reliability, maintainability, and availability analysis expectations—taking advantage of available industry standard practices—and implement an engineering analysis of aging critical facilities and infrastructure at major EM sites (Hanford and Savannah River on a priority basis) to identify urgently needed repair and maintenance needs for systems, components and infrastructure that are vitally necessary to support safety systems and emergency management.
- EM-1 should personally conduct and lead periodic performance reviews of major EM projects and operations, to include safety, cost and schedule performance, quality, and risk management, among other elements of the applicable project.
- The Board should consider holding a series of public hearings to investigate potential worker safety impacts and concerns arising from implementation of remediation and environmental regulatory requirements.
- The DNFSB and DOE should collaborate to develop an efficient process that reduces the time it takes to resolve a safety issue identified by the Board, from its initial identification to DOE-EM through letters, subsequent elevation to a formal DNFSB Recommendation, DOE response and development of an effective implementation plan and DOE follow-through to expeditiously carry out all steps in the plan.

- The DNFSB should state in its letters to DOE whether a particular recommendation refers to an adequate protection issue, in which case cost should not be a consideration, or is a safety enhancement, in which case cost and other considerations should be part of the decision-making process.

4.2 INCONSISTENCIES IN CLEANUP REQUIRMENTS AND POLICIES AMONG SITES

Legislative and Regulatory Regimes

- **Congress should establish a standing Interagency Task Force, comprised of senior officials of DOE, EPA, DNFSB, and independent experts, and co-chaired by DOE and EPA**. The mission of the Task Force would be to advise and assist DOE in taking actions, with EPA cooperation, to promote consistency and risk-informed decision-making and results, both within DOE sites and across the DOE complex, with respect to site cleanup priority-setting, resource allocation, integration of regulatory authorities and standards, regulatory compliance, cleanup technology and approaches, dispute resolution and other activities that impact the cost-effectiveness of, and risk-informed decisional basis for, cleanup decisions at individual sites and across the DOE complex. The Task Force should be appropriately staffed, supported by technical staff and have a budget line. It should prepare an annual report for Congress, the Secretary of the DOE and Administrator of the EPA.
- Congress should extend the Section 3116 process for HLW to DOE's Hanford and West Valley sites, in order to more efficiently enable low-level fractions of tank waste at Hanford to be managed as LLW and to enable empty HLW tanks at the West Valley site to be closed.
- Congress should authorize DOE to reclassify, on a sound scientific basis, defense HLW, based on their degree of hazard and intrinsic characteristics, instead of based on their origins as is presently the case.

Implementation of National Contingency Plan

- DOE: The NCP remedy selection process should be reinstated at all DOE sites, as soon as possible, including remedy selection considering, rigorously and in depth, all nine CERCLA remedy selection criteria and designated land uses. Final RI/FSs, Proposed Plans and final RODs should be completed before cleanup takes place. Interim actions at DOE sites should be limited, going forward, to short-term risk reduction interventions in compliance with the NCP with clear guidelines to be established by the Interagency Task Force.

Determination of Applicable or Relevant and Appropriate Requirements (ARARs)

- The Interagency Task Force should direct DOE and EPA to work together to ensure that potentially "high-cost" state ARAR decisions are made on the basis of a rigorous analysis of the grounds for the decision and through a transparent, well-documented process (e.g., when the

cost exceeds $75 million, consistent with NRRB review threshold). The Review Committee recommends requiring preparation by EPA of a detailed, written analysis of state ARAR applicability or relevance and appropriateness, begun early in the remedial process, for any potential state ARAR that is a potential major remedial cost driver at a DOE site. The analysis should assess the grounds on which applicability of the State ARAR is asserted by the state and provide a detailed analysis of whether and how statutory preconditions for applicability or relevance and appropriateness of the State ARAR have been met and assess whether there may be any potential grounds for a waiver. The Review Committee also recommends that all such analyses should be required to be reviewed and approved by DOE and EPA headquarters-level officials and made publicly available prior to use of a high-cost state ARAR in the remedy development process.

Land Use Determinations

- The Interagency Task Force should develop a consistent process and criteria for making—and, when necessary, revising-- land use determinations and devise ways to ensure that these land use determinations are used appropriately in risk assessments and other remedy selection steps at all sites in the DOE complex.
- DOE Headquarters and EPA Headquarters should work together to provide effective oversight and ensure that site cleanup levels and remedies at all DOE sites are selected to match DOE land use determinations that have been made in accordance with Congressional land use planning mandates to DOE and consistent with relevant EPA Headquarters CERCLA Land Use guidance.

Application of Cleanup Technologies/Approaches

- DOE should commission independent, site-specific risk reviews, for major DOE sites (i.e., those with cumulative expenditures of greater than $250 million) to help assure risk-informed prioritization and resource allocation within and across the complex. The reviews should be performed by a well-qualified, non-conflicted entity that is independent of the cleanup contractors performing work at that, or other DOE sites.
- The Interagency Task Force should develop guidance to ensure consistency in implementation of appropriate legislative authority, national regulations, and policies at DOE sites when selecting cleanup technologies and approaches addressing similar categories of site activity.

Dispute Resolution Method

- Congress should establish an alternative dispute resolution process to which parties to an FFA or FFA consent decree would be required to resort if exhaustion of FFA dispute resolution procedures does not result in a satisfactory resolution of the matter under dispute. This process would involve resolution of disputes by an expert national panel whose decision would be binding, subject to opportunity for judicial review of its decision in the Court of Appeals for the

D.C. Circuit. It would be in lieu of a consent decree or resort to litigation in a local federal court and would result in a binding decision applicable to all the parties to the FFA.

National Remedy Review Board

- The Interagency Task Force should (1) evaluate the feasibility of creating an EPA RCRA team analogous to the National Remedy Review Board (NRRB) (with the provision of adequate resources) to expeditiously review all high cost RCRA corrective action remedies at DOE sites and (2) develop an effective procedure for assuring appropriate DOE input to NRRB and RCRA team deliberations and ensuring action by EPA, DOE, and applicable state officials in response to NRRB and RCRA team recommendations.

4.3 RISK INFORMED PRIORITIZATION AND RESOURCE ALLOCATION

- DOE HQ, with advice from the Task Force should provide more detailed guidance to DOE sites to inform site priority-setting and budgeting. DOE HQ should work with the sites to ensure that HQ guidance is implemented consistently at all sites and that prioritization and budgeting are fully risk-informed. DOE EM and EPA headquarters need to play a more active role in the process in order to provide a national perspective and better match resources to risks.
- DOE HQ should compare/rank priorities across sites on the basis of risk and use this risk comparison/ranking as a primary basis for risk-informed cleanup resource allocation in an integrated national EM budget. HQ should further develop clear criteria for, and document its decisions regarding, integration of site criteria into a unified national EM remediation risk-informed priority list. The ultimate objective should be to assure best use of limited budgets.
- DOE: Prioritization and budgeting at the site and HQ level should be informed by risk reviews conducted at all major DOE sites. The Committee recommends, consistent with the Secretary's approach in his December 1, 2014 Memorandum on Improving the Department's Management of Projects, that these reviews be performed by a well-qualified, non-conflicted entity that is independent of the cleanup contractors performing work at that, and other sites.
- EM should utilize current cost and time-phased projections of cleanup work, based upon a realistic near and out year budget projection, align that work with regulatory milestones, and renegotiate milestones as applicable with the regulators. If such budget-constrained cleanup schedules at that level of detail are not available to EM, then an independent development of such a timeline should be accomplished across the complex. By doing this, the various regulators, as well as the EPA HQ, will be able to see realistic projections of milestone accomplishment, and also be able to evaluate whether a re-prioritization of activities should be considered in the resource-constrained and risk-informed environment.
- DOE HQ should create a separate budget category for maintenance and renewal of infrastructure, and should implement a consistent infrastructure prioritization process complex-

wide, such as is done at the Savannah River Site using their Critical Infrastructure Integrated Priority List (CIIPL) process. EM should provide guidance on how to integrate such CIIPL requirements into each site's annual budget scenario input to EM headquarters.

Site Flexibility Recommendation

- Congress along with DOE HQ should provide a mechanism that will permit site managers with more flexibility in moving funds within and among PBSs' and control points in order to address emerging issues. This will permit the Site Managers, who are charged with, and accountable for, operations and safety at complex nuclear sites, to be responsive to emerging situations that could impose significant risk, as well as the flexibility to address risk reduction as may be required. The Committee is not recommending the elimination of control points, it is recommending that Congress review the process that constrains the reallocation of funds insofar as they may impact site management ability to respond to an emerging threat.

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APPENDIX A: COMMITTEE STATEMENT OF TASK

A Review of the Use of Risk Evaluation and Risk-Informed Management in the Department of Energy, Office of Environmental Management's Cleanup Program for Former Defense Nuclear Sites

Congressional budget authorization language directed the DOE to "retain a respected outside group..[to] undertake an analysis of how effectively the Department of Energy identifies, programs, and executes its plans to address those risks [to public health and safety from the DOE's remaining environmental cleanup liabilities], as well as how effectively the Defense Nuclear Facilities Safety Board [DNFSB] identifies and elevates the nature and consequences of potential threats to public health at safety at the defense environmental cleanup sites."[113] Currently, the DOE-EM program manages cleanup at 17 sites in 11 states, including large and complex cleanup and decommissioning responsibilities at the Hanford (WA), Savannah River, (SC), Oak Ridge (TN), Idaho, Portsmouth (OH) and Paducah (KY) sites.

Much of DOE's cleanup is mandated by environmental laws and their associated regulations and guidance, most notably the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). The purpose of these laws is to reduce the risk of contaminated sites to levels that are protective of human health and the environment. Their implementation is overseen by the U.S. Environmental Protection Agency and state environmental agencies and guided by federal facility agreements and permits with these agencies and with public involvement. In 1992, recognizing the magnitude of contamination at federal facilities and the significant costs of cleanup, the Federal Facilities Environmental Restoration Dialogue Committee was federally chartered under the U.S. Environmental Protection Agency to address setting of priorities regarding where and how to spend available funds. The goal of the Committee was to develop consensus policy recommendations aimed at improving the process by which federal facility environmental cleanup decisions are made. The Final Report (April 1996) set forth the Committee's consensus recommendations which DOE generally attempts to follow.

In addition, DOE-EM is guided by Risk Principles that were developed by the Office of Management and Budget and Office of Science and Technology Policy[114] and recommendations from several studies carried out by the National Research Council of The National Academies, and must comply with DOE nuclear safety policies and an array of state and federal regulatory requirements. DOE's cleanup effort also receives nuclear safety oversight from the DNFSB on nuclear safety and consults with the Nuclear Regulatory Commission and the Nuclear Waste Technical Review Board in several relevant areas. The

[113] Consolidated Appropriations Act, 2014, Public Law 113-76

[114] OMB/OSTP Memorandum: M-07-24, Updated Principles for Risk Analyses (September 19, 2007 available at http://www.whitehouse.gov/omb/memeorandum/fy2007/m07-24.pdf).

overarching goal of all of these regulations, requirements and guidance is the protection of worker and public health and safety and the environment, although approaches to the underlying consideration of risk varies considerably. Additional factors that must be considered as part of risk management and the EM cleanup program implementation decisions include efficiency in risk reduction (i.e., appropriate work sequencing, cost-benefit), the available capacity to achieve program objectives (i.e., workforce availability, technological limitations, disposition pathways), financial constraints and input from local, state and national stakeholders, as well as tribal nations that have treaty-based claims against the DOE.

The proposed study would be for The Consortium for Risk Evaluation with Stakeholder Participation to organize an independent review of the use of risk and risk-informed management as directed by Congressional language indicated above and with the following specific objectives: (i) identify and review how specific federal policies and guidance shape DOE-EM's evaluation and use of risks to human health and safety as part of program decisions; (ii) review how the DNFSB identifies and elevates threats to public health and safety, and how DOE considers DNFSB concerns as part of program decisions; (iii) how risks to public health and safety are considered as part of state and federal regulatory compliance and priorities at DOE-EM cleanup sites; (iv) how DOE-EM uses human health risk and public safety input and information from a broader range of sources as part of program decisions; and (v) how DOE-EM uses the range of human health risk and safety information available along with the broader range of input and constraints to balance cleanup priorities within and between cleanup sites.

The review committee would be comprised of nationally distinguished individuals with diverse experience in risk evaluation, public health and safety, nuclear safety, risk management, and public policy. The review would be carried out through review of documents and interviews and meetings with current and former managers and senior staff at DOE-EM, DOE-EM sites, state regulators, EPA, DNFSB members, and other individuals as the committee finds appropriate. A final report, reviewed for factual accuracy by DOE and the DNFSB, is to be completed within 12 months of the date of enactment of the fiscal year 2014 omnibus budget bill, January 16, 2015.

APPENDIX B. SHORT BIOGRAPHIES OF COMMITTEE MEMBERS

Michael Greenberg, PhD; *Review Committee Chair*

Dr. Greenberg studies environmental health. He is professor and faculty dean of the Edward J. Bloustein School of Planning and Public Policy. His recent books include *The Environmental Impact Statement After Two Generations* (2012), *Nuclear Waste Management, Nuclear Power, and Energy Choices* (2013), and *Protecting Seniors Against Environmental Disasters: From Hazards and Vulnerability to Prevention and Resilience* (2014). Professor Greenberg has been a member of National Research Council Committees that focus on the destruction of the U.S. chemical weapons stockpile, chemical waste management; the degradation of the U.S. government physical infrastructure, and sustainability in the U.S. EPA. He serves as associate editor for environmental health for the American Journal of Public Health, and was editor-in-chief of Risk Analysis: An International Journal.

George Apostolakis, PhD

Dr. Apostolakis is a professor emeritus of the Nuclear Science and Engineering Department of the Massachusetts Institute of Technology. He served as a Commissioner of the U.S. Nuclear Regulatory Commission (NRC) from April 23, 2010 until June 30, 2014. From 1995 until 2010, he was a member and former Chairman (2001-2002) of the statutory Advisory Committee on Reactor Safeguards of the NRC.

He is a member of the National Academy of Engineering and a Fellow of the American Nuclear Society and the Society for Risk Analysis. He has received the Tommy Thompson Award and the Arthur Holly Compton Award from the American Nuclear Society. His interests include methods for probabilistic risk assessment of nuclear power plants and nuclear waste repositories; uncertainty analysis; nuclear reactor safety; risk-informed and performance-based regulation; and risk management involving multiple stakeholders.

Dr. Apostolakis holds a Ph.D. in Engineering Science and Applied Mathematics (awarded in 1973) and a Master of Science degree in Engineering Science (1970) from the California Institute of Technology. He earned his undergraduate degree in Electrical Engineering from the National Technical University in Athens, Greece, in 1969.

Timothy Fields, Jr.

Tim Fields has 40 years of experience addressing complex environmental site assessment, cleanup, waste management, redevelopment, and environmental justice issues, including 30 years at the U.S. Environmental Protection Agency (EPA). While at EPA, he served for four years as Assistant Administrator for the Office of Solid Waste and Emergency Response (OSWER), where he directed a program with an annual budget in excess of $2 billion. He has chaired multiple EPA advisory panels, including the Federal Facilities Environmental Restoration Dialogue Committee (FFERDC), where he directed the development of consensus policy recommendations targeted at improving the Federal

facilities environmental restoration decision-making process. This resulted in significant changes in procedures for risk-based priority-setting and stakeholder involvement during Federal facilities cleanup. He is experienced in developing and implementing Federal facilities and Superfund reform measures, and in mediating complex environmental disputes. Tim has received four Presidential Rank Awards for Meritorious and Distinguished Executive Service. He graduated from Virginia Tech with a B.S. degree in Industrial Engineering, and from George Washington University with an M.S. degree in Operations Research. Mr. Fields serves as a Senior Vice President heading MDB's Environmental Management practice. He is an expert mediator/facilitator, and serves as an expert witness on environmental cleanup and waste management matters.

Bernard Goldstein, MD

Dr. Goldstein is currently Professor of Environmental and Occupational Health, Graduate School of Public Health, University of Pittsburgh. An environmental toxicologist, his research interests have focused largely on the concept of biological markers in the field of risk assessment. Dr. Goldstein is interested in risk assessment and environmental public policy issues, particularly the interface between science and regulation, and the role of the precautionary principle. Dr. Goldstein is also active in international environmental health.

Dr. Goldstein was professor and chairman of the department of environmental and community medicine at the University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School, where he established and directed the largest academic environmental and occupational health program in the United States -- the Environmental and Occupational Health Sciences Institute. He also has served as an officer with the U.S. Public Health Service and as Assistant Administrator for Research and Development at the U.S. Environmental Protection Agency.

Dr. Goldstein received his medical degree from New York University and undergraduate degree from the University of Wisconsin.

Stephen L. Krahn, PhD

Dr. Krahn is Professor of the Practice of Nuclear Environmental Engineering in the Department of Civil and Environmental Engineering at Vanderbilt University. Prior to coming to Vanderbilt in 2010, he served in U. S. Department of Energy as the Deputy Assistant Secretary for Safety & Security in the Office of Environmental Management. He is a member of the American Academy of Environmental Engineers & Scientists and is a Board Certified Environmental Engineer.

Dr. Krahn brings to Vanderbilt more than 35 years of technical and project management experience in positions of increasing responsibility in government, private industry and the military. His technical highlights have included: providing leadership to the nation-wide safety program of a $9 billion/year nuclear program at DOE; providing technical direction and leadership for a major DOE engineering program; managing a federal agency providing safety oversight to the nuclear weapons complex; directing a $25 million division in an engineering services company; leading the technical review of

numerous technical and systems issues at nuclear facilities; and providing senior engineering consulting services to the U. S. nuclear industry. His project management highlights include: management of the $140 million complex overhaul of a nuclear submarine; management of the $30 million nuclear work package for two submarines; producing the first-ever strategic plan for a federal agency; technical direction of the R&D program for a DOE program office; and the direction of the design and construction of two major safety upgrades at DOE nuclear facilities.

He has participated in/led technical reviews on nuclear chemical and waste processing technologies for the Department of Energy at Hanford, Savannah River, Oak Ridge, Los Alamos and Idaho sites. He was the approval authority for startup of DUF6 deconversion plants at Portsmouth, OH and Paducah, KY.

R. Bruce Matthews, PhD

Dr. Matthews has over forty years of scientific and engineering experience in nuclear technologies with a primary focus on nuclear materials, nuclear reactor fuels, nuclear facility operations, and nuclear safety. Matthews worked at national laboratories as a scientist, line manager, and project leader and has been involved in Department of Energy programs in stockpile stewardship, nuclear materials disposition, environmental management, and space and terrestrial nuclear power systems. While at Los Alamos National Laboratory, Matthews was the Director of the Nuclear Materials Technology Division with overall responsibility for the TA-55 Plutonium Facility and the Chemistry Metallurgy Research Building. Matthews is a Fellow of the American Nuclear Society, a former Member of the Defense Nuclear Facilities Safety Board, and former technical judge for the Atomic Safety Licensing Board. Matthews is currently an independent consultant focusing on nuclear materials and nuclear safety.

James A. Rispoli, P.E., BCEE

James Rispoli, a licensed professional engineer in multiple states and an American Academy of Environmental Engineers' Board Certified Environmental Engineer, is Professor of Practice at the Center for Nuclear Energy Facilities and Structures at North Carolina State University in Raleigh, NC. His focus at the Center is on performance management for nuclear projects and activities, and incorporates lessons-learned from projects and research performed globally. His AAEE Board Certification as an Environmental Engineer recognizes his focus is on nuclear radiation, protection and construction. Additionally, he serves as a senior executive advisor for PT&C, LLC, where he was previously president from 2010 through 2012.

Mr. Rispoli completed over three years of service as the Assistant Secretary of Energy for Environmental Management. He was unanimously confirmed by the United States Senate on July 29, 2005, and was appointed to that position by President George W. Bush on August 2, 2005. He was responsible for the cleanup of waste and environmental contamination from the nation's nuclear-related research and production activities.

During his tenure, he implemented new approaches to construction site safety and nuclear operational safety, resulting in the Environmental Management program's sites achieving the best safety performance in the Department.

Previously, as an executive with career status, he was Director of the Department of Energy's Office of Engineering and Construction Management. Mr. Rispoli completed over 26 years of service to the nation in the U.S. Navy, retiring as a Captain, Civil Engineer Corps. Subsequent to that service, he was Managing Principal for an ENR top tier engineering firm and regional President of another top tier engineering firm, leaving the private sector to join DOE's new Office of Engineering and Construction Management in 1999. He earned his Bachelor of Engineering degree in Civil Engineering from Manhattan College, a Master of Science degree in Civil Engineering from the University of New Hampshire, and a Master's degree in business from Central Michigan University.

A Fellow of the American Society of Civil Engineers, Jim recently served on their Board of Direction, is past Chair of its Industry Leaders Council, past Chair of its Construction Division, and has served in several local section officer positions. He is also a Fellow of the Society of American Military Engineers for which he held several officer positions at the local level, served as the national society's Vice President for Environmental Affairs, and as a member of the Board of Direction. Mr. Rispoli is an active member the National Academies of Sciences and Engineering's Board on Infrastructure and the Constructed Environment (BICE), serves as Chair of that institution's Federal Facilities Council, and has served on several study teams.

Jane B. Stewart, J.D.

Jane B. Stewart is an environmental lawyer with over 35 years of experience in the private and nonprofit sectors. She founded and directs the International Environmental Legal Assistance Program of New York University School of Law's Frank J. Guarini Center on Environmental and Land Use Law. Formerly a lawyer with Paul, Weiss, Rifkind, Wharton and Garrison and a senior staff attorney with the Natural Resources Defense Council, she has since 1996 provided environmental law and policy advice and consultation on a wide variety of issues to governments, international organizations, academic institutions, law firms and nongovernmental organizations. She is also one of the key personnel of the Consortium for Risk Evaluation with Stakeholder Participation, where her research focuses on the history and evolution of nuclear waste law and policy in the U.S. and options for the future, including lessons learned from the WIPP and Yucca Mountain repositories, options for interim storage of SNF and HLW, and options for managing GTCC nuclear wastes. Ms. Stewart is co-author, with her husband, NYU Professor Richard B. Stewart, of *Fuel Cycle to Nowhere*, published by Vanderbilt University Press in 2011. She received her A.B. from Brown University and her J.D. from NYU School of Law.

APPENDIX C: SUPPORTING EVIDENCE FROM INTERVIEWS

QUESTION SET 1: INTERVIEWS WITH DOE HEADQUARTERS

(Notes fact-checked by DOE Headquarters staff led by Matthew Duchesne).

1. How do specific federal policies and guidance shape DOE's evaluation and use of human health and safety risk-related information as part of environmental cleanup program decisions? How does DOE headquarters balance a broad set of objectives to set priorities?

Eight members of the Committee met with senior DOE managers and staff on September 11 and 12, 2014 (Apostolakis, Fields, Goldstein, Greenberg, Krahn, Matthews, Rispoli, and Stewart). Two staff were also present (Lowrie, Pannella). The Committee had submitted 12 questions to the DOE headquarters staff about environmental policies, and each of these had multiple questions. Four members of the Committee visited or called DOE HQ on October 17, 2014 in order to clarify their understanding of several issues.

During conversations with DOE staff, it became clear that these questions should be folded into four broad areas: (1) the policy process and the organizational structure that manages it for human health and safety and other issues; (2) the influence of interactions among DOE headquarters (HQ), DOE sites, the DNFSB, EPA, state officials, and other contributors on the decision-making process; (3) the allocation of increasingly scarce resources across a set of competing human health and safety, as well as other needs; and (4) the opportunity to incorporate changes that could improve DOE's management of human health and safety risks, as well as other program objectives.

1a. What are the specific federal policies and guidance that provide the basis for evaluation and use of human health and safety risk-related information as part of program decisions? What is the organizational structure that implements these policies and guidance? How does this structure provide checks and balances?

Through discussion and document review, it is clear that human health and safety are EM's highest priority (see text box for an illustration). DOE has evolved a complex set process of policies, guidelines and internal and external interactions aimed at protecting its employees and the public. It has regulations, requirements standards grounded in conservative safety analyses, requiring multiple backup systems to reduce the risk of failures that would create exposures. The standards present acceptable methods and techniques for meeting DOE requirements. Second, its staff must meet rigorous requirements to become and stay employed. Third, nuclear facilities are regularly assessed and monitored to determine vulnerabilities. The standards support guides, rules/orders/manuals, and DOE policy. The guides identify methods considered acceptable for implementing the requirements. The policies are higher order statements of principles and objectives.

1b. Which specific program decisions are impacted by these policies and guidance? How important are legal mandates (e.g., agreements signed with EPA, state EPAs, and others), community preferences, economic costs and benefits, historical precedent, and other issues in how human health and safety is prioritized by DOE? How does DOE EM prioritize these factors in decision-making? How does DOE make tradeoffs among worker, resident and ecological health in its decision-making processes?

Five types of policy decisions that directly involve human health and safety risk are as follows:

- CERCLA Records of Decision
- NEPA Records of Decision
- Radioactive Waste Disposal Authorization Statements
- Waste Determinations for certain wastes previously managed as high level waste, but for which actions have been taken to support disposition as non-high level waste
- DOE project management requirements for start of operations of a radioactive facility

DOE has evolved risk assessment processes that characterize risk, and senior staff characterize these processes as informing decisions, that is, their decisions are risk-informed but not entirely risk-based. DOE managers indicated that "numerous tiger teams" focus on assessing the risks and then determining risk management options to effectively reduce them.

The Committee heard from multiple DOE managers, as well as from their site counterparts (See section 4 below), that the biggest risk-related challenge is that the Department is being driven by different parties to make very difficult choices about priorities. Harmonization among DOE HQ, the DOE sites, DNFSB state, EPA, and other stakeholders across the sites is driven in different directions by:

- The signatories to the bilateral and trilateral cleanup agreements that govern the EM program
- DOE's multiple missions, including nonproliferation risks
- DNFSB's focus on human health and safety
- DOE's historic role as an economic engine of several major regions in the DOE complex

At the project level, the DOE can face one environmental health challenge when it tries to manage another. For example, the Savannah River Site had an old coal-fired power plant to deliver energy. In response to requirements to improve sustainability at DOE sites, the site replaced the coal-fired boilers with biomass burning ones. While from a sustainability perspective, this was a proper investment (this case was used in a recent National Academy of Sciences report to illustrate a step toward sustainability at a major government-owned site (National Research Council, Committee on Scientific Tools and Approaches for Sustainability, 2014), the change requires DOE to deal with ash basins and the attendant RCRA requirements sooner than they had anticipated.

Despite these challenges, DOE headquarters noted that they have worked closely and effectively with their sites, the DNFSB, the states and EPA to negotiate issues as they emerge. Headquarters managers used the case of Building 324 at the Hanford site, which has emerged as a much more complex project

than had been expected. The DOE has worked with the regulators and the DNFSB, as well as the contractors to develop a safe risk management solution. They expect to determine if the risk management solution works, and will keep their partners involved at every step. (See section 4 below for a longer discussion of Building 324).

Headquarters managers shared several other examples of DOE's focus on human health and safety. For example, transferring hazardous radioactive material from the tanks for further processing is considered a risk. DOE's position is if transfers can't be done safely, they shouldn't be done. Transfers need to be carefully planned, discussed and tested by those involved in the activity. Sometimes it takes longer than had been anticipated. The regulators would like DOE to move faster than it sometimes can. But DOE would rather have regulatory agencies impatient with progress than take an added risk. For example, DOE thought that the Hanford tank-waste evaporators were not ready to resume operation following extended outage, in part due to worker safety, and in discussion with the partners was able to halt the process until the issue was addressed.

A second example is the Hanford tank farm. DOE had been working with the DNFSB, the State of Washington, and EPA to determine the priority of focusing on the leak in the double shell tank vs. addressing leaking single shell tanks (see section 4 below). After several years an agreement was reached about the leaking double-shell tank in question (AY-102).The DOE's partners all played a role.

DOE management noted in the context of worker risks and the tanks that DOE is self-regulating for nuclear matters and for safety and health, and it is not obliged to follow OSHA-mandated regulations, but in general DOE does comply. In fact, DOE contractors are required to follow the Department's regulations for non-nuclear worker health and safety, which are published in 10 CFR 851. Also, DOE and DNFSB usually agree on issues, worker health and safety issues, although they may not always agree on the relative importance or scheduling aspects of addressing risks.

An important question is can environmental projects be ranked from the highest to the lowest risk across the complex or at least at each site. A clear consensus among DOE managers is that they have data that allows them to rank hazards but they do not believe that it is realistic to implement a policy that would allocate resources solely on the basis of human health and safety risks. They noted that that DOE has a moral commitment to reduce the risk across the sites, not just one or two. It is unrealistic, for example, to assign all the resources to Hanford or to Savannah River to manage the tanks wastes.

Another reason why a single list is unrealistic is that the sites and their communities are very different. For example, arguably cleaning up at Rocky Flats, located about ten miles from Denver may not have reduced human health and safety risk as much as closing another high level waste tank, but the closing of the Rocky Flats eliminated a risk of great concern in the Denver area and also eliminated the need for annual $100 million cost for security and site infrastructure. Closing a site sends an important message, potentially opens up parts of sites for redevelopment by local communities, as well as saving taxpayer dollars. The DOE does not want to start projects, fund them for many years, and then stop progress

when completion is near. Hence, it was a good decision to start and complete the Rocky Flats cleanup, as well as Fernald and others.

That being said, however, it was apparent that in the light of budget restrictions senior DOE officials want to base even more of their decisions on human health and safety risk considerations. One said: "DOE HQ is going to base decisions on relative risk considerations if there is not enough money to be fully compliant. For example, FY 2015 DOE will not be fully compliant with TPA's and will base funding decisions on risk." He added: "Comparing risks across the complex is very hard – pie in the sky. But comparing risk within individual sites is helpful." Several managers noted that given budget limitations it may not be possible to always use the most stringent clean-up approaches and provide economic and social support to local communities. Furthermore, DOE managers indicated that EM recognizes the significance of the cleanup program to local economies, but economic and social support of local communities is not one of its missions.

1c. How does headquarters balance between allocating resources at different EM sites? Specifically, how important are human health and safety, site closure, and the tri-party agreements in resource allocations to different EM sites and within each site to individual projects? For example, Hanford, Savannah River, Oak Ridge, and other site-specific projects that have large ongoing budget requirements to complete cleanups of underground tanks, stop the flow of contaminants into water bodies, encapsulate hazards in old and deteriorating buildings? How do you balance the risk to the outside public and workers?

Without doubt, more time was spent at both the two DOE headquarters and three site meetings (see section 4 below) on the relationship between funds and reducing human health and risk than on any other topic.

Current budget priorities reflect DOE EM's focus on human health and safety:

1. Maintain safety of workers and public
2. Address tank waste
3. Focus on nuclear materials
4. Remediate soil and groundwater (off-site impacts)
5. Treat and dispose of other radioactive waste
6. Remediate onsite groundwater
7. Address other priorities, D&D, etc.

The DOE has a formal budgeting process to try to match those priorities to resource allocations. As context, DOE HQ managers noted that they know how much they need to complete all the projects that they would like to complete (estimated as $8-$9 billion a year at this time). The problem is that while they work with their partners (states, EPA) to scope out the needs, the difference between what is needed and what they have to spend has notably increased. Given this gap, the DOE negotiates with its sites and then with OMB to reach a final allocation.

The DOE's perspective is that it is responsible for all the elements of its environmental management and others missions, whereas the DNFSB, the EPA and the states are not legally responsible for every element, which creates a dynamic tension for ongoing negotiations among the parties about which risk-related priorities are the most significant. Also, DOE cannot forget that OMB plays a critical role in bounding the budget process and in arguing for some allocations and against others.

DOE budget managers noted that the current EM budget reflects plans and requests that are 2 ½ years in the making. The budget process is as follows:

1. OMB sets a target for DOE, which allocates a portion to EM.
2. EM HQ sets preliminary targets for each site and issues guidance requiring sites to develop multiple scenarios (A = based on last year's amount, B = based on a slight increase, about 10%, C=Based on a slight decrease, about 10%).
3. Sites come in and brief EM HQ.
4. Preliminary recommendations are made at the EM level
5. Undersecretary is briefed and a budget request level is determined for presentation to the Secretary.
6. After the Secretary is briefed and makes final decisions on what EM will submit to OMB, EM prepares its budget request, identifying what workscope is within the Budget Target, and what regulatory activities covered by Executive Order 12088 are requested as Over-target (See section 4 for discussion of how Hanford and Savannah River set their budgets).

Executive Order 12088 (October 13, 1978) requires all federal agencies to request the full amount necessary to be compliant with all applicable pollution-control requirements. Because the enforceable milestones in EM regulatory agreements are the means by which DOE comes into compliance with applicable pollution control standards, Executive Order 12088 requires DOE to request the full amount of funding needed to comply with those milestones. The sites submit their budgets at a level of detail consistent with budget control points established by Congress and these are discussed with Headquarters, as well as the full funding level needed to meet compliance agreements per Executive Order 12088. HQ staff is involved in budget formulations by assessing the need for the technical scope and schedule reflected in the sites' budget request, with HQ managers responsible for specific cleanup programs (e.g., soil and groundwater cleanup) advocating for the sites as appropriate.

There was considerable discussion at the HQ meeting between the Committee and DOE management about the need to use resources as effectively as possible, including in several cases, to even more closely connect budgets to human health and safety risks. For example, one manager noted that liquid waste is the main human health and safety issue to be dealt with, and this is an expensive undertaking. If there is a defensible need, it can be accommodated, and this needs to be a major focus. Other managers returned to a discussion of the need to conduct remediation and risk reduction across the complex, not just at a few sites and programs at those sites. A senior staff member said "We struggle with how to prioritize work within a flat funding profile. We try to prevent rising costs in future years, but also needs to address current risks. It is hard to compare risks because each unit (and subparts of

units) have different hazards, receptors and pathways. In ARRA times, with more money, there was a 'bias for action' and a lot of work was done to remove waste without a great deal of risk analysis." At that time, DOE officials note that emphasis was on reducing risk and the site mortgage by focusing on "shovel ready" projects capable of creating jobs.

DOE managers indicated that in the past, there was more ability for regulators to allow flexibility, but with tighter budgets, there is now more pressure to meet the regulatory requirements. All nuclear hazardous facilities that pose a threshold hazard, i.e., Hazard Category 3, ensure DSA's (Documented Safety/Hazards Analyses) are prepared, and any controls identified to maintain safe operations are the highest priority (see section 4 for discussion of the Hanford and Savannah River budgets).

Headquarters recently reinstituted its Internal Remedy Review Board process, originally established in the early 2000s then stopped in the later 2000s. Its purpose is to review proposed remedy decisions to evaluate, among other factors, the costs of the remedies relative to their risk-reduction benefits. Criteria for selection of proposed remedies to review include cost, complexity and visibility. One DOE official indicated that the Internal Remedy Review Boards can be used as a good cop/bad cop process. Headquarters will not override a field manager, but provides an evaluation removed from the day-to-day pressures of the stakeholders and regulators. One manager described it as DOE "working at the margins of the budget to make the best assignments of resources."

DOE's ability to move funds across categories is a major issue at the two sites. Headquarters budget managers described flexibility as follows:

- Congress allows DOE to transfer appropriated funds between congressional control points up to $5 million or 10 percent, whichever is less, for human health and safety, or project-completion reasons, without first notifying and obtaining approval from Congress (referred to as an "internal reprogramming").
- Any transfer of funds greater than $5 million or 10% requires a "formal" reprogramming, including congressional approval before the transfer can be made.
- In a true national emergency, the Secretary of DOE is authorized to transfer funds within DOE's overall appropriation to address the emergency – but the Secretary must still formally notify Congress within a set period of time after making the transfer.

For Richland, there are three congressional control points:

- Richland Community and Regulatory Support
- River Corridor and other Cleanup Operations
- Central Plateau Remediation

For SRS, there are currently four congressional control points:

- Savannah River Risk Management and Operations
- Radioactive Liquid Tank Waste Stabilization and Disposition -2035

- Salt Waste Processing Facility (Line Item Project 05-D-405)
- Savannah River Community and Regulatory Support

In addition, Savannah River has 4 PBS's within the site's Risk Management Operations control point that are apportioned separately by OMB. DOE budget managers noted that SRS is an anomaly in the DOE complex. Most sites have broader control points than SRS, which has a full range of EM missions, some of which are heavily scrutinized by OMB.

In regard to OMB in this process, DOE managers expressed high regard for the OMB staffer who has been working with the DOE for many years. They noted that OMB is reluctant to provide resources that cannot be proven to truly be needed, for projects that might not be successful, and are outside the purview of the DOE's remediation mission. However, they added that it can be difficult for DOE to get OMB to release funds due to policy disagreements. For example, should the DOE pay for material to go through H-Canyon for non-proliferation goals, or should another part of the federal government pay for this?

The threat of law suits against the DOE is a manifestation, said HQ managers, of the tri-party signatories to force the DOE to allocate resources to local projects. This not only leads to inter-site competition but also to competition among projects on the same site. DOE HQ expects these law suits and threats to be ongoing in the face of flat budgets and the fact that some states have Consent Decrees and others do not. The net effect of these suits and action forcing mechanisms is to squeeze out projects that are likely to be based on human health and safety risks and reduce the DOE's ability to respond to emerging risk-related challenges.

Overall, DOE HQ managers favor more flexibility in moving resources across controls. A number of factors contribute to their request. One is the flat budget that constrains their programs, and a budget they assume will be about $5.6 billion the near term future. This compares to an estimate of $8-$9 billion a year required to meet their planned programs. Second, DOE HQ and especially the sites have a difficult time dealing with sequestration and continuing resolutions. Both increase their level of uncertainty in meeting obligations that they argue require multi-year commitments to maximize programmatic efficiency.

Upper management explained the budget process, noting that the budgets are a reflection of needs of 2+ years ago. Spending >$100 million a year on WIPP was not part of the plan a few years ago. But WIPP is essential and demands high priority. At the same time, the needs to address the tank wastes at Hanford and Savannah River remain for the foreseeable future.

It should be noted that senior managers while calling for more flexibility acknowledged their need to be more effective in allocating the resources among all the competing priorities. Only recently has HQ had to shift money between sites, because it is now a "zero-sum game."

1d. Do the current federal policies and guidelines allow appropriate protection of human health in the short-term (next five years) and the longer term (50+ years)? What can DOE do to improve its human health and safety risk programs? What can Congress do to aid the DOE?

DOE HQ staff recognizes that some sites will be operating for the next 50+ years. Accordingly, the Committee discussed what changes EM can envision that will both reduce human health and safety risk as soon as possible and conserve scare resources for application to other projects, which in turn will reduce risks.

The DOE and Committee pursued two major threads of discussion. One, consistent with DOE's history, focuses on technology. For example, a headquarters staff member said that DOE is trying to reduce waste volumes in order to maximize efficiency, unless reducing volume would increase risk. The basic idea is to minimize worker risk, transport risk, handling risk by such actions as the choice of containers to be used, and optimizing transportation, among others. Repackaging of certain materials for transportation to WIPP involves new capabilities and improved safety casks to be certified for deployment at SRS. This in turn enabled avoidance of need to use plasma arc techniques. In other words, the goal is to use technology that both reduces risk and allows resources to be reallocated.

Not all of the DOE's efforts to use new technologies are agreed to by stakeholders. For example, U233 is stored in various containers and bottles. Congress directed that the inventory be dealt with as waste, and for DOE to deal with uranium 233 inventory as a waste rather than retained for isotope production. Initially, DOE thought that an annex needed to be built for processing 400 containers to enable disposal rather than being disposed of in its current form. A detailed alternatives evaluation by DOE determined that the cylinders meet the definition of low level waste and can be accepted at a DOE low-level waste disposal facility without further processing. This could avoid significant processing and risk to workers, and avoid $600 million in program costs. However, a public anti-nuclear organization opposed this plan, leading to concerns on the part of the host state that have delayed implementation for two years.

A second line of discussion was policy adjustments. DOE would define treatment and waste management based on human health and safety and other waste attributes rather than on waste source. Radioactive waste categorized as high-level waste becomes very expensive to deal with, even if it is not always as dangerous as the definition implies, because of the requirement that it be disposed in a geological repository for spent nuclear fuel and high-level waste. Some waste classified as low level waste is inherently more dangerous. This led to a discussion between "performance-based assessment" and rigid standards. DOE prefers performance standards, while regulators often look for a specific or rigid standard (e.g. RCRA) that might not make sense when looking at how the whole system operates. The TPA requirement to remove 99% of the waste from Hanford's tank farms was cited as an illustration where DOE argues that the requirement is unnecessarily stringent from a risk perspective (see section 4 for a longer presentation). For the record, when asked about actions that Congress could take to support DOE's efficient management and protect human health and safety, senior DOE managers chose performance based assessment instead of standards as the highest priority.

Summarizing, DOE suggests that the Congress could help the DOE EM program reduce risk as follows:

1. Changing the definition of high level waste in the Nuclear Waste Policy Act (NWPA) to risk based rather than source based
2. Incorporating performance-based cleanup levels (consider the entire system) in CERCLA rather than standards-based levels (ARARs). In essence it is time to re-think it after 30 years and consider the risk based on the situation (e.g., why remediate ground water at Hanford if there is no receptor)
3. Making the basis of decisions more transparent and more consistent so that stakeholders get a consistent message from the DOE and regulators
4. Increase the flexibility of the sites to adjust to emerging issues by making the budgeting process more responsive to needs.

As part of the policy adjustment process with the DOE EM program, DOE is trying to get a more realistic view of what can be done with a reduced budget, and what kinds of negotiation mechanisms can be developed to increase flexibility for all the parties. HQ managers noted that they are creating a future picture for DOE Management to clarify the future funding picture and what can be done with it. They expect the Department to engage in more negotiations to balance regulatory considerations. One way of adding more flexibility to the regulatory process is to extend the rolling-milestone concept already employed at some sites to other sites where enforceable milestones are established many years, and often decades, in advance, and changes are a matter of *ad hoc* rather than regularly scheduled consultations and negotiations. Under the rolling-milestone concept, milestones are only enforceable for the current and next two fiscal years. Milestones with due dates beyond that window are considered unenforceable planning milestones and are mutually reviewed and agreed to by DOE and its regulators before the beginning of the fiscal year in which they would "roll over" into enforceable milestones, which would allow milestones to be enforceable in the year of execution, but allow for re-negotiation in Years 2 and 3 from the execution year. In the out years beyond that, they would not be enforceable. Another is about land use. Requiring remediation be done to residential standards where it seems very unlikely that the land will be occupied for residential purposes, and where DOE has stated in NEPA documents tied to future land-use plans that the land will not be used for residential purposes, needs to be revisited.

There may be a need to separate some elements from aggregate budgets in order to bring more attention to them. For example, regarding infrastructure needs, the Hanford site is considering putting in a new budget category to make infrastructure issues more visible. SRS is doing a good job at looking at deferred maintenance, and other sites are looking at what might be done programmatically. HQ is looking at a strategy to address the infrastructure issues for sites like Hanford and Savannah River that are going to remain open for decades to come. Hanford has a separate contractor for infrastructure, and some managers at Headquarters believe that approach may be a more effective than some of the alternatives, because it provides a means to tailor contract incentives to infrastructure needs. Teams evaluating the status of infrastructure across the cleanup complex have so far visited only Savannah River and Hanford. So far, there is no clear budget answer to the infrastructure issue.

The issue of safety culture has been an issue of concern for DOE and its contractors, as well as the DOE and the DNFSB throughout the existence of the DOE. And the need will continue for as long as the DOE EM mission continues. DOE considers its safety record to be far above industry standards. For example, EM publishes quarterly safety records, and the one for the first quarter for FY2015 summarizes a variety of safety incidents. Looking at the aggregate data from the second quarter FY2012 through the first quarter FY2015 shows that EM's rate of events that require medical treatment and lead to days away from work average between one-half to one-fifth of those for the U.S. construction industry and waste management and remediation service industries as a whole (Office of Safety & Security 2015). There is no obvious trend in the EM data. The report also shows differences in the rates by site, with ORL, RL, and Savannah River with stronger records than WIPP, Portsmouth/Paducah, and Idaho. However, the report has limitations. It does not adequately explain why some sites have lower and others higher rates. Arguably, the explanation could be type of work on the site. Alternatively, the explanation could be that a single incident at a smaller site has a larger impact than at a larger one. And, of course, there could be other explanations. Furthermore, not every health-related outcome is included in these reports. For instance, a recent note reports a legal challenge against the DOE and a contractor regarding tank farm worker exposure to vapors. Overall, EM cannot rest on the quantitative record that appears in these reports.

Nevertheless, given ongoing concern about safety culture, most recently illustrated by events at WIPP, the DOE has made it clear that it is responsible for making sure that DOE employees and that contractors improve their attention to the multi-faceted actions that constitute safe behaviors. Toward that end, senior DOE managers told the Committee that is has created a safety culture and improvement panel. That panel has been charged with developing a process and plan for improving safety across the complex. It will be charged with developing safety metrics, tightening up self-assessment, improving training for first-line supervisors and all other employees. Legal staff will examine contract language to make sure that safe performance is part of the DOE acquisition regulations.

DOE believes that a major problem is that contractor employees are afraid to report a safety issue that might delay accomplishment of a task because contractors make more money if they complete work rapidly. Some options to overcome this problem include separate hot lines for this purpose, the establishment of communities of practice that will be able to share knowledge, lessons learned and best practices across and within sites.

Committee members engaged in several lengthy conversations with DOE managers sharing experiences and suggestions from government and private enterprise. DOE managers expect their new panel to provide a set of ideas that may take the form of orders, guides, and policies.

QUESTION SET 2: INTERVIEWS WITH DNFSB HEADQUARTERS

Meeting with DNFSB Representatives. Fact- checked by Steve Stokes

This section reports on a meeting held at the DNFSB headquarters at 625 Indiana Avenue, Washington, DC on July 28, 2014. Jessie Roberson, Vice Chairman of the DNFSB and Steven Stokes, Technical Director of the DNFSB responded to the Committee's questions and provided post-meeting reports.

The following Omnibus Committee members were present: George Apostolakis, Timothy Fields, Michael Greenberg, Steven Krahn, and James Rispoli. Jane Stewart and R. Bruce Matthews called in. Harrison Pannella and Karen Lowrie were support staff.

Main Question: How does the DNFSB identify and elevate threats to public health and safety, and how does DOE consider DNFSB's concerns as part of DOE program decisions?

2a. How does the DNFSB choose from among all the issues and actions that DOE is responsible for? For example, how did you arrive at the Highest-Priority Safety Problems listed in the Annual Reports to Congress? Can you identify and illustrate the processes that DNFSB uses to prioritize relative risks? For example, Hanford has tank waste programs, buildings that are older and have hazards associated with them, contamination flowing toward the Columbia River, and other issues. On the other hand attention to seismic design and safety culture issues at the Waste Treatment Plant may have delayed cleanup of the tanks? How do you and DOE-EM balance priorities between these different types of risks? How does this effort interface with the Board's Strategic Planning and plan implementation efforts?

DNFSB officials interviewed reported that the Board's Staff has a planning process that it follows to develop an annual oversight strategy. This process uses a multi-variate analysis scheme whose inputs are qualitative in nature (This is discussed in this section below). The Staff's annual plan is reviewed and approved by the Board. The plan, however, cannot be rigid; it needs to be flexible, as emergent challenges, such as WIPP, occur that require the re-allocation of Board resources. (See below for a discussion of WIPP).

In regard to quantitative risk assessment, the Board's decisions are grounded in engineering experience and judgment— a deterministic approach, not a probabilistic one. In regard to DOE, the Board representatives commented that the DOE does not widely use probabilistic risk assessment (PRA). DOE uses 3009 Standard—a quantitative deterministic approach for accident analyses. The Board has recommended that DOE establish standards for PRA. (Probabilistic risk assessment is a systematic methodology to quantify the number of impacted individuals, the likelihood of them being impacted, and the consequences of these impacts. The process uses event trees, fault trees, human reliability analysis, and Monte Carlo tools to test a variety of combination of events (See below for more).

DNFSB does use risk analysis ideas in its strategizing, as the following text box illustrates.

DNFSB Process for Developing Oversight Plans for Strategic Planning

DNFSB operating procedure OP-521.2-1 (approved June 17, 2014) shows that the DNFSB uses risk analysis-grounded principles to identify where and how to prioritize its operations with regard to DOE as part of DNFSB's annual work plan.

The section "Details on Prioritization Methodology" includes the following definition:

Risk= [(event frequency/safeguard effectiveness) x event impact].

This is a risk assessment definition that is consistent and expected from an agency with powers to impact safeguards. The method creates risk scores based on the degree of feasible mitigation. It considers public and collocated workers. Impacts are divided into four severity categories, DOE's activities to mitigate risk; the DNFSB's efforts in regard to the risk, human and technical safeguards; the extent to which the DNFSB Board and staff have been engaged; and issues related to timing of DNFSB's efforts.

Overall, as noted above, DNFSB's process requires engineering judgment but is driven by a process that is grounded in risk analysis principles.

The DNFSB does not try to set DOE's cleanup priorities nor does it attempt to address DOE's allocation of cleanup funds either among or within sites in the former DOE weapons complex; these forms of interaction with DOE would be outside the Board's mandate, interviewed officials believed. However, the Board's recommendations to and other communications with DOE can influence DOE's cleanup decisions and priorities. An example is when the Board evaluated risk-related information and provided priority-related information to DOE as Recommendation 2012-1. In this Recommendation, DNFSB recommended that DOE take "near-term action" to accomplish three scopes of work for cleanup at Building 235-F at the Savannah River: removing combustible materials, deactivating electrical equipment, and ensuring that safety systems maintained their required functionality. The recommendation was based on the Board's conclusion that these actions should be taken on a priority basis in order to avoid deterioration that would increase risk. (This was discussed with DOE and DNFSB representatives when the committee visited Savannah River. 235-F is discussed below in the larger context of protecting human health and risk, as well as DNFSB, DOE, and State of South Carolina interactions.)

2b. How do you decide what to focus on at Hanford, as well as Savannah River, Oak Ridge, and Idaho? Do you engage DOE-EM in setting risk-reduction priorities? How do you evaluate major external events, such as earthquakes and volcanic ash vs. operational risks, such as electrical fires due to old wiring in an old building and deteriorated infrastructure that could cut off the water supply during a fire? What data and information sources do you rely on for information? (EISs, documented safety analyses, others?) How do the regular reports that you issue to Congress on Safety-Related Design and

Construction Issues and Safety-Related Infrastructure Issues at Operating Defense Nuclear Facilities play into such planning?

DNFSB officials interviewed stated that the Board is constantly monitoring activities at the DOE sites. DNFSB leverages timing of DOE activities to perform visits and oversight at sites. It reviews required reports, controls, operations, and maintenance reports from each site. D.C. staff use this information and their expertise/knowledge to guide oversight. There is a DOE-appointed liaison at every site to track major activities, with lots of back and forth communication (See responses to question 4 below for illustrations).

DNFSB monitors various performance indicators—using all available data sources, e.g. maintenance logs, etc. to consider safety implications. (At the Savannah River Site, the DNFSB representative provided an example of how surveillance of DOE reports revealed a trend in maintenance that he found potentially risky, and how this was discussed with the DOE staff, and has contributed to a focus on maintenance.)

Officials explained that the DNFSB has a formal process that considers the following factors in its scanning process at each site: (1) adequacy of the facility's safety basis (which includes beyond design basis events); (2) safety class & safety significant systems and design features; (3) the hazard categorization of facilities, completed in accordance with DOE Technical Standard 1027; and (4) number of limiting conditions for operation/technical safety requirements (LCO/TSRs). These indicators assist the DNFSB in prioritizing its oversight actions and planning. The Board looks for significant differences from what it would expect to see in human health and safety risk. However, according to Board officials, the cost of addressing site problems is not a factor considered by the Board.

Overall, DNFSB does not tell DOE what it needs to do nationally or at any site, but the Board does make recommendations to DOE when necessary to emphasize human health and safety.

The group discussed a current example of decommissioning of DOE facilities as a part of the cleanup at the 300 Area of Hanford. Board officials reported that the Board is currently looking at DOE's plans for decommissioning buildings 324, burial grounds 618 and 611. These reviews are focused solely on identifying potential safety-related concerns associated with DOE decisions. In regard to decommissioning, DNFSB's objectives are to ensure adequate protection of public health and safety. For example, Policy Statement PS-3, focuses on surveillance and monitoring in the decommissioning process. (Building 324 is discussed as part of question 4.)

The Board does identify potentially risky issues/areas at cleanup sites that DOE may not be addressing adequately or at all, and it will opine on how DOE can do what it wants to do (more) safely; it may even (and has in a number of cases) told DOE that it disagrees with what DOE plans to do because in the Board's view DOE's plan is altogether too risky (e.g., Hanford tanks mixing). But in such situations, the Board would not identify or propose alternative, safer approaches or remedies to those being developed by DOE, a role that the Board regards as beyond its purview. Further, the Board does not identify areas

where risks may be too low to justify priority action or substantial expenditure of DOE cleanup funds [e.g., Remove, Treat, Dispose (RTD) in the Hanford River Corridor], however, because this is not within their mandate.

2c. The data and your reports show more emphasis on letters, meetings and other mechanism and less on recommendations. What are the reasons for that trend? What lessons have been learned from this change? Has this influenced how you receive information and data about human health risk? Do the recommendations, letters, or meetings have more influence on how DOE allocates resources?

One reason is the kinds of issues have changed. In the early years of the Board, the larger number of recommendations reflected the need to take effective, timely actions to address issues that were consensus national priorities, such as:

1. Restart of production reactors and associate facilities at Savannah River to provided materials for nuclear weapon stockpile maintenance (Recommendations 90-1, 91-2, 91-5, 92-1, 92-3);
2. Restart of plutonium processing capability are Rocky Flats (90-4, 90-5, 90-6, 91-4); and
3. Urgent safety issues with high-level waste tanks at Hanford (90-3, 90-7, 92-4).
4. In parallel, there was an extended dialogue between the DNFSB and DOE concerning the need to put in-place and adequate set of standards and directives associated with nuclear safety (Recommendations 90-2, 91-1, 91-6, 92-5, 92-6, 92-7).

A second reason is that the Board and DOE have concluded that it is easier to reach an agreed upon path forward by trying to resolve issues at the staff level.

The discussion turned to the recent truck area fire and drum explosion at WIPP as one illustration of non-recommendation-driven, less formal interaction between DOE and the DNFSB and DNFSB's capability to adjust its resources to meet needs [see WIPP text box below].

Prior to the truck area fire at WIPP, DOE and site contractor had been in the process of resolving fire safety issues identified by the DNFSB in a letter of June 2012; a DOE-EM response dated September 2012 described corrective actions that the DOE was taking in the areas of fire protection and maintenance. The DNFSB Staff did a review in September of 2013 to evaluate the corrective actions which were in-process; an additional follow-up by DNFSB Staff review had been scheduled for February 2014, but the fire at WIPP intervened before that meeting.

DNFSB has been focusing attention on WIPP throughout the design, building and operations of the facility. Recent accidents at the facility have required greater focus on WIPP, but the interest has always been there.

- DNFSB personnel were deployed to WIPP within 48 hours of the incident, and were on-site to escort the accident investigation team. DNFSB also had a Facility Representative from LANL at WIPP. The DNFSB maintained full-time presence at WIPP until very recently.

- These personnel provided both full-time coverage of the DOE accident investigation and operational oversight of actions in the repository.
- The Board is still in the process of getting information about the accidents at WIPP.
- DOE informed the DNFSB about the fire at the truck area almost immediately. Currently, the Board is evaluating the WIPP operational data to which Board has access; the Board can also observe, and can make formal requests for information, and has the authority to seek information in other ways that are outlined in its charter. Throughout this process, the DNFSB is respectful of DOE's responsibility to perform its own investigation, and DOE shares information with the DNFSB.

At the end of the day, with regard to WIPP, the Board's objective is to have confidence that adequate safety controls are in place. This means meticulous follow-up on the (1) corrective actions from the truck fire, and (2) exact causes of the radiation incident and the path for radiation to reach the surface. In order to pursue its responsibility the DNFSB will work closely with DOE, but can independently seek information from other government agencies and NGOs, as noted earlier.

DNFSB will be devoting more resources to WIPP (e.g., two ventilation people for oversight because the likely path by which radioactive contamination reached the surface was assessed to be a ventilation system). But again, the Board noted that it does not try to control DOE schedules and priorities. DOE and the Board will be looking at ventilation redesigns for WIPP (as well as applicability for SRS and other sites). The DNFSB will focus on the extent to which there was process control at WIPP. Even though consequences to public appear to have been "extremely low," the Board cannot say with certainty that the recent accidents at WIPP are low probability, low consequence events. The Board is allowing DOE's investigation to proceed to see how extensive the problems may be.

WIPP, Salt Truck Fire and Radiation Release Events, 2014

Late in the evening on February 14, 2014, an as yet not completely understood event damaged at least one canister of transuranic waste stored in the one of the underground storage chambers at WIPP. Emissions were not contained in the underground chamber and emissions were monitored on the surface. Earlier, on February 5, a truck hauling salt had caught on fire in an underground chamber. The DOE (2014a,b) released a final report on the truck fire and later a Phase I report in April 2014 that characterized the second one. Both were found to be preventable, and both reports included causes and recommendations about preventive risk management that are described in the report. The events are important for the Review Committee because they represent health and safety cases and involve worker training and operations, maintenance, and others.

WIPP is an important site for the United States nuclear waste management program. As of March 2014, 11,894 shipments had been received at WIPP. Almost half of these were from Idaho, and much of the remainder from Rocky Flats, Savannah River, and Los Alamos. Small numbers have come from multiple other DOE sites, including Hanford, Lawrence Livermore, and Oak Ridge. The dependence on WIPP is increasing and any event that threatens expert, public and political support for long-term storage of nuclear waste merits analysis for this Committee in regard to the role of health and safety risks in the accident and in subsequent policy responses.

In regard to the second event, which included above-ground emissions, the DOE report listed and explained major categories of causes, and offered 31 conclusions and 47 specific suggestions. These call for more oversight by headquarters, the Carlsbad Field Office, and the contractor. The report notes the need for more effective maintenance, increasing expectations for operators, a more effective safety culture, and overall a stronger safety program. Formal investigators are proceeding, and more observations and recommendations will follow.

While it is premature to draw definitive conclusions about causes and remedies, it is appropriate to inquire as to steps taken to date and how human health and risk-related information is part of the ongoing analyses.

More generally in regard to communications with key parties at DOE weapons complex sites, the DNFSB has ongoing contact at the national and site levels. The DNFSB maintains contact with its on-site representatives at each of the major DOE sites. The DNFSB Technical Director has regular meetings with senior safety managers at DOE HQ, including the DOE-EM Chief of Nuclear Safety, NNSA Chief of Nuclear Facility Safety and DOE-EM Deputy Assistant Secretary for Safety, Security and Quality. Further, executive management personnel of NNSA and DOE-EM brief the Board on a monthly basis.

2d. How effective has the Board been with reducing risks to the public and workers at DOE-EM sites? Can you describe several examples of some of the more successful cases? Of those that were less successful? What makes the difference between major and more limited success? Have you observed unexpected beneficial, or negative, outcomes from these interactions (e.g., changes in policy, practice,

ideas, beliefs, and attitudes)? How central was human health risk information in DNFSB deliberations during these illustrations? Was there human health risk information in these cases that had not been collected that would have been valuable? Were there analytical tools that you could have used that were not available? Were there data quality issues that increased uncertainty in your efforts?

The DNFSB discussed cases where they believed that DNFSB action-forcing had resulted in risk reduction:

1. Recommendation 2012-1, DNFSB reviews led to a recommendation for a modified and accelerated path forward for the remediation of F-Canyon complex (235-F) at the Savannah River Site.(See question 4 below)

2. Recommendation 2009-1, DNFSB review and recommended path forward led to an acceleration of DOE actions to develop and codify and approach to probabilistic risk assessment applicable to nuclear safety in DOE non-reactor facilities; this path forward resulted in the issuance of a DOE technical standard on the subject (DOE Standard 1628), where past DOE efforts had not been able to reach consensus on a viable technical approach. (see Eggenberger 2009 and question 5 below)

3. Recommendation 2002-3, which led to a codification of DOE's approach to documenting and implementing administrative controls important to the safety of nuclear facilities.

2e. Do you on the DNFSB consider that the Department is prioritizing its projects and operations consistent with reduction of risk to human health and the environment? What other considerations do you view as impacting the programmatic priorities in the environmental management program? For example, do legacy commitments made as part of the regulatory process diffuse or enhance the Department's focus on a risk based prioritization of cleanup across the program?

The DNFSB discussed its formal process for describing the interface between nuclear safety matters and environmental regulatory concerns; this process was developed in response to the closure of the Rocky Flats Environmental Technology Site (RFETS) and is embodied in DNFSB Policy Statement 3 (PS-3, August 19, 1996). That document indicates that the Board recognizes that its interest in protecting human health is shared with EPA under CERCLA and RCRA, and that "the Board is prepared to work in an advisory or assist role with federal or state agencies having statutory responsibility for forcing corrective or remedial action." However, at this time, the Board does not have a broad agreement to advise or assist state or federal regulatory agencies.

2f. The Board staff and site representatives are often "the eyes and ears" of the Board. How do you evaluate the problems identified by your Staff to determine which require letters or recommendations? Are these potential issues discussed informally with DOE?

The DNFSB enabling statute authorizes it to place Site Representatives (SRs) at DOE facilities to provide day-to-day oversight (similar to NRC). These SR's attend regular planning meetings, walk-down facilities and hold regular interactions with site management to provide quick-turnaround feedback to DOE and

its contractors on safety-related matters. They document their oversight and observation in weekly letters to the DNFSB. The Board uses these letters to plan oversight actions, including reviews by DNFSB HQ technical staff; such reviews are planned with formal agendas. DNFSB HQ technical staff also provide weekly summary letters to the Board to document ongoing technical review activities. (See responses to Question 5 below for interchanges between DOE and DNFSB regarding risk assessment)

The DNFSB Technical Director has regular meetings with senior safety managers at DOE HQ, including the DOE-EM Chief of Nuclear Safety, NNSA Chief of Nuclear Facility Safety and DOE-EM Deputy Assistant Secretary for Safety, Security and Quality. Further, executive management of NNSA and DOE-EM meet with the Board on a monthly basis.

Both DOE and the DNFSB prioritize actions required to address nuclear safety issues. DOE and DNFSB share a "common language" for nuclear safety, based on DOE nuclear safety standards and directives; there is "healthy friction" between the two agencies. At times the priorities and/or planned actions are significantly different; these differences can come to the Board's attention in any of the above ways, or combinations thereof. It is these divergences that become the subject matter for DNFSB formal actions.

2g. The level of formality of risk assessments done by DOE and its contractors can vary over a wide range. Have risk assessments become more standard and reliable since implementation of Recommendation 2009-1? What is the Board's view of DOE Standard 1628, Development of Probabilistic Risk Assessments for Nuclear Facilities? What do you envision being changed within the DNFSB as a result of the Board's Policy Statement on Assessing Risks? What is your implementation plan?

DOE safety analyses result in a suite of controls to ensure safe operations of its nuclear facilities. These safety analyses are deterministic in nature, involving subject matter expert binning of the likelihood of accident scenarios; such accident scenarios include the spectrum of scenarios from anticipated events to beyond design basis accidents.

The review of DOE standards associate with nuclear safety is a major statutory function of the DNFSB.

1. The Board maintains a list of "Directives of Interest to the DNFSB";
2. Members review and comment on revised DOE directives and standards included in the interest list. DNFSB staff also review and comment on new and proposed DOE directives and standards;
3. There will be anywhere from 6-12 DOE technical standards and directives under review by the DNFSB and its staff at any given time;
4. Of these, there are standards that are foundations of nuclear safety, such as with nuclear safety standards associated with safety analysis (3009, 1189) nuclear facility design (DOE order 420.1).

DOE-STD-1628 was developed as a portion of the response to Recommendation 2009-1, the DNFSB has technical reviewed the standard and approved closure of the recommendation, in part, based on issuance of the standard.

QUESTION SET 3 – EPA WRITTEN RESPONSES TO COMMITTEE QUESTIONS, OCTOBER 14, 2014 (PRINTED VERBATIM)

This section reprints verbatim EPA's written response to the Omnibus Committee's questions. We note also that the Committee met with EPA at its facilities in Arlington, VA on September 18, 2014 from 2 p.m. to 3:30 p.m. The following Omnibus Committee members were present: George Apostolakis, Timothy Fields, Bernard Goldstein, Michael Greenberg, Steven Krahn, and James Rispoli. Jane Stewart and R. Bruce Matthews called in. Harrison Pannella was support staff. EPA indicated that they planned to prepare written answers to the Committee's questions, and these responses were received on October 14, 2014. EPA requested that the Committee use their written responses, rather than including a meeting summary, to most accurately present the Agency's views. In light of that request, and noting that the Committee also used in preparing this report information from our meeting with EPA and from subsequent conversations with EPA staff, we have included only EPA's written response to questions below.

1. How does EPA prioritize health and safety risks relative to ecological risks and natural resources protection impacts in the context of DOE sites? How do you prioritize workers risk and nuclear safety during prioritization of DOE cleanup actions?

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC § 9601 et. seq.) and the National Contingency Plan (NCP) (40 CFR § 300 et. seq.) do not contain explicit provisions or specific processes that per se provide for prioritizing health and safety risks relative to ecological risks or natural resources protection impacts. However, the remedy selection process under CERCLA and the NCP, and existing EPA CERCLA guidance, includes a number of opportunities for evaluating actual and potential risks to public health, welfare and the environment and for adopting the most appropriate cleanup approach for addressing those risks.

CERCLA provides the President with broad response authority to address actual and threatened releases of hazardous substances, and pollutants and contaminants which may pose an imminent and substantial danger, in a manner that ensures protection of public health, welfare and the environment. Consistent with CERCLA § 120, federal agencies must comply with substantive and procedural CERCLA requirements to the same extent as private entities.

NCP provides the regulatory blueprint for implementing CERCLA's statutory framework for cleanup. Consistent with the NCP, risk assessments are used to help evaluate actual and potential threats to human health and the environment posed by a site. In fact the NCP § 311, "Worker Protection," requires application of the substantive provisions found at 29 CFR §1910.120 for State and local government employees engaged in hazardous waste operations. CERCLA has separate provisions addressing natural resource damages, which are distinct from the statue's broad response authorities for ensuring protection of the environment.

Section 121 of CERCLA includes a number of important statutory requirements related to the selection of remedies. For example, CERCLA remedial actions must: 1) protect human health and the environment; 2) comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified; 3) be cost-effective; 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) satisfy a preference for treatment as a principle element, or provide an explanation as to why this preference was not met. The statute contains a clear requirement to ensure remedial actions provide protection of human health, the environment (which may include ecological resources - such as ground water).

Though there are no explicit provisions that prioritize health and safety risks specifically, there are a number of provisions and policies protecting human health, including protecting workers associated throughout cleanup actions. As part of implementing CERCLA, the NCP calls for balancing nine factors when evaluating alternatives during the selection of a remedial action. One of the NCP's nine criteria for evaluating alternatives includes the "potential impacts on workers." (*See* 40 CFR § 300.430(e)(9)(iii)). Protecting people who otherwise may be exposed to unacceptable risks caused by releases is integral to the statute's mandate to protect human health. (*See* 40 CFR §300.430 (e)(9)(iii)(A)). Current land use and reasonably anticipated future land use are both considered throughout the CERCLA remedy selection process, as discussed in existing EPA CERCLA guidance (e.g., "Land Use in the CERCLA Remedy Selection Process" (OSWER Directive 9355.7-04; May 1995); "Considering Reasonably Anticipated Future Land Use and Reducing Barriers to Reuse at EPA-lead Superfund Remedial Sites" (OSWER Directive 9355.7-19, March 17, 2010)).

With each operable unit presenting unique and varying complications in terms of the contaminants present and the actual and potential risks to human health, EPA typically conducts risk assessments on an operable unit basis. EPA's guidance on the "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions" (April 22, 1991) notes that EPA generally uses the results of the baseline risk assessment as the basis for taking remedial action. Risk assessments are usually generated for the distinct nature and extent of contamination present at an operable unit and current and future exposures. Another consideration could be the determination of cumulative risks for multiple operable units. In addition to risk, action may also be warranted based on exceedance of regulations that define protectiveness (e.g., maximum contaminant levels and non-zero maximum contaminant level goals). Guidance's addressing human health and ecological risks should generally be consistently applied whether the response action is performed by EPA or potentially responsible parties.

Another one of the NCP nine criteria used for analysis of remedial alternatives is community acceptance. As releases of hazardous substances from federal facilities may affect many diverse communities, other existing laws and guidance are considered in each risk assessment, including the effects on diverse and low income communities. Executive Order 12898 "Federal Actions to Address Environmental Justice (EJ) in Minority Populations and Low-Income Populations" made identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations a part of each federal agency's mission. The

federal government has an obligation to reduce the adverse effects of environmental contamination in communities that have historically lacked economic and political power, adequate health services and other resources.

Community partnering and engagement is also considered during the prioritization process. In the Office of Solid Waste and Emergency Response's (OSWER) "FY14 National Program Manager's Guidance," EPA introduced the Community Engagement Initiative (CEI) in 2010 to refocus and renew its vision for community engagement and improved practices that help communities meaningfully participate in OSWER program decision-making. Through CEI, many existing or new community engagement tools and processes have been updated or developed. The EPA's 1984 "EPA Policy for the Administration of Environmental Programs on Indian Reservations" was reaffirmed as recently as 2014. EPA's "Plan EJ 2014" continues partnerships with tribal governments, both at the federal facility level and at the national policy-making level. The overarching goal is to foster meaningful engagement with stakeholders; including community input as an integral part of the prioritization processes at federal facilities.

2. Do EPA and DOE generally share the same risk-related priorities at DOE sites? When you do not share the same priorities, why do differences exist? How are differences resolved?

Interagency agreements (IAGs), otherwise known as Federal Facility Agreements (FFAs), are intended to promote successful interagency interactions by providing for early, frequent communication and full disclosure of all relevant information that is accurate and of high quality and reliability. In effect, FFAs serve to identify many common risk-related priorities at DOE and other federal facility cleanups on the National Priority List (NPL). When FFA parties act openly and in good faith, this framework helps ensure timely, efficient cleanups that protect both human health and the environment. Because of the complexity of the CERCLA process, disagreements regarding any aspect of a cleanup or its associated documents, including site management plans, are anticipated.

Transparency and open communication provide opportunities for innovative approaches that can be explored consistent with the statute, NCP and existing EPA CERCLA guidance. The EPA Regional offices continue to work with DOE facilities, using a variety of approaches toward more effective and efficient cleanup and to resolve informal disputes, including those involving risk, and a number of other issues. A formal dispute process, largely standard across all federal facility cleanup sites and agreed to by the parties, is prescribed in the site FFA. It endeavors to resolve such disputes collaboratively, quickly and at the lowest levels possible. However, consistent with CERCLA § 120, EPA makes the final decision regarding remedy selections where the Agency and DOE disagree on the cleanup approach, including issues related to risk, as provided for in the FFA for DOE sites on the NPL.

Multi-agency teams have had a number of successful interactions in the past. In the National Academy of Sciences 2014 Workshop Series Summary entitled "Best Practices for Risk-Informed Decision Making Regarding Contaminated Sites," the Core Team Process at the Savannah River Site (SRS) and the multiagency decision-making process at Oak Ridge Reservation (ORR) were identified as best decision-

making practices. The Workshop participants noted that the SRS Core Team Process is built on trust, transparency and the acknowledgement that decisions may change. In addition, a multi-agency team provides more resources than any single agency could contribute, allowing for more ideas to be introduced. This structure facilitates a broader interpretation of standards in the decision-making process and ultimately results in wider acceptance of decisions.

DOE maintains a robust public involvement effort at SRS. The Federal Advisory Committee Act SRS Citizens Advisory Board, supported as liaisons by the EPA and the South Carolina Department of Health and Environmental Control (SCDHEC), hold regular Environmental Justice meetings co-hosted by EPA and DOE. There are also public workshops on an as-needed basis. In these meetings, all three agencies present risk information regarding the Superfund risk assessments developed for Operable Units as well as the DOE and South Carolina environmental monitoring data and any dose estimates DOE has developed through the Performance Assessment process on specific areas at the site (High Level Waste Tank Farms, etc.). Other agencies have also been invited to take part in these public workshops. The Agency for Toxic Substances and Disease Registry (ATSDR), for example, has made presentations regarding their health assessments and the Center for Disease Control's (CDC) has presented a Dose Reconstruction report.

At the ORR, EPA Region 4, DOE and the Tennessee Department of Environment and Conservation were in a set of disputes in 2010/2011 that used the FFERDC principles of "risk plus other factors" in an open and transparent way to prioritize cleanup. Use and documentation of this approach in the annual process for updating and setting cleanup milestones improves the transparency of the process to prioritize work and resolve differences. The team came up with the following principles (in general rank order) that are used as the risk-based prioritization principles for ORR:

1. Eliminate current human and environmental exposures
2. Eliminate or control significant human and environmental exposure threats
3. Eliminate or control off-site contamination
4. Eliminate or control Principle Threat Source contamination
5. Protect and restore ground water and other environmental resources
6. Achieve risk based performance requirements of records of decision (ROD)
7. Complete high risk demolition and decommissioning (D&D)
8. Complete cleanup of residual contamination in on-site environmental media
9. Complete low risk D&D

In Region 10, EPA participates actively with both the Hanford Advisory Board and the Idaho National Lab Citizens Advisory Board. The Hanford Board is unique in the DOE Complex as the Board advises DOE, EPA and the State of Washington. Its 32 members represent a broad spectrum of interests throughout the Pacific Northwest. In addition, the regulatory agencies play a key role in selecting new Board members.

3. Do EPA and the states generally share the same risk-related priorities at DOE sites? When you do not share the same priorities, why do differences exist? How are differences resolved?

States are typically (although not always) parties to the FFAs at DOE sites and, along with the federal agencies and EPA, are accordingly involved in the decision-making process. Federal environmental laws and regulations that constitute applicable, or relevant and appropriate requirements (ARARs) need to be met or a waiver justified. Similarly, state standards that are more stringent than the federal standards also may need to be met as an ARAR (or a waiver justified). However, in the rare instance that EPA, DOE and the state cannot agree on a remedy, EPA has the authority to select the remedy as specified in CERCLA § 120.

See responses to #2 and #5.

4. How does EPA further human health and safety-based risk cleanup within and across DOE sites? In light of funding constraints for the DOE EM program, what legal, scientific, engineering and other impediments are there with respect to EPA's ability to enable and promote human health and safety risk-based allocation of resources across the DOE complex?

In accordance with CERCLA § 120(c) EPA is required to establish a special Federal Agency Hazardous Waste Compliance Docket (Docket). Depending on the results of a preliminary assessment, EPA is required to evaluate the federal facilities on the Docket in accordance with the Hazard Ranking System (HRS). After solicitation of public comment about the proposed sites and, where appropriate, those federal facilities that meet established criteria are placed on the NPL. The NPL primarily serves as an information and management tool. At this time, EPA has listed 174 federal facilities on the NPL out of over 3000 facilities on the Docket. EPA Headquarters does not further reprioritize the facilities on the NPL as all are considered a national priority. Once on the NPL federal facilities are required by CERCLA § 120(e) to commence a remedial investigation /feasibility study and enter into an IAG, otherwise known as a FFA with EPA. As part of the FFA, the parties identify the necessary work required for cleanup, as well as, establish the priorities of the work and associated milestones to expedite the cleanup and promote joint accountability.

CERCLA and the NCP do not contemplate or provide a means to prioritize risks across the DOE complex beyond the goals, expectations and program management principles in the NCP. Similarly, they do not offer a relative risk scheme for prioritizing risks within a facility. However, CERCLA the NCP, and FFAs do contain provisions and criteria that allow for a flexible, facility specific analysis to protect human health and the environment and ensure all risks are addressed. As required by CERCLA, and consistent with the NCP, EPA's oversight role at DOE NPL sites includes ensuring that cleanup is protective of human health, including worker safety, and the environment.

In order to ensure protection of human health and the environment, cleanup decisions need to be based on the best and latest scientific and regulatory information. This approach is reflected in CERCLA, the NCP and existing EPA guidance. For example, Remedial Action Objectives, Preliminary Remediation Goals and cleanup levels typically are directly tied to any existing ARAR under CERCLA § 121(d). ARARs are often updated to reflect better scientific information related to actual or potential human health risks associated with exposures to constituents of concern.

DOE, EPA, and state regulators regularly evaluate and consider ARARs at all stages of cleanup. Even after the decision document is signed, remedy selection decisions may be changed to ensure continued protectiveness of the cleanup. Periodic reviews of the remedy selected are undertaken to account for evolving science, newly promulgated standards that are potential ARARs, or other site-specific information, for example. This ongoing obligation to consider new science and information is clearly reflected in CERCLA section 121(c), which requires five-year reviews of all CERCLA remedial actions where hazardous substances are left in place over the long term.

At DOE NPL sites, FFAs provide appropriate flexibility to adjust schedules in a manner that reflects budgetary realities. EPA recognizes the challenges associated with region-specific conditions or concerns and supports flexibility for strategies that align with our shared priorities and goals. By advancing remedial cleanups, we protect the public and the nation's resources.

The Government Performance Results Act (GPRA) requires agencies to develop plans for what they intend to accomplish, measure performance, make appropriate decisions based on information gathered, and communicate information about their performance to Congress and to the public. The "FY 2014-2018 EPA Strategic Plan" (April 10, 2014) charts the course for advancing EPA's priorities and mission to protect human health and the environment. The Plan identifies the measurable environmental and human health outcomes the public can expect over the next four years and describes how EPA intends to achieve those results, representing a commitment to EPA core values of science, transparency and the rule of law in managing our programs. In order to track progress of CERCLA cleanups, EPA's "FY2014 National Program Manager's Guidance" established GPRA goals such as "human health exposures under control" and "contaminated groundwater migration under control." These measures provide current site information regarding risk reduction at an NPL facility. Not having these aspects under control at an operable unit may indicate an unacceptable risk to human health and the environment.

To foster collaboration between federal agencies and citizens, in 1993 EPA established a forum, the Federal Facilities Environmental Restoration Dialogue Committee (FFERDC). The Committee included representatives from the United States Department of Agriculture (USDA), the Department of Defense (DoD), DOE, the Department of Interior (DOI), the National Oceanic and Atmospheric Administration (NOAA), ATSDR, state, tribal and local governments and numerous other nationally, regionally, and locally based environmental, community, environmental justice and labor organizations. FFERDC's mission was to provide recommendations and best practices for all stakeholders - the public, regulators and regulated agencies - to develop creative ideas for addressing the challenges associated with environmental pollution at federal facilities.

In 1996, the FFERDC issued a consensus report containing recommendations to assist ongoing efforts necessary to ensure federal facility cleanup decisions are cost effective and reflect the values of affected communities. The "FFERDC Final Report" provided a set of principles including the consideration of risk in decision-making and the use of "risk plus other factors" in priority setting. The FFERDC concluded that risk assessments should not be used by any party as a basis for unilateral setting aside of legal

requirements that embody public health principles and other societal values. The guidance provided by FFERDC and its report only supplement, and do not in any way affect or alter, CERCLA's requirements, the provisions in the NCP or EPA's CERCLA guidance documents.

5. What flexibility does EPA provide in TPAs if it is important to allow adequate resources are available to address higher priority health and safety risks? How do you deal with local/regional discretion vs. national consistency in issues such as groundwater cleanup, degree of post-cleanup restriction on site use?

CERCLA, the NCP and the FFA (Tri-Party Agreement (TPA) as it is known at the Hanford Site) provides considerable flexibility for implementing cleanup levels that ensure protectiveness of human health and the environment in response to the particular hazards and risks presented at a cleanup site. Relative cleanup priorities can reflect the cancer risk range, considering site-specific conditions, and incorporating new science and effective technologies that can save time and money. The FFA, which is required pursuant to CERCLA § 120(e), is an enforceable mechanism by which federal and state regulators oversee DOE's cleanup actions. The FFA is intended to ensure protectiveness of both human health and the environment, as required by law. In part, the FFA is intended to facilitate and encourage better communication and coordination between federal/state regulators and DOE and provide an orderly, timely process for resolving disputes regarding CERCLA cleanup activities at this site. For federal facilities, each FFA contains a provision that the federal agency shall take all necessary steps to obtain funding to meet all obligations. In EPA's view, the FFA works well and provides the parties with appropriate flexibility to address site-specific circumstances. When parties work collaboratively, milestones can be appropriately adjusted when circumstances require.

The annual federal budget process begins with a detailed proposal from the President. Congress next develops a blueprint called a budget resolution that sets limits on how much each committee can spend or reduce revenues over the course of the year. The terms of the congressional budget resolution are then enforced against individual appropriations, entitlement bills, and tax bills on the House and Senate floors. If sufficient funding is not made available to DOE through the federal budget process, provisions exist for making adjustments to the schedules of the unfunded obligations. To the extent that acceleration efforts affect milestones, the parties to the FFA should review the schedules and modify as appropriate. In order to ensure protection of public health, welfare and the environment, cleanup decisions need to be based on the best and latest scientific and regulatory information. This approach is reflected in CERCLA, the NCP and existing EPA guidance.

Issues related to cleanup, such as restoration of ground water to its beneficial use within a reasonable timeframe or making sure cleanup reflects current and reasonably anticipated future land use, are addressed in the NCP and existing EPA CERCLA guidance so that response actions across the country are undertaken in a consistent manner that ensures the protectiveness of human health and the environment. The "Hanford TPA" and the "Federal Facility Agreement for the Savannah River Site" are examples of such three party FFAs to which the EPA, DOE and the state are parties. While each federal facility is different, CERCLA provides sufficient flexibility and discretion to account for variability between

operable units to meet the overall goal of the response action--ensuring protectiveness of human health and the environment.

Enforceable cleanup agreements play a critical role both in overseeing priorities at a site and providing a means to define and balance the respected interdependent roles and responsibilities in federal facility cleanup decision-making. EPA, by law, must continue to hold federal agencies accountable for meeting the terms of these agreements to ensure timely and protective cleanup in the same manner and to the same extent as private sector cleanups.

The experience gained in cleanups throughout the CERCLA program, both at private party sites and federal facilities, is highly valuable, and thus shared programmatically in many forums, including the issuance of national guidance and technical fact sheets, and at regular national meetings involving all levels of program staff and management. Examples include the annual Federal Facility Forum, quarterly federal agency meetings, and the Superfund Radiation Meeting. Training sessions are provided year-round on the Contaminated Site Clean-up Information website (www.clu-in.org).

CERCLA remedy selection, remedial design and cleanup implementation are all governed by sound science, engineering expertise, and best professional judgment. For national consistency, EPA publishes guidance documents, in part, to help achieve protection of human health and the environment. For example, the “Risk Assessment Guidelines for Superfund” (EPA/540/1-89/002) include recommendations on evaluating potential and actual risk to human health and the environment. In response to the interest of federal agencies, such as DOE, in managing complex groundwater sites (brought to light in the National Research Council’s report “Alternatives for Managing the Nation’s Complex Contaminated Groundwater Sites,”), EPA recently published a “Groundwater Remedy Completion Strategy” (OSWER 9200.2-144) to provide a recommended step-wise process for evaluating complex groundwater contamination scenarios. Such scenarios often pose a challenge recognized by DOE for its facilities.

EPA also has published “The Sample Federal Facility Land Use Control ROD Checklist with Suggested Language” (LUC Checklist), (OSWER Directive 9355.6-12, January 2013). LUCs are effective supplements to engineering controls, and the Checklist contains suggested language to ensure that LUCs are properly documented for federal facility NPL sites and provides guidance on describing and documenting LUCs in federal facility response actions under CERCLA in Records of Decision. LUCs selected in a ROD are often referred to in remedial design documents, as well as remedial action work plans.

The LUC Checklist also provides recommended language for creating enforceable LUC requirements to ensure the protectiveness of CERCLA remedies. LUCs may be used when contamination is first discovered, when remedies are ongoing, and/or when residual contamination remains onsite at a level that does not allow for unrestricted use and unlimited exposure after cleanup. However, LUCs are meant to supplement engineering controls and consistent with the NCP should not be the sole remedy at a site.

The following paragraphs provide examples of how teams at DOE facilities have used the flexibility in IAGs to accommodate changing priorities, to improve communications, and to use LUCs effectively.

Examples of flexibility in the SRS FFA:

- The addition of language and appendices to the FFA to cover demolition and decommissioning as SRS ramped up their efforts in that area in the early 2000s;
- Revision of FFA language dealing with High Level Waste Tanks to incorporate language changes for definitions the three parties neglected to address in an earlier dispute; these changes were made as minor modifications by the FFA Managers at the three agencies.

An example of how risks have been addressed at the SRS can be found in the Lower 3 Runs Operable Unit. Sediment contaminated with Cesium-137 was excavated and disposed of in a low level waste disposal facility at levels that would be dangerous to an adolescent trespasser, the entire lower length then had additional fencing and signage installed and institutional controls (ICs) emplaced to protect against a future residential scenario. In addition, many operable units have been capped with ICs implemented to protect future land use scenarios.

At SRS, the three parties to the FFA use a Core Team Partnering process that has been successful at accelerating and accomplishing work in the soil and groundwater cleanup at the site. The successes extend from the closure of seepage basins, the resolution of Land Use Control Implementation issues, the closure of the P and R Reactor, co-hosting Environmental Justice meetings to respond to the public interest and stretch federal dollars to better inform the community, and finding common ground on risk assessments and using the information to perform balanced cleanups in the T Area operable unit, to name just a few. The process has been so successful that it was carried over and is in use in the High Level Waste cleanup process which involves a different DOE contractor and a different Bureau of the SCDHEC.

The cleanup of the Hanford Site has been ongoing for the past 25 years. An early focus of the cleanup under the site's FFA was to stop liquid discharges that provided a major driving force for contamination. Other early actions focused on getting groundwater treatment systems in place and a vapor extraction system to remove organics from the soil column. In 1994, with much consultation with the public and Tribal Nations, the Tri-Party Agencies developed a cleanup approach that focused on cleaning up waste adjacent to the Columbia River. This approach first focused on waste sites that received large amounts of liquid waste and then on sites that contained reactor components. The bulk of this work is now complete and the DOE and regulatory agencies will soon turn their attention to the waste located in the central part of Hanford. DOE, with EPA oversight, has also moved 2300 metric tons of spent fuel from a water stored pool next to the Columbia River to dry storage in Central Hanford. In addition, DOE, with EPA oversight, is in the midst of demolishing the Plutonium Finishing Plant, considered one of the highest hazard facilities on the Hanford Site. Ultimately the long-term protection of the Hanford Site is dependent on establishing treatment capability and removing the 56 million gallons of liquid waste stored in the 177 underground tanks.

To manage the milestones at Hanford, the team developed a "change control form" which contains all the information necessary to adjust milestones in the site's FFA. The form is an efficient way to add, modify or delete a milestone. Based on the request, the appropriate parties to the Agreement approve the change. The change is then incorporated into the next published version of the FFA. In July 2014, there were eight forms processed: two changes added work to existing milestones, four forms moved existing milestone dates, one form deleted waste units for an interim milestone, and one form deleted a milestone requirement from the agreement.

6. In recent discussions with DOE site officials, they have stated that sometimes EPA focuses too much on regulatory requirements to the sacrifice of higher priority health and safety risks. Does EPA agree that this is problem? If so, what remedy would it propose?

EPA does not agree that regulatory requirements sacrifice higher priority health and safety risks. In fact, CERCLA's overarching mandate is protection of public health, welfare and the environment from actual and potential threats posed by uncontrolled releases of hazardous substances, pollutants and contaminants. If there were to be a situation where compliance with a regulatory requirement, such as an ARAR or an OSHA standard, causes an unacceptable risk, the statue and NCP contain provisions that enable solutions with meaningful public comment that ensures protection of human health and the environment. Again, the FFA provides a procedural framework for resolving many types of disputes including those related to remedy selection. This process results in a transparent solution that is legally defensible and supported by data and information in the administrative record. For example, it may be possible to use CERCLA § 120(d)(4) to waive an ARAR, within the bounds of flexibility allowed by CERCLA and the NCP. Standards and requirements imposed on DOE by itself or other entities that do not meet the criteria for an ARAR are solely the responsibility of DOE.

7. What should be done to improve the EPA and DOE collaboration on addressing priority risks at DOE sites?

EPA's view is that FFAs, refined over some 30 years, work well. EPA enters into an FFA with federal agencies to ensure protective and timely cleanups at federal facility sites on the NPL. These agreements provide the technical, legal and management processes necessary for a federal facility to implement cleanup and places appropriate emphasis on public health and worker safety. In particular, an FFA specifies milestones for the federal facility to complete remedial activities, defines formal dispute procedures, stipulates penalties for missing milestones, and includes arrangements for long-term operation and maintenance at the facility. Further, the agreements provide the flexibility during implementation to address changing site circumstances, new technologies or budget challenges.

In EPA's experience, problems develop most often when communication fails or critical decisions are made unilaterally. EPA and DOE recognized the importance of collaboration and good communication in the 1997 "Final Guidance on Improving Communication to Achieve Collaborative Decision-Making at Department of Energy Sites" joint document. Clear and consistent communication can result in cost reduction, focused efforts on the appropriate actions and accelerated cleanup. As always, EPA supports

the premise that disputes should be resolved at the lowest level possible in a timely manner. The regional project managers are delegated authority for prioritization and sequencing of work through the IAG processes. EPA Headquarters does not typically provide input or review these decisions unless a Region requests Headquarters involvement or if a dispute is likely to occur.

The 1996 FFERDC report elaborated on 14 principles, established by consensus, that the Committee believed should be considered in federal facility cleanup decisions and should apply to all persons and institutions involved in the process. The principles serve as the foundation for the Committee's specific recommendations about four key areas: 1) sharing information, 2) ensuring environmental justice, 3) establishing advisory boards and 4) understanding the federal budget process. EPA continues to look to these principles to help cleanups be efficient and effective with the support and backing of the affected communities. Ultimately, the investments made in cleanup should build healthy, safe, and economically viable communities.

8. How are projects identified for review by the National Remedy Review Board (NRRB)?

EPA created the NRRB in January 1996 as part of a comprehensive package of reforms designed to make the cleanup programs faster, fairer, and more efficient. The NRRB is a technical and policy review group that understands both the EPA regional and headquarters perspectives in the remedy selection process. It reviews proposed cleanup decisions that meet cost-based review criteria to assure they are consistent with Superfund law, regulations, and guidance. The NRRB is composed of managers or senior technical or policy experts from EPA offices important to remedy selection issues.

The Board will typically review proposed interim and final Superfund response decisions at both NPL and non-NPL (including Superfund Alternative) sites for which the proposed:

- Remedial action costs more than $50 million; or
- Non-time critical removal actions (NTCRA), at sites other than a federal facility, is estimated to cost more than $50 million; or
- Board reviews will also occur for NPL and non-NPL sites following changes made after the release of the proposed plan:
- A different or modified alternative (which was included in the original proposed plan) is selected by the region that costs more than 20 percent when compared to the original proposal and these costs trigger review criteria (even when the earlier proposed action had undergone Board review).
- A new alternative is developed and the costs of the new alternative would trigger a review.

The Board may review (at regional discretion) sites where the proposed action's original cost estimate increases more than 20 percent after issuance of the Proposed Plan due to either updated cost information or minor changes to the alternative that trigger review criteria. Examples of minor changes are presented in Chapter 7 of "A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents," (OSWER Directive No. 9200.1-23P, July 1999).

Federal facility sites (other than DOE but including Formerly Used Sites Remedial Action Program sites) follow the same review criteria above with the exception of NTCRAs; federal facility NTCRAs do not undergo Board review unless requested by the federal facility. BRAC sites do not undergo Board review.

For DOE facilities the NRRB typically will review sites where the primary contaminant is radioactive waste and the proposed remedial action costs more than $75 million. The Board will also review NPL sites with NTCRA exceeding $30 million involving primarily radioactive waste; (per joint Department of Energy/EPA memorandum dated October 5, 1998).

QUESTION SET 4 – INTERVIEWS WITH DOE, DNFSB, STATE OFFICIALS AT HANFORD, SAVANNAH RIVER, AND OAK RIDGE SITES WITH SELECTED TEXT BOXES FOR ILLUSTRATIONS

Site Visit Notes: Savannah River, Hanford, and Oak Ridge

The Committee visited the Hanford, Savannah River and Oak Ridge Sites. The following section presents the results of each site visit separately. The reader will find common responses to many questions. Those common responses as well as differences are integrated in the major findings and recommendations sections.

HANFORD VISIT NOTES

(Fact-checked by ORP and RL and a combined set of notes sent to Committee)

Five Committee members (Apostolakis, Greenberg, Krahn, Matthews, Rispoli) accompanied by two Committee staff members (Lowrie, Pannella) visited the Hanford site on August 4-6, 2014. On August 4, the Committee toured facilities across the 580 square mile site and had an opportunity to talk with DOE and contractor staff. The Committee entered some facilities, such as Waste Encapsulation Storage Facility (WESF), and viewed operations at the Environmental Restoration Disposal Facility (ERDF).

On August 5 and 6, the Committee met with over 30 representatives of the Richland Operations Office (RL) and Office of River Protection (ORP). These meetings included senior managers for both RL and ORP, as well as staff who report to these managers. Several senior Hanford staff visited with the team 2 or 3 times in order to share their insights and engage in discussions. The Committee also met with representatives of the DNFSB and the State of Washington's Department of Ecology. Region 10 of the USEPA declined to meet with the Committee in Richland. The Committee met with EPA officials during September 2014 in Washington, D.C.

Committee staff took more than 40 pages of notes and each Committee member took his/her own notes. The presentation that follows is not a written recitation of the notes. Some discussions receive more attention than others. Specifically, the report emphasizes policies to reduce nuclear and other

hazardous material exposures, the tension among policy levers that seek to achieve those reductions, and emerging human health and safety issues.

Other issues are only briefly acknowledged or not discussed at all. For example, the Committee visited the 100+ acre ERDF landfill and spoke about other landfill issues (Jacobs 2013; Maxson et al. 2010; Mehta et al. 2013). Lack of focus on ERDF and other parts of the site in this report does not mean lack of importance. Indeed, the Committee came away from the site visit with an image of a series of interconnected gears that must work in order for the risk reduction machine to operate. The failure of an asset like ERDF would slow down Hanford's efforts to reduce human health and safety risks.

The presentation is organized by questions posed to site officials by the Committee. Please note that no one is identified with a particular statement. While on site, the Committee found some questions to be more important to the Committee's work than others. Accordingly, several of the questions were not pursued in depth in order to allow more time for others.

4. General Question: How are risks to public health and safety considered as part of state and federal regulatory compliance and priorities at DOE-EM cleanup sites?

Hanford 4a. How does the DOE at the (Hanford/SRS) site prioritize public health and safety compared to ecological risk and natural resource restoration and protection (e.g., water resources)? Prioritize worker health and safety compared to the health and safety of people currently living off site or may be present in the future as a result of land use changes? Are there specific cases that illustrate how you balance these?

Everyone the Committee spoke with stated that human health and safety was the highest priority, ranging from senior site managers familiar with the entire program to project-specific representatives who check on day-to-day worker practices in the field. Their examples were different, but their emphasis was the same.

Site managers emphasized human health and safety priorities in relationship to the budget process that they follow. Every year, the site receives a budgeting letter with specific directions from DOE HQ, It includes the following:

- HQ program priorities
- A budget "target"
- Guidance about providing appropriate priority to regulatory compliance, Tri-Party Agreements (TPA) milestones, DNFSB recommendations and other budget elements
- Suggestions about near-term and long-term compliance issues and milestones.

Site managers, place HQ guidance into three budget priority bins:

1. Minsafe and associated essential facilities and activities
2. Requirements under TPA
3. All other issues

Site staff indicated that Congress can change local priorities and mandate that the site do more work on certain projects, for example, additional funds for the tank farms. However, at Hanford and Savannah River providing money for a specific project may not proportionately reduce risk as rapidly as Congress expects because another component of the system required for risk reduction is not ready for the additional operations, in other words, one of more of the interconnected gears stops or slows down progress. Site staff much prefers multi-year funding that will allow them to plan and implement a smooth implementation of operations. This preference was underscored by State of Washington representatives (see below).

Both RL and ORP, as required by DOE headquarters (HQ), began their explanation of their annual budget request with the so-called Minimum Safe and Essential Services (MinSafe) elements, which include resources needed for operating facilities for keeping operating facilities in a readiness state (Tyborowski 2012). This highest priority set of requirements allows the site to meet its objectives and minimize risk to human health and safety, whether it is the tanks farms, pump and treat, or other on-site activities. Another component of MinSafe requires resources to maintain surplus facilities that are to be deactivated and decommissioned. This element of MinSafe, the Committee was told, prevents non-operating facilities from deteriorating in ways that could threaten human health and the site's mission by leading to a release, posing a physical hazard, and requiring more expensive D&D at a later time. The third component often under MinSafe is facilities that do not directly advance the site missions but are essential, including infrastructure. Site management estimated that MinSafe may absorb 50%-80% of the total budget.

The next level of drivers is based on the Tri-Party Agreements (TPA). The bottom line, according to Hanford site managers, is that if there is a budget shortfall, MinSafe, nuclear, and OSHA takes priority over TPA, RCRA, CERCLA and in the case of Hanford, even requirements in the Consent Decree portion of the TPA. Site managers indicated concern about an already large and growing TPA-related backlog, although noting that historically 95% of all TPA milestones had been met. They added that DNFSB letters/recommendations have the potential to conflict with TPA/Consent Decree requirements and cause TPA deadlines to be missed. They emphasized that while they follow the DOE HQ blueprint in their budget plan, they will shift whatever resources they can to address emerging problems that arise. Several of these problems, all concerning human health and safety, are discussed below.

The Committee asked RL staff where they would direct their resources in order to protect human health and mitigate safety risks, if there were no constraints on how to use the money. This precipitated a lively discussion.

One staff member said:

1. Worker health and safety
2. Groundwater, including the 324 building and the contamination beneath it, and the 618 burial ground
3. Take the plutonium finishing facility to slab on grade

4. Take nuclear fuel sludge away from the river, put the sludge into one basin and treat it.
5. Reduce the risk as the Waste Encapsulation Storage Facility (WESF).

A second said:

1. Groundwater
2. Plutonium finishing plant
3. Take the sludge away from the river and place it in one basin for management
4. WESF
5. Building 324
6. 618-10 burial ground

A third indicated:

1. Treat the sludge near the river
2. Remediate the 618 burial ground
3. 324
4. Get the capsules in WESF into dry storage
5. D&D the plutonium finishing plant

There is considerable agreement among these three interviewees. However, these three viewpoints do not necessarily represent the site as a whole because the Committee only asked this of RL staff, not ORP, which is responsible for the tanks. With this caveat noted, all the RL priorities are related to health and safety. They range from individual building projects, to large area-wide ones; low probability, high consequence events to chronic emissions; emergent risks only a few years old and others that have been near the top of the list for many years. The challenge for the site managers is how to deploy constrained resources to meet their mission goals, protect the workers and the public, and reduce the legacy of contamination on the site. This challenge falls primarily on the DOE, but the same challenge was clearly voiced by the representatives of the State of Washington (see below).

The Committee illustrates the tension in the budgeting priority process and TPA deadlines with two emergent activities. The Waste Encapsulation Storage Facility (WESF) stores high level waste containing cesium and strontium in capsules in a large pool of deionized water for cooling. When the lights are turned off, the pool containing the capsules glows from activity. Site management has been concerned about the impacts of degradation of the concrete from 30 years of irradiation through the tank walls holding the waste. Hence, WESF has been on the site remediation list, but its priority was increased when events at Fukushima in Japan raised concern about beyond design basis accidents, that is, events that could be triggered by natural hazard events. The combination of a structural breach leading to a loss of cooling water and lack of access for trucks carrying cooling water due to an earthquake has led HQ and the site to focus more attention on WESF. According to site managers, WESF contains 32% of the site radioactivity, and that a beyond-design-basis accident could in the words of one DOE staff member create “a bad day for Washington.” This is a low probability but high consequence event for

the site and region, and the site has been identifying resources that will allow the risk to be reduced as soon as possible, given the budget constraints. According to site management, the original milestone still may not be met.

Building 324 was erected to test special nuclear materials. DOE was in the process of demolishing this building when a breach in the floor was found that had leaked high level radioactive material into the area beneath the site. Upon recognizing the human health and safety risk, the DOE reformulated its plan for the facility. The new plan, according to the Hanford staff, is to excavate under the building and use the building itself as a containment during the remediation. Custom-designed, remotely operated tools that have removed 12,000 curies from the B-cell in 324 will be used for the Building 324 work. However, the remediation approach is not yet proven. On-site staff at the Building 324 site told the team that DOE would not meet the milestone to remove Building 324, but that the State of Washington when informed of the issue had agreed to delaying final judgment until the new approach could be tested (see State of Washington comments below).

Hanford: DOE 324 Example

A major spill of approximately 510 liters of highly radioactive liquid occurred within the 324 Building B Cell located in the 300 area of Hanford during a test of borosilicate glass waste matrices that could be used to manage Hanford's high level defense waste legacy. The facility is 205 ft. by 235 ft., and is 45 ft. high (Rodovsky, Jayamaha 2011). Constructed between 1964 and 1966, the building was used for metallurgical and chemical processing tests and experiments until it was closed in 1996. The two hot cells had viewing windows, remote manipulators, cranes, and access to electrical power, water, steam and air. Metal liners and sumps without drainage outlets were installed to prevent exposures outside the cells. The facility also had HEPA filters and an electronic precipitator in the B cell.

The spill occurred during the "mid-1980s" (p. 5) in the B cell, which is described as 22 ft. by 25 ft. by 30.5 ft., and as extending from 10 ft. below grade to 20.5 ft. above ground. The floor and walls were lined with stainless steel, and the cell is surrounded on three sides by 4 ft.-5 ft. 4 in. thick concrete with oil-filled lead glass windows for viewing.

The DOE apparently did not know that spilled liquid had seeped through the structure and reached the outdoor environment. In November 2009, radioactive grout was being removed from the cell, a clear breach was found in the stainless steel liner. Investigations found

"high dose rates, up to 8,900 Rad/hr. directly below the B Cell floor expansion joints. Samples from below B Cell were collected and sample results confirmed high levels of cesium-137 and strontium-90 contamination. Characterization efforts to date have indicated that contamination has not spread horizontally beyond the building's footprint and not migrated to groundwater." (p. ES-1)

The preliminary evaluation uses a semi-quantitative analyses to examine 14 alternatives across 15 criteria. Four of the 15 are human health and safety (radiation safety, industrial and occupational safety, air impacts, contamination control. The first two of these four are weighted as "critical," the highest score. Across the 14 treatment options two in-situ options have the most protective scores, and yet the authors classify two others as preferred.

Recognizing that two in-situ options have the most protective scores Rodovsky and Jayamaha (2011) invoke CERCLA and note:

"Leaving contamination in place is not consistent with the Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site (Record of Decision [ROD]) (EPA 2001) and CERCLA documentation for the 300 Area. In addition, regulators (U.S. Department of Energy, Richland Operations, and U.S. Environmental Protection Agency) have indicated that they believe in situ alternatives are not acceptable and would be unfavorable with respect to qualitative consideration of "modifying criteria." The approach is also unfavorable with respect to balancing criteria "long-term effectiveness and permanence," which was not included in the specific screening criteria. If determined to be viable, the in situ alternatives would receive a more detailed evaluation beyond attributes common to remove, treat, and dispose." (p. ES-2)

This is a preliminary screening risk analysis. It is meant to eliminate some options and suggest that others be moved forward for further review. It includes attributes that fit under the category of human health risk assessment and risk management. From a human health perspective, on the surface the

report suggests the importance of previously existing legal agreements compared to those of relative human health risk, albeit the human health risk numbers are low.

Site management has devised a plan that would limit the risk by using a cell within 324 to manage the contaminated material. However, according to the field manager, the approach needs to be proven to be feasible. If it fails that test, then the site is prepared to move in other directions. The State official and the DNFSB representatives the Committee spoke with were quite aware of 324 and were participating in efforts to find a solution. It is always possible that the DOE, State of Washington, DNFSB, and EPA (not heard from) will not be able to reach an agreement on how to proceed. But at the time of the Committee visit that appeared to be the intent, that is, to agree upon a solution that minimizes human health and safety risk.

In contrast to these two relatively recent emerging issues that have stressed managers and the site budget, other projects are considered lower priorities, such as the cocooned reactors adjacent to the Columbia River.

Overall, section 4 focuses on the relationship between priorities and the budget process, emphasizing the primary position of protecting human health and safety through the use of risk-informed and performance-based data to grade impacts and efforts to respond to emerging events.

Hanford 4b. How would you characterize the role of the Tri-Party Agreement as a mechanism to protect human health and safety versus ecology, economy and other priorities? Does it limit how DOE can adjust to new information, in general, and to health and safety information, more specifically? Does the TPA increase your communication and influence on DOE's decisions? Would you adjust the TPA to place more emphasis on human health and safety? If so, how?

The DOE was out of compliance with federal law when the Tri-Party Agreements were signed. For example, 149 single-shell tanks are not RCRA compliant. The TPA agreement has allowed the DOE to continue to operate under interim permits. Site management noted that there is a general consensus that the agreements, written 25 years ago, are dated, and that some of the elements need to be renegotiated in order to allow the DOE to have a more flexible response to emerging events. The State manages and licenses the Hanford site for RCRA and EPA directly manages CERCLA on the Site. EPA also has a RCRA compliance Division at Region 10 in Seattle that oversees the State's management of RCRA at Hanford. All are actively involved in remediation decisions – not all through the TPA. Sometimes it is difficult to satisfy all the parties in a way that is consistent with human health and safety risk reduction. A site manager noted that system-wide the DOE needs an annual budget of $7.5 billion and only has $5.5 billion, so that tough choices need to be made in order to determine the most important priorities, which the staff considers to be human health and safety. At Hanford, the managers estimated that they need $3.5 billion to meet all compliance requirements and that $2.2 billion is the site budget. At Hanford, the TPA agreement is to be renegotiated in the near term future, and the Committee sensed that the DOE and State of Washington representatives were reluctant to provide many details to the Committee.

With that caveat noted, some staff feels that it is difficult to meet all the demands under TPA and optimally protect human health and safety. The group discussed programs that are more important for human health and safety and those that may be important but are somewhat less urgent. Here are several examples that were discussed at the meeting. The Committee notes that these illustrations were offered by site staff, and the Committee does not believe it is part of its charge to prove or disprove the contentions, but rather it is to reflect and comment on their perspectives.

DOE staff indicated that they are required to remove 99% of the volume from every high-level waste tank. They would prefer to be able to average across an entire tank farm. They asserted that human health and safety risk does not increase by leaving 8% or 10% in the tanks, that is, 90% to 92% removal rather than 99%. They argued that the material is not mobile and that overall risk may actually be increased by spending more worker time on every tank, or as one manager indicated: “everything that doesn’t add value toward reducing risk extends risk.”

Based on their analyses, they observed that radiation hazards are not equally distributed in every tank, nor is there is a consistent product in every tank. Some tanks need more volume removed to reduce the risks than others. Accordingly, it would be more effective, argued Hanford staff, in regard to reducing risk to assess the hazard in each tank rather than applying a simple rule across every tank. Less clear to us was the impact on worker safety of having workers remove additional material from the tanks. ORP can ask for an exception to the 99% volume requirement in the consent decree, but that requires trying two technologies and then the tank closure may not pass NRC performance assessment tests for closure.

The question of what is the best set of policies to manage the tanks requires risk analyses that involve technical and legal inputs, and the decision has multi-billion dollar implications, as well as human health and safety ones.

A second example, at a very different scale, is the disposition of contaminated pumps and other components. The Hanford site practice was to bring them to the site landfill and encase them in concrete. However, this practice has had to stop because the landfill legally is not considered a treatment location. Hence, the encapsulation has to take place at the removal location. Staff asserted that this increases worker risk because the component being carried to the landfill is much heavier and difficult to handle. This RCRA-related constraint is being negotiated, but pending resolution continues to be a worker-related risk.

A third example is the requirement that low level waste be vitrified. Insistence on “glass or as good as glass” absorbs a great deal of resources that could be shifted to other health-related risks and more quickly reduce the overall risk burden, argued several staff.

Overall, Hanford staff said that they are funding “mostly the right things” to reduce the risk, but they were candid about their concerns that the complex regulatory regime makes it difficult for them to optimize their resources so that the risk can be decreased more rapidly.

There was considerable discussion about the pros and cons of the TPA, CERCLA, RCRA, and consent decrees and how these impact the Project Baseline Summaries (PBSs) that are the categories of budget expenditures that the sites work with. The essence of the staff remarks is that the Consent Decrees receive the highest budget priorities because DOE would like to avoid being sued and forced to pay penalties (The DOJ is a party to Consent Decrees, and hence they are more difficult to modify because judicial approval is required.) Second, changes in RCRA have been hard to make, according to site managers. CERCLA was discussed as a law permitting more flexibility. The idea of folding all of the controls into FFA was discussed. The advantages and disadvantages were considered in the context of the political realities that the states or that the EPA would lose some control if everything was put under FFA.

In regard to the control points, site managers asserted that these are too restrictive and that the site needs approval from HQ and Congress to change these. They called for more aggregate categories. RL has 9 control points and ORP has 2, which is further broken down by project groups. Reducing the number of control points would allow the site to be more responsive to new information and events.

A final point concerns how much flexibility sites need in order to be more responsive to emerging human health and safety issues. No single figure or proportion was stated by Hanford site representatives. However, when Committee members worked through several examples with site representatives, about 5% to 7% seemed to be the shift needed to give upper management more flexibility to deal with issues like Building 324 and WESF. (This discussion also occurred with Savannah River and will be continued in that presentation.)

Summarizing, section 4b raises issues about how clean is clean enough and how to decide on priorities based on human health and safety compared to other considerations informed by risk information and performance assessments.

Hanford 4c. What sources of human health and risk information do you rely on? (EIS, safety reports, feedback from DNFSB, EPA, state regulator reports, etc.). Examples?

Committee time for this set of questions was limited. The Committee concentrated on the role of the DNFSB, which along with DOE, plays a key role in gathering and interpreting data. The Hanford's DNFSB representatives indicated that they are present at the site for direct observation and for quicker access to information and site personnel. DNFSB's technical expertise is focused in DNFSB headquarters. DOE and DNFSB representatives have regular meetings and the State and EPA representatives will be engaged when an issue overlaps their concerns. DNFSB representatives, joined by several DNFSB HQ representatives via the phone, explained how they worked as a group and with DOE.

DNFSB representatives look at compliance with DOE orders and a great deal of their effort is on nuclear-related worker safety. Noting that they do not direct DOE data gathering or analysis priorities, and certainly not budget priorities, nevertheless, their recommendations can change DOE priorities. An example is the ventilation system at the double-shell tanks. DOE downgraded the system from "safety

class" to "safety significant." After interactions with DNFSB, the system designation was changed back to safety class, which has implications for DOE's data gathering and analysis and funding. (Safety class means protection of the public and safety significant means worker protection.)

DNFSB staff has also been involved with many other issues, such as contaminated dust blowing in the area of the site closest to the city of Richland, fire main breaks, and vulnerability caused by an older fire water delivery system, electrical shorts, and falling of telephone poles. DNFSB staff is concerned about budget shortfalls that make it difficult to upgrade this critical infrastructure during the extended life of the Hanford site. Each of their concerns has implications for DOE's gathering and analysis of data, and in the bigger picture of how to deploy limited resources. The Committee sense of their effort is that it relies heavily on reviewing DOE's data, especially safety information. For example, DOE Order 413.3-7A (Department of Energy, Office of Management 2011) requires that each project maintain a risk register that ranks major projects risks, including human health and safety ones. These data would be available to the DNFSB site representatives, and their involvement begins during the planning stage all the way through closeout and lessons learned.

DNFSB has been involved in the WESF project, most notably with the call for an upgraded ventilation system and removal of the capsules to dry storage. Other elements of the WESF plan were discussed, including their role in the 30% design review for the entire site. The WTP is not operational until 2027; hence their concern about the integrity of the facility has increased. DOE's objective is to get the capsules to dry storage by 2018-2020. Removing the capsules to dry storage, according to the DNFSB representatives is being planned and DNFSB representative will be involved at every stage focusing on human health and safety. DNFSB staff will be present at events, will be part of briefs, and will examine DOE reports. One issue that was part of the discussion is that the DOE self-regulates nuclear safety and this does not fall under the TPA, but it is part of the DNFSB mandate.

In regard to methods and tools used by DOE, several discussions were held in regard to use of quantitative or probabilistic risk assessment (or PRA). Two staff members noted that DOE has not embraced the tool and explained that there remains a tendency to rely on deterministic approaches that reduce risk by multiple redundancies and other safeguards (Marusich 2012; Office of Management 2011). Several attendees noted that probabilistic risk assessment would reduce the number of redundancies, some of which increase risk, as well as serve as a planning tool that can be used to examine the implications on human health and safety of alternative risk management steps, some of which increase risk. A discussion ensued about the appropriate use of PRA on a site-wide basis or for a particular site still in design such as the WTP or the MOX facility. The benefits of PRA application were discussed. They include:

- The identification of vulnerabilities and subsequent risk reduction by taking appropriate action
- Using PRA in early enough stages to optimize the design of systems

However, every analytical approach has disadvantages, in this case, it takes time to build the models, special expertise to operate them, and appropriate data. This issue is raised again as part of question 5.

For context, there is an ongoing need to consider the advantages and disadvantages among those who historically relied on engineering judgment and safety standards and those who have incorporated PRA into their set of toolbox.

Summarizing, section 4c focused on the role of the DNFSB in human health and safety at the site, and it was clear to the Committee that the DNFSB representatives are deeply invested in human health and safety issues. This section also touched on the potential use of PRA in the DOE's toolbox at this site.

Hanford 4d. Is there a lessons learned program? How is this used to reduce human health risk and worker exposure and injury, the site's strategic plans?

Time constraints limited our focus on applying lessons learned programs to human health and safety at this site. Our major opportunity was a meeting with the operational safety oversight personnel. They indicated that they schedule based on their judgment of which activities and/or processes presented that highest level or risk. They presented their impact on health and safety as follows:

- Documenting human health and safety findings that are graded according to the level risk associated with the deficiency (Level 1, Level 2)
- Turning these into lessons learned and sharing these with staff and with the contractors.
- Convincing the contractors that they should decide on their own to curtail work when they are unclear about what to do is better than having the operational staff halt work
- Participating in detailed work planning meetings and ensuring that safety and health requirements are properly reflected in work packages is essential to reduce exposures and injuries and improve training
- Participating in evaluating contractors for the determination of how much "award fee" (profit) they will earn is an important mechanism for making sure that contractors listen to the lessons learned

The operational safety personnel use their observations and findings to recommend "special emphasis areas" for safety improvement. They noted that "We are focused on safety and health" and "are not under schedule pressure," which they asserted allows them to provide unbiased safety input to senior managers.

The operational staff noted that they had a good working relationship with the DNFSB Site Representatives, who were doing work that complements their efforts, and they provided examples and photos that illustrate what they do on a day-by-day basis.

Hanford 4e. How do you evaluate and balance your focus on major external events, such as earthquakes and volcanic ash vs. electrical fires due to old wiring in an old building and deteriorated infrastructure that could cut off the water supply during a fire? How are they balanced and should the balance change?

Balancing among objectives is a constant issue for the sites. At this time, one area is out of balance. There is growing concern that the 50+ year-old site infrastructure needs attention. This concern was heightened by the recent events at WIPP, and the staff is now focusing on critical infrastructure, most notably energy and water. The bigger picture for site managers is that they were going to be running active programs longer than they had anticipated, which means that the already old infrastructure would be further stressed and had a higher likelihood of failing. In other words, the risk was not static and site management needs to re-evaluate deferring maintenance because not only could cost increase as a result of failure but key safety systems could be compromised by failures in water and electrical systems that lead to increased human health and safety risks.

This was a consistent theme mentioned and discussed at almost every meeting. This site is expected to retain key functions for many decades in at least a central core, and managers and other staff are assessing what infrastructure is critical to human health and safety and to continuation of the missions.

Hanford 4f. What roles do institutional controls, and land use designations play in protection of human health and safety at the DOE site? How much do you rely on them to protect human health and safety?

Site management explained that the Hanford land use plan, which is a product of many meetings among the site specific advisory board (SSAB), and contains input from the state and EPA, is to shrink the contaminated area at the edges, especially along the river and gradually move back to a 10-square mile area on the central plateau. Shrinking the area of major concern would allow more focus of resources on the major facilities on the central plateau where the high level and low level nuclear wastes are managed. This plan will also reduce any contamination flowing into the Columbia River, and eventually could lead to some sections of the site.

Hanford 4g. Asked of DNFSB and state representatives. Can you provide us with examples of some of the more successful interactions with DOE? Of those that were less successful? What makes the difference between major and less success? Are there unexpected beneficial or negative outcomes from these interactions? (e.g., changes in policy, practice, ideas, beliefs, and attitudes)? How central was human health risk information in the illustrations?

Site management noted too much emphasis on RCRA, which they believe leads to allocation of resources in ways that would not follow a health and safety based prioritization. An illustration is the finding that a “cupful” of waste had leaked from the inner tank in a double-shelled tank system into the annulus. According to site management, too much emphasis has been placed on the leak, whereas site management would have preferred to spend that money on thousands of gallons of waste that had leaked and was in the environment. The managers emphasized that the leak in the double-shelled tank should be addressed, but is a lesser risk than others. They indicated that the estimated cost of dealing with this cupful of waste was $90 million out of the total tank farm budget of $500 million. DOE representatives noted that there were 90+ milestones in the TPA and the regulators felt that they were

obliged to enforce these, including the double-shelled tank illustration that they raised (this example was also discussed with DOE HQ and EPA).

The State of Washington representatives discussed their ongoing relationship with the DOE (notes fact-checked by State representative). The State of Washington is deeply engaged with site management regarding on-site activities and focused on those that impact the health of residents of the state, as well as ecological systems and cultural assets. The State supports the idea of reducing the footprint to the 15 square mile area because it will reduce risk and move activities away from the Columbia River. The State representatives noted that worker health was not part of their responsibility, but that they clearly were concerned about it. Nuclear safety per se is not a focus area of the State, and that is more in the purview of DNFSB. However, the State is involved in discussions about all of these issues, even if they do not regulate them.

Much of the discussion between the Committee and the State representatives focused on the TPA and the consent decree, which is in the process of being renegotiated. The sense of the Committee is that the State balances human health risk concerns against other priorities. When the American Recovery and Reinvestment Act (ARRA) dollars were available, the DOE was able to build and begin operating the groundwater treatment plant, which was a major success story. But with reduced budgets it has become progressively more difficult for the State as well as DOE to set priorities.

State representatives summarized their process as requesting all the elements of the TPA, but that when the budget comes back they meet with EPA, RL and ORP to discuss the priorities. In addition to regularly scheduled monthly meetings, there are semi-annual meetings among the Director of Ecology, EPA's CERCLA director, RCRA director, and the site managers of RL and ORP, and there are informal meetings to discuss emerging issues.

State representatives candidly discussed their priorities. In a budget crunch, their priorities would be soil in the central plateau, the canyons, the tanks and the waste treatment plant. Their concern is that under a reduced budget regime the DOE would be forced to "rob Peter to pay Paul." One representative illustrated that they had made excellent progress on transuranic (TRU) wastes until the current WIPP problems. Now they were concerned about delays in removing the rest of the TRU (about half has been removed from Hanford) as on ongoing risk. They would be discussing this issue with DOE.

The State wants the low level waste facility to begin operations, but the state representatives believe that it will be a challenge to begin the operation, and they are concerned that once processing begins it will not be sensible to stop, and yet with declining budgets, the pressure will be on the DOE to find funds to do this risk reduction work and not slowdown other programs.

Asked to compare the state's risk-related priorities with EPA's and the DOE's, the state representatives stated that they generally were the same, with several differences. The State of Washington, they noted, thinks TRU is more important than the EPA does. All of them think that the tanks and groundwater pose the most serious human health risks. A State representative noted that they were

also concerned about leaking drums exposing workers, albeit this is not their major legal responsibility. The State noted their concern about deteriorated infrastructure, and was pleased that the DOE was including them in discussions of what is included in MinSafe.

Washington State representatives noted that there is a perception that the State is inflexible and only focused on what they are legally responsible for. They noted that there have been 458 changes to the TPA milestone in the TPA over 25 years, and that the State was always ready to meet with DOE to discuss issues. They will be negotiating a new consent decree with the site and this could lead to more being included than the current 50 requirements. The State of Washington team recognized that it wanted a consent decree, but that it does not want judicial orders (consent decrees) replacing the TPA to set priorities. They acknowledged that the State can use consent decrees to keep the tanks on the "front burner." They urged the Congress to provide DOE with multi-year funding to allow the site to plan and implement their programs.

The State representatives challenged the DOE and scientists to develop tools to better characterize risks, focusing on the impacts on human health and safety, as well as ecological risk in three categories:

- Long-term vs. short-term risks
- Worker vs. environmental risks
- Serious vs. more minor risks

Such tools would help them better understand and explain the challenges that DOE faces to non-scientists. The State of Washington representatives noted that human health and safety risks cannot be used as the singular determinant for actions.

This session ended with a discussion of the need for more than one year funding. The State believes that a lack of consistent funding makes it difficult for the DOE to plan projects, hire and retain workers, and complete the projects in a timely manner. They noted that this is an issue for Congress, OMB, as well as the DOE. (This issue will be repeated in the discussions with Savannah River officials).

SAVANNAH RIVER VISIT NOTES

(Fact-checked by Bill Clark)

Three Committee members (Greenberg, Krahn, Rispoli) accompanied by two Committee staff members (Lowrie, Pannella) visited the Savannah River Site on August 11-13, 2014. On August 11, the team heard an overview of the site from a senior site manager and then toured multiple facilities, including the H-Area (nuclear materials), a tank farm, the Defense Waste Processing Facility (DWPF), the F- and D-areas, including building 235-F, and the Savannah River National Laboratory. Three members visited the L-Basin (nuclear materials) on August 13.

Savannah River (SRS) field staff was responsive to questions, emphasizing the role of these facilities in the context of the overall site missions. In every case, when members entered an area with radioactive material, the Committee wore dosimeters, were monitored for exposure, were guided so that the group avoided restricted areas, were told to stay hydrated and keep a look out for snakes.

On August 12 and 13, the Committee met with 19 members of the SRS management group. A senior manager provided the Committee with a flow chart that ties together the operations of more than a dozen major facilities. He stressed the relationships among the activities at these sites and emphasized that a slow down at one would cascade through site operations. The theme of a series of interconnected gears was addressed on many occasions during the Committee's site visit at SRS and other sites.

During the visit, the Committee spoke with a DNFSB staff member and with a representative of the State of South Carolina via the telephone. Committee staff and the three Committee members took copious notes that primarily reflect the views of DOE managers, but also include valuable insights from a DNFSB representative and a South Carolina regulator. The presentation that follows focuses on ongoing efforts to reduce nuclear and other hazardous material exposures, the tension among policy levers to achieve those reductions, and management of emerging human health and safety issues in waste management-related programs.

Other issues on the site are only briefly acknowledged, or not discussed at all. For example, the Committee visited the L-Basin and the Savannah River National Laboratory, affording us insights about security at the site and efforts to use the site's attributes to manage nuclear risks in the United States and elsewhere. These visits provided valuable context, but are not emphasized here. For example, the Committee did not pursue the human health and risk implications of DOE's consideration of down-blending spent nuclear fuel for sale to the Tennessee Valley for use in a power plant (Mitre 2013). The implications of that consideration involve use of the H-Canyon and L-Basin, the site's vitrification plant and canister storage areas, as well as other risks associated with transportation.

This presentation is organized by questions posed to site officials by the Committee. Please note that no one is identified with a particular statement. While on site, members found some questions to be more important to the Committee's work than others. Accordingly, several of the questions were not pursued in depth in order to allow more time for others.

A note of context about what constitutes risk is in order because SRS site management raised the issue of what is meant by risk on several occasions. (The discussion of different kinds of risk is found in sections 2 and 3.) For complex multi-attribute sites like Savannah River, risks include those that impact human health and safety, as well as compliance with regulations, mission objective, and cost. The Committee asked SRS staff in charge of risk management what proportion of risks is directly related to health and safety. With the preface that all the risks are indirectly related to human health and safety because every action engenders risks, they indicated that about 20-50 of 800 in the risk register were primarily human health and safety risks (OSHA, radiation, and environmental risks).

4. General Question: How are risks to public health and safety considered as part of state and federal regulatory compliance and priorities at DOE-EM cleanup sites?

Savannah River 4a. How does the DOE at the SRS site prioritize public health and safety compared to ecological risk and natural resource restoration and protection (e.g., water resources)? Prioritize worker health and safety compared to the health and safety of people currently living off site or may be present in the future as a result of land use changes? Are there specific cases that illustrate how you balance these?

From the site manager down through the ranks to the field staff that routinely check for exposures and safety violations, human health and safety was the highest priority.

Senior managers listed SRS site priorities as follows:

- Safety and security
- High level nuclear waste management (radioactive tank waste stabilization, treatment and disposal; spent nuclear fuel storage, receipt and disposition)
- Other nuclear waste management (special nuclear material consolidation, processing and disposition, high risk groundwater remediation, TRU and mixed/low level waste disposition)
- Deactivation and decommission (D&D) of excess facilities

These priorities are fitted into an Integrated Priority List (IPL) with the following major components:

- Existing pensions, post-retirement benefits, essential site services, landlord and other services
- Existing Technical Baselines (including MINSAFE, regulatory compliance, making progress)
- Critical Infrastructure Integrated Priority List (risk ranking based on probability and consequence of impact on health and safety, compliance and regulatory impact, mission support, and cost impact)
- Emerging Scope (Externally driven (IG, GAO, DNFSB); Weather-related; New Programs [SNF dry storage, Small Column Ion Exchange (SCIX)]

Staff comments about human health and safety were not subtle. They focused on budget-related issues. According to management, SRS's ability to maintain its priorities, meet its TPA schedules and respond to emerging risk-related threats had been undermined by the following:

- Budget cuts, including most recently to the program to reduce the tank waste
- The sequestration of funds and the potential for abnormal events such as an ice storm that absorbed contingency funds
- Lack of flexibility in the budget control points (PBSs)

Recent budget cuts have been a major blow to the site, especially to the high priority effort to process liquid tank waste and process the high level waste into vitrified waste in canisters. The site says that it can process about 300 high level waste vitrified canisters a year, and only expects to be able to process about 150 during this fiscal year. Not only has the canister program slowed down, but the effort to build the Mixed Oxide Fuel Fabrication facility (MOX) has been slowed down. (The MOX program would convert some of the 34 metric tons of weapons grade plutonium to reactor fuel, which is a NNSA program.)

Senior management indicated that the State of South Carolina is greatly distressed and expects the State to take action legal action to gain more resources for these programs (See State comments below). Not far below the surface of this issue, the Committee members sensed that there is the perception that sites with Consent Decrees have received more funding than those that do not – the "squeaky wheel gets attention" were the words of one staff member. Under the worst circumstances, SRS management observed that dollars set aside to reduce risk would be diverted to pay penalty judgments against the DOE, potentially in excess of $100 million. This legal action was taken later in 2014.

Site managers stated that the highest risk is in high level waste in tanks, and they will have a difficult time meeting their TPA schedule because of budget shortfalls slowing down key parts of the program. As context, they noted that 6 of the 51 HLW tanks have been closed. But 14 tanks are in water table (the team visited several of these), and these are the highest priority risk-related activities. Managers noted that the site could close two tanks every 12-18 months, and had hoped to close up to 3, but that accomplishment did not seem possible at this point.

The Committee observed that sometimes budget and technology constraints have been conflated. For example, radioactive salt waste that contains about half the curies in the tanks is a high risk priority, and site management indicated that the Saltstone facility needs more support than it has received. The site system plan, which goes through the year 2042, indicates how much salt will be dissolved, what tanks will be closed and when, and all of these need to work together to reduce risk sooner rather than later (Chew et al. 2009). Technology can also be an issue. A new facility, the Salt Waste Processing Facility or SWPF (using new technology) will be able to increase production to 5 million gallons per year. The site hoped to have the SWPF in service by September 2018; but SWPF may not be getting sufficient funding to finish the project sooner. The budget process needs to fund "all steps" in the gear chart not just a select few, argued site management. The slowest cog reduces progress toward risk reduction, as noted by site management. However, there remains some uncertainty about the technology and other alternative technologies (see below).

In regard to technology, one option for dealing with the SWPF facility issue would be to have a small-column ion exchanger and microfiltration. This could add 3 million gallons a year to throughput. But site management believes that it is not needed to meet project schedule and would add benefit only in the short-term and as a redundancy. They would prefer to put that money increasing the volume going to the Actinide Removal Process (ARP) and Modular Caustic Side Solvent Extraction Unit (MCU). These integrated units work to remove nearly all of the radioactive isotopes from salt waste solutions in SRS's waste tanks before the waste is transferred to the Saltstone facilities for disposition. So, technology choices are available and will need to be made in the context of risk reduction, as well as cost.

Sequestration of federal government funds is a problem for this site that go beyond an overall budget reduction. SRS senior management emphasized that the site depends on skilled workers working safely with dangerous materials. Safety of onsite systems was not compromised by the sequester in 2013. The site was able to manage key hazards, such as the tank farms in a “safe and secure” state. But there was no maintenance at the site, no training, and work on other non-hazardous projects was halted. The stoppage slowed progress.

Site managers explained the longer term impact of sequestration on human health and safety and the overall site mission. They had to furlough 1700 workers in the liquid waste program, and more across the site. When work resumed, many of these highly skilled employees did not return because they had lost confidence in the DOE site as a reliable source of employment. Context for this observation is that new nuclear energy facilities are being constructed across the Savannah River in Georgia, and some of the most capable employees moved over to those sites. When work resumed, the site contractors had to recruit new employees, which is always a human health and safety concern when they are working on hazardous material projects. Regarding worker skills, site managers noted that it takes 12-18 months for operators to become fully functional. The site has a problem, especially concerning younger engineers, who see the writing on the wall, and go elsewhere. In regard to security, the site’s number 1 concern is about a distressed worker scenario and he noted this entails some dependence on supervisors to monitor behaviors. The “insider-insider” threat is present too. Reducing risk requires careful attention to employees along the entire chain of command, which requires retention of key managers. Furloughs cut into that cadre of experienced employees.

The Committee witnessed the need to retain experienced employees in order to avoid potential risk producing errors during a tour of the H-Canyon. H-Canyon receives nuclear materials from the L-Basin and other on-site sources and sends waste to the tank farms and nuclear materials to other storage areas on site. The massive control room in the Canyon includes some equipment that dates from the 1950s and ends with recently installed panels. Many of the operators are young and require training on equipment that crosses three generations. Furthermore, the parts are a challenge to find, and the site searches e-Bay to find spare parts.

The DNFSB representative indicated that the contractors training staff has been cut 50% and the study guides are out of date (see more DNFSB comments below). With fewer engineers, the site moves them to most critical areas, so other areas (e.g. F-area) may have increased risk. As technical skills are lost, site

management is concerned about conduct of operations, in particular risky shortcuts. Indeed, a letter was sent from DNFSB about concerns regarding conduct of operations. When senior people are lost, "soft skill" judgment to deal with problems is lost. Younger personnel may be less willing to critique contractor personnel. The DNFSB representative rank ordered as worker training as a priority higher than maintenance of non-safety systems, and emergency drills.

Several staff noted one particularly serious example of critical infrastructure-related risks. On January 6, 2014, a polar vortex weather event enveloped the SRS area with unusually cold weather. The Ameresco steam and power plant (wood chips used to produce steam that replaced a coal plant) was not designed for such cold weather and the plant broke down shutting off steam to site facilities for a week because of a lack of backup steam generation facilities. With regard to thinking in terms of infrastructure requirements for "beyond design basis" events, a comment was made that a point to remember is that offsite services that might be counted on normally may not be available and this could compromise safety.

In addition, site management noted that sometimes there is a disconnect between budget allocations versus when funds actually become available. For example, if funding is received after 5 months have already passed during, then only minimal work can be accomplished because it is difficult (perhaps unworkable) to ramp up to complete enough during the remaining 7 months to use all the funding. In short, in addition to budget reductions, according to site management "continuing resolutions (CRs) are killers." Only the lowest amounts in different federal budgets are permitted to be spent through CRs, the funds are unpredictable and there are effects such as the furloughing of staff. Current funding environment is such that planning is now done with the expectation of operating in a CR environment every year. SRS spends $5 million/day so CR money may not go very far.

Site managers were expecting to close large parts of the site and complete risk reduction programs within a decade. For example, the site has 115 remaining waste units, mostly in operational areas. The current site life-cycle goes to 2065, with the final 20 years being a "D and D" phase. This extended period of operations means that critical infrastructure must be maintained. Roads in some parts of the site are a challenge to navigate. For example, remediating coal ash basins has become a major project and the site has over 200 monitoring wells in operation. Road access to this site that served the facility coal plant is difficult (The Committee can testify to that fact through personal experience.) The site is monitoring closed sites and 14 groundwater plumes. Many areas have been allowed to go to brownfield status, assuming that current boundaries stay the same. However, roads, water, and other basic services will still be needed for many of these. Neglecting major areas of the site because they were supposed to close is not prudent, and safety issues, not necessarily nuclear ones will increase, unless they are addressed.

In regard to budget flexibility, site managers indicated that to the best of their knowledge SRS's budget flexibility is even less flexible than Hanford's. OMB, they contend, has placed additional control points on SRS. The site indicated that they had 9 control points, and they thought that 4 would be more appropriate (nuclear materials, nuclear waste, soil and groundwater, safeguards and security). If savings

are achieved in one area, they can't be transferred to another area, they asserted. SRS site management would ideally prefer one PBS for all cleanup (i.e. high level waste and spent nuclear fuel waste), and a separate PBS for safeguards and security. They would like the flexibility to move about 5% of $1.3 billion budget (~$50 million) to address high risk issues. The site estimates deferred maintenance at about $1 billion. For example, it has taken them three years to assemble funds to deal with fire water issues. At several meetings staff noted that some of the structures and technologies are so old that the site uses e-Bay to search for replacement parts (See H-Canyon above).

The Committee and DOE discussed the idea of charging a tax to all PBSs to pay for infrastructure maintenance or to have a separate PBS for maintenance. No conclusion was reached about how to increase funding, which is consistent with the views of other committees that have examined the value of investing in maintenance and repair of federal facilities and ways of funding those investments (National Research Council, Committee on Predicting Outcomes 2012).

Overall, section 4a focuses on the relationship between priorities and the budget process, emphasizing the primary positon of protecting human health and safety in the process, and how the site tries to respond to emerging human health and safety issues and an unpredictable budget pattern that leaves managers with the need to find short-term fixes. As one manager said: "We are in a position to have to decide whether to grout another tank or how aggressively deal with 235-F because of the budget situation." A strong recommendation from site management was "stable, sensible funding" that would allow sites to make good decisions because they would know what will have to work with year to year, as well as more flexibility in the PBSs to move funds more rapidly to risk-related needs.

Savannah River 4b. How would you characterize the role of the tri-party agreement as a mechanism to protect human health and safety versus ecology, economy and other priorities? Does it limit how DOE can adjust to new information, in general, and to health and safety information, more specifically? Do the tri-party agreements increase your communication and influence on DOE's decisions? Would you adjust the tri-party agreements to place more emphasis on human health and safety? If so, how?

Various DOE staff indicated that the TPA has allowed the site to continue to operate, and at SRS the site has had a good working relationship with South Carolina, and that the EPA has tended to defer to the State but has been a good partner. The site has been able to make a great deal of progress on the most challenging nuclear hazards partly because of this support. But these relationships have been threatened by budget shortfalls and inflexibility. (See comments from the South Carolina Representative below in 4g). Overall, the TPA appears to be a good mechanism at this site, at least until recently.

Savannah River 4c. What sources of human health and risk information do you rely on? (EIS, safety reports, feedback from DNFSB, EPA, state regulator reports, etc.). Examples?

This section focuses on our conversations with the DOE and DNFSB using the example of building 235-F. This case study illustrates cooperative relationships and use of multiple sources of risk information. Site

management works cooperatively with the DNFSB staff, and the Committee left the meetings with the DNFSB and the site staff with a sense that both groups respect the other's expertise and ideas.

235-F was constructed in the 1950s. It handled nuclear materials in chambers accessed with glove boxes. Pu238 is the substance of greatest concern in the building. When work ceased hazardous materials were left. A recent assessment indicates it is a high priority human health and safety risk concern. DOE staff indicated that it is the top MinSafe priority. Assuming a lapse in security at the building, a worker could conceivably find a way to take Pu238 offsite. Removal of a TRU barrel is likewise a conceivable possibility but since this is a larger item, it would not be as easily executed as a worker who would sweep up some Pu238 dust (very fine powder) in the words of a staff member is "very corrosive to the metal around it."

Recommendation 2012-1 from DNFSB to the DOE concerned 235-F. A group formed at the site for addressing the recommendations. Concerns focused on the transient and stationary combustibles, electrical system being de-energized, and emergency response (including nearby facilities with co-located workers in emergency situations, such as a seismic event). An implementation plan was developed, with Board and CAB input, within 45 days.

DOE's plan is to start in the west side of the building (with less Pu), replacing manipulators before moving to higher Pu areas. Workers will be trained in mock-up areas first. The greatest worker risk is if containment is breached (e.g. to get to a manipulator.) Staff provided us with an estimate of the Pu238 inventory, and their plan of removing the grams is conservative and consistent with risk practices that protect human health and safety.

DOE staff expected that 235-F would be a $20 million a year project. Now, it is expected to be a $10 million a year project. One reason is that the building has limited space for workers. The project budget may even turn out to be $7 million a year if that is the limit of available funding. The implementation plan continues to be revised with the goal of making progress with priority focused on limiting worker exposure. The current plan removes the material by 2019.

As part of forward movement on 235-F, there have been discussions and negotiations with regulators on the degree of cleanup in view of the level of contamination next door in F-Area.

A DOE staff member noted that DNFSB recommendation about 235-F helped to keep funding "above the line" and that DNFSB was heavily involved in the 235-F operations. Concerning 235-F, an emerging issue, the DNFSB site representative reiterated much of what the DOE staff said. The site is the largest hazard of concern for the potential of a sizeable public release.

The near time concern, he noted, is that the amount of transient combustibles has grown steadily, e.g. magazines in lockers. Also stationary combustibles, including old wiring needs to be de-energized and attended to. He further commented that once work is started in places in 235-F where plutonium is present, the work needs to go through to fruition. It cannot be halted. He asserted that DNFSB is

promoting having the site get sufficiently sustained funding so that the work can be engaged and completed.

The DNFSB representative noted their role in 235-F focused on what he called indirect risks, that if not addressed could lead to serious exposures and injuries. Indirect sources of risk come from inadequate training, maintenance, and emergency preparedness. As corrective maintenance declines, the backlog increases. Preventive maintenance is often deferred. He noted that the DOE is looking at metrics to measure the importance of maintenance, but historically it has not been a lesser priority than the hazards agreed to in the TPA.

Areas he observed to be falling by the wayside were those below the "safety significant" level that are decided by contractors, such as:

- maintenance on portable air purifiers
- not measuring calibration, so won't have to report it
- fire protection not tested at DWPF

A present concern is about training and qualifications of operators. This DNFSB representative sits through every interview of oral exams for shift supervisors since these are critical positions. Moreover, lots of hiring has been done so representatives keep an eye on the suitability of hires in key safety management positions. An example concerned the HB-line at H-canyon. No processing had been done there since 2008, but then material was to be produced for the MOX activity. There was a desire to train a core team of first-line operators for the re-start. It was difficult to get enough people through the training and exams. Beyond the core team, operators were very rusty since they have not had this work to do since 2008. The DNFSB representative indicated that familiarity with TSRs (Technical Safety Requirements) was not at a proper level.

Emergency preparedness is another area of indirect risk. Preparedness drills were being formulated too narrowly; i.e., not enough attention given to natural phenomena, and not looking at multi-facility impacts. The DNFSB representative noted that emergency planning staff has been decimated; there currently are none writing risk scenarios for testing. He further noted not being impressed with answers given concerning responses on actions to be taken during emergencies or the means for doing actions, e.g., siphoning gas from cars for fuel needs.

He indicated that his observations are shared with site contractor, who "often" takes action. They are also shared with DOE managers, who will often do an assessment. He notes SRS is in fact more responsive to DNFSB observations than other sites that he has been involved with.

In regard to process, the DNFSB site representative noted that he sends weekly reports to DNFSB headquarters. Also, he makes requests to the Board for reviews. Different factors pertinent to the site are scored in the process of assembling a review team for specific issues. The Board (HQ) then assigns a lead and develops an oversight plan, with site representative providing input.

While time was limited, the subject of risk analysis was raised at Savannah River. The site uses elements of the process. For example, as part of its budget development process, the risk of events are classified as “very likely” (p=.875, event could occur in <1 year, or >75% chance of occurring), “likely,” (p=.6) “unlikely,” (p=.3) and “slight” (p=.075), event could occur in >3 years, or <15% chance of occurring. The risk management group uses Monte Carlo simulation to bound the site risk for various combinations of risks and budgets.

Summarizing, section 4c focused on the role of the DNFSB in human health and safety at the site, and it was clear to the Committee that the DNFSB representative that the group spoke with is extremely knowledgeable and vested in protecting human health and safety.

Savannah River 4d. Is there a lesson learned program? How is this used to reduce human health risk and worker exposure and injury, the site’s strategic plans?

Time constraints did not permit the Committee to explore this area in sufficient depth to respond to the question.

Savannah River 4e. How do you evaluate and balance your focus on major external events, such as earthquakes and volcanic ash vs. electrical fires due to old wiring in an old building and deteriorated infrastructure that could cut off the water supply during a fire? How are they balanced and should the balance change?

The focus of our SRS meeting was deteriorating infrastructure, and site management explained their site wide infrastructure priority list, which they call the Critical Infrastructure Integrated Priority List (CIIPL) (Guideline for Management 2013). Like Hanford, there is growing concern that the 60+ year old site infrastructure needs attention. Site managers indicated that there is a need to preserve infrastructure even as budgets become reduced and timelines (for going out of business by completing missions) expand into the future. Priorities have come both from the site (up) and from DOE headquarters (down.) It’s always a balance of progress, safety and infrastructure. (See discussion of infrastructure in Question 1 above).

Site managers, as well as the DNFSB representative, noted the need to change the paradigm that systems are to “run to failure” in view of the site’s ultimate closure. There has been a reticence to invest in infrastructure, although not for safety systems. Nevertheless, a downside of current situation on deferred maintenance is that processing systems being driven to failure may not work optimally and regulatory commitments may not be being met. Run-to-failure decisions are implicit; nowhere is this stated explicitly. HQ now doesn’t want “run to failure,” but doesn’t have enough money to support needed infrastructure.

The IPL has a list of “highest” infrastructure needs that totals $300 million. The site tries to find dollars to address these needs, such as the A-area fire water system. The Committee learned that laboratories and the firewater system have been funded for current and succeeding year. HEPA filters, however,

that are 60 years old need attention or replacement. Likewise, the radio trunking system is antique and needs to be replaced for security purposes.

In responding to a question on the prioritization process within the site and how it relates to human health and safety, management answered that they relied on

- Input from facility representatives, operations managers, and other staff working in the field.
- Operating contractors identify facilities as top priority for MinSafe

The IPL is built around human health and safety in the following order:

1. Safety
2. Capital projects (e.g. SWPF)
3. Progress on regulatory commitments and compliance
4. DNFSB recommendations (e.g., 235-F)

Deterioration of facilities was a consistent theme at this site and at Hanford. This site is expected to retain key functions for many decades in at least a central core, and managers and other staff are assessing what infrastructure is critical to human health and safety and to continuation of the missions.

Savannah River 4f. What roles do institutional controls, and land use designations play in protection of human health and safety at the DOE site? How much do you rely on them to protect human health and safety?

Regarding a vision for footprint reduction, the site has had a plan for many years to moving back to a core area. Their goal to reduce the geography of hazards and risk on the site. A goal to move barricades so that the B-Area is not within security area such that driving through security guard gates can be avoided and greater area of site can be accessed. This would reduce that number of guard stations and guards and allow resources to be used to move up the risk reduction schedule elsewhere.

Part of this plan is to open the site for selected other activities. Site management mentioned partnering with the South Carolina National Guard for lease of some lands, and also processing bundles out of L-basin to mitigate the need for building more racks there. The site has 210 miles of paved road. SRS management would like the State to take over some of the roads. But they need to continue to shrink the active area for this transfer to happen.

In the short run, staff indicated that footprint reduction activities, such as trailer and cooling tower teardowns absorbed resources without a great deal of risk reduction, but in the short run the large sites need to reduce their footprint, which will reduce risk.

The Committee and site staff discussed the possibility of increasing risk by concentrating risks in a relatively small area. The site has modeled some scenarios and believes that reducing the footprint in the long run will help reduce risk.

Summarizing, section 4f shows that SRS has moved toward consolidating its activity in a central core area. The site believes this will reduce human health and safety risks in the long run, as well as reduce the need for security and infrastructure management costs, which can then be reallocated to more rapid risk reduction elsewhere on the site.

Savannah River 4g. Asked of the state representatives. Can you provide us with examples of some of the more successful interactions with DOE? Of those that were less successful? What makes the difference between major and less success? Are there unexpected beneficial or negative outcomes from these interactions? (e.g., changes in policy, practice, ideas, beliefs, and attitudes)? How central was human health risk information in the illustrations?

The Committee spoke with a representative of the South Carolina Department of Health and Environmental Control (DHEC). That representative was candid and clear about the State's interactions with the site and how these are related to reduction of human health and safety risks. These notes were fact-checked by the representative of South Carolina.

High level waste and tank closure are the State's top priorities. Management and disposal of TRU is going well, but HWL remains the biggest risk because of its liquid form, its voluminous amount, its danger, and the degrading structure of the tanks. The State needs to see a focused effort that is "steady and aggressive."

The DWPF up and running, but still needs the salt waste processing facility to complete having a full cycle system approach: "The existing treatment reduction is not a technical issue, it is caused by a funding reduction." The representative indicated that reduced budgets increase human health and safety risks, especially when the delay causes the site to lose momentum and leaves the hazard siting in an aging tank or building.

As part of the FFA, there are 30 milestones concerning high level waste stretching to 2028 and this is the SC DHEC's major focus. SC DHEC is pushing DOE hard to make progress. In the interest of making progress, SC DHEC has been cooperative with DOE in the past but now the lack of funding is constraining progress. The DOE tells South Carolina that milestones are in jeopardy due to lack of progress at SWPF, and the State's concerns are growing.

Reductions in environmental management budget for high level waste by DOE headquarters is a "source of disappointment," especially while funding for another site has increased. With reduced dollars available, it would be best to move more into HLW. Instead, the FY14 budget was down $100 million in HLW.

The delay regarding the Salt Waste Processing Facility (SWPF) has impacts that affect the whole system. In addition the whole budget shortfall is slowing existing treatment, and this is not considered acceptable by the SC DHEC.

In regard to the FFA, the State representative indicated that it has worked superbly, with a "cleanup team" concept:

- Milestones have been met
- 77 percent of contaminated areas have some sort of progress in place.

  The South Carolina representative noted that in the whole history of the FFA, there had been only one dispute between the State and the DOE, which involved the milestone closure delay of Tanks 18 and 19, when the DOE blamed the delay on NRC. The State representative indicated that having involvement by the NRC has been a value-added and that current delays are not attributable to the NRC. South Carolina ended up extending the milestones and asked DOE not to blame NRC for timing issues.

The State representative observed that it seems some states are demanding higher standards of DOE than South Carolina, which made concessions to accept the risks of Saltstone waste. Another state required vitrification of all waste.

South Carolina will be required to be very tough because the representative indicated that the DOE budget request for SRS was not adequate. DOE should have made an adequate request. This has set up a less cooperative relationship between the DOE and South Carolina that may involve penalties.

The report turns briefly to the SRS Site Specific Citizens Advisory Board (CAB), which has been active for many years (two Committee members have attended SRS CAB meetings) and has influenced priorities. The CAB gets a briefing on IPL, with 30 days to review. SRS staff indicated that the CAB agrees that liquid waste is the top priority. Site management added that the CAB questions the importance of the CAB's input when they see budgets for liquid waste go down.

A DOE staff member indicated that CAB input is beneficial and helpful almost all the time, and that the CAB helps with community concerns. For example, the CAB raised concern about a site decision to reduce the level of monitoring on the Georgia side of the River. The CAB recommended that the site re-consider this decision and the DOE responded by changing this decision. Once in a while there is disagreement. For example, site staff indicated that the CAB wants investment in transmutation technology, which is separating the hazardous long-lived radionuclide components of by neutron bombardment to form nuclides that would be either stable or radioactive with a much shorter half-life. The DOE has invested in this technology, and currently the site is opposed to using resources for this purpose at SRS.

Overall, the State wants the site to move forward with human health and safety risk-based remediation, but the lack of adequate and predictable levels of funding makes it difficult for the DOE to follow-through on its commitments. The State feels that it cannot get an explanation about funding reduction from DOE HQ, and it makes South Carolina feel as if they are "at the bottom of the priority list." The Committee spoke with a representative of the South Carolina Department of Health and Environmental

Control (DHEC). That representative was candid and clear about the State's interactions with the site and how these are related to reduction of human health and safety risks.

The comments from Hanford and State representatives to these questions are not at all surprising. Signed by representatives of the States of Washington, Nevada, South Carolina and New Mexico, the Environmental Council of States sent a letter to Donovan Robinson of the White House Office of Management and Budget (Sturdevant et al. 2012) that offered five resolutions. Two are quoted because of their direct relevance to state concerns about risk reduction in the wake of the budget reductions following ARRA.

> "ECOS urges U.S. DOE officials to request fully funded, full compliant annual budgets for the EM program to ensure enough funds are provided to all sites to achieve cleanup milestones on schedule as required by FFAs, permits and consent folders."

ECOS urges the U.S. Congress to appropriate the levels of funding necessary to ensure EM annual budgets are fully funded and fully compliant as just described.

OAK RIDGE VISIT NOTES

Jim Rispoli visited the Oak Ridge site on November 6, 2014. Jane Stewart, Timothy Fields and Michael Greenberg called in for all or part of the day. This set of interviews was with DOE site officials, and a face-to-face meeting with two officials from the Tennessee Department of Health and Environmental Control. There was no site tour, given time constraints. The notes were fact-checked (Sue Cange). Fact-checked notes were returned to the Committee on December 1, 2014. In addition to the questions that were asked at all sites, additional questions were asked. In each case the question is listed along with the response. The format of this presentation is different from the previous ones because only one team member was at the site, and the visit was only for a single day.

General Question: How are risks to public health and safety considered as part of state and federal regulatory compliance and priorities at DOE-EM cleanup sites?

Oak Ridge 4a. How does the DOE at the Oak Ridge site prioritize public health and safety compared to ecological risk and natural resource restoration and protection (e.g., water resources)? Prioritize worker health and safety compared to the health and safety of people currently living off site or may be present in the future as a result of land use changes? Are there specific cases that illustrate how you balance these?

DOE-OR uses an Integrated Priorities List – certain activities that are categorized in –

1. Base operations, which include MinSafe essential services and other operations that must be met to ensure safe operations, a safe working environment and asset protections.
2. Remaining priorities balanced – three different types of risks presented by three sites:
   a. Greatest environmental risk - Release of Hg into surface waters discharged from Y-12
   b. Greatest nuclear or radiological risk – Presented at ORNL with U-233 and TRU waste storage and processing as well as other facilities and waste storage/disposal areas
   c. Greatest life cycle cost risk – ETTP, large facilities that were not put into safe shutdown mode. They have degraded considerably, increasing the cost of cleanup. In addition, nearly $60M/year is spent on base operations at ETTP.
3. Try to identify near-term priorities, mid-term priorities, and longer-term priorities to balance progress to address these types of risks. Identified several near-term priorities:
   a. Continuing demolition of gaseous diffusion buildings at ETTP,
   b. Continuing TRU waste processing at ORNL,
   c. Dispositioning U-233 material from ORNL,
   d. Constructing new Hg treatment facility at Y-12 to reduce Hg- concentration in waterways and as a necessary step to prepare for the eventual demolition of former Hg-use buildings at Y-12, and
   e. Planning for a new on-site disposal cell, so we don't have an interruption in cleanup progress as existing on-site cell is filled in the early 2020s.
4. IPL looks at Base Operational needs, and these near-term priorities that attempt to balance progress to address the different types of risks.

5. DOE-EM Program started in mid-80s and has completed work addressing offsite releases/migration. Work for past several years and the current focus is on addressing on-site sources of contamination and receptors/risk areas on site.

Oak Ridge 4b. How would you characterize the role of the Federal Facilities Agreement (regulatory regime) as a mechanism to protect human health and safety versus ecology, economy and other priorities? Does it limit how DOE can adjust to new information, in general, and to health and safety information, more specifically? Does the FFA/regulatory regime increase your communication and influence on your decisions? Would you adjust the agreement to place more emphasis on human health and safety? If so, how?

EPA Region IV and TDEC are DOE-OR regulators. They are predominately focused on environmental risks and addressing environmental media. They are interested in cleanup of soils, sediments, surface water and groundwater. These are also a priority for the government, but they are not our only priority. FFA has been a useful tool for the 3 parties to work together to prioritize our actions and to help with the allocation of budget to address those risks, but it has taken time and frankly a lot of hard work to have regulators accept that DOE is going to allocate some resources to actions that are a priority to the Department but not necessarily to the regulators. The U-233 project is good example. This is not a CERCLA project, not regulated by outside agencies. It is high priority for DOE, nation's storehouse for U-233 in the world's oldest nuclear facility in the center of ORNL. That facility drives the entire security posture for ORNL, which is another reason why it's a high priority to DOE, but not necessarily to the regulators. Through a fair amount of work and continued communication, we have emphasized the need to balance regulator needs with DOE priorities. For the most part, today, we are being successful.

Oak Ridge 4c. What sources of human health and risk information do you rely on? (EIS, safety reports, feedback from DNFSB, EPA, state regulator reports, etc.). Examples?

FFA is the driver to help to prioritize for certain activities, but not all of them. Various DOE requirements are also drivers. As far as the information that we rely on to make decisions on priorities and inform risk-based work– simple answer is we rely on everything we have, and it is predominately information that we have generated.

We have the DOE Computerized Accident Incident Reporting System (CAIRS) which includes the Total Recordable Cases (TRC) and Days Away/Restricted/Transferred (DART); quarterly reports, Occurrence Reporting System, worker safety and health, risk assessments, RI/FS under CERCLA, letter reports from DNFSB. EPA/TDEC don't talk about worker H&S per se, which are aimed more at releases offsite. It is difficult to balance all that; it's hard to compare a CERCLA risk with a risk that's evaluated in a DSA. Trench 13 is an example, where we have Cat II quantity of pyrophoric materials in one of the Solid Waste Storage Areas (SWSAs) contaminated with plutonium. The State wants it dug up and removed; for worker health and safety, you would leave it there. It would take a DSA to do it. A very small quantity, but we are currently in dispute with the state over this situation. This is a place where is difficult to make that balance.

Oak Ridge 4d. Is there a lesson learned program? How is this used to reduce human health risk and worker exposure and injury, the site's strategic plans? Are lessons learned transmitted to your counterparts at other DOE sites?

We do have lessons learned program here in Oak Ridge, and Jason Armstrong, who you will be speaking with next, is the owner of the Lessons Learned program. It's an extremely important program, and we are working to improve its utility. Jason has been working with both DOE and the contractor. We employ several mechanisms for sharing lessons learned internally – email, monthly all-hands meetings, etc. Also we share with other sites when we think that the lessons learned might be useful. Lessons learned also are entered in the HQ-run Lessons Learned database.

We have our integrated assessment schedule. We have twice weekly meetings internally where we talk to facility representatives, safety folks, and project managers, and so there's informal sharing of lessons learned there.

Oak Ridge 4e. How do you evaluate and balance your focus on major external events, such as earthquakes and volcanic ash vs. electrical fires due to old wiring in an old building and deteriorated infrastructure that could cut off the water supply during a fire? How are they balanced and should the balance change?

A couple years ago, we recognized that it was important as we developed our annual IPL that we look at the condition of our facilities at all three of our sites and make sure that we recognize and address any upgrades or improvements that need to be made. That's a relatively new practice for us, but it's an important practice for us to continue. We have identified several examples where we have facilities or systems that are in need of repair or being upgraded. We have tasked our contractors to develop plans to incorporate those needs into our integrated priorities list. Of course, you can't plan for the force of major incidents, but you have to be aware that they could happen at any time. We recognize that there is the chance for both low frequency activities with high consequences and high frequency activities with low consequences. It's very difficult sometimes to plan and prepare for both, but it's necessary that you do what you can to be prepared. In addition, we meet all DOE requirements to make sure that we are doing what we should be doing to ensure that repairs/upgrades are factored into the IPL and are part of what we consider to be our base operational cost. These other things that are outside of that, we have done a thorough review (our contractors have) and have ranked our recommended actions and have started to build into our IPL the highest ranked priorities that have been identified.

Oak Ridge 4f. What roles do institutional controls, and land use designations play in protection of human health and safety at the DOE site? How much do you rely on them to protect human health and safety?

I'll be a little bold in saying that OR is an excellent example where we rely quite a bit on institutional controls as an important part of our remedies. We have been successful in the past to have our regulators – both EPA and the State – agree and support the use of institutional controls. There is a fair

amount of variability across the EM sites in the success in using IC. We have encapsulated a lot of buried waste and materials here on the reservation, relying upon institutional controls and it is a core of our protectiveness determination. Regulators have accepted this to date, but we have noticed recently perhaps a shift in EPA and TDEC thinking as to whether that is the right approach. But we have been successful in getting them to accept it to date – and that is an important part of our remedies. As an example, regulators have agreed that DOE will remediate ETTP to industrial standards – we are transferring that site as we clean it up to be a private use industrial park. We have not been driven to cleanup to residential use.

Other Oak Ridge Questions and Answers

What could Congress do to facilitate your work?

Good question. There are several things that Congress could do.

1. Provide greater certainty in budget process. It is difficult to start each fiscal year with a continuing resolution without really knowing when we're going to have an appropriation to continue with our plans and the execution of our work. Because most of the work in Oak Ridge is multi-year – very large, very expensive projects –which makes it hard to be cost efficient. The unpredictability affects not just our progress in the field, but also our workforce, and meeting our commitments to our regulators.

2. DOE-OR has little flexibility in shifting funds across projects because we have so many control points. Three different types of funding for cleanup - UED&D fund, Defense funds, and non-Defense funds. In FY14, we had eight control points for a $430 million budget. We do have authority to do a small amount of internal reprogramming but for the most part, we cannot shift money between different control points without notification and/or getting approval. That's a lot of control points for a budget of our size and it can really tie our hands, if things happen that are not anticipated. An example is at ORNL, where we have an old reactor pool that is seeping. Not something that was anticipated, but something we must address this fiscal year. And the cost is not negligible so it's very difficult to shift funding to address that.

3. It's very challenging for the department to have to comply with a lot of different standards that have been established for other programs and other purposes. It would be helpful for the DOE-EM program – because we are so unique when you look at cleanup programs across this country – to have standards that are focused on performance, rather than being driven to a certain statutory requirement that may have been developed for a different purpose. A great example is the Hg treatment facility that we are currently planning for. The regulators are driving us to design that plant to meet a requirement that is not science-based; we know today it won't address the issue that we're trying to address which is to ultimately eliminate fish advisories in the region. We want to design/build a plant that will reduce the concentration of Hg in the water while we continue to study the science and figure out how to remove fish advisories, rather than designing a plant for

many millions more to meet a certain water quality criteria that all the scientists agree will not address the fish problem. Helping us to focus on performance standards rather than meeting various statutory requirements that were established for other purposes would be helpful.

To what extent are control points set by DOE or OMB or Congress?

Budgetary control points are set by all parties. As an example, we have a new control point for FY15 that was established by OMB – using non-defense funds for our historic preservation activities. Other control points are established by Congress like PBS 11D for the U-233 project. I think that part of the reason we have so many control points is because we have lots of parties that are setting them for us.

Re the Hg project - how is the ARAR for state water quality determined? It's not a given that a state water quality standard would apply. How is that determined? On paper? Any real analysis? Are there lawyers who go through and figure out if this ARAR is consistently applied? Can you provide documentation about the analysis that been done (not the ROD, but documentation of deliberation)? Would be helpful to see some of this for the Hg example.

There is a process – we have established project teams with representatives from each party that work as an integrated project team on each of our projects. As we go through the CERCLA process, project teams identify ARARs. There is a deliberation process that the teams go through, and sometimes it can be extensive. In the case of the mercury treatment facility, it has been extensive. For this particular project, all of the parties have agreed that the Ambient Water Quality criteria is an ARAR for the final remedy for cleanup of the Y-12 site; but this Hg treatment facility is an interim action and one of many interim actions that will be taken at the site. Therefore, we're currently in deliberation with the regulators on whether they agree to this is an interim action. Evidence of the determination is generally written down in the CERCLA documentation that goes back and forth between the agencies. Much of the deliberation is done through meetings; there is a collection of examples – some of it is comments on the CERCLA documentation, some of it may be in meeting minutes or meeting summaries. We can provide an example of the type of dialogue that occurs, but each project is handled differently depending on what the discussion is and whether there is agreement, or the discussion needs to be elevated to the next level. We are still in deliberations with the State and EPA on this particular project, so I'm a little hesitant to preempt any future decisions that might be made.

In regard to near term risk priorities where you have to determine resource allocations between sites, how do you then decide how much you allocate to environmental risks that address EPA and the state under the FFA in the context of the other priorities that you have that are not environmental? What is the decision making process in wrestling through all that?

A quick thought before I leave – I think it really comes down to the baseline planning for the program. About two years ago, we rebaselined the entire program in terms of work that is left to be done. We have a computer model that we use where all of the various projects have been identified and have some level of scoping that has been done – some more than others. We have a comprehensive baseline

plan for the remainder of the cleanup work here, and the planned resources year by year are tied to the comprehensive baseline plan. We include both environmental projects and other project that must be completed in our integrated plan. We try to make progress on multiple fronts.

Other Questions and Answers with Oak Ridge DOE Staff

From the title, none of you appear to have much direct regulatory involvement?

I do; served in several capacities that involve direct interaction. I met every Friday with them. My role over the past twenty years has been focused on running back and forth between DOE and the regulators to ensure provisions of FFA are being met.

How do you integrate regulatory requirements driven by EPA and the state with nuclear safety and nuclear requirements of the Department as a self-regulated entity, the DNFSB, and worker safety? How does that play into the development of your IPL?

Annual budgeting cycle – the budget does set priorities. How we allocate our budget is a reflection of how we set our priorities. We work with the regulators each year to develop out-year budget submission, which is two-years out. It starts with setting aside budget to meet all health and safety matters. Regardless of the driver, a "tithe" is set aside to meet minimum safety requirements. Of ~$400 million, roughly half is used to ensure we can operate our waste management facilities, maintain our nuclear safety requirements, deal with all the things that are required to ensure we have no offsite releases, or onsite hazards that are not properly managed. Some of that half is also compelled by regulatory drivers. Half of budget goes towards making progress on D&D of buildings and cleanup of soils and groundwater. Significant additional portion goes to the disposition of waste that is currently safely stored but for which we have regulatory commitments (e.g., TRU) to move towards disposition under the site treatment plan.

Does maintenance of infrastructure get adequate attention?

There is a continuous tension between forward progress and ensuring that we do a good job on base operations. During my time at DOE, we have had multiple reviews to try to lower base costs to the lowest possible level. We have come close to having fine tuning that process – further cost reductions are made at some risk to the base operation – just a personal opinion.

Do you have any major issues that worry you about your ability to prioritize critical infrastructure as it pertains to nuclear safety and risk?

We have a pretty active program for looking at deferred maintenance. We work with our contractor to examine risk associated with our aging facilities. We developed a system for scoring those facilities that are at risk and what priorities should be given, if we have extra funds to apply, to those facilities that are aging. A living document, constantly reviewed together to make sure DOE and contractor are on the

same page. Dedicated DOE FPD (Bill McMillian) oversees it. We get a lot of input from facility representatives and project managers, as well as engineering, safety, and quality divisions.

At other places, we've seen a focus on environmental issues by regulators, not the DOE self-regulated issues. We've also seen instance where, post Fukushima, DNFSB has come back with recommendations that have upped the consideration of risk in facilities by looking at natural threats, beyond design basis threats. Has anything like that happened here?

After Fukushima, DOE-HQ sent a memo to look at all sites to look at and identify natural phenomena hazards – we are adding section to SARs, DSAs. Some additional cost, I'm sure. We are taking a "no events here" philosophy.

We are curious about the level of flexibility within the FFA? We been told that it's a living document, it gets amended. But what is the process for updating it? Does anything ever get dropped or substantially revised because they've been rethought?

I was FFA manager. Yes, it is flexible. It allows us to adapt to changed priorities. We have been allowed to change where change made sense. In the early days, focus was on off-site releases because that was a priority to them. As time has gone on, and we have addressed offsite releases and generally brought them under control, regulators have recognized that it is important to us to deal with these aging facilities. There has been some debate regarding the balance of resources between D&D, special materials disposition, and environmental cleanup to make sure that it was properly balanced. About three years ago, we developed a mutually agreeable set of priorities for the reservation. Everybody had to give and take; we now have a set of priorities that we're setting our milestones against and working cooperatively on.

If a significant condition – an unanticipated condition - were to develop at one of our facilities, the agreement would allow us to adjust to that – and I think our relationship to the regulators would also allow us to adjust to that. This flexibility is the result of the relationship with the regulators and professionalism and attitude on the part of our regulators. They have been practical people who have allowed us to use real risk consideration to set priorities. They also understand the cost part of the equation. So they have allowed us to cap hundreds of acres of burial grounds in place rather than spending billions of dollars exhuming it – and allowing us to get on with the D&D of other facilities that were above ground.

We have a special set of stakeholders – their degree of understanding have been contributors to the process and aided us.

Oak Ridge is a unique community in that way. A large portion of the community understands what takes place at the place and have a comfort level with the concepts of risk management. We have actually had community come in and tell the regulators they were possibly being too demanding on some of the environmental risks. Both community advisory board and individual citizens have been very active and have had very positive effect for our program.

Are there specific areas that they have been more focused on?

They have been a key part of past and probable future decisions regarding on-site disposal available to the cleanup program. My sense is that if it weren't for the SSAB and citizen position that on-site disposal would be key to a successful cleanup program, we would have spent a lot longer persuading our regulators to agree to that, perhaps without success. We began our program by convening a working group to look at land use across the reservation. It looked at burial grounds and said those were going to be burial grounds. Areas that hadn't been impacted should be kept that way. We laid out a template for the end state for all our cleanup programs. All CERCLA RODs have used that template as the map for moving forward, which was another important area.

The process of developing land use expectations seems to vary a great deal from site to site. Not always agreement between the parties. We heard that there is no part of the reservation that is designated for unrestricted use? It that correct?

Yes. It was developed in the 1998-2000 time-frame. Most of the 30,000 acres of the reservation are basically an unimpacted forest ecosystem– we've declared those in "no further need of investigation." Options for that portion are wide open. Other areas – industrial facilities and waste management areas – future land use is essentially unchanged from current land use. We've looked at transferring facilities, but for restricted (e.g., industrial) reuse. Subsequent RODs have confirmed this.

Remedies at each site call for continued use by DOE. Cleanup goals are to 10-foot depth at ETTP, 2-foot depth at ORNL and Y—12. A rigorous excavation controls program will be necessary at both ORNL and Y-12 to ensure worker H&S. Below 2 feet, we place emphasis on eliminating source of GW contamination. Remedies at both sites are dependent on institutional controls.

The SSAB at OR is very strong. Does DOE hold periodic meeting between the SSABs to share lessons learned?

Yes – semi-annual meeting of citizen chairs of the SSABs; typically a federal meeting associated with the meetings. Also approximately monthly calls occur between SSABs.

Our board's membership is entirely from the 7-county area; most from Anderson/Knox county. They have an interest is a successful and practical approach. It is shaped by their understanding of resource availability. They are given a good education once a year on the budget/budget process each year and program duration.

We have not heard anything about the eleven tanks – what is the story and plan for those?

OR was where the initial research into the production and isolation of plutonium took place – put ORNL on the map. We have the graphite reactor, the 3019 building, which was the extraction facility, and we have the gunite tanks, which were where wastes from the plutonium production activities were stored. They are 11 tanks in center of ORNL. Waste has been removed – and is at the TRU waste facility for eventual disposition at western facilities – WIPP and if appropriate, NTS. The tanks have been

evacuated and filled with grout to stabilize them. ROD for ORNL at large has them remaining in place (top 2 feet and protective of groundwater).

How emptied were they? How was the determination made on how empty they needed to be?

They were emptied to limits of technology. Some residual was left – could find out how much from project manager. Spray/vacuum (sluicing) technique was used to remove waste –thorough cleaning. Gary Riner was the PM. Once they took the first pass with the technology, in order to leave the residual in place, there was a risk-based approach evaluating what was being left. This occurred in the early 2000s. These tanks were cleaned up under CERCLA authority. The State and EPA accepted the in-situ closure component, when supported by risk assessments. Lots of what we've done in OR – burial grounds closed in place after showing that we're leaving the environment in an acceptable condition.

This issue passed by my desk when it occurred. We did not go back to RCRA regulation to define "empty" – action was completed under CERCLA.

Hanford cleanup takes place under RCRA, SRS under the Clean Water Act.

Key physical difference – much of waste headed for shallow burial, not HLW. ORNL wastes are not classified as HLW – they do not meet the definition.

They may be characteristically similar, but these were R&D processes, so they are not HLW.

This is an example of the irrationality of the definitions in that similar materials are classified by the process that generated them, not their inherent characteristics.

There is restriction on WIPP waste – must be of defense origin.

It would be helpful if someone could summarize or document characteristics of waste in the gunite tanks and how it was viewed from a regulatory basis, so we really understand.

It would be good to discuss the difference between a standards-based approach vs performance based-approach. What are the practical implications?

Its impact on priorities…and how resources are allocated to reflect them?

Is there an example or two from Oak Ridge that we can use to illustrate this point?

The Hg-treatment facility is a good example.

Other Questions and Answers the followed discussions with TDEC officials

What are the priorities at the Oak Ridge reservation?

Are budget instructions different every year, or just the numbers?

Just the numbers are different. The funding limits what we can do.

As budget gets more constrained, some sites feel that allocation between sites isn't fair. What do you think?

Initial focus of program was on addressing releases. Over time, we've addressed immediate needs of release. Current focus is more on D&D, but budgets are shrinking. Hg treatment at Y-12 is next in line after ETTP D&D. Budget in maintenance areas are constraining/hurting now such that it is difficult to perform critical maintenance needs for facilities awaiting D&D.

In the early stages of the EM program in Oak Ridge we focused on issues with Public Health and Safety – elimination of sources that have PH&S impacts. Now we have several priorities that we need to balance. One of these, at ETTP, is life-cycle cost. At Y-12, Hg-contamination, and at ORNL, U-233, as well as security and worker impacts. Excess nuclear facilities are maintained to continue compliance – but really try hard to balance…

Priorities are based on the bottom line number for Oak Ridge, and MinSafe is at the start of Integrated Priorities List. D&D funds ETTP; Defense funds ORNL and Y-12 activities.

This approach complicates this, rather than simplifies, because funding is restricted.

We look at the whole site collectively, then later by funding type. Balances work at all three sites as well as prioritization

What would be a reasonable budget to do what you need to do?

Rather than current $430 million, need more like $500-$600 million.

$500 million.

We haven't really been allowed to dream.

It is not a question of fairness – it's how the risk prioritization is developed. EM current priorities are HLW at Hanford and SRS. Risks to mission at ORNL and Y-12 are not typically factored in – it's how the overall risk prioritization is developed.

Looked for exposed materials; source terms of materials within building bounded by DSA.

Sr-90 release at ORNL in 2003 – was a parking lot, but they now house new Science facilities. Wasn't a huge deal then, but it would be today.

Mostly in a response mode for catastrophic events. We did take some action at White Oak Dam with an ARRA project.

Would a global risk assessment help when you're trying to figure out how to allocate resources? Put everything on an equal footing? Did the CRESP review help?

It helps to have these conversations and to think through things. It helped us verify our priorities, but with regulatory involvement and MinSafe, it hasn't fed as an input to our priorities. Commitments to the regulators have been used as inputs to the priorities.

Surface water quality standard is used as a ARAR for Hg work. How would the approach be different if you were able to use a performance-based approach? What is the cost differential?

We have a ROD for Upper East Fork Poplar Creek, with ultimate objective of reaching the standard of 51 ppt. This objective was waived to 200 ppt until final remedy was implemented. Thanks primarily to the Recovery Act, we have been able implement, over the years, a significant portion of the remedies outlined in the ROD to achieve those limits for surface water. We are still not meeting the 200 ppt standard, even after completing those actions. The water that leaves the Y-12 Plant is more like 400-450 ppt of Hg. Regulators consider the environmental protection a high priority and wanted to see more emphasis on this. DOE proposed adding an additional remedy to the ROD, basically building a larger water treatment facility that would treat the effluent that is the main contributor to the Hg levels. At the same time, we put together an overall Hg strategy to address the entire for Hg cleanup at Y-12, which includes, in the near term, building the water treatment facility to reduce the levels of Hg and later on, going after the Hg sources that are still in very large excess facilities within the Y-12 site. These facilities are comingled with mission facilities supporting the NNSA mission at Y-12. And to remediate soils and sediments on the creek, our approach is that the Hg treatment facility is an interim measure, an interim action, just like all the other things that we have done to date to get to the 200 ppt goal. DOE's parameter for that facility is that we would get to 200 ppt limit or less for the effluent. The regulators are saying that DOE has to meet the 51 ppt limit at the effluent point. In order to do that, we would have to add a step to the process that would add about $23-24 million to the cost. We have the potential to meet the 51 ppt limit with the design we are proposing – this is supported by bench scale studies. DOE wants to build the facility as designed, operating it to see how it performs. If the plant doesn't get to 51 ppt, we can use the $23-24 million to remove sediments downstream that may have a more significant effect in reducing the Hg levels leaving the site than achieving 51 at the plant effluent. TDEC's position is that new treatment facility is the final remedy and the 51 ppt standard at the effluent needs to be meet. Basis for the waiver of 51 ppt was as an interim action under CERCLA.

How do you deal with ARAR questions when there is contention?

There have been lots of discussions with EPA and TDEC for over a year at many levels: staff level on project teams, the supervisory level, the Executive Program Council (which involves the State of

Tennessee), and the director of the CERCLA Division at EPA. I think we've gotten the state to agree, but the EPA is still not on board.

What are we trying to protect? Fish? Subsistence eating humans?

It's about the ability to eat the fish. Levels in water already meet drinking water standards and standards for protection of the aquatic life. They don't meet recreational water standards (the 51 ppt) where the fish would be edible. 51 ppt is the surface water limit so that DOE can remove the fish-consumption advisories. So fish can be consumed.

EPA sees this as a final action, not an interim action. That's the crux of the matter. The State seems to have come over to DOE's side. EPA continues to view the treatment plant as a final action.

Have land use designations and institutional controls been a big factor at your particular facilities? Are they different for the different sites?

Overall, ICs have been relied upon pretty heavily in our interim RODs. We are not looking for unrestricted release.

There is not excessive variability among the sites. But it is an important part of the program. Regulators do seem to recognize this. We are getting challenged a little with the Trench 13 project – flare-up a number of years ago with pyrophoric materials. Pyrophoric materials are not the Pu that state wants to remove. But there's some Pu there, and the State is pushing to remove the Pu. DOE position is that from a risk basis, it does not pose additional risks from other wastes in the SWSA. Institutional controls is the method that will likely be the protection factor from the public risk perspective in the final ROD, demarking the burial grounds in deed restrictions to cite where these burial places are and how deep you can dig, etc.

How close is residential use to the sites?

Within a mile at both Y-12 and ETTP. And we are a pretty wet site, we get a lot of rain.

Southern and western boundaries are the Clinch River, so we have residents that are right across the river. Scarborough community is right across the ridge from Y-12. GW close to the surface – 20-30 feet from surface.

Is GW a major source of drinking water?

Some, but most drinking water is public water supply from surface water.

Other Questions and Answers

Chris Thompson (TDEC) is pretty new, but she seemed to bring in some perspectives that were strident. She seems to have some issues that were important; she said they discussed everything they brought up with us with their commissioner. The one that they dwelled on for quite a while was the legacy deep well injection of strontium and cesium back in the 60s to the 80s and the find of radioactive indications in the wells across the river. The original model said the river was a natural barrier, but now they are not so sure They expect this testing that you're doing to either show there is a correlation or not. But I would say it took up half of their half hour.

Very interesting. I'm not surprised to hear that – I think that is consistent with what we had discussed this morning where EPA/TDEC are very focused on environmental media. They want us to address and increase in priority our work with groundwater, soils, and surface water. One of the things that we had agreed to accelerate and become a priority was the Hg outfall 200 treatment facility, and another thing which I didn't mention this morning was we agreed to add further attention to groundwater. We formed a tri-party groundwater working group and last year developed a groundwater strategy for the reservation. We held a series of six day-long meetings where we brought in an expert from the USGS as well as other experts and we developed a strategic plan for groundwater investigations. We committed to dedicate $1.5 million/year for 3 years to execute a project that everyone agreed would be our highest priority coming out of the strategic plan. EPA wanted us to look at wells where we had done some fracking on the reservation and TDEC was insistent that we do this off-site groundwater monitoring work. Collectively, the three agencies came to an agreement that we would first start with the monitoring of the offsite groundwater wells. Our agreement to begin with the offsite wells is consistent with the approach I mentioned this morning where we look at offsite first and then move to onsite issues. We have all been working together on data quality objectives and the Sampling and Analysis Plan. We plan to begin our monitoring activities in early 2015. That's a good example of listening to the regulators to increase the priority of groundwater investigation and then to try to follow the plan. Our experts do not believe that there is a correlation between what occurred on site many years ago and the few, very small hits that have been detected across the river, but we're doing the investigation and the data will tell us what the story is.

Although we gave leading questions a couple times, we didn't get much feedback on the influence of DNFSB influence on the overall prioritization of risk. Correct?

We work very closely with the DNFSB site reps, but the majority of their focus here in Oak Ridge is at the Y-12 Site and with NNSA. They are interested in a few of EM's projects – that includes U-233 disposition and TRU waste processing activities. If I can generalize, that is really the extent of their interest with EM. There have been a lot of work and studies that we have done ourselves that the DNFSB has observed and participated in, etc., but I can't think of anything specific that they have done for those two projects. DNFSB did identify an issue for our TRU sludge processing that had to do with spray leak detection; so there might have been one.

Last thing to build on something Michael asked you but that you also brought up and that is the uncertainty related to year-to year funding. What could we tell Congress that might help. It occurred to me that DOD has something called the Five Year Defense Plan (FYDP); now Future Years Defense Plan. So it wasn't an annual budget battle – the battle took place in the FYDP. Once that was approved, your money flowed annually through the budget. The focus was a rolling five-year view so you had some continuity that you could expect. Would something like that be a worthwhile thing to consider?

It would be helpful if the Program could have a budget plan for more than one year. It would help us be more efficient in the execution of our work. It would only be useful if it somehow helps to replace the annual appropriations process. The concept of multi-year funding for these projects that cost tens or hundreds of millions of dollars – to me it's pretty obvious that would be of benefit to the program from a planning and execution perspective. Our budget submittal is a five-year budget submittal, but it has more to do with the appropriations than it does the planning.

CRESP did a risk study at the Oak Ridge site, and is now doing one at Hanford. I'm curious as to whether that has been helpful to you in setting and planning new ideas and new projects.

Their report really was not developed with the purpose of helping us to plan new projects. If it was, I'd have to say that is not how we utilized it. We asked them to assist with a prioritization process in an effort to help bring DOE, EPA, and TDEC together. The results were consistent with what DOE has planned, consistent with the near –term priorities we talked about this morning, but we really haven't utilized the results for future planning. I think it might have helped bring the parties together. It served its purpose, but is not a living tool.

OR took a pretty big hit – how did you revise your strategy in light of budget hits?

Prior to the Recovery Act, our annual budget here in Oak Ridge was approximately $500 million, now it's about $400-430 million. A lot of that reduction was offset by Recovery Act funds. In Oak Ridge, we just completed our Recovery Act portfolio of work in 2014. Defense funds are clearly a challenge for us, particularly because we have 3 new capital asset line item projects (outfall 200 Hg treatment facility, the new disposal cell - EMDF, the sludge build-out project, an annex to our TRU waste processing center). We are struggling to be able to continue our planning activities for those three projects in as efficient a way as we possibly can. We are doing what we can to create cost efficiencies, to evaluate closely our base operational cost, and to look at other projects that are in the queue to evaluate whether they rise to the same priority level as those three projects.

I'm hearing that you may need to slow down projects – delay completion dates?

We are trying to keep all three of our capital asset projects moving forward because they are all critical – but we are slowing them down. One of the things that we are doing is identifying logical points where

we could stop each of the projects, where we would still have value in what was done for future activities.

How do the regulators feel about the delays?

It's a process – and it can be a lengthy process. They are never happy when there are delays or when we request changes to our regulatory milestones. It certainly doesn't help our credibility. And it also erodes trust. But we have been very fortunate here in Oak Ridge to have a TDEC commissioner and EPA Region IV as well willing to work with DOE-OR. Their mantra has been that they want to make sure that we continue to make progress. Often a little bit of trading goes on when we have to change things.

Committee Interviews with Two Representatives of the State of Tennessee

The key question was as follows: **How are risks to public health and safety considered as part of state and federal regulatory compliance and priorities at DOE-EM cleanup sites?**

TDEC considers risks with EPA and DOE under the FFA; and we've generally agreed on the priorities at ORR. However, there are a few things we want to stress from a risk-based perspective, as they are concerns that may require additional funding in the future. We've discussed these with our Commissioner and he's aware of these concerns. Examples include:

- Radionuclide contamination in wells off-site (across the Clinch River)
- Uncertainty about waste disposal using hydrofracture from 1963 to 1984; the site pumped about a million gallons of liquid rad waste and grout injected into the ground at about 1000 feet at 3,000 psi; at least 1.4 million curies, mostly Sr-90 and Cs-137
- Possibility of deep aquifer contamination (the Knox – which goes all the way to middle Tennessee) from HF and other sources

There are huge source masses onsite that will remain a threat to human health for thousands of years. Our position is that risk analysis needs to include all risk, including proximity to population and not just the factors or contaminants that DOE wants to count.

Equity is a concern to us. Compared to other sites, we are probably the closest to a population center. The site is within the corporate boundaries of the City of Oak Ridge. The public has access to roads on and through the site. About 815,000 people live in the immediate adjacent counties. The Oak Ridge Reservation doesn't have the buffer areas that SRS and Hanford have.

That is a huge consideration, given the unknowns and huge source masses that are not scheduled to be addressed, based on current funding.

We have been willing to work with DOE. Recognize though that our missions are not exactly the same. TDEC's priority is to enhance the quality of life for Tennessee citizens, by protecting and improving air, land, and water quality. While environmental protection is important to DOE, they are also focused on

public health and safety of employees on the reservation, maintaining a trained and cleared workforce, and cost.

When the Reservation was first put on the NPL, the original conceptual model indicated that the vast majority of groundwater contamination would surface prior to leaving the site, and would be carried away through the surface water. So DOE has maintained that the Clinch River is a boundary that contaminants wouldn't cross. However, the model is now being questioned, whether deep groundwater may be playing a greater role, as low levels of contaminants have been identified in wells across the river.

DOE is working with the State and EPA to implement an offsite groundwater monitoring program. It's a limited and fairly nominal effort---$1.5 million for the next 3 years; but it is an important step towards identifying the potential level of risk. Depending on the results, there may be a need to assign higher priority to groundwater remediation than in the past.

We understand the need to work with DOE through shifting priorities driven by shrinking budgets. Unfortunately we're seeing that the timeframe to address issues, particularly related to remediation, are getting pushed further and further out. We understand that it's a budget constraint, but that combined with a questionable (and possibly flawed) conceptual site model makes it difficult to determine how well risk is really being addressed.

The FFA does not restrict any access to information among the tri-parties, nor does it prevent /delay changes to mid-year corrections to priorities.

When budget is not available, DOE does request delay or elimination of milestones. We understand that and are open to working with them, but it is frustrating when milestones are pushed out to 2024 and some of the other issues still don't get resolved.

Does DOE encourage and listen to your recommendations regarding re-prioritization?

Flexibility is based on all three parties agreeing, so it is a negotiation, based on circumstances at the time. If funding is available, it's not an issue. If funding is restricted, it's boils down to which state in the DOE Complex has got the biggest stick. Tennessee has been more willing to work with DOE to modify milestones and accommodate funding restrictions than some of the other states.

When DOE is developing its priorities, if you say "we need to move GW up on priority list", do they listen?

Yes, but it's a slow process. And because of funding, DOE at the site level may not have the flexibility to change priorities, even if they wanted to. For instance, the U-233 project was given to EM with no dollars, so funding had to come out of the EM budget ($25-30 million per year), reducing funding for other important projects.

But it's mostly a collaborative relationship?

The relationship is very collaborative in information exchange; in ability to change, not as much. We work together and are ultimately trying to accomplish the same goals; but we each have different constraints.

Are the land use restrictions OK with you?

Yes, we agree with DOE that industrial use is appropriate.

QUESTION SET 5 – INTERVIEWS WITH DOE HEADQUARTERS ABOUT INFORMATION AND TOOLS USED IN DECISION ANALYSIS

5a. DOE has access to data from the NRC, EPA, OMB, state and even local government, the National Academies, academic and other institutions, the media, and other sources. How does DOE-EM gather, filter, and determine which data sets and sources should be incorporated into its human health risk and public safety actions? Are current efforts adequate? If not, what might make them more valuable to the DOE?

(Fact checked by Matthew Duchesne)

DOE managers indicated that DOE receives data and input from all the groups listed in our question and others not listed. Taking a step back from the question, they noted that DOE's nuclear sites are among the "best studied sites in the world," with ongoing surveillance and data bases, as part of the Department's effort to increase their level of understanding in support of cleanup decisions, as well as to report on off-site environmental releases through annual environmental-monitoring reports required by DOE order.

They provided the Committee with several examples based on interactions with non-DOE sources.

- EPA has over 200 guidance documents on implementation of CERCLA. Most waste/operable units or aggregates have a Remedial Investigation/Feasibility Study (RI/FS) that are quantitative and at least an interim ROD. Risks have been identified; often interim actions are used. Baseline risk assessments are also performed as part of the CERCLA process.
- DOE Order 435 on Radioactive Waste Management was initially based on the ASChemE framework for hazards analysis during each phase of operations, focusing on risks to the environment, workers and the public. The basis for requirements in the Order evaluated the major unit operations involved in waste storage, pre-treatment, treatment and transfer between facilities, and the hazard posed by these operations. The technical basis for the Order classified risks into high, moderate, and low hazards, and that classification was used to determine whether control of some sort was necessary to mitigate the risk. Additionally, DOE chartered an independent group of technical and public-health experts to provide an independent review and evaluation of the process and ultimately the requirements themselves.

- DOE managers noted a long history of engagement with the National Academy of Sciences. One of the more famous examples is the recommendation to find a repository for permanent storage that date back more than half a century. Many more have followed.
- DOE has Site Specific Advisory Boards that are used to obtain suggestions and provide input to the public (See question 4 discussion with Oak Ridge) for an illustration).
- To make a determination that radioactive waste previously managed as high-level waste can be managed as other than high-level waste at the Savannah River and Idaho sites, DOE is required to consult with the Nuclear Regulatory Commission (NRC) regarding DOE's technical analysis and determination that the required criteria have been met.

5b. What is DOE's position with regard to the use of risk analytical tools in decision-making, such as probabilistic risk assessment (PRA)?

In regard to all the interviews with DOE, DNFSB, and other contributors, the subject of the use of formal risk analysis tools was not considered to be anywhere near the top of the list as a major policy issue. Yet, it did provoke considerable discussion about the utility of these approaches as aids for human health and safety decisions.

DOE uses the term "risk-informed" rather than risk-based, which means that its decisions not only heavily rely on quantitative data and analytical tools, but also qualitative data, collective experience of its experts, and conservative standards. Also, DOE management referred back to the Federal Facilities Environmental Restoration Dialogue Committee (see section 2 above), which discussed the factors that influence decisions and the role of risk assessment in those. Notably, at our meeting, DOE EM management had a copy of the report with them.

Senior management explained that their documented safety analyses (DSA) are deterministic, largely qualitative process, in contrast to quantitative (probabilistic) safety analyses used in the commercial nuclear industry. Their position has been that their approaches are conservative and protect human health and safety without necessarily requiring probabilistic risk assessment.

In cases where more formal risk analyses are required, they are done to support decisions. For example, a DOE manager provided a "risk ranking" list of the top 20 major DOE projects that he uses to prioritize his staff resources to focus on the highest risks. A total of 93 nuclear facilities have been evaluated in terms of nuclear safety and risk ranked based on the hazards. The Committee discussed the profile as an approach of how to structure the process of how decisions are made.

The Committee's interest in risk analysis tools is clearly not new to the DOE and DNFSB. The Committee provides text boxes below that summarize some of interactions in regard to more formal risk analytic tools.

Perhaps the most interesting exchanges were between the DNFSB and the DOE. Under the administration section of the DNFSB report for 2014, the report makes note of risk as follows:

> "One modification requires the Board to 'specifically assess risk' when issuing recommendations. In response to this direction, the Board developed the necessary guidance to implement the change. The guidance includes a publicly visible Policy Statement defining how the Board will assess risk. As a corollary effort, the Board's staff developed supporting internal directives that define the methods to be used in implementing the Policy statement."

The Congressional requirement is an opportunity to gain insights on how the DNFSB views risk.

The Board responded with a three page policy statement on August 15, 2013. It acknowledges the change in the National Defense Authorization Act of 2013:

> "In making its recommendations, the Board shall consider, and specifically assess risk (whenever sufficient data exists), the technical and economic feasibility of implementing the recommended measures." (p. 1).

The DNFSB's policy statement notes that the "standard for adequate protection of the health and safety of the public cannot be influenced by considerations of costs or assessments of risk. Therefore, the Board's mandate to issue recommendations necessary to ensure adequate protection of health and safety of the workers and the public is not contingent upon its ability to conduct a risk assessment or consideration of cost." (pp. 1-2).

The DNFSB looked for definitions and use of the word risk in the Atomic Energy Act of 1954, as amended. It observed that the meaning of the word in the defense and commercial nuclear industries combines analyses that answer three questions: what can go wrong, how likely is it, and what its consequences might be.

As noted earlier (section 2.1.1 these three questions were first written by Kaplan and Garrick 1981) in the first issue of a new journal *Risk Analysis, An International Journal*. These same three questions or declarative versions of them are found in the DOE's (2010) notice "Risk Assessment in Support of DOE Nuclear Safety" and a recent risk analysis literature paper (Greenberg et al. 2012), which summarizes major achievements in risk analysis.

> The policy statement then describes factors that influence the risk to health and safety of workers and the public associated with operation of a facility. These are indicated to be location of the facility relative to workers and the public; the type of nuclear materials; possible release mechanisms; safety systems, including their resilience; unproven or unique applications or materials; and new circumstances about the operations and/or facility. These are consistent with factors in the literature for chemical and physical agents. The report includes a statement that the DNFSB will explicitly document its assessment of risk when drafting recommendations to the DOE Secretary.

While noting that quantitative data may not always exist, the DNFSB policy statement notes that the Board used quantitative data in its Recommendation 2009-2, Los Alamos National Laboratory Plutonium Facility Seismic Safety. Along with the brief policy statement, the LANL case is another opportunity to examine DNFSB's perspective on risk, along with the DOE's. The first and perhaps most important written assertions about risk, risk assessment, risk management and risk analysis resulted from DNFSB Recommendation 2009-1 to the DOE and are summarized in the accompanying text box.

Recommendation 2009-1: DNFSB and DOE Exchanges about Risk Assessment

DNFSB Initiation

We quote much of the exchange so that the reader can judge the emphasis placed on certain issues by the DNFSB and the DOE. The DNFSB (Eggeneberger 2009-1) wrote to the DOE on July 30, 2009 regarding DOE's about risk assessment. After very briefly commenting on risk assessment use by federal agencies, the recommendation noted that

> "the Board's concern was that DOE was using quantitative risk assessment methods without having in place a clear policy and set of procedures to govern the application of these methods at facilities that perform work ranging from assembly and disassembly of nuclear weapons to nuclear waste processing and storage operations . For this reason, the Board wrote to the Secretary of Energy on April 5, 2004, and made the following observation: [T]he Board has reviewed the DOE's use of risk management tools at defense nuclear facilities. This review revealed that DOE and its contractors have employed risk assessment in a variety of activities, including the development of documented safety analyses and facility level decision making. The level of formality of these assessments varies over a wide range. The Board's review also revealed that DOE does not have mechanisms (such as standards or guides) to control the use of risk management tools nor does it have an internal organization assigned to maintain cognizance and ensure the adequacy and consistency of risk assessments. Finally, the Board's review showed that other federal agencies involved in similar high-risk activities (e.g., National Aeronautics and Space Administration, U.S. Nuclear Regulatory Commission) have, to varying degrees, formalized the use of quantitative risk assessment in their operations and decision-making activities. These agencies have relevant standards and defined organizational elements, procedures, and processes for the development and use of risk management tools.
>
> The Board's initial concerns on this issue have been reiterated in letters dated November 23, 2005, and May 16, 2007. In the Board's 2006 Annual Report to Congress, the section on Risk Assessment Methodologies noted "the slow pace of its development," and the 2008 report noted that "all progress [has come] to a halt ." The Board's most recent annual report stated that at "a time when governments, financial institutions and industries worldwide are expediting the implementation of enterprise-wide risk governance programs, DOE's slow pace for developing a policy is of serious concern.
>
> DOE's most recent correspondence [to the DNFSB] on this issue, dated January 9, 2007, outlined plans and progress toward developing a policy and accompanying guidance document on the use of risk assessment at defense nuclear facilities. This DOE letter indicated that the draft policy and guidance document would be ready for

submittal to the DOE directives system in March 2007. Despite periodic meetings with the Board's staff and briefings to the Board, as of July 2009, the draft policy and guidance document has not been entered into the DOE Directives system, and near-term resolution of the issue is not evident. Without such a policy, DOE has little basis to accept the validity of existing risk management tools that use quantitative risk assessment. This is particularly important since the managers of DOE's field elements are allowed to accept the safety risks that high-hazard operations pose toward workers and the public based on widely varying levels of assessments. Though Title 10, Part 830 of the Code of Federal Regulations (10 CFR 830, Nuclear Safety Management) and its associated quality assurance considerations govern nuclear safety evaluations at a fundamental level, these existing requirements are not of sufficient specificity to guide the use of complex quantitative risk assessments. The continued pursuit of ad hoc applications of risk assessment in the absence of adequate DOE policy and guidance is contrary to the standards-based approach to nuclear safety espoused by DOE and endorsed by the Board. (See Department of Energy 2013)

Therefore, the Board recommends that DOE:

1. Establish a policy on the use of quantitative risk assessment for nuclear safety applications.

2. Consistent with this policy, establish requirements and guidance in a DOE directive or directives that prescribe controls over the quality, use, implementation, and applicability of quantitative risk assessment in the design and operation of defense nuclear facilities.

3. Evaluate current ongoing uses of quantitative risk assessment methodologies at defense nuclear facilities to determine if interim guidance or special oversight is warranted pending the development of formal policy and guidance.

4. Establish a requirement to identify deficiencies and gaps in ongoing applications of quantitative risk assessment along with the additional research necessary to fill those gaps in support of the development and implementation of the final policy and guidance."

DOE Response

The DOE accepted the DNFSB's recommendation in its reply of April 27, 2010 (DOE 2010). In their response, the DOE made several important points. One of these is that the DOE does use "elements of risk assessment techniques as part of the development of safety bases for nuclear facilities and in support of decisions related to the upgrade of its facilities." (p. 4). The response notes that the DOE

primarily relies on what it calls hazard-based deterministic analyses that are mandated by its safety directives and rules. It then notes that changes are appropriate for "certain directives and standards" (p.4) to improve clarity. Risk analysis is permitted, but the response is that risk analyses "are not substitutes for compliance with the DOE requirements." The requirements are specified in Secretary of Energy Notice (SEN) 35-91. DOE-STD-3009, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis (CFR title 10, Part 830, Nuclear safety management, subpart B) specifies required analyses. That document indicates that the level of data required for a quantitative risk assessment is not expected. When QRA are used, quality assurance is required.

The DOE reply emphasizes that the inconsistent use of risk assessment is due to lack of a shared understanding of what it is and the fact that SEN-35-91 has not been updated. Acknowledging the development of risk assessment, the DOE proposed near-term activities that included issuing interim notice on the need for quality assurance when QRA is used, create a technical experts working group to assist the DOE, updating the training module about risk assessment for DOE executive leadership, and developing a new risk assessment course for staff and managers. To further address the recommendation, the DOE indicated that it would revise in Nuclear Safety Policy (SEN-35-91) following a formal study.

DOE (2011) released its modification of SEN-35-91 in July 2011. The report states five actions that DOE takes to protect public and worker health, and number 4 is about risk assessment.

> "1. Establish and implement nuclear safety requirements that utilize national consensus (or other government) standards or applicable regulations in accordance with DOE's process for developing and implementing rules, directives and technical standards;
>
> 2. Implement core functions and guiding principles of Integrated Safety Management (ISM);
>
> 3. Use a safety management approach that includes minimizing use of hazardous material, and establishing controls that provide defense-in-depth;
>
> 4. Allow appropriate use of quantitative and probabilistic risk assessments to support nuclear safety decisions; and,
>
> 5. Establish safety goals related to worker and public risk from DOE nuclear facility operations."

The report is definitive about quantitative and probabilistic risk assessment:

> "Ensuring that quantitative and probabilistic risk assessments, when employed, are used in a manner that:

a. Supplements qualitative/deterministic processes for hazard assessments, hazard control development, and safety management programs development,

b. Is consistent with DOE directives, and

c. Is supported by industry practices and availability of risk data."

The document notes a requirement for "a high-level of formality in operations [that] are a center piece of DOE defense-in-depth approach for nuclear safety" (p. 3) and adds:

> "The fundamental safety measures (effective hazard analysis, application of appropriate controls that utilize defense-in-depth and quality assurance, and other safety management programs) reduce the likelihood and consequence of events to acceptable levels, in which the worker, public and environment are adequately protected."

These exchanges, the Committee believes, do not sufficiently highlight the issue of uncertainty in decision-making. Risk involves likelihood and consequences, and much of the literature has focused on probabilistic risk assessment as a tool for informing decisions. Likelihood cannot always be estimated, even by experts. The Committee provides two illustrations of the potential utility of these approaches to draw out and highlight the uncertainty in risk-informed decisions. The text box is about the use of risk assessment for a nuclear waste management case.

West Valley Risk Assessment

Application of Risk Assessment to Nuclear Waste Management at the West New York site.

Probabilistic risk assessment (PRA, also known as quantitative risk assessment) is an analytical approach widely used to manage and assess the risk-related status of nuclear reactors. However, PRA was not applied to management of nuclear wastes until the New York State Energy Research Development Authority (NYSERDA) commissioned a group of risk analysts to consider the case a nuclear waste management facility in Western New York (Garrick et al. 2010). The site contains an estimated 2.4 million $ft.^3$ of radioactive waste that sits in seven trapezoidal-shaped trenches, which in turn sits on clay bedrock on a 15 acre site. As required by federal law NYSERDA did performance assessments on the site. NYSERDA asked the risk analysts, led by the researcher who led efforts to apply PRA to commercial nuclear reactors, to apply PRA to their site. Their objective was to better understand the risk of managing the nuclear waste in the same configuration for the next 30 years.

The authors of the study evaluated the three risk assessment questions set forth above (initiating events, likelihood, consequences). The group developed 31 scenarios that represent possible triggering events, including flow of contaminants from the landfill latterly into the groundwater, breaches of the waste trenches, overflow of the trenches and airborne releases from the landfill. Their specific goal was to estimate human exposures resulting from these 31 scenarios. The authors used multiple quantitative models that estimated air and water emissions trench overflows, stream transport and deposition, erosion as well as failures of engineered facilities. Recognizing that each of these models individually as well as all collectively have uncertainties associated with them (Cox 2012), the authors use probabilistic Monte Carlo tools to develop aggregate estimates of risk associated with each type of emission pathway. They concluded that there is an exceedingly low probability of exposing the hypothetical individuals at risk to radioactivity above federal standards. The authors of the paper note that NYSERDA used these findings as part of their case for not substantively changing the management of these nuclear wastes.

This study is an example of the application of risk assessment thinking and analytical tools. It's limitations in regard to this Committee's charge have nothing to do with the study itself, but are associated with the reality that this site has a limited amount of nuclear waste. Hence, while the analysis stands as an illustration of how to conduct such a study, it should be noted that the authors consider their study was instrumental to the Authority's decision. Furthermore, the authors were not asked to address non-human health and safety risks described earlier in this report. Furthermore, they did not evaluate possible worker and public exposures in the event that NYSERDA chose to alter the configuration of the site or even remove the nuclear waste from the site.

It is clear to the Committee that DOE can make more use of quantitative risk analysis methods to inform decisions than it has. However, these methods are much more likely to be applicable to some circumstance than to others. In discussions with the DOE, the following two suggestions emerged:

- Large project: A major new investment in a project is planned that includes high levels of uncertainty where PRA tools could be used to assess the consequences of different levels of uncertainty on the choice of options and sequencing of the project.
- Site plans: A reevaluation of site sequencing of projects is required because of reduced budgets and an emerging issue that requires resources to be shifted within a site. Risk prioritization decision tools may help the DOE assess options that without such input seem like comparing apples and oranges.

APPENDIX D: NOTES FROM INTERVIEWS WITH CONTRACTOR EXECUTIVES

Interviews conducted by Jim Rispoli on October 22 and 23, 2014 and fact-checked by the contractor executives who responded to Jim Rispoli

Interview #1.

Question: From your perspective, how do you see the priorities at your site (ORP):

Answer:

#1. ISM (Integrated Safety Management), worker, public nuclear safety

#2. Contain the Hazardous Material - so it stays contained. (e.g., tank farms containing high level waste.

#3. Reduce vulnerability in #2, for example, move plutonium (Pu) to a more secure location; move tank waste to double shell tanks.

#4. Place nuclear materials into long term configuration.

Question: How are priorities set?

Answer: All this is done by deterministic assessment, considering laws, regulations, etc. The contractor originates the list, DOE iterates. Security is always paramount; vulnerability analyses and assessments; how does work being done on site affect security.

For environmental considerations, performance assessments of the end state should govern.

He would spend two years assessing and doing performance assessments of the end state of various wastes. He would focus on the highest radiation levels, the longest lived isotopes, structural integrity of the tanks.

This action would not stop ongoing risk reduction efforts. For example, on the tanks, he would assess what is the risk at the end state? Would it present an exposure to rivers? What is the source term? He would quantify the curies. How much could be left in the tanks and stabilized? He would "forget" the 90 percent removal (since that volume was not determined through a performance assessment, and every tank is different). The remediation could be done faster. It could be 75 percent removal, or zero removal (tank by tank performance assessment).

Another current example is tank AY-102 (at Hanford), the double shell tank where a small quantity of HLW has been found in the annulus. Although (at the conference) the state regulator indicated the

state had showed flexibility on this issue, in fact, all the regulator agreed to was a longer time period to address this. And that was only agreed to when the regulator was informed that if the water (liquid) portion of the tank was removed, the decay heat would be uncontrollable, and there could be a conflagration in the tank; this could destroy the ventilation system and present a significant hazard and risk. (Jim Rispoli note: during an EM briefing at the Decision Makers' Forum in Florida (the site where these contractor interviews were conducted we were told that the ORP will spend $30 million this year starting work on AY-102.)

The regulators have agreed to the tank-farm-wide strategy (which the Committee was briefed on during the tour). This would enable items of work to prepare for closure to be done tank-farm-wide, rather than tank by tank; this should result in faster and safer performance of the work.

The contractor notes that interim storage facilities at Hanford will contain 10 percent high level waste (HLW), 90 percent low activity (LAW). The LAW is currently slated to be encapsulated in glass. His proposal would be "should always start with a performance assessment of the waste form" and this might result in a different method (other than vitrification).

Question: In your view, what would be the likely EM-wide priorities?

Answer: #1 would be the Hanford river corridor (and other similar risks to the public); #2 would be the SRS tanks because some of them are in the water table.

Question: What is the role of the DNFSB is setting priorities.

Answer: DNFSB has stayed out of this debate on overall program priorities. They look at nuclear safety applied to the remedy. They have been black and white; they push for the greatest margin of nuclear safety. Board member Roberson brings the moderation.

Question: How should critical infrastructure be managed?

Answer: Kevin Smith, (note: Kevin Smith is the EM Site Manager for ORP) working with the contractor has provided an award fee consideration for predictive maintenance to minimize down times; developed a set of metrics for this (award fee). They have established milestones, to provide performance based incentives for maintenance of piping, ventilation. The regulator has bought into this.

Question: How would you organize the cleanup effort?

Answer: start with the end in mind; a performance assessment of the waste form. What does the risk profile really look like? The regulator seems to only look at an 18 month schedule slip, but how does this affect the risk profile?

Interview #2.

Question: How concerned are you about Infrastructure?

Answer: Worried about work-arounds

Example: the EOC is in the basement of the otherwise abandoned former federal DOE HQ building at SRS. The building is not maintained; especially worrisome is ventilation and wiring. A new roof is being put on but nothing else. There are no funds to relocate the EOC; there are roof leaks everywhere, posing a hazard to workers in the building.

Another example: the high voltage breakers (the Committee heard about this on site). The compressed air tanks that contain the energy to trip the breakers are so badly deteriorated that repairs can no longer be done. This has been on a priority list for a long time. Now, a Critical Infrastructure Integrated Priority List (CIIPL) has been developed; 130 items are on it. This is bringing focus. It is important to tie these maintenance issues to mission impact.

The recent events at WIPP have forced a recognition of the importance of infrastructure maintenance. Ines Triay, as EM-1, refocused priority at SRS on closure, so the maintenance force dwindled. Now, the SRS contract's parameters are: 55% on cleanup; 45% on NNSA (including tritium, non-proliferation, etc.)

Funds come to the contract by PBS (Project Baseline Summary). The contractor does not have the flexibility to shift between PBSs. PBSs include spent fuel; waste management; H Canyon, etc. Maintenance inside the facilities is included with that PBS. All site-wide infrastructure maintenance is housed within the waste management PBS, and not many resources are in it. Contractor makes prioritization recommendations, and works to get the Performance Based Incentives (PBIs) aligned with those priorities. But there are "lots of PBIs -- too many." Meanwhile all of NNSA is Award Fee, with performance objectives.

Question: From your perspective, how do you see the priorities at the sites?

Answer:

#1 Min safe

#2 Ground water destined for the river

#3 SRS tanks

The Washington State grout issue "is big" (discussion point at SRS). It is so costly (to vitrify) that it drains dollars for risk reduction elsewhere. As to the allegation that the RL site dug up Chromium "to China" to interdict from the groundwater, this contractor executive would not question that decision.

Question: What is the role of the DNFSB?

Answer: They are not focused on overall risk prioritization. They pay attention to operations. The site reps are more tactical. An excellent example of DNFSB highlighting a risk to increase priority was building 235F, where the DNFSB looked at the risk posed by Pu238. This has resulted in a focused effort to remove combustibles, improve the fire protections system, and plan for a solution.

Interview #3.

Question: From your perspective, how do you see the priorities at your site (ORP):

Answer: Technical risk alone does not and should not drive the priority. Technical is very important, but not the only thing.

The contactor sees the "buckets" for development of the priority list (for budget, considering risk) to be:

- technical risk
- politics, work force stability, budget constraints (my note: non-technical, non-regulatory factors)
- regulatory milestones and requirements

These buckets are not listed in any priority.

The contractor believes that the each site does a risk-informed prioritization, and that the list is audited internally, and those sites come up with an integrated priority list based on that analysis.

But local politics plays a part, for example, Yucca Mountain; the decisions on the leaking tanks at Hanford, where there are massive volumes, small leaks. In his view, the double shell tank with a small leak is still a smaller risk than the older single shell tanks.

Many sites, and their congressional representatives, look at the DOE clean-up as leaking tanks at Hanford, where there are major communities. Increasing funding (to conclude sooner)? Is it driven by politics, milestones?

Question: What is the role of the DNFSB?

Answer: DNFSB is not a factor in prioritization overall. But in individual technical situations, they engage to the good. For example, Building 235F - now this building is getting funding and he believes the funding will be sustained until the Pu disposition is resolved.

> "They (DNFSB) can be a significant factor in technical and oversight, but not the priority of the specific things that need to be done."

Additionally, there was a situation at the Pantex plant where the DNFSB technical staff objected to spending on infrastructure maintenance when they felt the dollars should be spent on nuclear safety. As Plant Manager, this person felt the infrastructure problems posed a more immediate risk to worker safety.

Question: How should critical infrastructure be managed?

Answer: Sites have known about the infrastructure issue, shrinking budgets have led to growth of the overdue maintenance lists, but only now is there an impetus to do something about it.

Question: What is the role of EPA? Do they help moderate and provide some consistency in evaluation of cleanup standards?

Answer: This executive offers one specific example of EPA involvement. There was an asbestos issue at Hanford, in which the trade unions were involved. The local EPA had agreed to a solution, but EPA HQ overruled the local EPA and imposed a fine on the contractor.

Contractors Interviewed:

Greg Meyer, Fluor
Carol Johnson, Fluor (previously many years with URS and its predecessor companies)
Dave Olson, URS (now part of AECOM)

APPENDIX E: FURTHER NOTES ON RISK, RISK ASSESSMENT, AND RISK MANAGEMENT

Several overlapping definitions of risk assessment, risk management, and risk analysis are presented here. The first combines two papers (Kaplan and Garrick 1981, Greenberg et al. 2012, see also National Research Council 1983). This pair defines risk assessment, management and analysis as a process that seeks the answers to six questions:

- What can go wrong?
- What are the chances that something with serious consequences will go wrong?
- What are the consequences if something does go wrong?
- How can consequences be prevented or reduced?
- How can recovery be enhanced, if the scenario [events and events that follow from it] occurs?
- How can key local officials, expert staff, and the public be [organized and] informed to reduce concern and increase trust and confidence.

The first three questions constitute risk assessment, the second three constitute risk management, and together the six constitute risk analysis. The key point is that risk assessment and risk management are a series of interconnected steps with the objective of reducing vulnerability and hence the risk of hazard events.

A somewhat different view, especially with regard to the starting place, is presented by Reinschmidt et al. (2005). This document is important because it was prepared in support of DOE and risk management is a series of

> "Identification and analysis of project risks are required for effective risk management. One cannot manage risks if one does not characterize them to know what they are, how likely they are, and what their impact might be. But project risk management is not limited to the identification and aggregation of risks, and it cannot be repeated too often that the point of risk assessment is to be better able to mitigate and manage the project risks. Additional effort is needed to develop and apply risk management strategies.
>
> The major steps in a risk management process discussed in this report are the following:
>
> - Project risk identification
> - Qualitative risk assessment
> - Quantitative risk analysis
> - Risk mitigation
> - Setting contingency, and
> - Portfolio risk management."

The differences between this definition and the first are partly explained by their intent. The first entirely focuses on human health, safety and environmental risk, not on other organizational goals, such as organizational, legal and other risks.

The third view presented herein is that issued by the International Organization for Standardization (ISO) in their ISO 31000:2009. This document provides principles and generic guidelines on risk management. The ISO web site states:

> "ISO 31000:2009 can be applied to any type of risk, whatever its nature, whether having positive or negative consequences.
>
> Although ISO 31000:2009 provides generic guidelines, it is not intended to promote uniformity of risk management across organizations. The design and implementation of risk management plans and frameworks will need to take into account the varying needs of a specific organization, its particular objectives, context, structure, operations, processes, functions, projects, products, services, or assets and specific practices employed.
>
> It is intended that ISO 31000:2009 be utilized to harmonize risk management processes in existing and future standards. It provides a common approach in support of standards dealing with specific risks and/or sectors, and does not replace those standards."

Continuing with the ISO contribution, ISO published ISO Guide 73:2009, from which excerpts are presented:

- terms relating to risk;
- terms relating to risk management;
- terms relating to the risk management process;
- terms relating to communication and consultation;
- terms relating to the context;
- term relating to risk assessment;
- terms relating to risk identification;
- terms relating to risk analysis;
- terms relating to risk evaluation;
- terms relating to risk treatment;
- terms relating to monitoring and measurement.

As is indicated by the hierarchy presented, the overall context is "risk management." It provides a common approach in support of standards in this report, including risk assessment and risk analysis.

Stepping back from the differences between the first two studies and the second two, the first two sources are organized so that risk assessment and risk management are elements of risk analysis. The second two focus on risk management and include risk assessment and analysis as part of risk

management. The key point is that both include all the elements of the process, that is, they include likelihood and consequences and the elements of risk management. This report focuses on procedures and recommendations relevant to DOE EM.

Another issue is who makes risk management decisions. Risk management decisions are rarely made by a single decision maker. They are made by groups of managers. For example, a report (G-ESR-G-00082) that the Review Committee received from the Savannah River Site (Savannah River 2013) provides what it calls "a simple and structured, process for managing and controlling changes to the Critical Infrastructure Integrated Priority List (CIIPL)." This report defines the group membership to include site organizations and supporting DOE representatives, as well as additional members who are called upon to provide support and guidance in the areas of technical and administrative support. Risk management decisions are based on the current state of knowledge of the decision makers. The state of knowledge consists of awareness of various commitments, regulatory requirements, costs, and various kinds of risks, e.g., to health and safety of workers and the public, environmental, and programmatic. It also includes relevant engineering and scientific knowledge and past experience.

DOE: Risk Characterization and Management Tools

Specific risk characterization and management tools are required under DOE nuclear safety and EPA policies. Use of additional tools is optional and may be appropriate in specific circumstances. The different foci, methodology and applicability of the required and available tools add important insights but also complexity to the risk analysis process and interagency deliberations.

Documented Safety Analysis (DSA), required as part of nuclear safety, describes the life cycle hazards of a facility (e.g., design, construction, operation, and cleanup) and then is used to require operating and engineering controls to minimize the risk. DSAs are required and along with risk assessments are important human health and safety risk management procedures. DOE STD-3009.94 See DOE (2014a,b) http://energy.gov/sites/prod/files/2013/12/15/documented-safety-analysis.pdf. Accessed 12-4-14.

EPA risk assessment guidance under CERCLA requires very specific protocols, procedures and training. It operates with a clearly prescribed source to receptor process and with specific pathways resulting in human exposure assumed (Environmental Protection Agency 2014), Radiation Risk Assessment Guidance, Chapter 10. http://www.epa.gov/oswer/riskasessment/ragsa/ch10.pdf. Accessed 12-4-14.

Probabilistic Risk Assessment, sometimes called Quantitative Risk Assessment, is a systematic quantitative methodology that uses event trees, human reliability analysis, Monte Carlo, and other tools to estimate the likelihood of events and their consequences of a variety of events. It is an important approach in risk assessment, and is discussed in greater detail in the human health and safety theme and in Appendix C.

Analysis, Deliberation and Integrated Decision-Making

The National Research Council (1996) issued a report that recognizes two parts in decision making: analysis and deliberation. *Analysis* "uses rigorous, replicable methods, evaluated under the agreed protocols of an expert community-such as those of disciplines in the natural, social, or decision sciences, as well as mathematics, logic, and law-to arrive at answers to factual questions." *Deliberation*, on the other hand, is "any formal or informal process for communication and collective consideration of issues. Participants in deliberation discuss, ponder, exchange observations and views, reflect upon information and judgments concerning matters of mutual interest and attempt to persuade each other."

The NRC distinction between analysis and deliberation is a useful way to think about environmental and regulatory decision-making at the DOE. Figure 1 shows the sequence of activities that leads to regulatory decisions. During deliberation (Figure 2), the decision makers scrutinize the analytical results and question the assumptions behind the analyses. Analysis and deliberation provide an iterative interaction leading to decisions. It is essentially the same as the process that one DOE manager showed the Review Committee during on DOE HQ meeting of September 13, 2014.

This presentation emphasizes the reality that regulatory and environmental decisions are never entirely ***risk-based***, that is, driven solely by risk calculations. That is, decisions are informed by risk and not risk-based criteria. Decisions are ***risk-informed****:* risk information is an input to the deliberative part of the process. Of course, one can use risk assessment as part of a process to rank facilities or sites with respect to the risk they pose to worker health and safety. This ranking would be risk-based. However, when a decision is made regarding resource allocation, the risk-based ranking will be an input to the deliberative process that will lead to the decision, i.e., the latter will be the result of a risk-informed process.

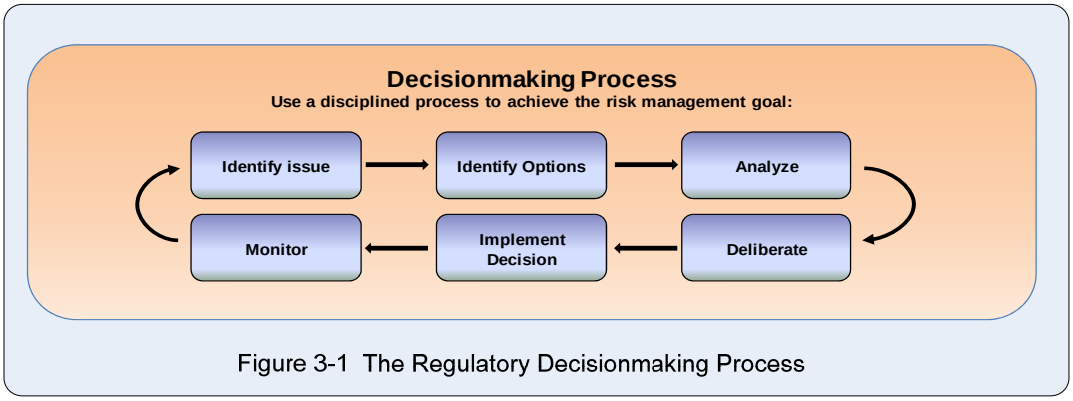

Figure 2. The Regulatory Decision-Making Process (Source: NUREG-2150, Figure 3-1)

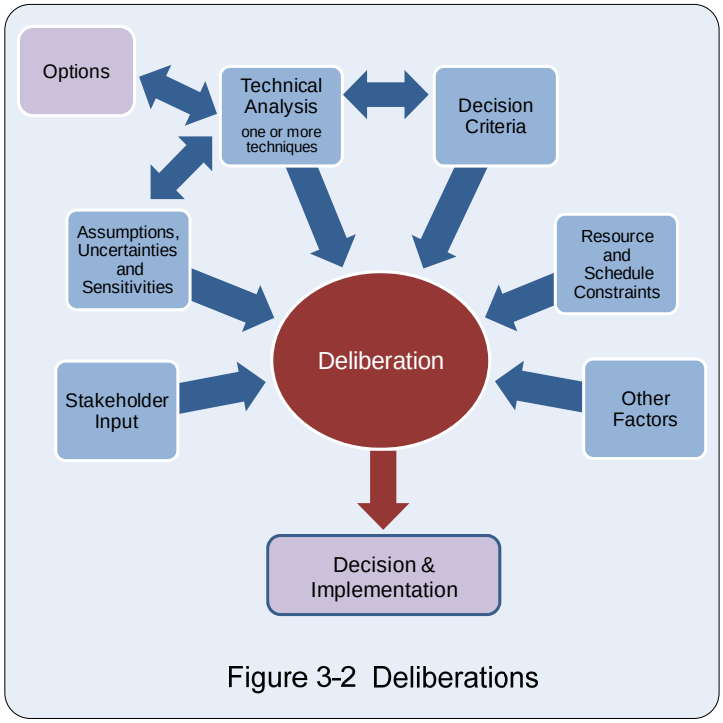

Figure 3. The Deliberative Part of the Decision-Making Process (Source: Nuclear Regulatory Commission, NUREG-2150, 2012, Figure 3-2)

A recent effort to reconsider the role of risk assessment in the context of risk analysis was undertaken by the U.S. EPA (2014) in a *Framework for Human Health Risk Assessment to Inform Decision Making*. It is consistent with the effort to orient risk assessment to answering risk management questions. The 2014 report offers eight principles to guide a human health risk assessment. The eight begin with the statement that "a risk assessment should be fit for its intended purpose," and end with "risk assessments should be presented in a readily understandable and useful form for the intended audiences." (p. 3) The authors of the EPA report note that the framework established by the so-called "red book" (a report prepared on the potential uses of risk assessment by the National Research Council, 1983) is maintained, but "an emphasis [is placed] on the utility of the risk assessment for informing risk management decisions [and] begins with planning and scoping and continues throughout the process. …. The framework supports enhanced dialogue between risk assessors and risk managers while recognizing the differences in their distinct roles." (p. xii) A key emphasis is placed on consultation with the public, stakeholders and the community. "Emphasis on utility is maintained throughout the process, beginning with planning and scoping and continuing through the evaluation of the applicability of the risk assessment in informing decisions." (p. 49)

The FFERDC, OMB, and EPA documents call for narrowing the gap between risk assessment and risk management and involving stakeholders. Indeed, DOE does seek input from local communities, including from citizen advisory panels (Branch, Bradbury 2006).

APPENDIX F: LIST OF PERSONS INTERVIEWED

Hanford, Office of River Protection (ORP) and Richland (RL)

Josh Allen (RL)
Kaylin Burnett (ORP)
Bryant Charboneau (RL)
Stacy Charboneau (RL)
Mike Cline (RL)
Ray Corey (RL)
Mark Coronado (RL)
Janet Diediker (ORP)
Jonathan Dowell (ORP)
Al Farabee (RL)
Bryan Foley (RL)
Michael Frank (URS)
Jeff Frey (RL)
David Gutowski (DNFSB)
Jim Hansen (RL)
Rob Hastings (ORP)
Jane Hedges (Washington Department of Ecology)
Doug Hoffman (RL)
Mat Irwin (ORP)
Greg A. Jones (RL)
Greg L. Jones (RL)
Deanna McCrain (RL)
Nina Menard (Washington Department of Ecology)
Paul Pak (RL)
Steve Pfaff (ORP)
John Price (Washington Department of Ecology)
Bob Quirk (DNFSB)
Kevin Sandgren (ORP)
Doug Shoop (RL)
Ron Skinnerland (Washington Department of Ecology)
Kevin Smith (Site Manager, ORP)
David Thrasher (RL)
Ben Wallace (RL)
Ming Zhu (DOE-HQ)
Pam Zimmerman (RL)

Savannah River

Angelia Adams
Ron Bartholomew
David Bender
Elena Cuartas-Villegas

Bill Clark
Jim Folk
Phil Giles
Doug Hintze
Gary Howard
John Lopez
Pat McGuire
Michael Mikolanis
David Moody (Site Manager)
Tony Polk
Linda Quarles
Sharon Robinson
Mark Sautman (DNFSB)
Ed Szymanski
Michael Smith
Terry Spears
Vicke Wheeler
Shelly Wilson (South Carolina Department of Health and Environmental Control)

Oak Ridge

David Adler
Terry Allen
Jason Armstrong
William Bailey
Wendy Cain
Sue Cange (Site Manager)
Brian Demonia
Bill McMillan
Jay Mullis
John Owsley (Tennessee Department of Environmental Control)
Chris Thompson (Tennessee Department of Environmental Control)
Laura Wilkerson
Ed Worth

EPA Headquarters

Robin Anderson (OSRTI)
Charlotte Bertrand, Acting Director (Federal Facilities Restoration and Reuse Office, FFRRO)
Reggie Cheatham, Acting Director Office of Emergency Management
Arthur Collins (EPA Region 4)
Jeff Crane (EPA Region 4)
Kathleen Doster (FFEO)
Dennis Faulk (EPA Region 10)
Melanie Garvey (FFEO)
Franklin Hill, Acting Deputy Director OSRTI and Director of Region 4 Waste Management Division
Michele Indermark (FFRRO)

David Kling, Director (Federal Facilities Enforcement Office, FFEO)
Monica McEaddy (FFRRO)
Charles Openchowski (Office of General Counsel, OGC)
Rob Pope (EPA Region 4)
Robin Richardson, Acting Director (Office of Superfund Remediation and Technology Innovation, OSRTI)
Jennifer Tufts (EPA Region 4)
Dane Wilson (FFEO)
Jim Woolford, Acting Principal Deputy Assistant Administrator, Office of Environment Information and Director of OSRTI

APPENDIX G: ABBREVIATIONS AND ACRONYMS

ARRA	American Recovery and Reinvestment Act
AEA	Atomic Energy Act
ACRS	USNRC Advisory Committee on Reactor Safety
ARARS	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
CAV+B	Citizens Advisory Board
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CIIPL	Critical Infrastructure Integrated Priority List
CRESP	Consortium for Risk Evaluation with Stakeholder Participation
CWA	Clean Water Act
D&D	decontamination and decommissioning
DEAR	DOE Acquisition Regulation
DHEC	South Carolina Department of Health and Environmental Control
DNSFB	Defense Nuclear Safety Board
DoD	United States Department of Defense
DOE	United States Department of Energy
DOE-EA	United States DOE Office of Enterprise Assessment
DOE-EM	United States DOE Office of Environmental Management
DOI	United States Department of Interior
DOJ	United States Department of Justice
DSA	documented safety analyses
ECP	Employee Concerns Program
EIS	Environmental Impact Statement
EM	United States DOE Office of Environmental Management
EPA	United States Environmental Protection Agency

ESD	Explanation of Significant Difference
FFAs	Federal Facility Agreements
FFCA	Federal Facilities Compliance Act
FFERDC	Federal Facilities Environmental Restoration Dialogue Committee
FMEA	failure modes and effects analysis
GPRA	Government Performance Results Act
GAO	General Accountability Office
HLW	High Level Waste
IAGs	Interagency agreements,
ICs	institutional controls
ISM	integrated safety management
ISO	International Organization for Standardization
LANS	Los Alamos National Security
LAW	low activity waste
LLW	low level waste
MOX	Mixed Oxide Fuel Fabrication facility
MTCA	Model Toxics Control Act
NASA	National Aeronautics and Space Administration
NCP	National Contingency Plan
NPL	National Priority List
NDDA	National Defense Authorization Act
NOAA	National Oceanic and Atmospheric Administration
NRRB	National Remedy Review Board
NTCRA	Non-time critical removal actions
NYSERDA	New York State Energy Research Development Authority
OMB	Office of Management and Budget
ORP	Office of River Protection

ORR	Oak Ridge Reservation
PBSs	Program Baseline Summaries
PRA	Probabilistic Risk Assessment
RCM	reliability-centered maintenance
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RTD	Remove, Treat, Dispose
SCDHEC	South Carolina Department of Health and Environmental Control
SCIP	Safety Culture Improvement Panel
SNF	spent nuclear fuel
SNM	special nuclear material
SWP	Salt Waste Processing Facility
SWSA	Solid Waste Storage Area
SRS	Savannah River Site
SSAB	Site-specific Advisory Board
TPA	Tri-Party Agreement
TRU	transuranic waste
TSRs	Technical Safety Requirements
WIPP	Waste Isolation Pilot Plant
US DOE	United States Department of Energy
USNRC	United States Nuclear Regulatory Commission
USDA	United States Department of Agriculture
UST	underground storage tank
WESF	Waste Encapsulation and Storage Facility
WIR	Waste Incidental to Reprocessing