# ROADMAPPING – A TOOL FOR STRATEGIC PLANNING AND LEVERAGING R&D COMPLETED BY OTHER AGENCIES

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## ABSTRACT

The Department of Energy (DOE) is responsible for management of the environmental legacy of the nation's nuclear weapons and research program. This is the largest, most complex environmental cleanup program in the world. The issues and problems encountered in this program create the need to develop many scientific and technological solutions.

To be effective, the process used to create these solutions must be well coordinated through DOE's Environmental Management program, the rest of DOE, and other Federal agencies. Roadmapping is one strategic planning tool to provide the needed coordination. Past roadmapping accomplishments include:

> *"We need to find ways to continue progress and meet our commitments more efficiently and at a lower cost. … to identify steps to* ***strengthen project management, implement contracting strategies that help reduce costs and schedules, better employ new technologies, and sequence work more effectively****."* [Emphasis added]
> -Secretary Spencer Abraham

- Issuance of the Draft EM Roadmapping Guidance
- Issuance of the EM R&D Program Plan and Strategic Plan which established the direction for Roadmapping
- Issuance of the OST Management Plan which calls out Roadmapping as a key tool in EM Research & Development (R&D) Strategic Planning
- Completion of or progress on key EM Roadmaps, i.e., Savannah River High Level Waste (HLW) Salt Dispositioning Roadmaps, Hanford Groundwater/Vadose Zone Roadmap, Robotics and Intelligent Machines Critical Technology Roadmap, Complex-Wide Vadose Zone Roadmap, Long-Term Stewardship Preliminary Roadmap, Hydrogen Gas Generation R&D Plan (Roadmap), Idaho National Engineering and Environmental Laboratory (INEEL) Sodium Bearing Waste Dispositioning Roadmap, INEEL Voluntary Consent Order Tanks Characterization Roadmap, INEEL Vadose Zone/Groundwater Roadmap, Calcine Treatment Alternatives Roadmap

These efforts represent a great start; however, there is more to be accomplished in using Roadmapping as a tool for planning strategic initiatives and in coordinating the R&D performed by multiple federal agencies. The Environmental Management Advisory Board (EMAB) Ad Hoc Committee on Science and Innovation recognized this need in April of 2001 and requested that "flexible roadmaps be developed." The Hanford Site in their recent "Strategic Assessment on Hanford Site Cleanup Challenges and Opportunities for Science and Technology (S&T)" proposed roadmapping as a key mechanism for integrating cleanup activities. Dr. Carolyn Huntoon commented on the assessment, "the suggested Roadmapping activities are excellent

ways to provide the needed integration and engage the technical talents of the focus areas and the entire DOE Complex."

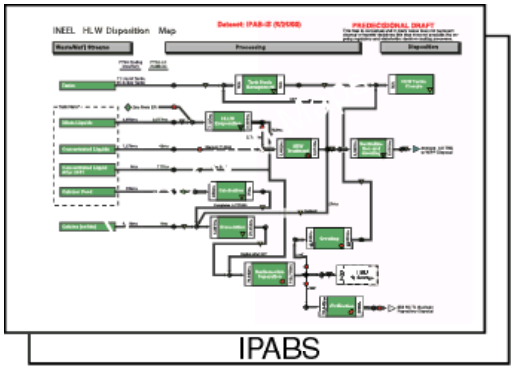
## BACKGROUND

The magnitude of the EM cleanup-stewardship technical, budgetary, and schedule challenges require a well coordinated Environmental Management Research and Development Program. To meet these challenges the Office of Science and Technology initiated the implementation of sound project management techniques. This included an adequacy analysis of "where" to invest R&D dollars, a forward looking EM R&D Program Plan to establish "how" the work will be performed, a management plan to establish roles and responsibilities concerning "who" will perform the work and Roadmaps to coordinate the R&D, "what" and "when" the investment must be made (*See Figure 1).*

The EM R&D Program Plan, published in 1998, describes an R&D program centered on addressing the needs of the end-user and mandates Roadmapping as a tool to sequence the necessary R&D activities. This new approach has resulted in an R&D program that is responsive to the science and technology needs of EM cleanup-stewardship activities. That program plan has been implemented and the R&D program is performing at a much higher level of success, as validated both by performance measures and by numerous program reviews.


***Where*** to invest

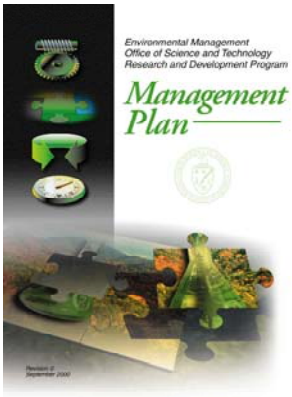
***What*** to invest in

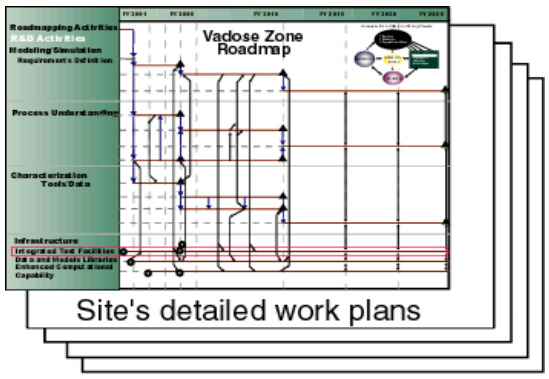




***How*** we will do the work

***Who*** will do the work




***When*** investment must be made

Fig. 1. Sound Project Management to Meet the EM Cleanup Challenges.

Project-level roadmaps are key to ensuring research is tactical and end-user focused, and program-level roadmaps are key to ensuring research and development activities are coordinated in meeting the EM's strategic initiatives (*See Figure 2).* One of the strategic thrusts is to better leverage the R&D activities performed at other agencies. Roadmapping serves as a good tool for leveraging and coordinating the R&D performed elsewhere with the work performed within EM and ensuring a total solution to the cleanup problem is provided.

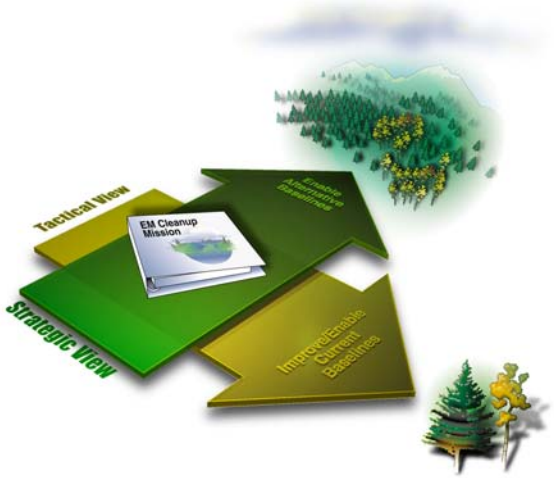



Fig. 2. Meeting EM's S&T Needs Requires a Comprehensive Approach.

Part of the success is due to project level roadmaps which coordinate research and help the research community be more responsive to the end-user needs. However, the performance of the EM R&D program must now be enhanced to complete the EM mission in a safer, quicker, less costly manner. Program enhancement will be accomplished by incremental advances achieved through continuous improvement of current activities and quantum advances achieved by taking advantage of new opportunities. Much like project-level roadmaps are key to ensuring research is end-user focused, program-level roadmaps are key to ensuring research and development activities are coordinated in meeting the EM's strategic initiatives.

This paper presents Roadmapping as a tool for:

- responding to end-user needs,
- providing science base needs for quantum advances, planning strategic initiatives,
- incorporating and coordinating the R&D performed by multiple federal agencies.

## SUCCESS IN DEMONSTRATING NEEDS RESPONSIVENESS

Roadmapping has been used recently to define the path forward of specific projects and resolve problems faced by the end-users. These project-level roadmaps provide operational near-and mid-term responsiveness through identifying solutions to on-going cleanup activities. The

identified near- and mid-term R&D is primarily driven the S&T needs provided by the end-users. Examples of operational responsiveness through tactical planning include the several successful project level roadmaps:

- INEEL Sodium Bearing Waste Disposition Roadmap
- SRS Alternative Salts Processing Roadmap
- INEEL Voluntary Consent Order Tanks Characterization Roadmap

In FY 2001, the INEEL aggressively sought to plan their path forward in eliminating legacy high-level waste containing sodium. Currently, 1,000,000 gallons of this waste exists in liquid form. The roadmapping task brought together the Engineers and Technologists, responsible for developing the required waste forms, with the Process Engineers, responsible for designing the flowsheets and facilities to implement the technologies.

Both groups learned from one another as they roadmapped their path forward. They established their goals to remove uncertainties that prevented proceeding with flowsheet design. With the goal in place, they determined that the R&D efforts that removed the greatest uncertainty were delayed until after decisions were needed (*See Figure 3*).

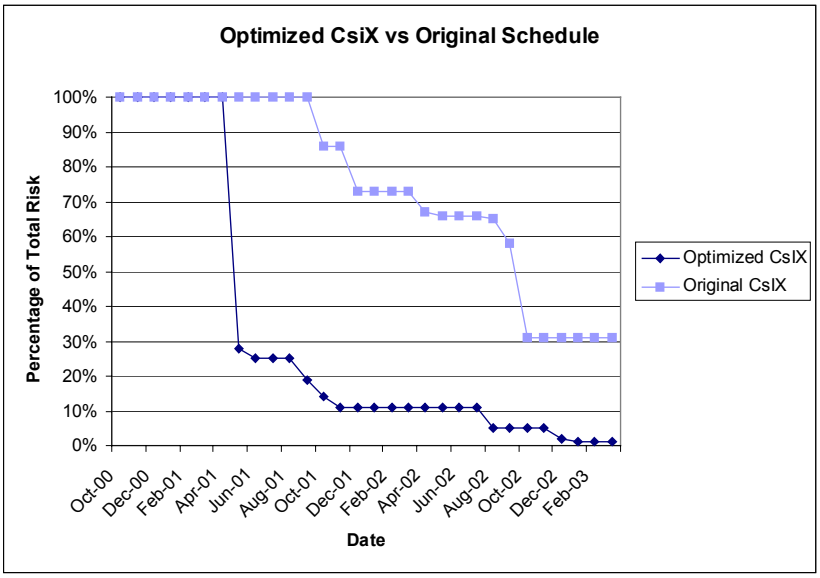



Fig. 3. Accelerated Risk Reduction

By roadmapping the path forward, they adjusted schedules to move the critical R&D forward and postpone the R&D needed to fine-tune the process. This significant roadmapping effort is credited with reducing program costs from $105 million to $25 million, in life-cycle dollars for this specific alternative.

Another successful project-level roadmap helped resolve SRS's salt disposition viability issues in ten months rather than the anticipated 36 months. Here, a team of experts from throughout the DOE complex, academia, and industry evaluated alternative technologies to the in-tank precipitation process identified a large number of uncertainties with conversations in the meeting that the work would probably take 3 years to complete. DOE's SRS decided to use an integrated

decision roadmapping process to define what was needed to select the preferred technology. This then led to a list of key uncertainties that could affect the technology selection. The uncertainties were roadmapped and the work was performed in only 9 months and completed on schedule. The consultants said this was the best development plan they had seen, and congratulated SRS on a job well done.

Project-level roadmaps were required to coordinate numerous INEEL tasks. In June, 2000, the Idaho Department of Environmental Quality and the Department of Energy Idaho Operations Office, signed the INEEL Voluntary Consent Order (VCO). The VCO identified specific actions that would enable the INEEL to bring a large number of voluntarily identified hazardous waste items into regulatory compliance with the Resource Conservation and Recovery Act (RCRA). This included the inspection and characterization of over 700 tanks and vessels that could contain hazardous materials. Many of these tanks were small and had no inspection ports or were in inaccessible areas.

Using approximately $100K of program funding, a technology roadmap was developed to match VCO functional requirements and related technical issues with potential inspection technologies, with emphasis on preexisting technologies developed for other purposes. Several dozen technologies were evaluated by technical and operations experts, with four recommended for verification and calibration experiments on mock-up and actual VCO tanks. Of particular interest was the ability to identify whether a tank was completely empty or contained residual liquids or sludges without opening the tank and possibly exposing workers to hazardous or radioactive chemicals.

After testing, a digital radiography and computed tomography system originally developed for inspecting chemical warfare munitions was found to provide high quality images of tank internals. By not opening tanks to verify their empty status, the INEEL estimates it will save several million dollars on the VCO project while minimizing worker risks. Additional technologies for remote characterization of tanks with residual liquids and sludges are also being evaluated. Since these remote methods are not currently recognized as acceptable for RCRA characterization, their use will be limited to screening activities, with positive results being followed up by traditional sampling methods.

These roadmapping efforts represent a great start; however, there is more to be accomplished in using Roadmapping as a tool for planning EM's Strategic Initiatives and in coordinating the R&D performed by multiple federal agencies. The EMAB Ad Hoc Committee on Science and Innovation recognized this need in April of 2001 and requested that "flexible roadmaps be developed." The Hanford Site in their recent "Strategic Assessment on Hanford Site Cleanup challenges and Opportunities for Science and Technology (S&T)" proposed Roadmapping as a key mechanism for integrating cleanup activities. Dr. Carolyn Huntoon commented on the assessment, "the suggested Roadmapping activities are excellent ways to provide the needed integration and engage the technical talents of the focus areas and the entire DOE Complex."

## PROVIDING THE SCIENCE BASE FOR QUANTUM ADVANCES

The Assistant Secretary for EM has challenged the DOE EM complex to reduce the life cycle program cleanup costs by $100B and 30 years. These huge program cost and schedule

reductions will not come from program enhancement, but can only be achieved through quantum advances in the waste management justified with a sound scientific basis.

Program-level Roadmaps can be used to identify the long-term, strategic R&D needed to develop and implement alternatives to the current baselines and programmatic approaches to achieving the clean-up stewardship mission. As top-level strategic operational initiatives are identified for the department, the strategic investments in R&D must be roadmapped. These program-level or strategic roadmaps establish a credible path forward to make the out-of-the-box strategic operational initiatives a reality. Collectively the strategic operational initiatives are revolutionary, provide a quantum step toward cleanup and could save the department significant dollars, accelerate cleanup, and provide significant risk reduction.

These program-level roadmaps should include:

- Quantum improvements to save significant dollars and schedule over the baseline which require a sound science basis for regulatory change
- Decision-making that requires sound science basis
- Collaboration with the other federal agencies.

## PLANNING NEW STRATEGIC THRUSTS

The R&D required to support EM's Strategic Initiatives can be added through roadmapping long-term basic and applied research that coordinates the needed R&D. Examples of recent program-level roadmaps include:

- Hanford Ground Waster/Vadose Zone Roadmap
- Robotics and Intelligent Machines Critical Technology Roadmap
- Complex-wide Vadose Zone Roadmap
- Long-Term Stewardship Preliminary Roadmap
- Hydrogen Gas Generation R&D Plan (The Roadmap shown in *Figure 4).*

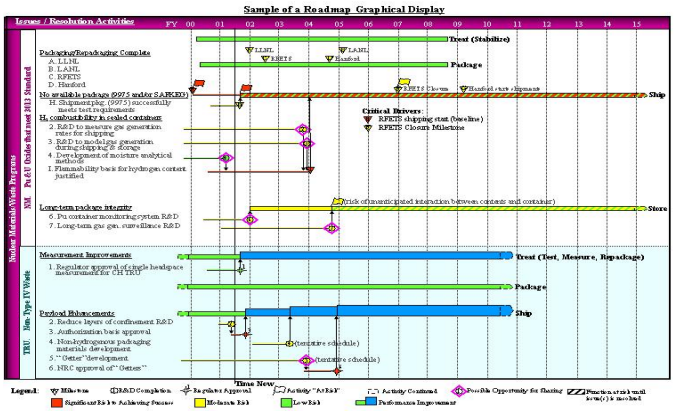



Fig. 4. Roadmaps Coordinate Multiple R&D Activities.

## CONCLUSION

The current climate requires that the DOE EM complex manage the world's largest, most complex environmental cleanup program in a manner that greatly reduces projected cost and schedule. If the DOE EM complex is to be successful in this endeavor we must strengthen our project management, develop targeted science and targeted technologies, and plan our work to take advantage of the best knowledge available. Roadmapping has proven an effective method of ensuring the multi-faceted activities are working together to achieve the common goal. As we employ these techniques, the DOE EM complex will be able to effectively clean up the sites.