

**Team 4**

## **GROUP ASSIGNMENT - 6**

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# **RISK MANAGEMENT JOURNEY & KEY INSIGHTS**



**Presented by:**

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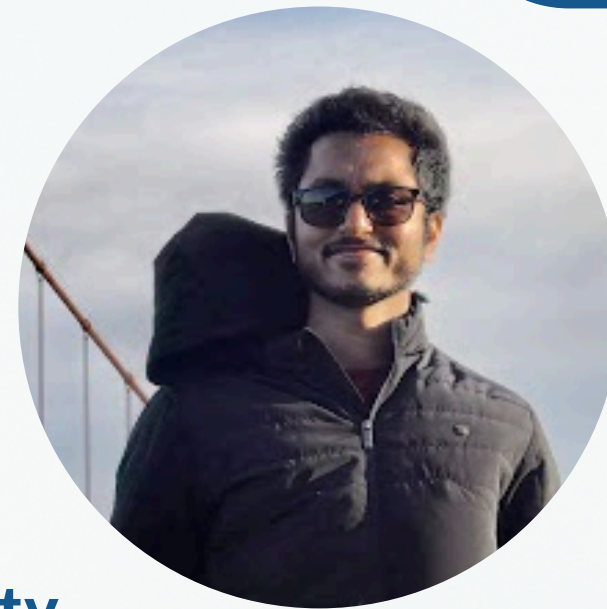
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# TEAM INTRODUCTION - MEET TEAM 4



**Anurekha Chakraborty**



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# PROJECT OVERVIEW – BRIGHTSOURCE ENERGY'S IVANPAH SOLAR ELECTRIC GENERATING SYSTEM



## Project Overview

- **Location:** Mojave Desert, CA (3,600 acres)
- **Managed by:** US Bureau of Land Management
- **Construction started:** October 2010



## Technical Highlights

- 3 solar towers; 170,000 smart mirrors
- Sun-tracking mirrors heat boilers
- Dry cooling cuts water use by 90%



## Power Generation

- 2.2 billion, 392 MW
- Powering 140,000 homes
- Long-term PP contracts with Pacific Gas and Electric and Southern California Edison

# PROJECT OVERVIEW & IMPACT



## ● Environmental Impact

- Reduces 400,000 metric tonnes of carbon dioxide emissions annually
- Equivalent to removing 70,000 vehicles from road each year



## ● Economic and Social Contributions

- Created 2,600+ skilled labor jobs
- 70% of equipment sourced from within the United States



## ● Wildlife Protection

- Actively protected desert tortoise habitat
- Approved to relocate 1,200 tortoises; only 172 moved

# PURPOSE OF RISK MANAGEMENT PLAN



1

Identify threats early (environmental, technical, financial, regulatory) - Assess and analyze impacts on project objectives (cost, schedule, performance)

2

Choose right responses - Avoid, mitigate, transfer, accept, or build a contingency.

3

Continuously monitor and report risk status

4

Facilitate informed decision-making.



# KEY COMPONENTS

## Risk Identification

- Environmental Impact Assessments (EIAs) - Project's impact on Environment.
- Expert consultations and historical project reviews
- Stakeholder consultations (regulatory bodies, environmental groups)
- Project documentation (WBS, scope, requirements)

## Qualitative Risk Analysis

- Probability-Impact matrix (visual heat-map)
- Risk scoring methodology (numerical scores: High=5, Medium=3, Low=1)
- Prioritization based on probability, impact, urgency

## Quantitative Risk Analysis

- Monte Carlo simulations
- Tornado charts to highlight critical tasks



# KEY COMPONENTS

## Risk Response Planning

- Tailored response plans (Avoidance, Mitigation, Transfer, Acceptance, Contingencies)
- Integrated into overall project plan

## Risk Response Implementation

- Clearly assigned responsibilities and accountability
- Resource allocation and integration into project timeline

## Risk Monitoring, Controlling, and Reporting

- Regular bi-weekly and milestone-driven reviews
- Continuous identification and adjustment of responses
- Transparent stakeholder communication and reporting mechanisms

# RISK REGISTER: STRUCTURE

Tab	Data Captured	Decision Making
Qualitative Risks	<ul style="list-style-type: none"> <li>• Risk ID and title (marked as threat/opportunity)</li> <li>• High, Medium, Low ratings for Probability, Schedule, Cost, and Performance</li> <li>• Color-coded score (Red, Orange, Yellow, Green)</li> </ul>	<ul style="list-style-type: none"> <li>• Helps focus on high-priority risks (Reds and Oranges)</li> <li>• Low risks stay monitored but need less attention</li> </ul>
Response Actions	<ul style="list-style-type: none"> <li>• Mitigation strategy for each risk</li> <li>• Assigned owner</li> <li>• Planned vs actual start &amp; finish dates</li> <li>• Expected mitigation cost</li> <li>• Post-mitigation H-M-L ratings</li> </ul>	<ul style="list-style-type: none"> <li>• Holds owners to deadlines</li> <li>• Verifies whether the fix moves the risk from Red → Yellow or Orange → Green.</li> </ul>
Quantitative Risks	<ul style="list-style-type: none"> <li>• Low / Most-likely / High cost range</li> <li>• Auto-calculated EMV (Expected Monetary Value)</li> </ul>	<ul style="list-style-type: none"> <li>• Turns each risk into dollar value</li> <li>• Helps estimate required total reserve money</li> </ul>
Task Impact	<ul style="list-style-type: none"> <li>• WBS task that would slip if risk occurs</li> <li>• Best-case, most-likely, worst-case delay (or cost)</li> </ul>	<ul style="list-style-type: none"> <li>• Feeds Monte-Carlo simulation and tornado chart</li> <li>• Identifies which tasks are most at risk of causing project delays</li> </ul>

# RISK REGISTER: SNAPSHOT

## QUALITATIVE RISKS TAB

Risk		Pre-mitigation					Response				Post-mitigation				
ID	Type	Title	Probability	Schedule	Cost	Performance	Score	Strategy	Title	Total Cost	Probability	Schedule	Cost	Performance	Score
R101	Threat	Desert tortoise relocation exceeds estimate	H	H	H	H	20	Mitigate	Adaptive Wildlife Relocation Plan	\$1,000,000.00	H	H	H	H	18
R102	Threat	Dust pollution exceedances trigger shutdown	M	L	L	L	6	Mitigate	Dust Suppression and Monitoring Program	\$300,000.00	M	L	L	L	4
R103	Threat	Delay in BLM right-of-way permit	H	M	M	M	14	Mitigate	Accelerated BLM Permit Task Force	\$500,000.00	H	M	M	M	12
R104	Threat	Failure to comply with environmental condition	M	M	M	M	12	Mitigate	Environmental Compliance Assurance Plan	\$800,000.00	M	M	M	M	10
R105	Threat	Heliostat control software instability	M	H	H	H	18	Mitigate	Redundant Software Validation & Patch Deployment	\$1,200,000.00	M	H	H	H	16
R106	Threat	Dry cooling system underperformance	M	M	M	M	12	Mitigate	Performance Tuning & Backup Cooling Strategy	\$600,000.00	M	M	M	M	10
R107	Threat	Extreme heat/dust storms halt work	M	L	L	L	6	Mitigate	Weather-Contingent Work Shift Schedule	\$400,000.00	M	L	L	L	4
R108	Threat	Skilled labor shortage	M	L	L	L	6	Mitigate	Skilled Labor Recruitment & Retention Program	\$250,000.00	M	L	L	L	4
R109	Threat	Heliostat mirror supply chain delay	M	M	M	M	12	Mitigate	Alternate Supplier & Expedited Logistics Plan	\$700,000.00	M	M	M	M	10
R110	Threat	DOE loan milestone miss	L	H	H	H	16	Mitigate	Milestone Recovery and Stakeholder Negotiation	\$1,500,000.00	L	H	H	H	14
R111	Threat	Environmental mitigation costs overrun	M	M	M	M	12	Mitigate	Cost Control & Mitigation Budget Tracking	\$550,000.00	M	M	M	M	10
R112	Threat	Environmental NGO lawsuit injunction	L	M	M	M	10	Mitigate	NGO Engagement and Legal Readiness Plan	\$900,000.00	L	M	M	M	10
R113	Threat	Investor withdrawal	L	H	H	H	16	Mitigate	Investor Assurance & Contingency Financing	\$2,000,000.00	L	H	H	H	14
R114	Threat	Grid interconnection approval delay	M	M	M	M	12	Mitigate	Utility Coordination and Pre-Commissioning Plan	\$600,000.00	M	M	M	M	10
R115	Threat	Commissioning fire at receiver tower	L	H	H	H	16	Mitigate	Enhanced Fire Safety & Emergency Response Plan	\$2,500,000.00	L	H	H	H	14

# RISK IDENTIFICATION - VALUE TO APPROACH

## > Environmental Impact Assessments (EIAs)

- EIAs and site surveys revealed unexpected number of desert tortoises
- Time to plan environmental delays before construction began.

## > Regulator and Stakeholder Workshops

- Sessions with engineers, software developers, environmental consultants, and finance experts.
- Identify technical risks that normal checklists miss - **new heliostat control software issues.**

## > Historical Check-lists

- Used past data from similar desert solar projects
- Realistic numbers for risk scores and reduce guesswork.

## > Public and stakeholder input

- Gathered feedback from government agencies, environmental groups, and investors like Google.
- Raised concerns that became real risks in register - permit delays.

## > Structured WBS brainstorming

- Reviewed every part of project — site prep, mirror delivery, and grid connection — risk mapped at each step.

***Why it worked: Combining evidence-based field data, multi-discipline perspectives, and structured check-lists caught the most severe threats, aligned them with stakeholder tolerance, and tied every risk to dollars and informed decision making***

# DIFFICULTY & LESSONS

## Wild-Life inconsistency

- Field biologists counted more desert tortoises than desktop EIA
- **Lesson:** Schedule on-site checks before finalizing the schedule.

## Extreme desert weather

- Dust storms and temperatures above 120 °F shut down work / cut productive hours in peak summer.
- **Lesson:** Plan key tasks around weather and allow flexible shifts.

## Shifting permit calendars

- California Energy Commission, Bureau of Land Management, and more permit conditions moved - disturbing start dates.
- **Lesson:** Use one **permit dashboard** shared to all stakeholders for real-time updates.



# RISK PRIORITIZATION APPROACH

## How were risks prioritized?

- ✓ Probability-Impact Matrix based on PMI standards
- ✓ Steps:
  - Assign qualitative labels:
    - Probability: High (H), Medium (M), Low (L)
    - Impact: Highest score among Schedule, Cost, Performance
  - Convert to numerical values: High = 5, Medium = 3, Low = 1
  - Final score: Risk Score = Probability × Impact



## What was the risk threshold?

Risk Score	Priority	Action Required
20–25	Critical	Immediate mitigation & weekly review
12–19	High	Detailed response & monthly review
6–11	Medium	Monitor & keep fallback plans ready
1–5	Low	Watch-list only

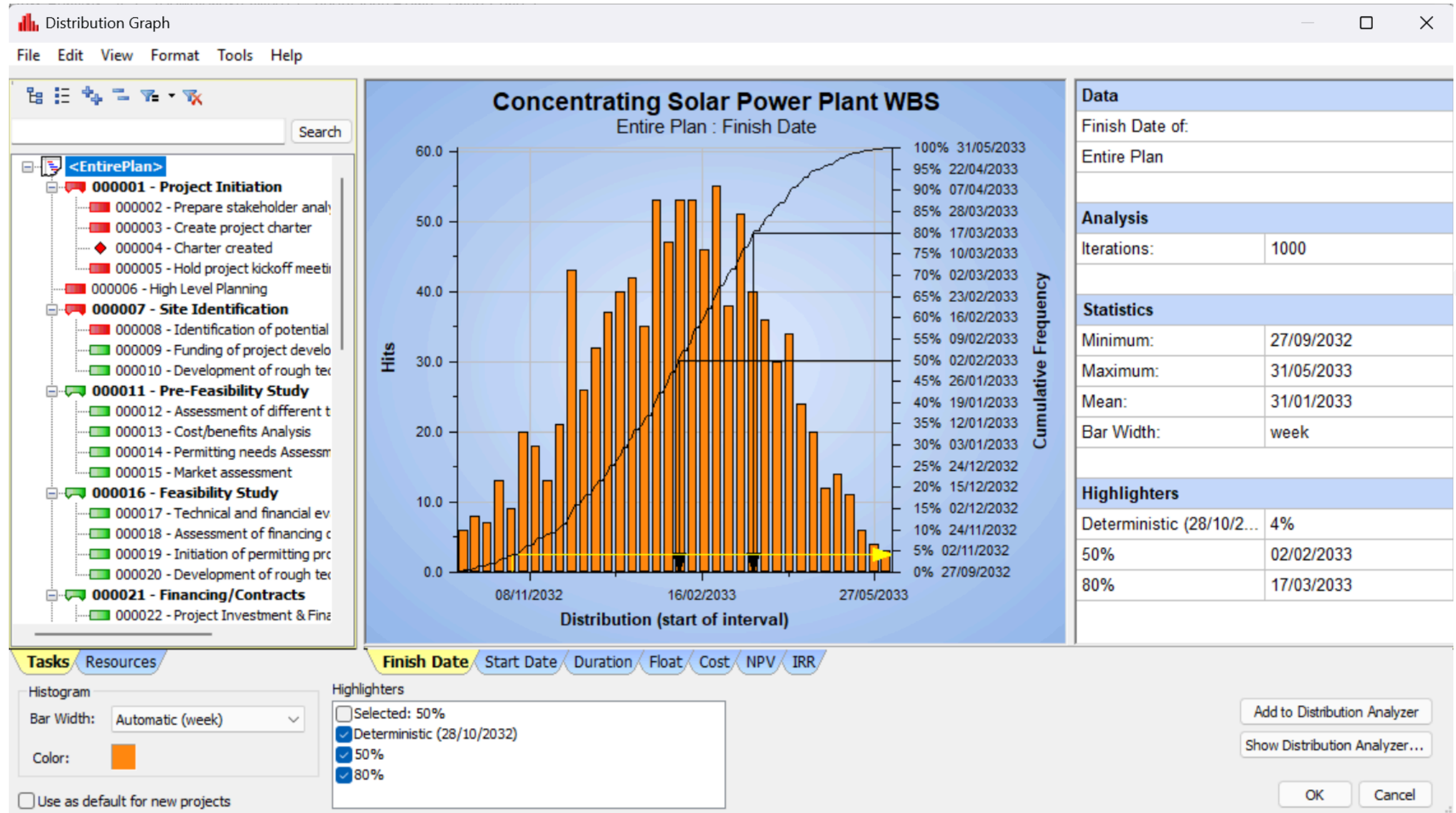
## How valid is this approach?

- ✓ Strengths:
  - Clear and structured
  - Aligns with PMI best practices
  - Supports focused decision-making
- ⚠ Limitations:
  - Relies on subjective judgment
  - Cannot reflect dynamic changes unless updated regularly

# PROJECT COMPLETION

## Finish date

80% Confidence  
 Finish Date:  
 17/03/2033, with  
 only 4% chance of  
 meeting  
 deterministic date  
 28/10/2032.



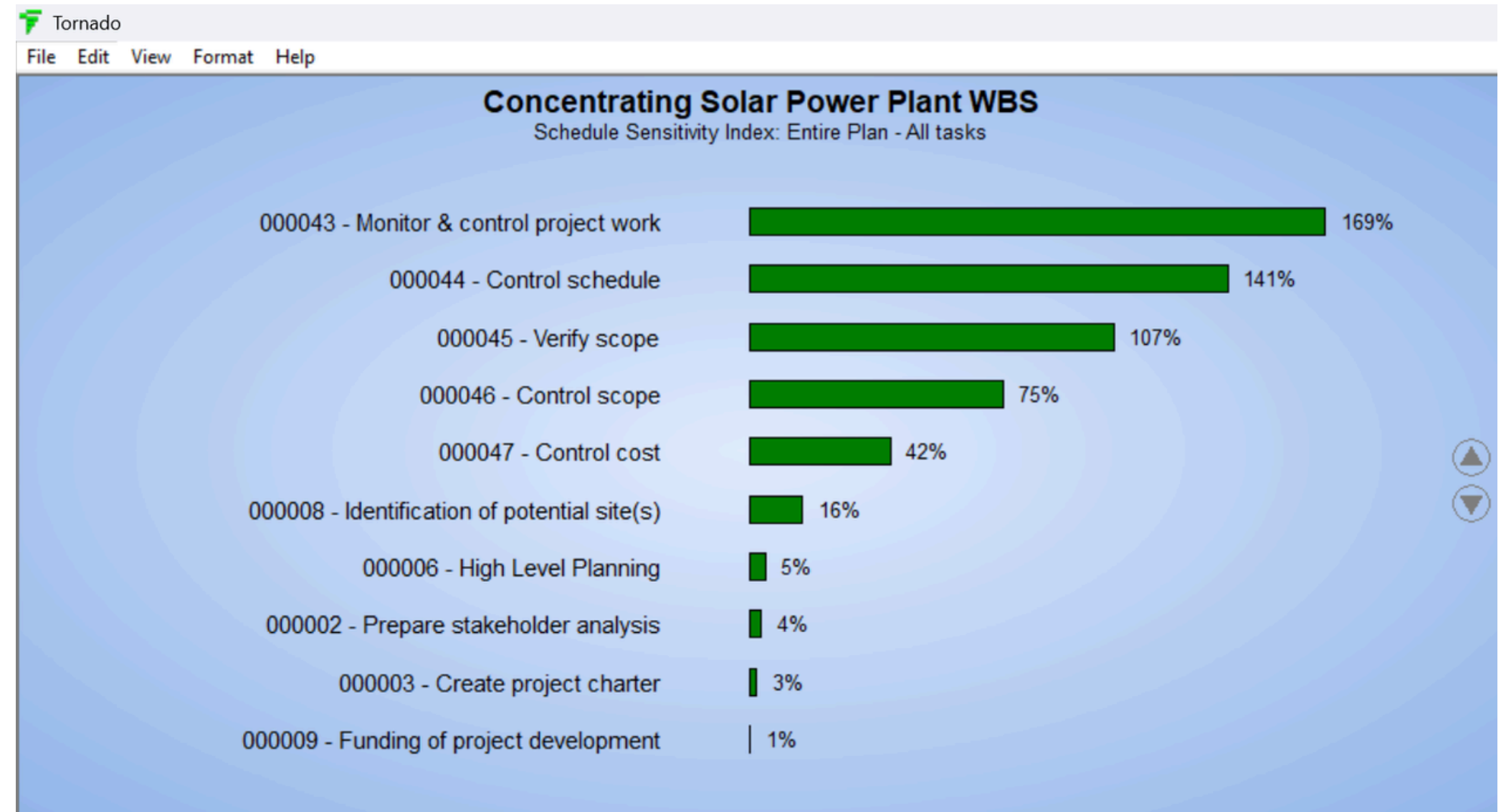
# RISKIEST PARTS

## > Tasks most likely to cause delay:

- Monitor & control project work
- Control schedule
- Verify scope
- Control scope
- Control cost
- (Highest schedule sensitivity indices from tornado chart: 169%, 141%, 107%, 75%, 42%)

## > Key risk areas:

- Environmental compliance (e.g., desert tortoise issues)
- Permitting and regulatory delays
- Construction challenges (e.g., remote desert conditions)
- Technology performance (e.g., heliostats, dry-cooling)  
(High-probability, high-impact risks from risk register)



# RISK RESPONSE STRATEGIES

## Development of Strategies:

- Avoidance: Adjusted heliostat layout to minimize tortoise habitat disruption
- Mitigation: Hired 150+ biologists, used dust control measures
- Transfer: Added performance guarantees in supplier contracts
- Acceptance: Accepted minor risks with low impact
- Contingency: Secured alternate suppliers, built schedule buffers (Tailored to high-priority risks)

## Integration with Planning:

- Embedded into schedules, budgets, design, and construction plans

## Secondary Risks:

- Added to risk register (e.g., mitigation cost overruns)

## Value Addition:

- Completed on schedule despite challenges
- Avoided major lawsuits, built stakeholder trust
- Secured DOE loan and investor confidence

# CONTINGENCY RESERVE

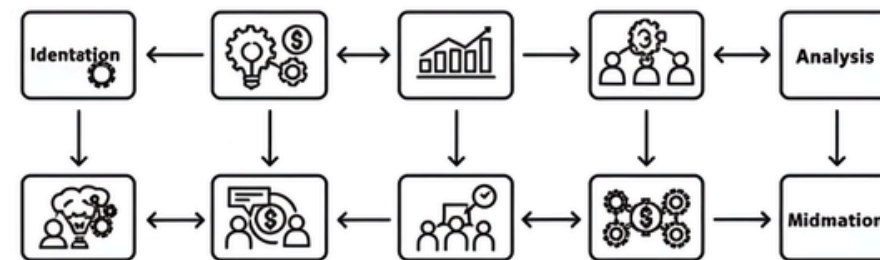
# \$138,000,000

Scenario Name	Risk ID	WBS/Task ID	Cost Minimum	Cost Likely	Cost Maximum
Pre-mitigation	R101	7.3	\$7,000,000.00	\$10,000,000.00	\$13,000,000.00
Pre-mitigation	R102	8.1	\$2,100,000.00	\$3,000,000.00	\$3,900,000.00
Pre-mitigation	R103	6.3	\$3,500,000.00	\$5,000,000.00	\$6,500,000.00
Pre-mitigation	R104	8	\$5,600,000.00	\$8,000,000.00	\$10,400,000.00
Pre-mitigation	R105	9	\$8,400,000.00	\$12,000,000.00	\$15,600,000.00
Pre-mitigation	R106	11	\$4,200,000.00	\$6,000,000.00	\$7,800,000.00
Pre-mitigation	R107	8.2	\$2,800,000.00	\$4,000,000.00	\$5,200,000.00
Pre-mitigation	R108	8.3	\$1,750,000.00	\$2,500,000.00	\$3,250,000.00
Pre-mitigation	R109	9	\$4,900,000.00	\$7,000,000.00	\$9,100,000.00
Pre-mitigation	R110	6.1	\$10,500,000.00	\$15,000,000.00	\$19,500,000.00
Pre-mitigation	R111	8.1	\$3,850,000.00	\$5,500,000.00	\$7,150,000.00
Pre-mitigation	R112	6.3	\$6,300,000.00	\$9,000,000.00	\$11,700,000.00
Pre-mitigation	R113	6.1	\$14,000,000.00	\$20,000,000.00	\$26,000,000.00
Pre-mitigation	R114	12	\$4,200,000.00	\$6,000,000.00	\$7,800,000.00
Pre-mitigation	R115	12	\$17,500,000.00	\$25,000,000.00	\$32,500,000.00

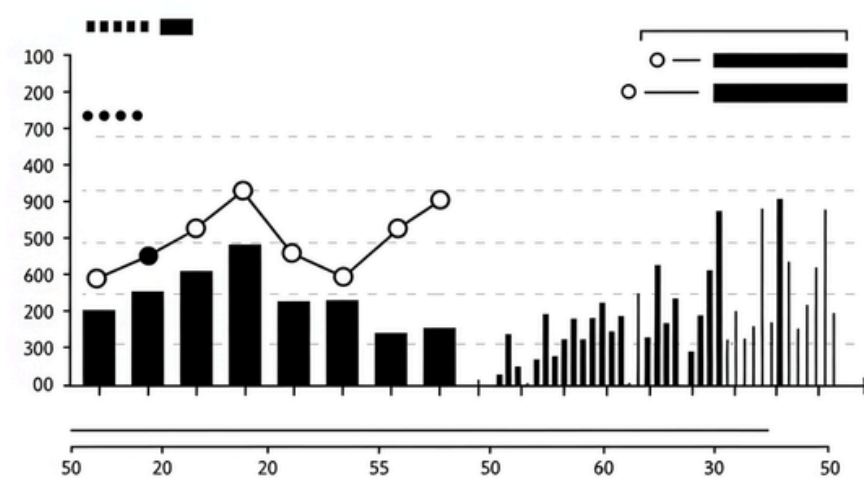
Taken the total cost of 'cost Likely'

# RISK MONITORING AND CONTROL

## Risk Monitoring Process + Change Management Process



**Data  
Analysis**



**Technical Performance  
Analysis**



**Reserve Budget  
Analysis**

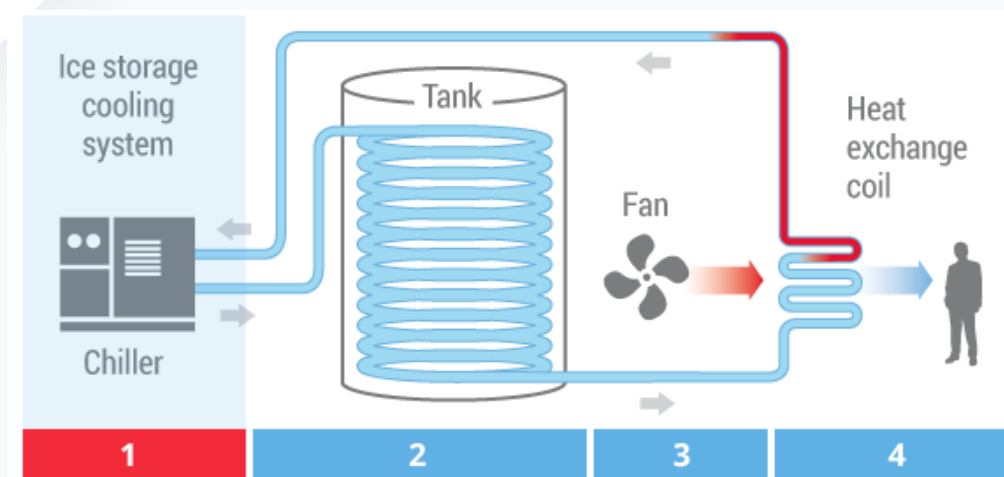


**Risk  
Audits**

# THE VALUE OF RISK MANAGEMENT IN THE IVANPAH PROJECT

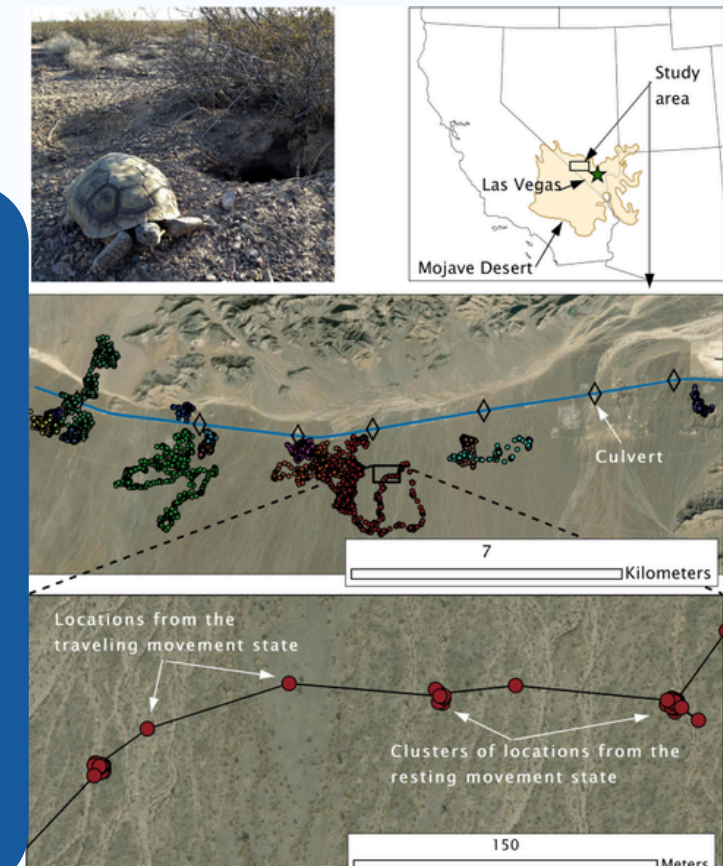
## Project Benefits

- Avoided delays by planning tortoise relocation (Cart, 2012)
- Stayed within \$2.2B budget and finished on time (Schifrin & Kennedy, 2013)
- Effective communication with stakeholders (PMI, 2017)
- Dry cooling reduced water use by 90%, improved environmental compliance (PMI, 2017)
- Project footprint adjustments avoided lawsuits and shutdown risks (Cart, 2012)



## WHAT'S LEFT TO BE DONE

- Monitor operational risks like equipment efficiency decline (PMI, 2017)
- Consider thermal storage to improve energy dispatch
- Apply predictive analytics for real-time risk detection
- Maintain long-term communication with stakeholders and regulators (PMI, 2017)



**THANK YOU!**