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Technical Risk Rating of DOE Environmental Projects – 9153

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ABSTRACT

The U.S. Department of Energy's Office of Environmental Management (DOE-EM) was established to achieve the safe and compliant disposition of legacy wastes and facilities from defense nuclear applications. The scope of work is diverse, with projects ranging from single acquisitions to collections of projects and operations that span several decades and costs from hundreds of millions to billions US$. The need to be able to manage and understand the technical risks from the project to senior management level has been recognized as an enabler to successfully completing the mission.

In 2008, DOE-EM developed the Technical Risk Rating as a new method to assist in managing technical risk based on specific criteria. The Technical Risk Rating, and the criteria used to determine the rating, provides a mechanism to foster open, meaningful communication between the Federal Project Directors and DOE-EM management concerning project technical risks. Four indicators (technical maturity, risk urgency, handling difficulty and resolution path) are used to focus attention on the issues and key aspects related to the risks. Pressing risk issues are brought to the forefront, keeping DOE-EM management informed and engaged such that they fully understand risk impact. Use of the Technical Risk Rating and criteria during reviews provides the Federal Project Directors the opportunity to openly discuss the most significant risks and assists in the management of technical risks across the portfolio of DOE-EM projects. Technical Risk Ratings can be applied to all projects in government and private industry. This paper will present the methodology and criteria for Technical Risk Ratings, and provide specific examples from DOE-EM projects.

INTRODUCTION

The U.S. Department of Energy's Office of Environmental Management (DOE-EM) has implemented project management processes to help ensure the successful completion of its mission to achieve the safe and compliant disposition of legacy wastes and facilities from defense nuclear applications. The scope of work is diverse, ranging from high level waste tanks and soil contamination to administrative and industrial facilities. The projects range in size from single acquisitions in the hundreds of millions to billions US$, to collections of projects and operations that span several decades and cost in the billions US$.

The need to be able to manage and understand the technical risks from the project to senior management level has been recognized as an enabler to successfully completing the mission. The DOE-EM project Technical Risk Rating is used to enhance EM management confidence and assurance that technical risks are being identified, managed, and communicated to management; and risk management is being implemented on projects on a consistent basis. The Technical Risk Rating, and the criteria used to determine the rating, provides a mechanism to foster open, meaningful communication between the Federal Project Directors and DOE-EM management concerning project technical risks. The Technical Risk Ratings bring pressing technical risks to the forefront, keeping DOE-EM senior management

informed and engaged such that they fully understand potential impacts of key technical risks. This was not always the case prior to the implementation of the Technical Risk Ratings. A secondary benefit is enhanced knowledge concerning key technical risks which will lead to improved management of risk by the project team.

Risk management is used to assist in managing DOE-EM's diverse and unique collection of projects. As DOE-EM's use of risk management processes matures, a need to be able to manage and understand the technical risks at a management level that oversees many projects has become apparent. DOE-EM's project management improvement efforts include tasks to improve risk management at the project level through improved guidance, training and expectations. The risk management process steps of monitoring and communicating have been identified as areas that need focus. In 2008 an effort was chartered to establish a means to focus attention on technical risks. A search of current risk management practices for monitoring and communication processes did not identify a tool that would meet DOE-EM's needs. Therefore, DOE-EM developed the Technical Risk Rating as a new method to assist managing technical risk based on specific criteria; to be derived using the existing risk data and information identified in the project risk management plans. The Technical Risk Rating approach should be beneficial for DOE, and in general, all projects.

TECHNICAL RISK RATING METHODOLOGY

Use of the Technical Risk Rating provides Federal Project Directors the opportunity to discuss what he/she considers to be the most significant technical risks. Per the *DOE-EM Engineering & Technology Roadmap* [1]: "Technical risks are known technical issues that could prevent project success. Uncertainties are indefinite or unpredictable technical aspects of a project." Technical Risk Ratings only address project technical risks (e.g. engineering, design, technology) and do not include other project or programmatic risks (e.g. regulatory, funding, NEPA, litigation risks).

The Technical Risk Rating is included in the Quarterly Project Review, conducted to brief DOE-EM senior management on project performance. Ratings are determined by the Federal Project Director. Use of the Technical Risk Rating during the Quarterly Project Review is one method for communicating risk information; however it is not be the sole method used to keep DOE-EM management apprised of project risk.

The criteria used to determine the overall rating allow separate candid judgments on technical risk severity and handling that enables presentation of a more accurate status on technical risk to the project. Four criteria have been selected to comprise the Technical Risk Rating:

1. Technology Maturity — A measure of maturity/availability/existence of the technology needed to address the consequences of the risk.
2. Risk Urgency — A measure of the relative time in the project schedule when risk consequences are expected to occur and intervention is needed.
3. Handling Difficulty — A measure of the complexity and/or difficulty in developing and implementing a suitable solution to technical issues.
4. Resolution Path — A measure of the progress made towards achieving expected results and reducing risk during implementation of the handling strategy.

Ratings for each of the criteria are indicated using a red-yellow-green "stoplight" type symbol. The color coding is intended to provide visual representation of the level of concern. In this context, red indicates an area that, in the judgment of the Federal Project Director, warrants additional attention by either DOE-EM leadership and/or the Project Team.

Sources of information for development of the Technical Risk Rating are: the Risk Management Plans, any available Technology Readiness Assessments, External Technical Reviews, Independent Project Reviews, and inputs from periodic project reviews. The Federal Project Director bases his/her determinations on evaluation of the High and Moderate technical risks in the project. The intent is to elevate pertinent issues and concerns in any of the rating categories to the attention of management. The bases for the ratings selected should be documented.

The overall project Technical Risk Rating is determined by a qualitative assessment done by the Federal Project Director based on the individual criteria values and other input as appropriate.

Technical Maturity

Technical Maturity is a measure of maturity/availability/existence of the technology needed to address the consequences of the risk. This criterion answers the question: "Are the needed technologies ready for deployment?" The Technical Maturity rating is based on the lowest or least mature element of the project. Technical Maturity is determined from either a formal Technology Readiness Assessment (TRA) or based on the Federal Project Director's judgment per the descriptions in Table I.

Table I. Technical Maturity

Technical Maturity Description[1]	Rating
Basic process technology principles observed and reported; or equipment and process concept formulated; or TRL = 1, 2.	
Equipment and process analysis and proof of concept demonstrated in a simulated environment; or laboratory testing of similar equipment systems completed in a simulated environment; or TRL = 3, 4.	
Bench scale equipment/process system demonstrated in a relevant environment; or TRL = 5.	
Prototypical equipment/process systems demonstrated in a relevant environment; or actual equipment systems/process system successfully operated in the expected operational environment; or TRL = 6, 7.	
Actual equipment/process successfully operated in limited operational and/or operational environments; or TRL = 8, 9.	

Risk Urgency

Risk Urgency is a measure of the relative time in the project schedule when technical risk consequences are expected to occur and intervention is needed. This criterion answers the question: "Are the impacts close, does the project have time to work the issues, and is the critical path delayed?" The impacts to be considered are the consequences of risk(s) (e.g., critical path schedule delays, cost increases, missed stakeholder commitments, etc.) taken from the risk assessments. This could be based on a single risk or several risks. The intent is to provide the opportunity to bring management attention to any potential impacts due to technical risks occurring in the near term. The Risk Urgency is determined using Table II.

[1] Technical Maturity descriptions are based on the March 2008 final EM TRA / TMP Guide [2] including the Technology Readiness Levels (TRL).

Table II. Risk Urgency

Risk Urgency Description	Rating
Performance and/or critical path impacts expected to occur within 6 months; urgent attention and increased focus required to address impact, need to work handling resolution actions aggressively.	
Performance and/or critical path impacts expected to occur within 6 to 9 months; response planning may be needed	
Performance and/or critical path impacts expected to occur within 9 to 12 months.	
Performance and/or critical path impacts expected to occur within 12 to 18 month planning window.	
Performance and/or critical path impacts expected to occur after 18 months; flexibility in implementing handling actions.	

Handling Difficulty

Handling Difficulty is a measure of the complexity and/or difficulty in developing and implementing a suitable solution to technical issues. This criterion answers the question: "How difficult is it going to be to define and perform actions that will mitigate the risk(s)?" This judgment could be based on a single risk or several risks. The intent is to inform management of difficult technical areas that present a significant challenge. If a technical peer review such as an External Technical Review has been conducted, the results of the review should be considered as input to the confidence in the plan. Handling Difficulty is determined using Table III.

Table III. Handling Difficulty

Handling Difficulty Description	Rating
Technical requirements incomplete; or handling strategy not defined; or handling strategy considered very complex and/or extremely challenging; or peer review rejected handling strategy.	
Some uncertainty with technical requirements; or handling strategy incomplete; or handling strategy considered complex and/or challenging; or uncertainty in completeness of handling strategy; or peer review identified problems with handling strategy.	
Technical requirements known, changes in interpretation possible; or handling strategy defined, changes possible or with some complexity/challenges; or some doubt in effectiveness of handling strategy; or peer review not conducted or no results yet.	
Technical requirements known, interpretation clear; or handling strategy defined, minimal challenges; or minor changes possible; or confidence in the expected results; or peer review supports most of handling strategy.	
Technical requirements known, interpretation clear; or handling strategy clearly defined and accepted, straightforward approach; or high confidence in the expected results; or peer review supports strategy.	

Resolution Path

Resolution Path is a measure of progress made towards achieving expected results and reducing risk during implementation of the handling strategy[2]. This criterion answers the question: "Are the results from the risk handling actions mitigating the risk(s) as expected?" From a project perspective, the Federal Project Director determines whether handling strategies have been defined in a measurable way; whether strategies are on track for implementation; and whether the forecast reduction in risk is occurring as expected. Additionally the Federal Project Director determines whether additional knowledge gained in implementing the handling strategies shows risks at a higher risk level (greater likelihood and/or consequence) than originally conceived. This judgment could be based on a single risk or several risks. Resolution Path is determined using Table IV.

Table IV. Resolution Path

Resolution Path Description	Rating
Results are contrary to expected outcomes; or negative impact on risk mitigation; or strategy not working, requires revision.	
Results are inconclusive, with doubt on effectiveness; or unknown impact on risk mitigation; or risk reduction may be in jeopardy.	
Handling strategy not started yet; or preliminary results as expected but inconclusive; or risk reduction is uncertain or somewhat less than expected; or handling strategy may need minor revision.	
Handling producing expected results; or results support risk reduction; or strategy is on track.	
Strategy has effectively reduced risk impact (confirmed by data or analysis).	

Technical Risk Rating

The overall project Technical Risk Rating is determined by a qualitative assessment done by the Federal Project Director. The Federal Project Director bases this judgment on the individual criteria values and other input as appropriate. The final Rating is assigned based on Table V.

[2] "Handling Strategy" and "Mitigation" are used here to discuss plans or actions necessary to avoid or minimize the impact of the risk as defined in DOE M 413.3-1 [3].

Table V. Technical Risk Rating

Technical Risk Rating	Management Impact
	Project technical risk(s) require hightened attention and may require Acquisition Executive decisions on direction or resources.
	Project technical risk(s) require additional focus and may require Acquisition Executive decisions on direction or resources.
	Project technical risk(s) have concerns in several areas and may require additional focus by the Integrated Project Team.
	Project technical risk(s) are manageable. Minor concern in selected areas, but additional focus not required.
	Project technical risk(s) are manageable as planned.

The Federal Project Director selects the overall Technical Risk Rating stoplight symbol for the Project based on a qualitative assessment of the overall project risk from the judgments made for the four criteria. This rating communicates the level of concern and potential management action needed for technical risk. The Federal Project Director should use the Technical Risk Rating to indicate a level of concern over technical risk and alert management to the potential action needed to address technical risk. There is flexibility when interpreting the four criteria ratings to provide an accurate message. The Federal Project Director may raise or lower the stoplight rating from the "average" to better communicate the degree of concern for technical risk for the project

Example:

Three  *+ one*  *may =*  *if the Federal Project Director wants to communicate a higher level of concern to management*

Development of the Technical Risk Rating

The Technical Risk Rating is developed using the project's risk information.[3] The Project Risk Management Plan and data is the primary source of risk information. Other sources include: risk register, risk data base, watch list, "top ten" list, external technical reviews, technology readiness assessments, and any other reviews that identify project risk. The Federal Project Director reviews the High and Moderate technical risks and risk assessment data. This review should consider all risks with technical implications.

Some risks are readily identifiable as a technical risk. Other risks may not be immediately recognized as having a technical impact due to the way the risk and the potential consequence were defined and/or how the risk was categorized (i.e., "binned" in the risk breakdown structure) for sorting and management purposes. Risks should not be automatically eliminated from consideration when determining the Technical Risk Rating due to how they were categorized.

[3] Guidance and examples for developing the Technical Risk Rating are provided in DOE-EM's Guide *Technical Risk Rating for Environmental Management Projects, Criteria and Methodology* [4].

After selecting the technical risks, the Federal Project Director performs a qualitative assessment relative to the Technical Risk Rating criteria using the existing risk information. The use of existing information is emphasized here to stress that this assessment and development of the Technical Risk Rating is not envisioned to create an undue burden or require extra risk development beyond the normal expected level of risk management activities for any project. The content should consider the following:

- Which risks could have a significant impact to project success
- What consequences the risks have on the project
- Whether the technology exists to address the risks
- When risk impacts might be realized
- Whether the risks are challenging to solve
- Whether the project is making progress in mitigating risks

It is important to note that the risk discussions prompted by the Technical Risk Rating are intended to focus on the technical risks of most importance to the project. Thus, the Technical Risk Rating and the message from the Federal Project Director is not to be a summary, "roll-up", average, or scoring of all the risks to the project. The expectation is that the Federal Project Director can concentrate on specific risks of immediate concern and improve communication information on technical risks. The Technical Risk Rating is not envisioned to be a "scoring" system for comparing one project to other projects.

TECHNICAL RISK RATING REPORTING

One of the requirements for the Technical Risk Rating tool was that is must fit into the format of the existing DOE-EM Quarterly Project Reviews. These reviews use a series of standardized "Quad Charts" to present information relative to the project's status. Thus, the Technical Risk Rating is formatted to use a standardized Quad Chart format in the Quarterly Project Review. The Quarterly Project Review charts include a summary description, earned value management information, level 1 schedule, safety performance, contract status, key risks and top issues. Figure 1 provides an overview of the information on the quad charts and the supporting charts.

Chart 1 - ▪ Summary Project Description ▪ Earned Value Management (CPI/SPI chart) ▪ Key Programmatic Risks ▪ Safety Performance	Chart 2 – ▪ Technical Risk Rating ▪ Quality Assurance Issues ▪ Funding Status ▪ Contract
Supporting Charts – ▪ Level 1 Schedule ▪ Earned Value (five quarters) ▪ Lifecycle cost and baseline ▪ Technical Risk Additional Information	▪ Milestones (next quarter) ▪ Contract Status ▪ Top Issues

Figure 1. Project Information Included in the Quarterly Project Review Charts

An example of the technical risk quadrant is shown in Figure 2. The Quad Chart concept is used to promote brevity and succinctness in reporting information on various topics at the Quarterly Project Review.

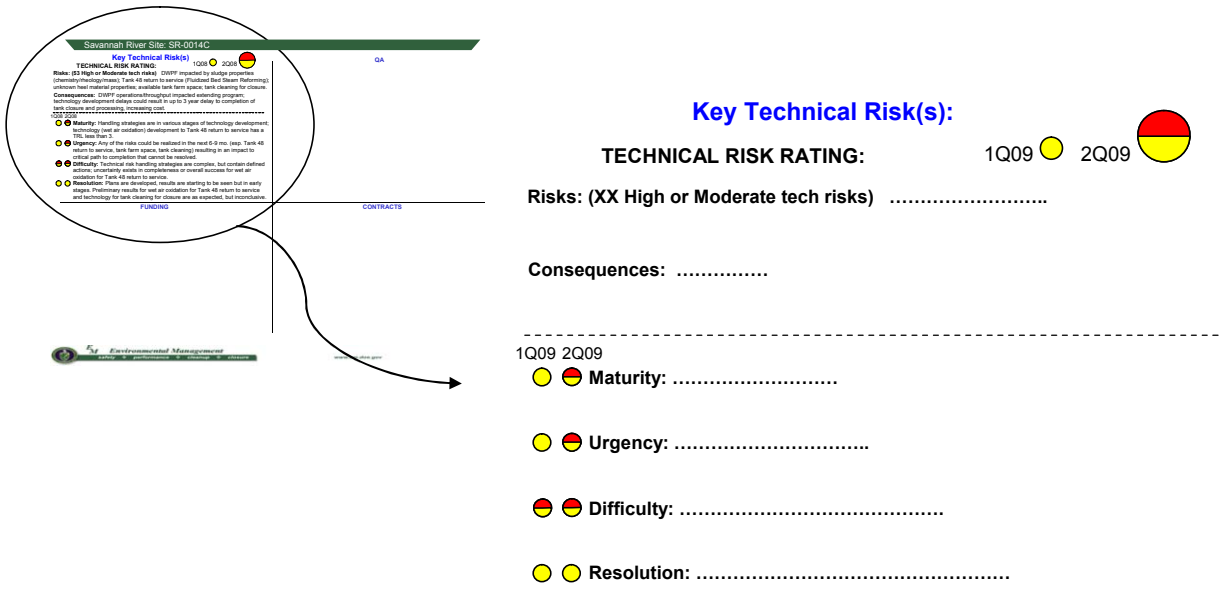

Figure 2. Quarterly Project Review Technical Risk Rating Quad Chart Format

In completing the Technical Risk Rating Quad Chart, an effective method is to list the key risks of concern, and then for each of these risks, identify the consequence to the Project and ratings for each of the criteria. This information can then be used to complete the chart's sections as discussed below.

The Technical Risk Rating is reported prominently at the top of the risk quadrant. This Rating should be selected after the sections are completed.

The text area in the upper part of the quadrant is used to identify:

- The total number of High or Moderate technical risks for the project (provides an overall reference for the extent of technical risk associated with the project).
- The key technical risks that are the basis for the Technical Risk Rating (risks of importance to the Federal Project Director; risks that warrant management attention). This should be short concise statements that indicate the risk, but not the complete risk statements. These statements may consolidate several risks.
- The consequences to the project as a result of those risks (provides an overall indication of the potential baseline impacts if the risks are realized). This section should indicate the technical scope and/or rework needed that result in additional cost and schedule, not just an indication of money and time.

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The individual judgments for each of the four criteria are reported in the lower part of the risk quadrant. The judgments are to include:

- Stoplight ratings for each criterion based on the descriptions in Tables I, II, III, and IV.
- Information to help understand the judgments made for the criteria.
- The specific risk or risks from the key technical risks driving the judgment.

Rating stoplight symbols for the criteria and the Technical Risk Rating from the previous Quarterly Project Review are carried over to show the trend to the current reporting period. A back-up slide may also be prepared (recommended) to provide additional detail on the key technical risks included in the Technical Risk Rating and/or additional project technical risks. The back-up slide provides additional information to management beyond the limitations of the Quad Chart.

USE OF THE TECHNICAL RISK RATING IN DOE-EM PROJECT REVIEWS

The Technical Risk Rating was developed during the first half of Fiscal Year 2008. Training on the development and use of the rating was completed during the summer of 2008. This training included a workshop to help the Federal Project Directors develop Technical Risk Rating examples using their project's risk information. The initial broad based use of the rating was during the Quarterly Project Reviews that started in September 2008. The Quarterly review addressed the status of approximately 70 projects at 20 sites.

Previously the Quarterly Project Reviews included a Quad Chart on key risks (top three to five). This chart tended to address risks associated with funding, approval of regulatory documents, and performance issues. As a result, the discussions during these reviews did not consistently address technical risks. The original Quad Chart for risk was changed to focus only on programmatic risks, while the Technical Risk Rating was added as part of a new Quad Chart. The initial use of the Technical Risk Rating in the latest Quarterly Project Reviews has resulted in:

- project Technical Risk Ratings of 2 red, 2 red/yellow, 18 yellow, and 9 yellow/green, with the remaining projects reporting either green or indicating no technical risks;
- identification of specific technical risks of concern;
- increased and improved discussion of technical risks, and all risks in general;
- focused discussion on the resolution of technical risks; and
- identification of assistance for resolving the issues and roadblocks associated with mitigating the risk.

A benefit derived from these improvements was an extended discussion concerning several key risks of interest to DOE-EM senior management. These risks include:

- Technology development or application for liquid waste tank hard heel material removal;
- Inadequate Pulse Jet Mixer technology limiting waste treatment;
- Undemonstrated leaching processes impacting waste treatment performance;
- Wet Air Oxidation technology development for tank cleaning;
- Proposed treatment of groundwater to reduce I-129 concentrations;
- Necessary Hg source reduction to achieve fish tissue concentration standards;
- Undemonstrated technologies for downblend of U-233; and
- Effectiveness of oxidant injection technology to treat trichloroethylene in soils

The risks identified in the Technical Risk Ratings will be used to develop a new technical risk "watch list" for DOE-EM management tracking. Additional technical support and independent reviews may be performed in the near future to assist resolution of the technical risks.

CONCLUSION

The development and use of the Technical Risk Ratings for DOE-EM projects have shown it to be relatively simple to generate, able to provide a concise and clear overview of key technical risks, and helpful in focusing a discussion on technical risks. The experience gained from the initial Quarterly Project Reviews has led DOE-EM management to conclude that the Technical Risk Rating:

- is a good tool for the Federal Project Directors to identify, evaluate and communicate the major technical risks in their Risk Management Plans to management, enabling management engagement;
- provides a good indication of the project's efforts in managing technical risk since information is derived from the project Risk Management Plans;
- provides benefit to management and project staff and is being implemented for all EM projects;
- the ability to identify key technical risks is improving;
- provides enhanced knowledge concerning key technical risks and improved risk management by the project team; and
- is applicable to and would benefit projects outside of DOE-EM.

The Technical Risk Rating will be refined as its use and the DOE-EM risk management process matures.

REFERENCES

1. DOE-EM Engineering & Technology Roadmap, March 2008

2. DOE-EM Guide, Technology Readiness Assessment (TRA) / Technology Maturation Plan (TMP) Process Guide, March 2008.

3. DOE Manual 413.3-1, Project Management for the Acquisition of Capital Assets, Approved March 28, 2003.

4. DOE-EM Guide, Technical Risk Rating for Environmental Management Projects, Criteria and Methodology, July 2008, Revision 1.