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# Risk Management Program for BETO Scale-Up Projects

## DOE Bioenergy Technologies Office 2023 Project Peer Review

April 3, 2023

**Systems Development and Integration Program**

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Pacific Northwest National Laboratory

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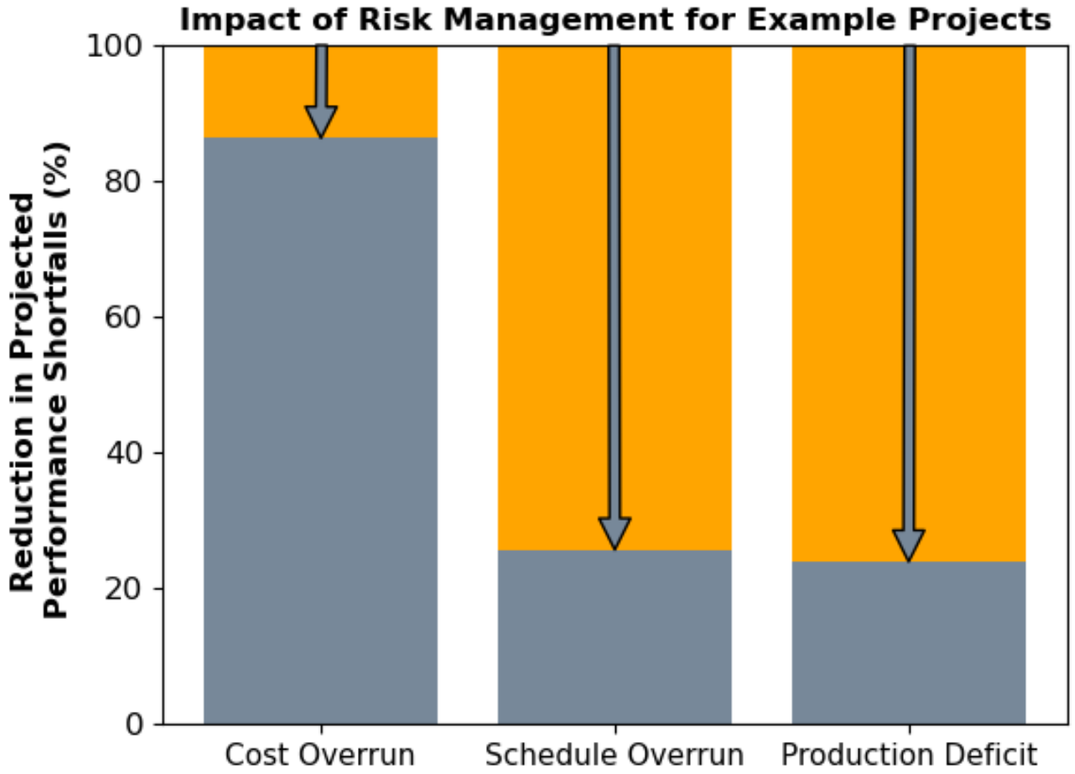
PNNL-SA-182796

# Project Overview

- **Purpose:** Develop and demonstrate a systematic framework and methods for identifying and assessing risks to the success of Bioenergy Technologies Office (BETO)-funded scale-up pilot and demonstration projects.
- **Current Approach:** Each BETO-funded project risk assessment approach is unique; there are no current BETO guidelines and assessment process.
- **Why Needed:** Lack of uniformity and quality in risk assessment methods and tools makes it difficult to effectively manage risks over the life cycle of BETO-funded projects.




** Risk reduction for example projects as a result of handling actions developed through a formal risk management program. Risk reduction for each category is represented as a percentage of the projected shortfalls prior to implementation of handling actions.*

# Background: **Risk management is an effective tool for increasing odds of project success**

**What can go wrong?**
(A *scenario*)

**How likely is it?**
(A probability of the scenario)

**How bad would it be?**
(A consequence severity of the scenario)

## Simplest expression of risk:

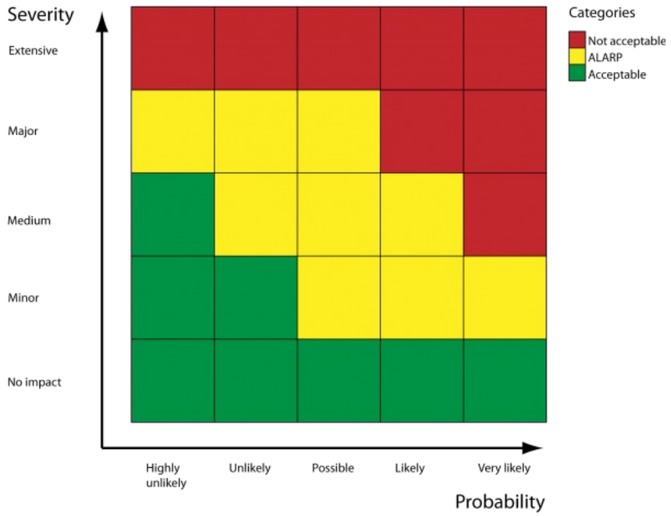
Risk = Probability × Consequence


** See additional slide 21 for more detail*

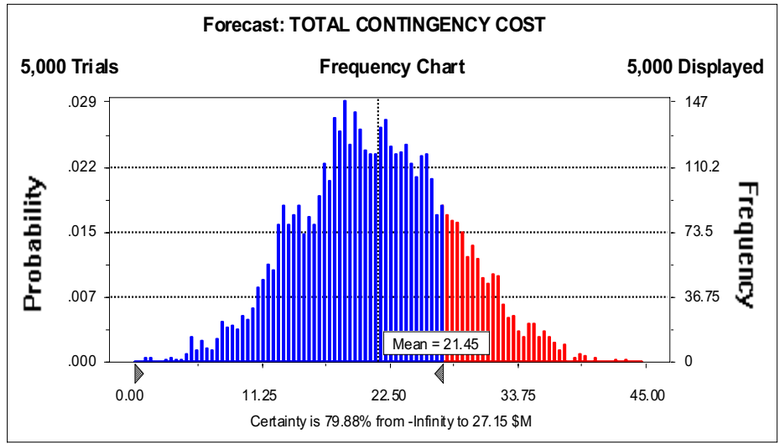
# Background: **Risk quantification can become more robust as the project progresses**

## DEGREE OF RISK QUANTIFICATION

**Qualitative** — **Semi-Quantitative** — **Fully Quantitative**




| Likelihood Scale: Project Lifetime | |
|---|---|
| **Likelihood Rating** | **Probability Range (%)** |
| VH – Very High | 75 – 100 |
| H – High | 50 – 75 |
| M – Moderate | 25 – 50 |
| L – Low | 5 – 25 |
| VL – Very Low | < 5 |

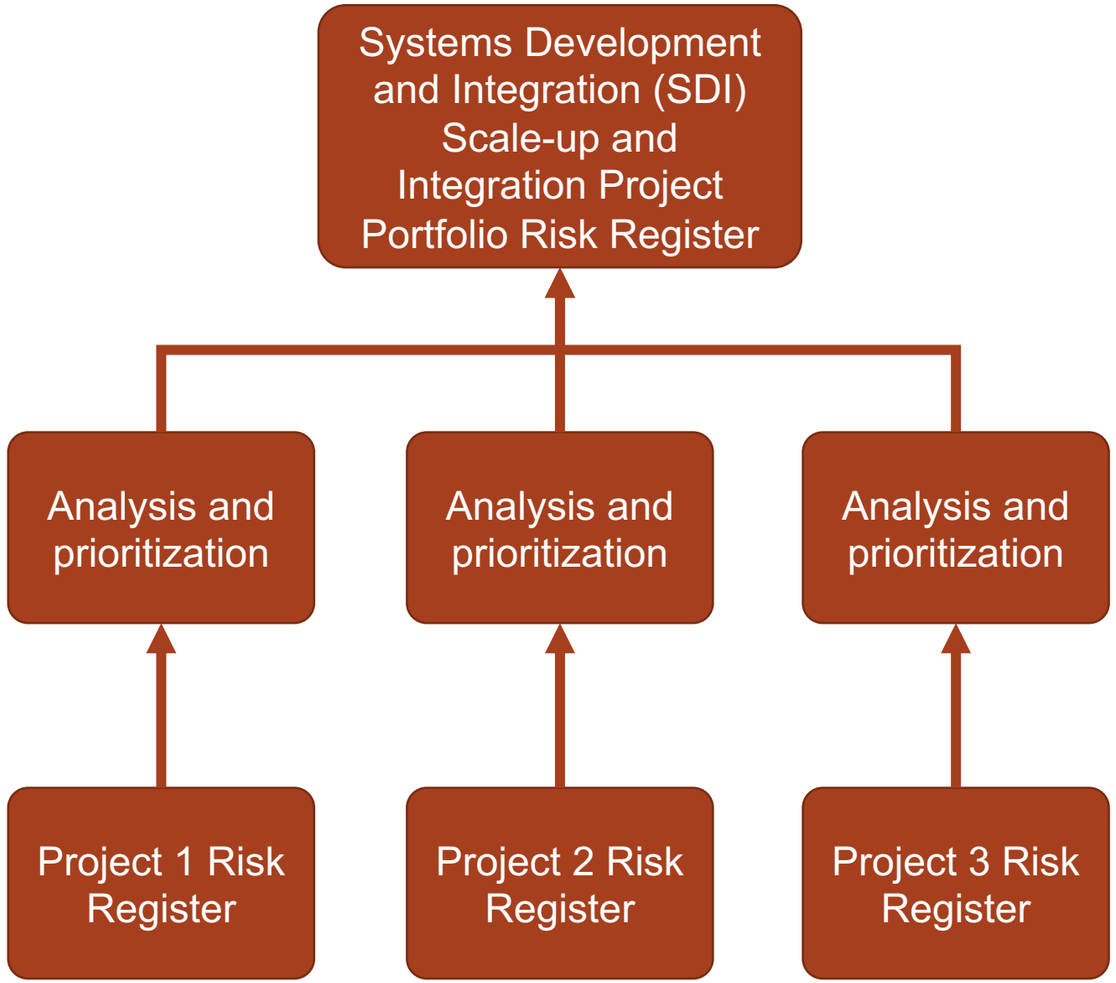



**Which methods you pick are driven by:**
**Degree of system definition, available data, required insights, project resources.**

Our approach: Start semi-quantitative, transition to fully quantitative as relevant.

# 1 – Approach: **Establish uniform risk management process for BETO projects that is consistent with industry standards**

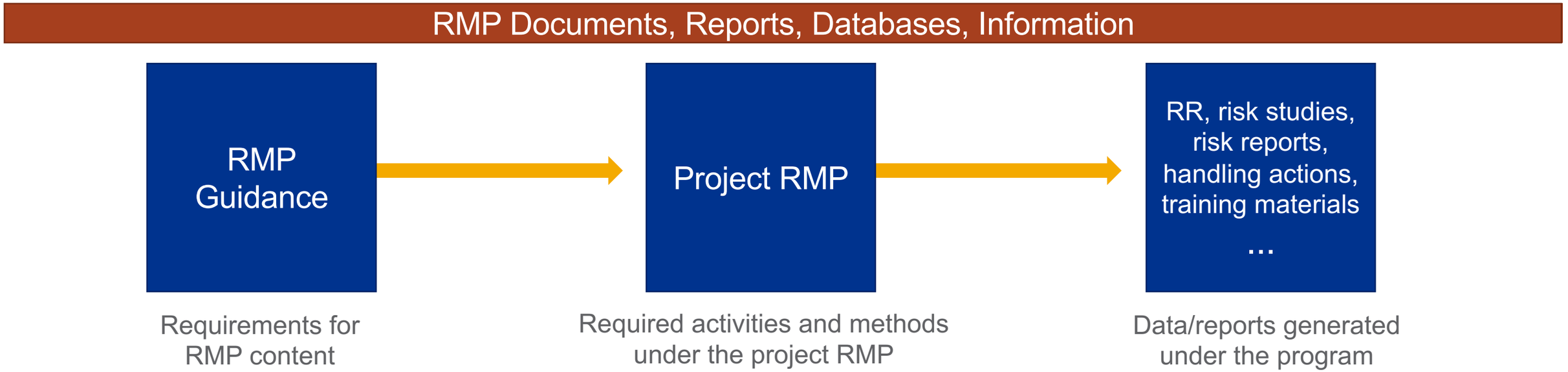
- Risk management program is established for each BETO-funded scale-up project following consistent industry standards:
  - Risk Management Plan (RMP)
  - Risk Register (RR).
- Ultimate goal: BETO will be able to track risk across its portfolio of scale-up projects. Use risk management as another dimension of quality when preparing for project stage gates and Go/No-Go decisions.



# 1 – Approach: **Develop a guide that provides a template to reduce effort and achieve consistency in BETO project RMP**

- RMP lays out:
  - Means of establishing the project RMP
  - Objectives, methods, and activities to maintain the program
  - Roles and responsibilities
  - Role of a risk advisory committee.

- Risk Management Plan Guide (RMPG):
  - Contains critical items that must be considered in an RMP
  - Provides pre-written content for more generic sections of an RMP (can be edited)
  - Identifies areas where project-specific information or inputs must be inserted.



# 1 – Approach: **Phase 1 projects use semi-quantitative risk analysis to assess and prioritize risks and mitigations**

- Risk assessment for Phase 1 projects uses a semi-quantitative approach to maximize ability to capture and characterize risks and mitigations (handling actions) for projects that may not have completed detailed scheduling and costing.
  - Probability and impact categories (Very High, High, Moderate, Low, Very Low) is used to generate risk estimates using a risk matrix.
  - Where possible, impact categories are explicitly defined by quantitative ranges, providing a more robust and consistent risk analysis.
- Develop criteria for determining whether a project should consider transitioning to fully quantitative risk analysis in Phase 2.

** See additional slides 22-23 for more detail*

# 1 – Approach: **Risk team incorporates feedback from bioenergy industry experts through multiple avenues**

- Technical Advisory Board
  - Composed of bioenergy subject matter experts
  - Provides feedback on project outputs to align with bioenergy industry needs.

*"As opposed to the typical U.S. method of not using an RMP and register, where the loss of certain individuals on the project has the potential to lose the context of the issues and path forward, the RMP documents the issues and proposed paths forward…" – Technical Advisory Board comment*

- Implementing risk management process in partnership with selected BETO scale-up projects allows for:
  - Demonstration of process
  - Refining of process to meet needs of bioenergy projects and BETO.

**Diversity, Equity, and Inclusion:** Both the Pacific Northwest National Laboratory (PNNL) technical team and the Technical Advisory Board exhibit gender diversity, with 50% of both teams being women.

# 1 – Approach: **PNNL project plan provides for incorporation of feedback from industry partners into development of risk management resources (e.g., RMPG, RR)**


## PROCESS AND COMMUNICATION

- Internal PNNL meetings on methodology and RR development as required.
- Monthly check-ins with BETO.
- Training and elicitations with selected Phase 1 projects as required.

## GO/ NO-GO

Adequacy of scale-up and integration partner participation.

**Criteria:** Draft RMP completed compliant with RMPG and risk elicitation efforts have been initiated in alignment with best practices to populate the RR.

# 1 – Approach: **Risks, challenges, and mitigations**

| RISKS AND CHALLENGES | MITIGATION STRATEGIES |
| --- | --- |
| **Risk:** If partner projects are unable to provide sufficient material/data to develop an RMP and RR, a risk management program cannot be established for that project through this process. | • Provide support to project for development of RMP and RR.<br>• Provide training to educate about the importance of risk management.<br>• Provide training to help explain content and process. |
| **Challenge:** Ensuring that scale-up projects are able to prioritize risk management along with other project priorities. | • Leverage initial efforts to develop level of effort estimates for future Phase 1 projects. |
| **Challenge:** Scale of some projects may indicate the need for a fully quantitative risk assessment, potentially requiring a higher level of effort. May be unclear which projects should make this transition. | • Develop list of criteria for projects that may need more quantitative risk assessment as part of Phase 2.<br>• Develop level of effort estimates for both semi-quantitative and fully quantitative risk assessments for Phase 2. |

# 2 – Progress and Outcomes: **Engaged two Phase 1 scale-up projects to pilot the risk assessment process**

- First partner Phase 1 Project:
  - Delivered trainings
  - Collaborated on an RMP outline
  - Draft RMP and RR under development.
- Second partner Phase 1 Project identified:
  - Completed kickoff call.
- Additional projects being identified.

- PNNL risk management project is currently behind schedule:
  - Process of identifying pilot projects and developing project-specific RMPs is taking longer than planned
  - Project schedules are shifting
  - Anticipate that lessons learned will help future pilots progress more quickly.

SKYNRG

LanzaTech

Project LOTUS

Lan

D3MAX

SAFFiRE

# 2 – Progress and Outcomes: **RMPG completed and used as template by first partner project to create their draft RMP**


Document Reference #: XYZ-Risk-1 Project XYZ RMP Revision: 0.0
Date: April xx, 2022
Page: 1 of 35

PROJECT XYZ

RISK MANAGEMENT PLAN

(TEMPLATE AND CONTENT GUIDANCE)

This is the cover page of the Risk Management Plan (RMP) for Project XYZ. The RMP is a dynamic document that will be periodically updated to reflect insights gained as the RMP is implemented. It is owned and maintained by the applicant, and it is suggested that ownership be reflected in the RMP cover by use of the applicant's branding.

APPLICANT'S BRANDING/ LOGO

| | |
|---|---|
| **COMPLETED** | • RMPG document.<br>• Reviewed by Technical Advisory Board members and comments incorporated. |
| **ONGOING** | • Developing risk reporting templates.<br>• Ongoing development, including process for transitioning to a fully quantitative risk assessment during Phase 2. |
| **OUTCOMES** | • First partner project draft RMP is generally consistent with the RMPG but with some differences.<br>• In process of iterating both the RMPG and draft RMP to resolve differences. |

# 2 – Progress and Outcomes: **RR tool enables uniform risk characterization for BETO scale-up projects**

| | |
|---|---|
| **COMPLETED** | • Completed draft RR and demonstrated it to first Phase 1 project during elicitation training.<br>• Developed beta RR during FY23 Q2 and shared with partner project. |
| **ONGOING** | • Adding graphs and tables to RR that can be used for risk reporting.<br>• Review of RR functionality by Technical Advisory Board members (FY23 Q3). |
| **OUTCOMES** | Tool that enables uniform and consistent capture and reporting of risk data to support enhanced programmatic risk analysis capabilities. |

**Risk Characterization**

| **Current Risk** | | | **Residual Risk** | | |
|---|---|---|---|---|---|
| **Likelihood** | High (50-75% probability) | | **Likelihood** | Very Low (<5% probability) | |
| **Consequence Severity Rating** | **Cost Increase ($K)** | High (1500 - 2500) | **Consequence Severity Rating** | **Cost Increase ($K)** | High (1500 - 2500) |
| | **Schedule (Weeks delayed)** | High (32 - 52) | | **Schedule (Weeks delayed)** | High (32 - 52) |
| | **Existential** | Not Applicable | | **Existential** | Not Applicable |
| | **Reputational (Extent of attention)** | Moderate (Regulators) | | **Reputational (Extent of attention)** | Moderate (Regulators) |
| | | | | | |
| **Likelihood and Consequence Basis** | Anticipation of project xxx will be ramping up staff resource requirements as Project XYZ approaches stage zzz | | **Likelihood and Consequence Basis** | Anticipatory hiring of capability yyy will reduce likelihood of scenario | |
| **Risk Rating** | **High** | | **Risk Rating** | **Moderate** | |

** See additional slide 24 for more detail*

# 2 – Progress and Outcomes: **Project has successfully completed milestones to date and Go/No-Go decision point resulted in a "Go"**

| MILESTONE | STATUS |
|---|---|
| Outline of RMPG | Complete |
| RMPG document fully drafted | Complete |
| Annotated outline of project-specific RMP for first selected Phase 1 project | Complete |
| Risk elicitation with first Phase 1 project scheduled | Complete, though being rescheduled due to shifting project timelines |
| Initial draft of project-specific RMP for first partner project | Complete |

## GO/ NO-GO (3/30/2023)

Adequacy of scale-up and integration partner participation:

**Criteria:** Draft RMP completed compliant with RMPG and risk elicitation efforts have been initiated in alignment with best practices to populate the RR.

**Status: Go –** Engaged participation from first two partner projects, first partner has completed a draft RMP and is on track to conduct risk elicitations and populate risk register in FY23 Q3.

# 3 – Impact: **Implementing a consistent risk management process across the BETO portfolio of projects**

- Project has developed an RMPG and RR tool for use by BETO scale-up and integration projects.
  - Implementation of these tools will improve BETO's awareness of risks across its portfolio of funded scale-up projects, enhancing its ability to prioritize risk management resources.
- Project has engaged with two scale-up project teams to pilot the risk management process, each expressed enthusiastic support for and commitment to participating in this effort.
- Project is providing training to the pilot projects on implementation of the RMPG.
  - Provides BETO performers with the tools needed for robust risk management, which will be attractive to potential investors and increase the probability of commercialization.
- Project is introducing state-of-the art industry and international consensus risk management standards to both BETO and scale-up projects.
  - Creates basis to extend risk management practices into the full commercial life cycles of the technologies, providing lasting benefit to the bioenergy industry beyond the BETO project life cycle.

# Summary

**GOAL**

Develop a uniform framework for risk management, following industry best practices, for implementation in BETO's scale-up projects to help BETO manage risks across project portfolio.

**APPROACH**

1) Develop materials that can be used by scale-up projects for implementing project-specific risk management programs.
2) Provide training to pilot projects on use and implementation of these materials.
3) Support pilot projects in their development and implementation of project-specific risk management programs.
4) Update materials to address feedback and lessons learned from the pilot projects.

**PROGRESS AND OUTCOMES**

- On-time completion of risk management resources that provide guidance to scale-up projects.
- Initiating RMP development efforts with two scale-up projects to pilot the RMPG.

**IMPACT**

- Providing BETO SDI with a framework for managing risk across project portfolio.
- Introducing state-of-the-art industry and international consensus risk management standards needed for robust risk management, which will be attractive to potential investors.

*"I have found a developer's RMP to be a good communication tool in communicating the status of project risks to project stakeholders (such as investors)." – Technical Advisory Board comment*

# Quad Chart Overview

## Timeline

- Project start date: October 1, 2021
- Project end date: September 30, 2024

| | | |
|---|---|---|
| | $625,000 | $1,400,000 (FY 2022-2024) |
| | $0 | $0 |

TRL at Project Start: N/A*

TRL at Project End: N/A*

* This project is not developing a technology and therefore does not have an associated TRL. However, the risk management framework is based on consensus industry standards that have been developed over decades.

## Project Goal

Develop a risk management process that will allow BETO to have awareness of risks across its portfolio of scale-up projects and handling strategies to address those risks. This risk management process will provide projects with the tools to increase the likelihood of meeting project goals on-budget and on-schedule.

## End of Project Milestone

Provide ongoing support to SDI and enable the RMP requirements to be rolled out across selected projects.

## Funding Mechanism

National Laboratory Call for Proposals for Fiscal Year 2022; AOI 4b: Risk Analysis Methodology and Implementation.

## Project Partners

**Technical Advisory Board Members**

- Bill Crump (Leidos)
- Carol Babb (ICF)

**Partner Projects**

- LOTUS (SkyNRG)
- SAFFiRE (D3MAX)

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# Additional Slides

# Responses to Previous Reviewers' Comments

- This project was not part of the FY21 BETO Peer Review because the project began in FY22.
- The first Go/No-Go review on whether to proceed with the first pilot is planned for 3/30/2023.

# Publications, Patents, Presentations, Awards, and Commercialization

- BETO RMPG (PNNL-32699)
- Training delivered to first pilot project team:
  - Introduction to BETO RMPG (PNNL-SA-173592; June 16, 2022)
  - Risk Assessment Part 1: General Principles (PNNL-SA-176471; August 18, 2022)
  - Risk Assessment Part 2: Elicitation (PNNL-SA-178573; October 17, 2022).

# Background: **Why a Rigorous Risk Management Process?**

- Bases for formal risk management have been established in consensus standards for industries and associated guidance.
- Provides a means of better forecasting, avoiding, mitigating, and preparing for challenges to the success of a project.
- Standardizes risk identification and evaluation methods and criteria.
- Provides basis for allocating resources for risk management.
- Allows tracking and trending of risk performance.
- Provides basis for keeping stakeholders informed and leveraging their input.
- Once the risk management system is learned, it can be used to increase successful commercialization.

# 1 – Approach: **Risk characterization considers probability of scenario and multiple consequence types**

- Risks and opportunities characterized using semi-quantitative rankings for several impact types: Cost. Schedule. Existential. Reputational.
- Risks and risk characterization developed through formal risk elicitation sessions.

## Event Probability

| Likelihood Scale: Project Lifetime | |
|---|---|
| **Likelihood Rating** | **Probability Range (%)** |
| VH – Very High | 75 – 100 |
| H – High | 50 – 75 |
| M – Moderate | 25 – 50 |
| L – Low | 5 – 25 |
| VL – Very Low | < 5 |

## Event Impact/ Consequence

| IMPACT TYPE | CONSEQUENCE SEVERITY RATING | | | | |
|---|---|---|---|---|---|
| | VL Very Low | L Low | M Medium | H High | VH Very High |
| Cost ($K) | <100 | 100 – 500 | 500 – 1500 | 1500 – 2500 | > 2500 |
| Schedule (Weeks delayed) | < 4 | 4 – 16 | 16 – 32 | 32 – 52 | > 52 |
| Existential | N/A | | | | Project Termination |
| Reputational (Extent of Attention) | Company ABC | DOE Sponsor | Regulators | Public/ Local | State/ National |

| IMPACT TYPE | IMPROVEMENT RATING | | | | |
|---|---|---|---|---|---|
| | VL Very Low | L Low | M Medium | H High | VH Very High |
| Cost Decrease ($K) | <100 | 100 – 500 | 500 – 1500 | 1500 – 2500 | > 2500 |
| Schedule Acceleration (Weeks) | < 4 | 4 – 16 | 16 – 32 | 32 – 52 | > 52 |

# 1 – Approach: **Risk in semi-quantitative analysis is characterized using a risk matrix**

- Semi-quantitative risk analysis implemented for Phase 1 projects.
- Risks assigned a ranking (Low, Moderate, or High) based on likelihood and consequence ratings.
- Risk matrix provides basis for:
  - Assessing risk tolerance
  - Risk prioritization
  - Assessing risk reduction for a mitigation option
  - Risk trending.

**Risk Rating Matrix**

| LIKELIHOOD | CONSEQUENCE SEVERITY: VL | L | M | H | VH |
|---|---|---|---|---|---|
| VH | moderate | moderate | high | high | high |
| H | low | moderate | moderate | high | high |
| M | low | moderate | moderate | moderate | high |
| L | low | low | moderate | moderate | high |
| VL | low | low | low | moderate | moderate |

**Opportunity Rating Matrix**

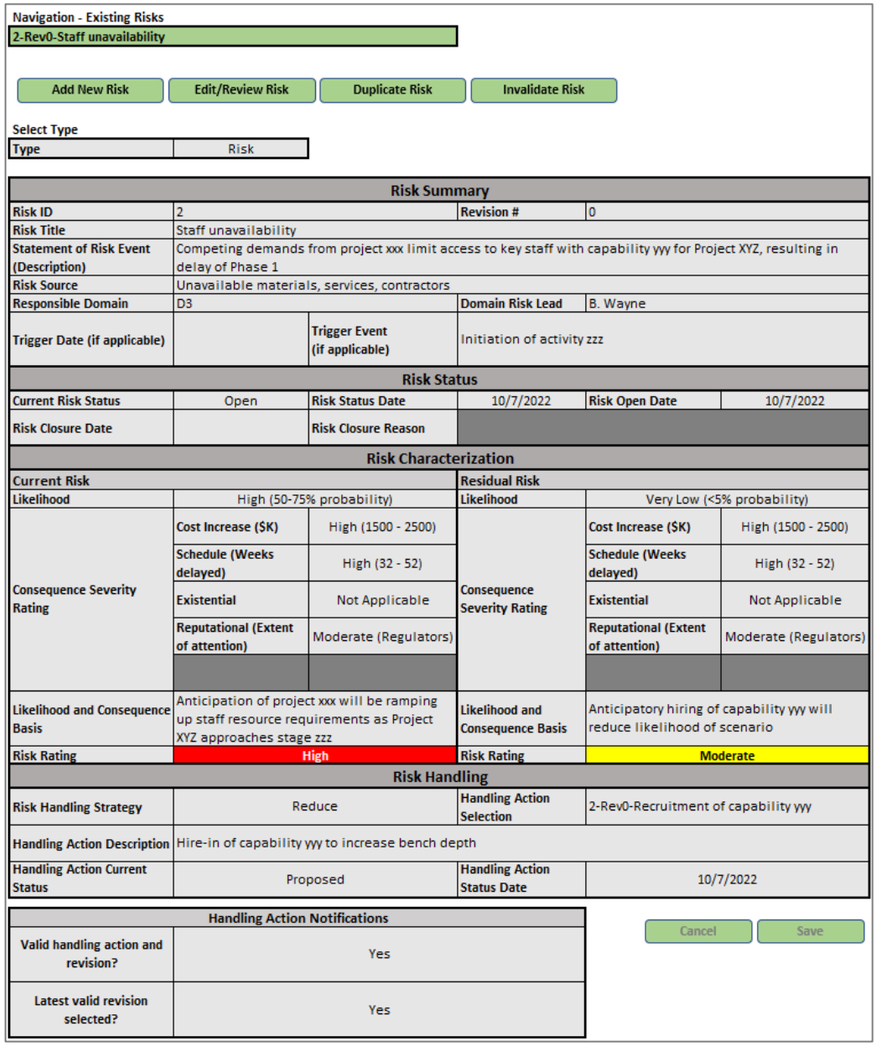
| LIKELIHOOD | IMPROVEMENT RATING: VL | L | M | H | VH |
|---|---|---|---|---|---|
| VH | moderate | moderate | high | high | high |
| H | low | moderate | moderate | high | high |
| M | low | moderate | moderate | moderate | high |
| L | low | low | moderate | moderate | high |
| VL | low | low | low | moderate | moderate |

# 2 – Progress and Outcomes: **Risks captured during elicitations documented in easy-to-use RR tool**

- Risks captured during elicitation sessions attended by relevant subject matter experts.
- Risks entered into Excel-based RR tool developed to track risks consistent with RMPG process.
- **In progress***:* Developing outputs for the RR tool to make it easier to regularly analyze risks and trends and to streamline risk reporting.

**Use of consistent RR across projects helps to:**

- Capture risks in a way that will be easy to roll up into a portfolio-level view for BETO.
- Capture information that can help projects transition to a fully quantitative risk assessment, if needed.



Navigation - Existing Risks

2-Rev0-Staff unavailability

Add New Risk | Edit/Review Risk | Duplicate Risk | Invalidate Risk

Select Type

| Type | Risk |
|---|---|

**Risk Summary**

| | | | | | |
|---|---|---|---|---|---|
| Risk ID | 2 | | Revision # | 0 | |
| Risk Title | Staff unavailability | | | | |
| Statement of Risk Event (Description) | Competing demands from project xxx limit access to key staff with capability yyy for Project XYZ, resulting in delay of Phase 1 | | | | |
| Risk Source | Unavailable materials, services, contractors | | | | |
| Responsible Domain | D3 | | Domain Risk Lead | B. Wayne | |
| Trigger Date (if applicable) | | Trigger Event (if applicable) | Initiation of activity zzz | | |

**Risk Status**

| | | | | | |
|---|---|---|---|---|---|
| Current Risk Status | Open | Risk Status Date | 10/7/2022 | Risk Open Date | 10/7/2022 |
| Risk Closure Date | | Risk Closure Reason | | | |

**Risk Characterization**

| Current Risk | | | Residual Risk | | |
|---|---|---|---|---|---|
| Likelihood | High (50-75% probability) | | Likelihood | Very Low (<5% probability) | |
| Consequence Severity Rating | Cost Increase ($K) | High (1500 - 2500) | Consequence Severity Rating | Cost Increase ($K) | High (1500 - 2500) |
| | Schedule (Weeks delayed) | High (32 - 52) | | Schedule (Weeks delayed) | High (32 - 52) |
| | Existential | Not Applicable | | Existential | Not Applicable |
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| Likelihood and Consequence Basis | Anticipation of project xxx will be ramping up staff resource requirements as Project XYZ approaches stage zzz | | Likelihood and Consequence Basis | Anticipatory hiring of capability yyy will reduce likelihood of scenario | |
| Risk Rating | High | | Risk Rating | Moderate | |

**Risk Handling**

| | | | |
|---|---|---|---|
| Risk Handling Strategy | Reduce | Handling Action Selection | 2-Rev0-Recruitment of capability yyy |
| Handling Action Description | Hire-in of capability yyy to increase bench depth | | |
| Handling Action Current Status | Proposed | Handling Action Status Date | 10/7/2022 |

**Handling Action Notifications**

| | |
|---|---|
| Valid handling action and revision? | Yes |
| Latest valid revision selected? | Yes |

Cancel | Save

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# Thank you