

INCORPORATING REGULATORY CONSIDERATIONS INTO WASTE TREATMENT TECHNOLOGY DEVELOPMENT

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ABSTRACT

It is generally recognized that the development of new and innovative waste treatment technologies can significantly benefit the U.S. Department of Energy's (DOE) environmental restoration and waste management program. It is hoped that new technologies will lead to faster, better, cheaper, and safer remediation of existing waste problems. DOE has established a research, development, demonstration, testing, and evaluation (RDDT&E) program, managed by its Office of Technology Development, to encourage and direct the development of new waste treatment and management technologies.

The development, acceptance, and application of new technologies involves more than simply problems of technology. The treatment, storage, and disposal of hazardous and radioactive waste is heavily regulated both at the federal and state levels. In order to achieve the goals of applying the best new technologies in the fastest and most cost-effective manner possible, it is essential that regulatory factors be considered early and often during the development process. This paper presents a number of regulatory issues that are relevant to any program intended to encourage the development of new waste treatment and management technologies. It will also address how the use of these basic regulatory considerations can help ensure that technologies that are developed are acceptable to regulators and can therefore be deployed in the field.

BACKGROUND

The U.S. Department of Energy (DOE) faces a formidable task to effectively address its environmental restoration and waste management problems. The current dilemma confronting DOE is the result of over 40 years of operating a highly intricate and secretive industrial complex in which protection of the environment was, at best, a secondary goal. The nuclear defense weapons complex, which comprises the bulk of DOE's environmental problems, consists of 17 major facilities located across the country. It is currently estimated that it will cost from \$35 billion to about \$65 billion to assess and clean up environmental contamination at inactive sites and an additional \$25 billion to dispose of hazardous, radioactive, and mixed wastes through the year 2010 (1). DOE must not only clean up environmental contamination and dispose of accumulated waste stored at these sites, it must also upgrade its facilities to ensure that it operates in compliance with current environmental, safety, and health standards.

It is widely recognized that developing new waste treatment and management technologies is essential to meeting DOE's goal of effectively addressing its hazardous waste** problem. (2) DOE has dedicated approximately 10 percent of its cleanup budget to its research, development, demonstration, testing, and evaluation (RDDT&E) program and has established a headquarters office, the Office of Tech-

nology Development (OTD), to manage this program. The objectives of the program are to rapidly advance beyond currently available technologies and provide solutions to key technical issues that, if not solved in a timely manner, will adversely affect DOE's ability to meet its 30-year cleanup goal. It is hoped that these new technologies will help DOE accomplish faster, cheaper, better, and safer remediation of existing waste problems; minimize the generation of new wastes; and provide safe, permanent disposal of waste in compliance with existing statutes and regulations. (2)

ORGANIZATIONAL ISSUES

Individuals managing any RDDT&E program must make numerous decisions regarding investment in new technologies. These decisions include selecting research proposals that are most deserving of funding and determining which technologies should continue to be funded throughout the technology development process. It is natural to expect that some percentage of the technologies originally funded at the research and development (R&D) phase will never be implemented in the field. Proposed technologies will drop out of the program for a number of reasons, such as technologies not functioning as expected in field testing, unacceptable escalating costs, and shifts in DOE programmatic needs.

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** For the purposes of this paper, the term "hazardous waste" will also include radioactive and radioactive mixed waste.

The success or failure of the RDDT&E program should not be judged solely by the fact that money is spent on technologies that never materialize. Rather, the goal of the RDDT&E program should be to make the most efficient use of limited financial resources by maximizing the number of "right" decisions made throughout the process.

In order to evaluate the success and impact of an RDDT&E program, it is necessary to determine the criteria for judging just what, over the long-term, is a "right" decision. Getting a technology implemented in the field is the ultimate measure. Unfortunately, it is not always sufficient that a technology work as predicted to be considered a success. The technology must not only work, but it must do so more cost effectively than other technologies intended to address the same problems. The technology must also match the programmatic needs of DOE at the time it is ready to be implemented, even if those needs have changed from the time the technology was originally proposed. And very important in light of DOE's intention to strictly comply with applicable environmental regulations, the new technology must be acceptable not only to DOE, but also to its regulators.

With respect to technology development for waste treatment and management, there are three different categories of individuals within DOE, each with differing regulatory needs. First, there are the researchers and scientists responsible for conceiving, developing, and demonstrating new technologies. From a regulatory point of view, they are primarily concerned with how regulations affect the actual technology development process. Second, there are those, generally in the DOE field offices, who are responsible for successfully applying the new technologies in the field. These individuals must be able to develop detailed strategies to gain the necessary regulatory approvals. Finally, there are the technology development managers in OTD, who must manage the development and technology transfer process, guide selected technologies through the RDDT&E program, and decide which projects to terminate. The process of applying the regulatory factors discussed here will generally be the responsibility of these individuals.

REGULATORY ENVIRONMENT

The treatment, storage, and disposal of hazardous wastes is heavily regulated, both at the federal and state levels. Therefore, technical performance alone is not the sole determinant of the success of specific technologies developed by DOE. Regulatory requirements can impact waste treatment and environmental restoration technology development in a number of ways. First, regulations could mandate specific performance criteria for specific waste streams being treated by the technology: examples are a number of the land disposal restrictions (LDRs) of the Resource Conservation and Recovery Act (RCRA). Such

regulatory factors could conceivably serve as a complete roadblock to the application of a technology in the field.

A second way regulations may impact technology development is whether the waste streams being generated from a specific technology are themselves hazardous, or otherwise contain hazardous constituents that make the waste streams subject to regulation. Finally, the permitting process necessary for implementing certain technologies, as well as the availability of waivers, exemptions, variances, etc., will also impact the ultimate acceptability of a technology. The realities of the permitting process could have a substantial impact on whether a new technology will ever be applied in the field. In such instances, regulations could significantly impede the deployment of a technology. While such impediments could be overcome, they likely would cause significant delays in using the technology and therefore adversely affect DOE's environmental restoration and waste management programs.

The early and regular consideration of relevant regulatory issues during the RDDT&E process can have several benefits. First, it can help ensure that technologies are developed that can be implemented because possible regulatory roadblocks and impediments have been recognized and addressed. Second, early consideration of regulatory issues can help enhance DOE's interaction with regulators by anticipating possible regulatory issues and resolving them in a timely manner.

REGULATORY CONSIDERATIONS FOR TECHNOLOGY DEVELOPMENT

Listed below are specific regulatory considerations against which all waste treatment and management technologies proposals should be evaluated. The manner in which these are applied and the context in which they are used will vary from technology to technology. The intention is not to impose a rigid set of conditions that predetermines decisions regarding the development of specific technologies, but rather to alert the decision maker to the regulatory issues that should be considered throughout the RDDT&E process. While the respective weights given to each of these factors will likely vary, depending upon a variety of factors affecting DOE, it is anticipated that these regulatory considerations will be applied as part of an overall DOE risk management program. The proposed regulatory criteria are as follows:

- What permits will be required at any stage of the RDDT&E process, if any?
- What permits will be required for the final application of the technology in the field?
- Will there be a need to obtain any other type of regulatory approval, such as those set forth in a

federal facility agreement (FFA), in order to deploy the new technology?

- Will the technology satisfy any applicable performance standards, such as those mandated by RCRA's LDRs?
- Will the technology meet generally accepted cleanup standards, such as the applicable or relevant and appropriate requirements (ARARs) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), for the wastes it will treat?
- Will the technology pose an acceptable risk to workers (both during development and application), as defined by any relevant occupational health standards?
- What documentation under the National Environmental Policy Act (NEPA) will be required during the development and application of the technology?

Other more general regulatory-related considerations that should be factored into the RDDT&E decision-making process include 1) whether the technology will facilitate the minimization or recycling of hazardous waste; 2) whether the technology will achieve or facilitate the permanent treatment of the waste; 3) whether the technology will conform with evolving regulatory trends; and 4) whether the technology will satisfy or otherwise facilitate meeting a milestone established in an FFA, a NEPA document, or any other legal agreement.

The relative importance of these regulatory criteria will vary according to each specific technology proposal to which they are applied. In some cases, few, if any, of these criteria will apply to specific proposals. Generally, however, it is expected that issues related to a proposed technology's ability to meet existing performance standards and cleanup levels, as well as various permitting issues, will have the greatest relevance to most proposals. These particular criteria include issues such as RCRA LDR requirements, permitting requirements under the Clean Air Act and Clean Water Act, and other potential ARARs at hazardous waste sites.

Applying these regulatory criteria should not be transformed into a major task, but rather should be viewed as a means to alert the appropriate decision makers about issues that can have a major impact on the RDDT&E program. The realities of the DOE decision-making environment are that a cumbersome and time-consuming tool would have little value.

ACTIONS FLOWING FROM THE CONSIDERATION OF REGULATORY FACTORS

Incorporating these regulatory factors into the RDDT&E decision-making process can assist DOE tech-

nology managers to make a number of different decisions with respect to specific proposed technologies. To understand the context for these decisions, it is necessary to appreciate that these regulatory criteria can be applied at several points throughout the RDDT&E process. For example, technology proposals can be reviewed against these regulatory factors when they are first submitted to OTD for funding, as they progress from the R&D stage to field testing, and on a regular basis to coincide with OTD's fiscal and funding cycle.

The most basic decision that the technology managers must make, based in part on these regulatory factors, would be to proceed with or terminate specific technology proposals. It is very unlikely that a proposal would be rejected, especially early in the RDDT&E process, based solely upon these regulatory criteria. However, it is possible that as a technology progresses through the RDDT&E program, it could become increasingly apparent that there may either be an insurmountable regulatory roadblock or significant impediments that would cause unacceptable delays in applying the technology. This would be especially true when two or more proposed technologies were compared with each other. For example, two otherwise equally promising proposed technologies may differ by the fact that one, because of its anticipated emissions, would likely have to obtain a permit, while the second proposed technology would not have to meet such a requirement. Under these circumstances, it may be possible that the technology managers would reject the first proposal in favor of the one that appeared to have fewer regulatory obstacles.

Another possible outcome from the application of the regulatory criteria would be for DOE technology managers to work with those proposing a new technology to modify either the technology or the R&D process to reduce possible regulatory roadblocks. For example, using a simulated hazardous material, rather than an actual hazardous substance, during the R&D or demonstration phase would likely reduce or eliminate the need for permits during the development phase, hopefully reducing the time necessary for deployment. In another instance, DOE technology managers could alert the developers of a proposed technology about emission levels or waste streams emanating from the proposed technology that could trigger certain regulatory requirements, then work with them to modify the technology to avoid these possible pitfalls. Again, the result would reduce the time in getting the technology deployed in the field.

Interaction between the technology development managers and the technology developers also has a side benefit of providing a clear understanding of the requirements for a successful technology development project. As a result, developers will be able to better evaluate the merits of their

own proposals, with the result being a better set of RDDT&E activities being proposed to OTD.

The early identification of regulatory roadblocks and impediments through applying regulatory considerations will also enable DOE technology managers to initiate discussions with regulators to collectively and creatively develop regulatory strategies for technology implementation. Ideally, regulations should not block the development and deployment of technologies that effectively address hazardous waste problems. In the real world, however, this is not always the case. There may be instances where technology-based standards, such as the RCRA LDRs, may require the use of specific technologies for specific waste streams. The development of improved technologies could conceivably be blocked, or could require a lengthy permitting or waiver process in order to be implemented. When identified early in the development process, these obstacles can potentially be mitigated through good-faith negotiations with regulators.

These discussions with regulators could either be at a national level to bring about changes in regulations having little or no flexibility in the use of new technologies, or at the state or regional levels to explore options within the existing regulatory framework for the speedy deployment of new, improved technologies. This is particularly relevant for sites where FFAs or other site-specific agreements are in place that establish a framework for and encourage open communications between DOE and its regulators. The bottom line is that regulators generally do not like surprises. DOE will be much more likely to achieve positive results from regulators if issues are raised before they become problems and if they are divorced from the other legal and political factors surrounding many of DOE's sites.

Using regulatory criteria may result in tentatively identifying potentially significant regulatory problems in specific technology proposals. DOE technology managers may decide to delay any funding decisions under these circumstances and seek additional clarifying information from those who proposed the technology. In addition, further information may indicate that the proposed technology, by itself, may not achieve cleanup levels mandated by the applicable regulations. This would indicate a need either to terminate the project or to make the proposed technology part of a treatment train to address the particular hazardous waste problem.

LIMITATIONS IN THE USE OF REGULATORY CRITERIA

The regulatory criteria outlined above are primarily intended to be used by the OTD technology development managers in conjunction with other considerations, such as cost and technical feasibility, within a framework of well-established DOE technology development priorities. The

application of the regulatory criteria should not be viewed as a tool to specifically guide technology developers regarding regulatory compliance during the research and development stage. In addition, this approach is not intended to be used, by itself, as a regulatory compliance tool. It is unlikely that the information necessary to formulate detailed regulatory compliance strategies will be available during much of the RDDT&E process. Regulatory compliance issues will necessarily remain primarily the job of those in the field directly responsible for applying the new technology. It will generally be possible, however, to apply these regulatory criteria to make a reliable prediction about the regulatory issues that may be most relevant to specific technologies.

To be beneficial, these regulatory criteria should not be used in an overly quantitative manner. First of all, the availability of data for various technology proposals at different stages of the RDDT&E process is likely to vary greatly. In addition, the regulatory arena is constantly changing and subject to a variety of influencing factors. Finally, not all technologies are equally suited to be evaluated using these criteria. For instance, the regulatory criteria are well-suited to evaluate a technology intended to address a limited number of well-defined waste streams where the regulatory requirements are rather clear. However, difficulties in applying the criteria are likely to arise with respect to technologies that are intended to address a wide variety of waste streams with less well-defined regulatory requirements.

In addition, certain categories of technologies are more likely to encounter regulatory difficulties than others. For instance, waste treatment technologies generally are heavily regulated. It is not quite as likely, however, to encounter as much regulatory interest with robotic or sampling technologies. Accordingly, a more qualitative, rather than a rigid quantitative system, is likely to be most useful to DOE to evaluate regulatory concerns.

SUMMARY

The development of new technologies is essential to helping DOE achieve faster, better, cheaper, and safer remediation of its existing hazardous waste problems. The key to success in developing new technologies to address DOE's environmental problems is to maximize the number of technologies that can go through the RDDT&E process and be successfully applied in the field. Evaluating new technologies as they are proposed and as they progress through the RDDT&E process against a number of basic regulatory considerations will help ensure that regulatory requirements do not unnecessarily block or delay the implementation of these technologies. By incorporating regulatory factors into its RDDT&E decision making process, DOE should be able to maximize its success rate with new technologies and enhance its interactions with regulators.

Such an effort also can play a strong role in guaranteeing that future regulations reflect the need to accommodate new technologies that effectively address hazardous waste and other environmental problems.

REFERENCES

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