RIA R&D: Risk and Opportunity – A Project Perspective

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Abstract

Delivery of a Major Project requires a robust planning effort to support effective project delivery and the critical decision process defined by the Department of Energy. One element of robust planning that supports effective project delivery is project risk management. Argonne National Laboratory has recently completed an initial baseline review process that establishes a risk management profile for RIA based on project driven priorities. The information generated by this assessment is useful to track the technical complexity of RIA, and establish priorities in the R&D Program from a project perspective.

Background

The risk and opportunity assessment performed in this document is based on the existing technical understanding of the Grunder Committee report and Harrison Committee cost estimate, which define the initial performance parameters and cost estimate of RIA respectively. These early documents represent a baseline to formalize in the preparation of a credible technical, cost, and schedule estimate. This baseline is consistent with the technical approach submitted to the Glashausser Committee for review and the NSAC long-range plan. Such a baseline must provide confidence that the technical expectations, costs, and schedule for the Rare Isotope Accelerator are self-consistent. The baseline must also be a working document that can adapt to technical change and accept innovation over time. The Grunder Committee report and Harrison Committee cost estimate were selected because:

- The Grunder committee report represents the consensus of the scientific community in its long range planning efforts

- The Grunder committee report presents performance criteria that can be rationally evaluated for technical achievement and scientific capability.

- The Harrison Committee estimate represents an independent evaluation of real costs of construction.

- The combined reports represent the most current understanding of the technical scope, schedule and budget for delivery of RIA. This became the basis for the RIA concept recommended in the NSAC 2002 Long Range Plan.

Methodology

Both quantitative and qualitative methods are used to establish the framework for risk assessment at this early stage of project lifecycle. Each subsystem of RIA, and/or technical assumption described by or inferred in the baseline described above is reviewed against today's scientific understanding. A best engineering judgment is made regarding the potential for technical, cost, or schedule impact if baseline technology is proven inadequate, or if emerging technology ideas are accepted into the baseline. These impacts are captured in a consequence assessment (Appendix A) and represent quantitative information describing effects of success or failure.

However, risk is defined as consequence combined with a probability of occurrence. Therefore, a further assessment is made regarding the likelihood of success or failure in achieving a subsystem technical objective. At this stage of a project, there is insufficient information to establish quantitative probabilities of success or failure, nor is that desired. Qualitative determinations of likelihood are therefore used to represent probability.

Finally, both consequence and probability are combined into a risk determination and an assessment is made regarding the projects ability to accept, mitigate, or avoid the risk conditions based on impacts and need dates.

Results

The results of the consequence assessment (Appendix A) evaluated against the likelihood of occurrence are displayed in a color-coded Risk summary (Appendix B). The color codes are ranked from highest to lowest consequence ranking, **Red** (highest) – **Blue** (moderate) – **Yellow** (lowest), which can then be used to establish focus and priority accordingly. Items coded **Green** represent areas of focus, which have demonstrated success conditions. The project can then accept any residual risk or plan future activities into a project technology development plan or other program. **Green** risk elements will then be "retired" at the next update and no longer tracked for project impact.

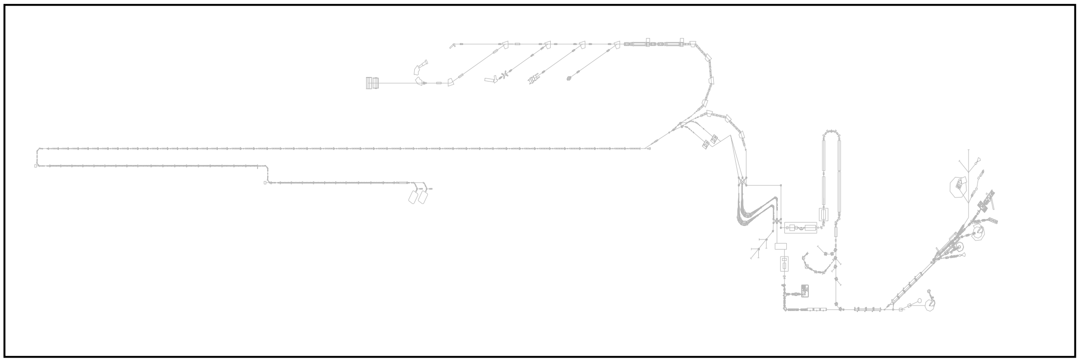
The colors represent topics of increasing importance; however, if not addressed in a timely manner, topics with the lowest consequence can quickly escalate and affect project performance.

Technical Baseline Specifications

In order to complete the assessment a set of minimum technical requirements must be established, against which all elements of the project are evaluated. The requirements below are taken from the summary report prepared by Argonne National Laboratory and Michigan State University. No attempt has been made to optimize the technical performance of subsystems described in the Harrison Committee report. However, for each RIA subsystem the question is asked,

"with no improvement, can the RIA subsystem technology meet the technical specifications and performance objectives below?"

Figure 1. 805 MHz Elliptical Cell Driver Linac Layout – Baseline Configuration



Performance Objectives

The goal of the Rare Isotope Accelerator project is to deliver an accelerator complex with the world's highest intensity radioactive isotope beams.

- *Driver capable of accelerating any stable beam – protons to uranium*
    - 400 MeV/nucleon uranium
    - 400 kW light ions, 100 kW uranium with credible low-cost upgrade to 400 kW

- *Deliver rare isotope beams for experimentation in four energy regimes*
    - keV/nucleon energies,
    - 0.1-1 MeV/nucleon energies,
    - 1 – 10 MeV/nucleon energies, and
    - 100's of MeV/nucleon energies

Consequence Assessment

Each subsystem of RIA is compared against the technical performance objectives described above. The process proceeds in a somewhat logical pattern from the Front End, through the Driver Linac and Beam Dynamics, to the Target area, In-Flight Fragmentation, and Post Accelerator. The potential for failure or success is evaluated based on what we understand as "best currently available technology". Where possible, physics parameters have been deduced from the baseline report and an engineering layout created to improve perspective. The assessment review for each RIA subsystem and its potential for success or failure results in an impact score of high, medium, or low impact to the cost, technical, and schedule baseline based upon best engineering judgment.

Impact to Cost Baseline

- ***High impact*** means that there is a potential for a greater than $20M cost change (i.e. either increase or decrease) in the Capital or life cycle cost of the subsystem.
- ***Medium impact*** means that there is a potential for a change in Capital or life cycle cost of between $1M and $20M
- ***Low impact*** means that there is a minimal potential for change in Capital or life cycle cost, i.e., less than $1M.

<u>Impact to the Technical Baseline</u>

The technical baseline includes impacts to scientific mission, safety, permitting or licensing, safeguards and security, environmental impact, reliability, maintainability, etc.

- ***High Impact*** means that the technical baseline could be changed significantly by using or failing in this technology.
- ***Medium impact*** means that the technical baseline could be changed moderately by using or failing in this technology.
- ***Low impact*** means that the technical baseline could be changed minimally by using or failing in this technology.

<u>Impact to the Schedule Baseline</u>

- ***High Impact*** means that there could be significant impact to the baseline schedule, i.e., the overall schedule baseline could be affected by more than 1 year.
- ***Medium impact*** means that there could be medium impact to the baseline schedule, i.e.., the overall schedule baseline could be affected by up to 1 year.
- ***Low impact*** means that there is likely to be a minimal impact on the overall schedule.

Probability Assessment

- ***Very Likely (VL) -*** means the potential for success or failure is based on fully understood conditions and the outcome will definitely occur.
- ***Likely (L) -*** means the potential for success or failure is based on a mix of known and unknown conditions, the outcome is likely to occur, and the potential for failure based on the unknown condition is minimal.
- ***Unlikely (UL) -*** means the potential for success or failure is based on unknown conditions, which are not quickly resolved, and the outcome will most likely not occur.

Risk Assessment

Risk is defined as a probability of occurrence combined with the consequence of occurrence. However, in the case of a project, the timeliness of resolution can have a dramatic effect on consequence. Therefore, a risk "retirement date" is established based on project timing for useful information from an R&D program, which can then be incorporated into the project without "additional" impacts. Using the consequence assessment above and evaluating the probability of occurrence as well as any perspective gained from "other" considerations results in the overall determination of risk summarized below and in Figure 2. Once a determination of risk is established, basic methodologies can be used to "do something about it". There are three options in dealing with risk.

- **Acceptance** – If the conditions surrounding the risk are sufficiently well understood, the project can accept the risk. For most technical elements an evaluation of contingency percentage (typically increase) is appropriate based on the nature of the risk conditions. Examples include costs associated with the production target facility, utility systems, etc.

- **Mitigation** – If the conditions surrounding the risk element are not clearly understood, but lend themselves to resolution, the project can mitigate the risk. For most technical elements, an investment in research and development (such as the RIA R&D Program) focused on reducing potential adverse consequences or in reducing the probability of occurrence is appropriate. These risk elements become part of a technology development plan and would be "accepted" into the project as the risk is ultimately reduced or the baseline becomes robust enough to "accept" the risk. Examples include technology changes such as the triple spoke technology, multi-charge state technology, etc.

- **Avoidance** – If the conditions surrounding the risk element are too random or occur in a manner better suited to specialized commercial practices, the project can attempt to avoid the risk. These risk elements become part of a contracting and procurement strategy, make versus buy evaluation(s), or novel contracting strategies and insurance options. Examples include fabrication risks, site construction safety risks, etc.

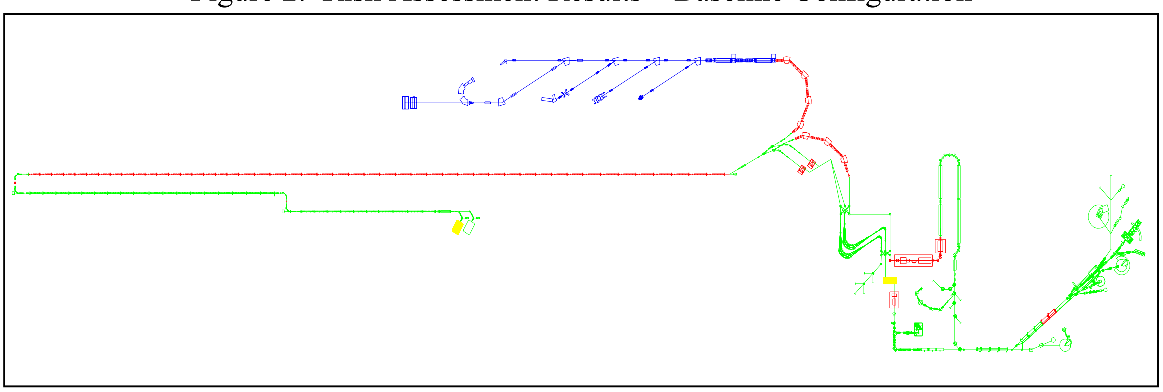
For RIA, a priority ranking is then established based on the risk assessment and risk retirement date.

- Priority 1 – Has near term risk retirement date and is high or moderate risk.
- Priority 2 – Has longer term risk retirement date and is high or moderate risk.
- Priority 3 – Has near term risk retirement date and is moderate or low risk.
- Priority 4 – Has longer term risk retirement date and is moderate or low risk.

Appendix A – Captures the consequence assessment for all subsystem elements of RIA.

Appendix B– Includes the probability and overall assessment of Risk, a recommendation of "what can we do about it", and the priority ranking.

Figure 2. Risk Assessment Results – Baseline Configuration



Potential for Project impact (threat or opportunity): Red = Highest, **Blue** = Moderate, **Yellow** = Lowest, **Green** = Risk is acceptable.