Alaska Risk Assessment of Oil & Gas Infrastructure

Alaska's Risk Assessment

Project Objectives

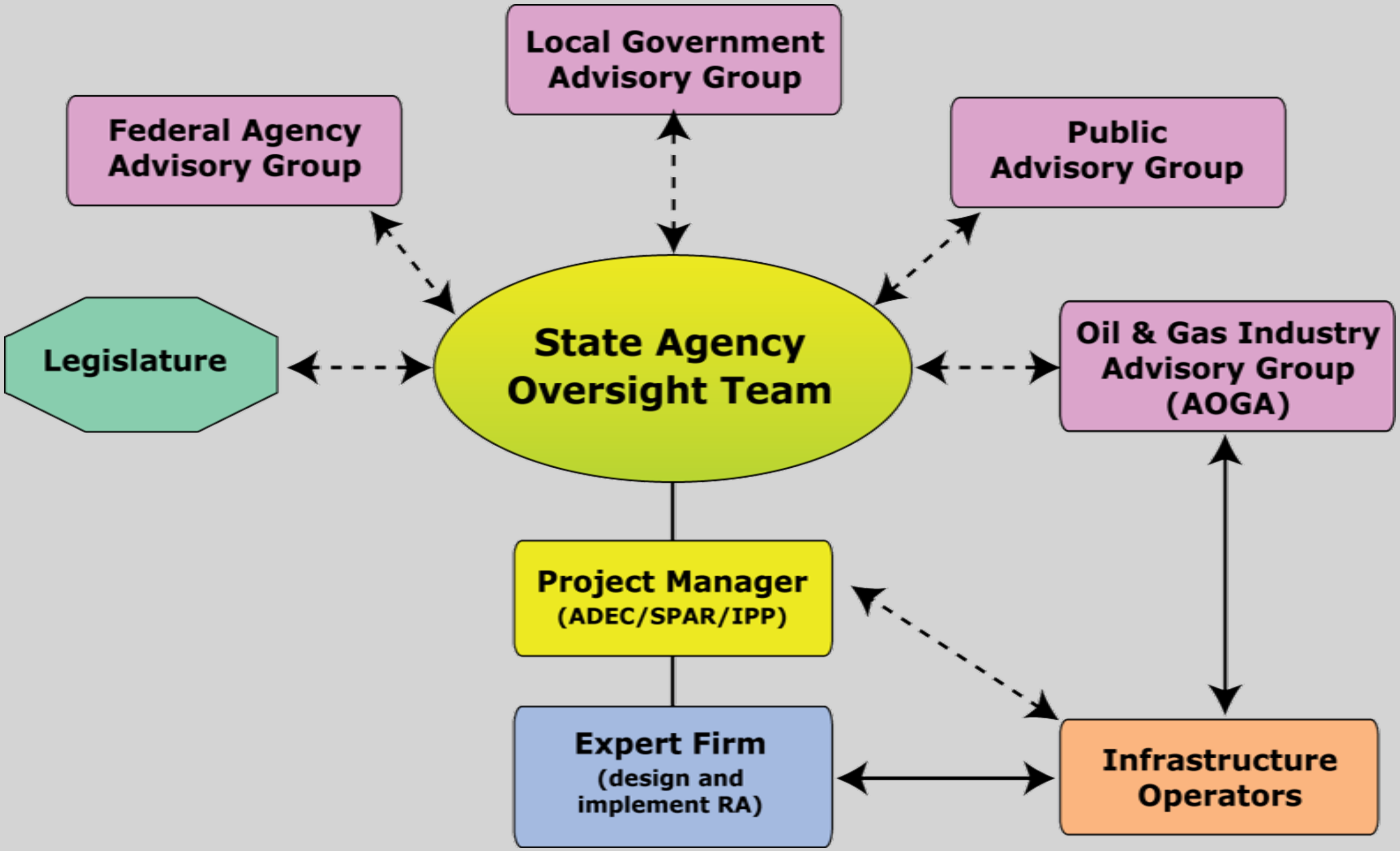
- Assess the current state of infrastructure & systems in place to operate it.
- Identify and rank areas of greatest risk.
- Present findings.

Project Background

- Parts of Alaska's complex oil and gas infrastructure have been in place since the early 1960s, and in some cases have already exceeded their original engineered lifespan.

- In 2006, North Slope oil production was interrupted with a failure in one component of the system.

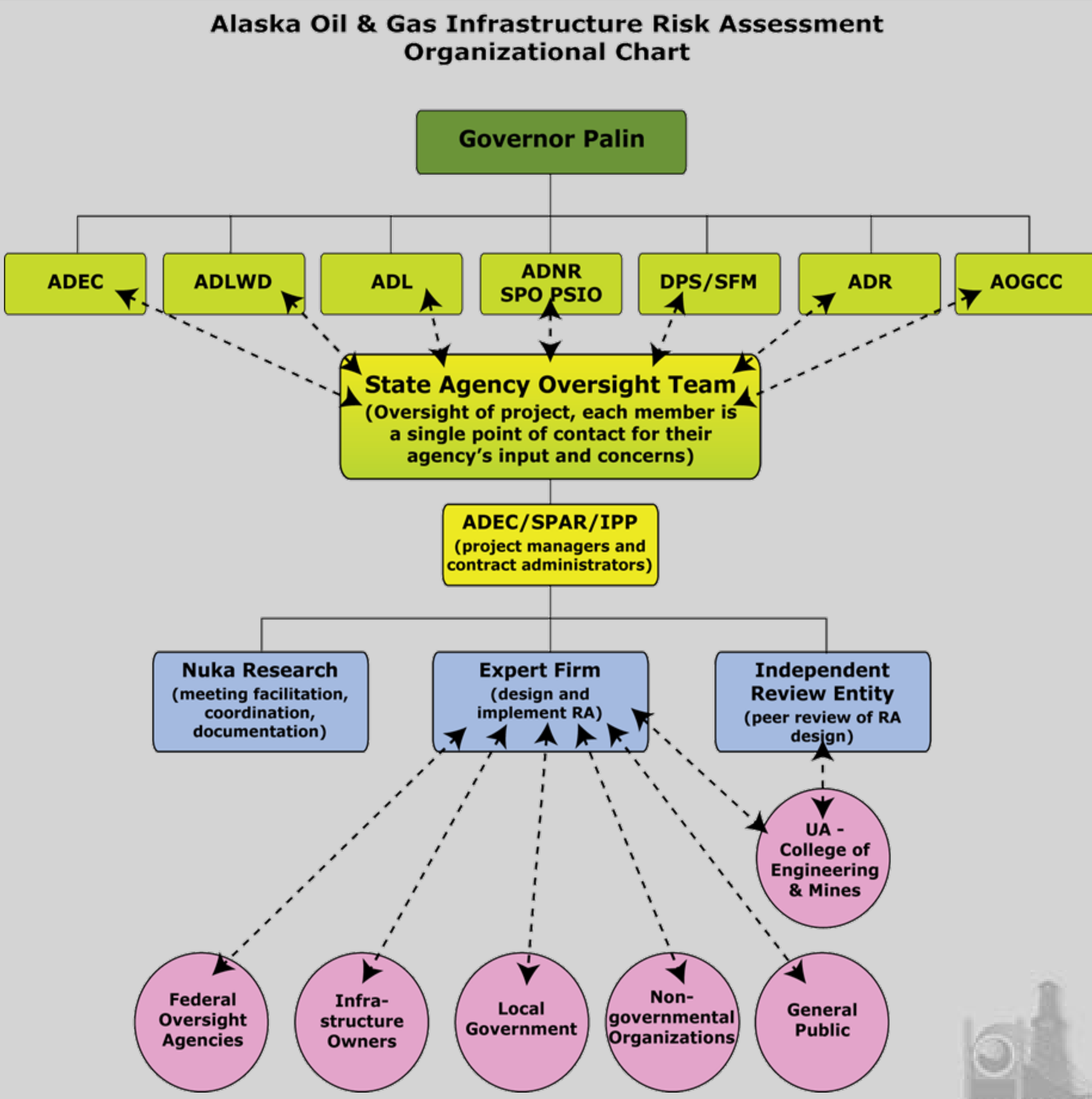
Project Organizational Structure



Project Organizational Structure

State Agency Oversight Team:

- Alaska Department of Environmental Conservation (ADEC)
- Alaska Department of Labor and Workforce Development (ADLWD)
- Alaska Department of Law (ADL)
- Alaska Department of Natural Resources (ADNR)
  - State Pipeline Office (SPO)
  - Petroleum Systems Integrity Office (PSIO)
- Alaska Department of Public Safety, State Fire Marshall (DPS/SFM)
- Alaska Department of Revenue (ADR)
- Alaska Oil & Gas Conservation Commission (AOGCC)



Project Purpose

- **Outcome of the Risk Assessment**
  - “Picture" of the system as it stands today, highlighting the infrastructure components with the highest relative risk of a potential significant event.
  - Provide information to State agencies that is necessary for them to perform their mandated duties to oversee the steady flow of oil and gas without unplanned interruptions, while protecting the public's safety and the environment.

What is a Risk Assessment?

- Organized and systematic effort to identify and analyze hazardous scenarios;
- Starts with answering the question "What can go wrong?"
- Evaluate "how likely" it is that a significant event will occur;
- Evaluate "how damaging" the event would be to people, the environment, or production and state revenue if the event were to occur; and
- Combine the factors to determine an objective risk level.

Three Step Process

Step 1

- Define the significant events
- Design the risk assessment

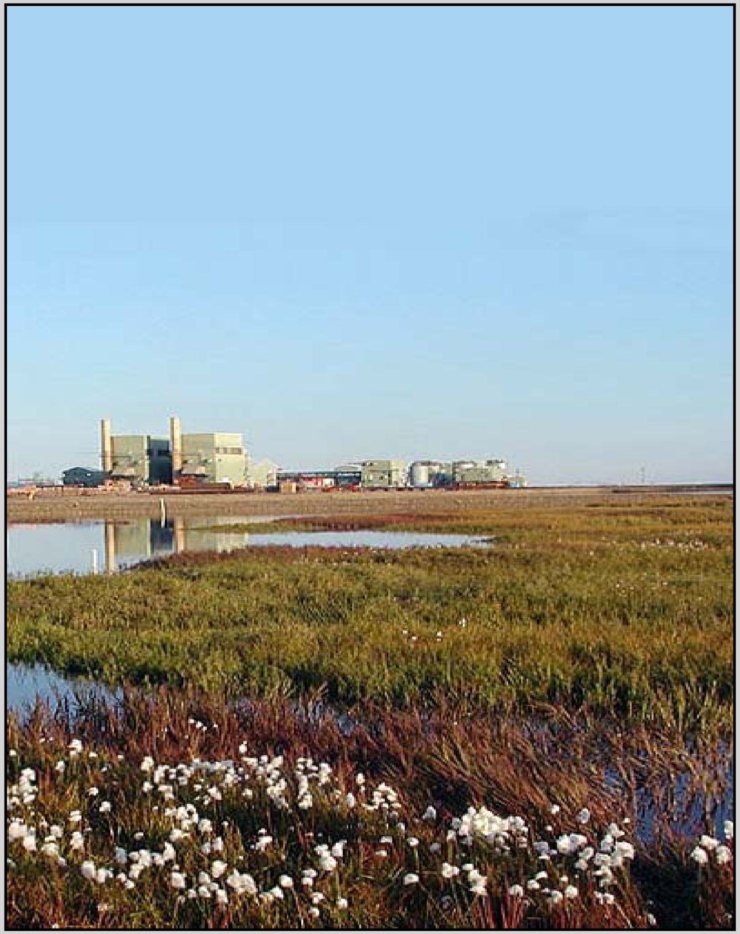
Step 2

- Conduct the risk assessment

Step 3

- Analyze the results
- Develop risk mitigation recommendations

Potential Recommendations



- Physical changes to infrastructure
- Changes to policies, procedures, standards, or regulations
- Changes to infrastructure audits, management, or oversight

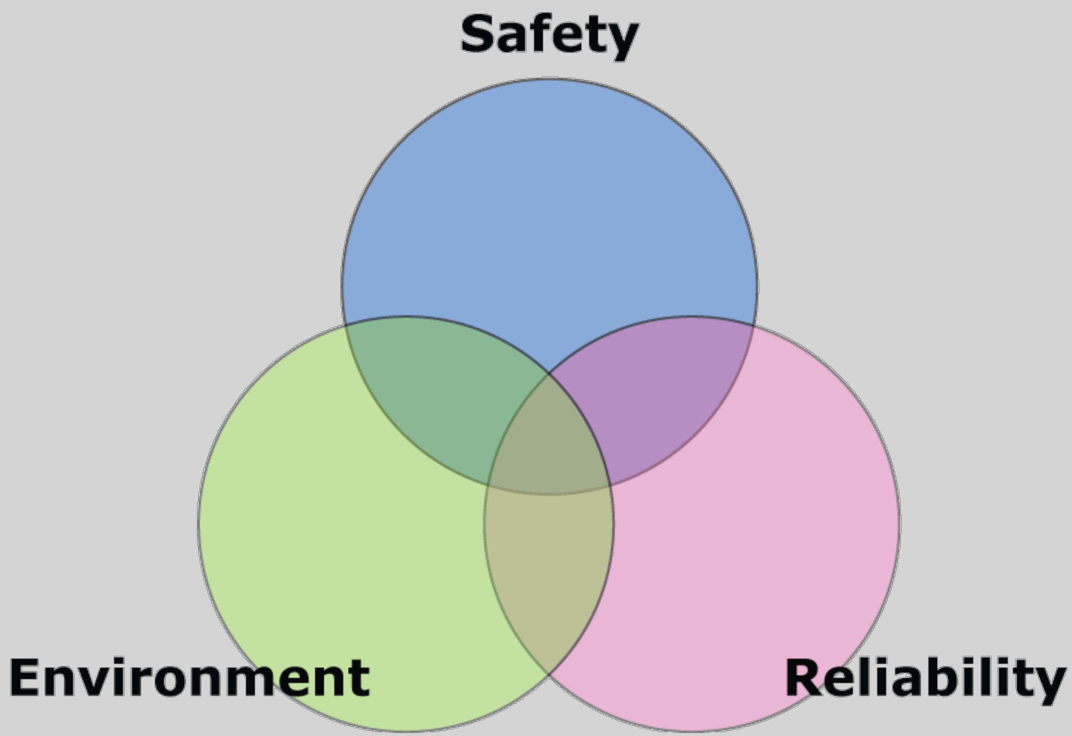
General Project Scope

North Slope

TAPS

Cook Inlet

Areas of Interest



Schedule

Phase 1:
Risk Assessment
Methodology Design
June 2008 – Aug 2009

→

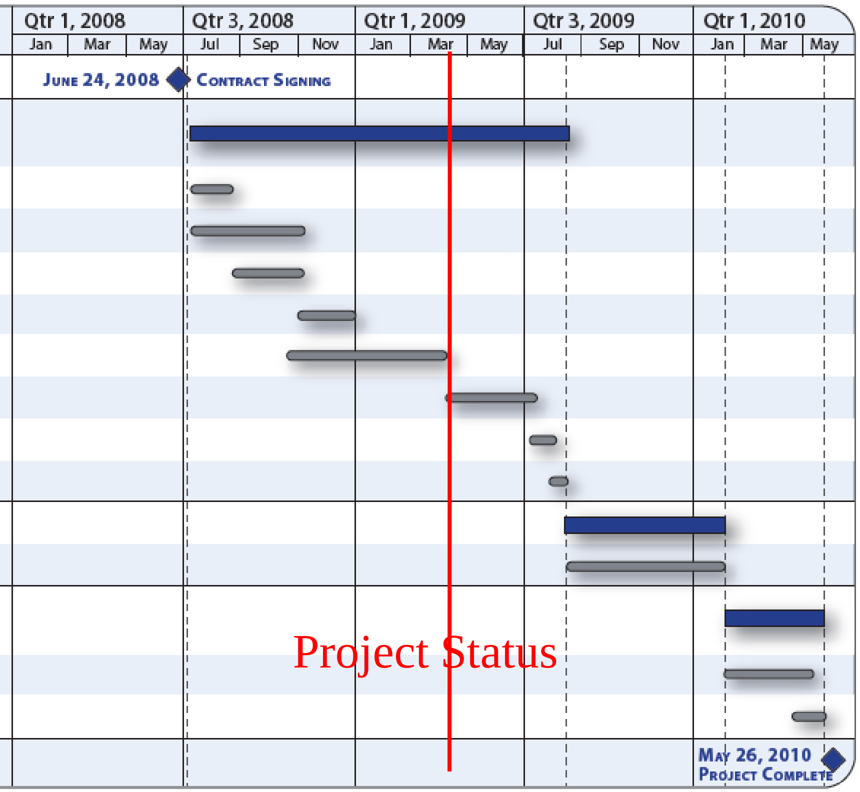
Phase 2:
Risk Assessment
Implementation
Aug 2009 – Feb 2010

→

Phase 3:
Analysis & Final Report
Feb 2010 – May 2010

Status

STATE OF ALASKA OIL & GAS INFRASTRUCTURE RISK ASSESSMENT	DURATION (in months) 22.14	START Tue 6/24/08	FINISH Wed 5/26/10
CONTRACT SIGNING	0 days	Tue 6/24/08	Tue 6/24/08
PHASE I: DESIGN RISK ASSESSMENT (RA) METHODOLOGY	13.5	Wed 6/25/08	Tue 8/25/09
Task 1a - Project Plan	1.14	Wed 6/25/08	Tue 7/29/08
Task 1b - Stakeholder Consulation	4.55	Wed 6/25/08	Tue 11/11/08
Task 1c - Existing Data/Information Review	3.41	Wed 7/30/08	Tue 11/11/08
Task 1d - Interim Report	1.25	Wed 11/12/08	Fri 12/19/08
Task 2 - Proposed RA Design	4.55	Wed 10/8/08	Fri 3/6/09
Task 3 - Evaluate RA Design	4.09	Mon 3/9/09	Fri 7/10/09
Task 4 - Proposed Final RA Design	1.14	Tue 7/6/09	Fri 8/7/09
Task 5 - Final RA Design	.55	Mon 8/10/09	Tue 8/25/09
PHASE 2: IMPLEMENT RA METHODOLOGY	5.23	Wed 8/26/09	Thu 2/11/10
Task 6 - Implement RA	5.23	Wed 8/26/09	Thu 2/11/10
PHASE 3: ANALYSIS, RECOMMENDATIONS, AND REPORT	3.23	Fri 2/12/10	Fri 5/21/10
Task 7 - Produce Draft Report	2.73	Fri 2/12/10	Thu 5/6/10
Task 8 - Produce Final Report & Presentation	0.73	Fri 4/30/10	Fri 5/21/10
PROJECT COMPLETE	0 days	Wed 5/26/10	Wed 5/26/10



Draft Methodology Report

Larry Hartig
Commissioner
P.O. Box 111800
Juneau, AK 99811-1800
www.dec.alaska.gov

STATE OF ALASKA
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Weld Royal
Information Officer
907.465.5009
cell: 907.321.5491
weld.royal@alaska.gov

Press Release — COMMISSIONER'S OFFICE

FOR IMMEDIATE RELEASE

New step in study of Alaska's oil and gas infrastructure

State invites public comment on risk assessment methodology; National Academy of Sciences also to review approach

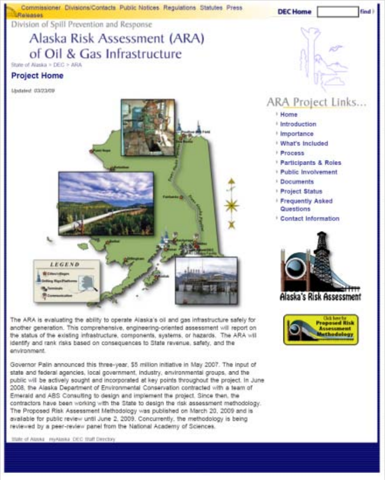
Contact: Ira Rosen, DEC project manager, (907) 465-6219

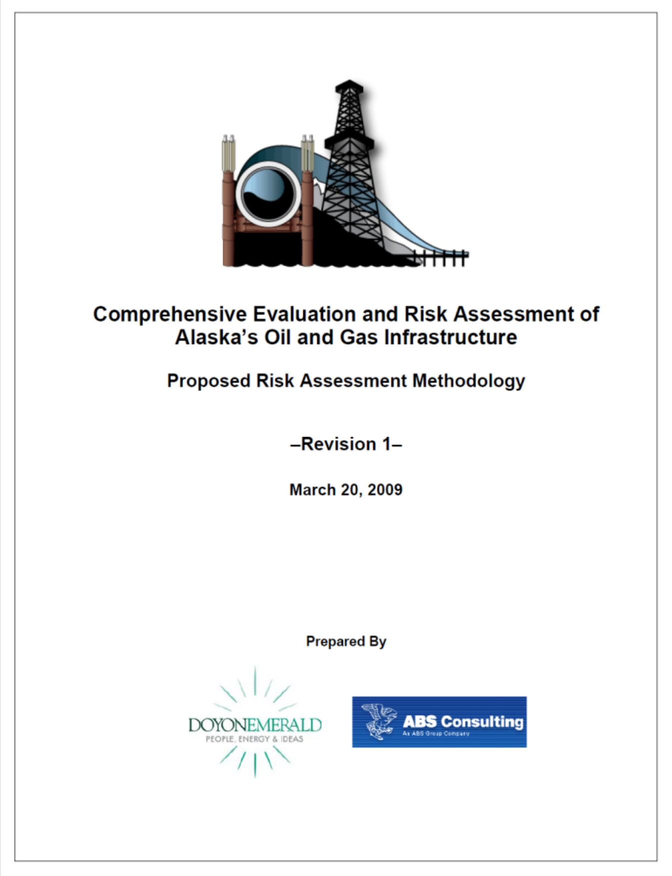
(Juneau—March 24, 2009) Members of the public now can comment on the approach developed to assess the health of the state's oil and gas infrastructure. Public meetings are planned for Anchorage, Fairbanks, Kenai, Barrow and Valdez to present the approach and answer questions. The comment period will end June 2.

Development of the methodology—a mathematical model to quantify risks--is the focus of the first phase of the Alaska Risk Assessment, a three-year, $5 million initiative to evaluate Alaska's oil and gas infrastructure. The study is an outcome of the spills, leaks and corrosion discovered on the North Slope in recent years. When complete, the assessment will report on the status of the existing infrastructure, components, systems and hazards. It will identify and rank risks based on consequences to state revenue, safety and the environment and will assist the state in making mitigation recommendations. The Alaska Department of Environmental Conservation (ADEC), working in cooperation with the Petroleum Systems Integrity Office (PSIO), is leading the risk assessment project.

"Finalizing the method we use to evaluate the condition of Alaska's oil and gas infrastructure is a key step in the overall assessment of this complex system," said Larry Dietrick, ADEC director of Spill Prevention and Response.

As part of the project, the State gathered input from government agencies, industry and the public in 2008. Those ideas helped shape the design of the risk assessment model. "Stakeholders now have a chance to confirm issues and concerns they identified have been included in our approach," said Ira Rosen, DEC project manager.





Comprehensive Evaluation and Risk Assessment of Alaska's Oil and Gas Infrastructure

Proposed Risk Assessment Methodology

–Revision 1–

March 20, 2009

Prepared By

DOYONEMERALD
PEOPLE, ENERGY & IDEAS

ABS Consulting

Press Release announces availability of the Draft Methodology Report

Project Results

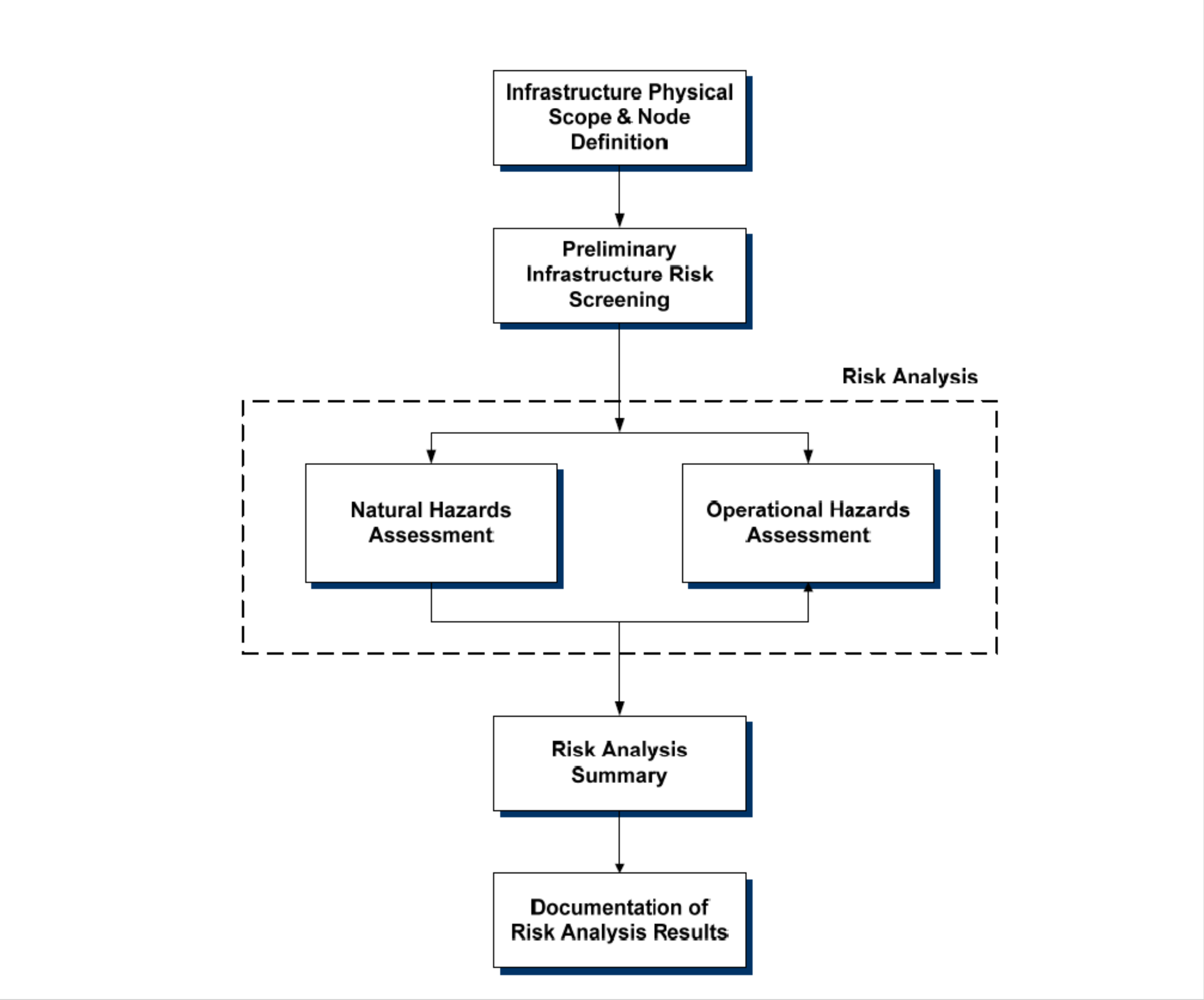
- Provide risk profile of infrastructure.
- Provide input for risk management decisions by Industry and the State.

Questions or Comments?

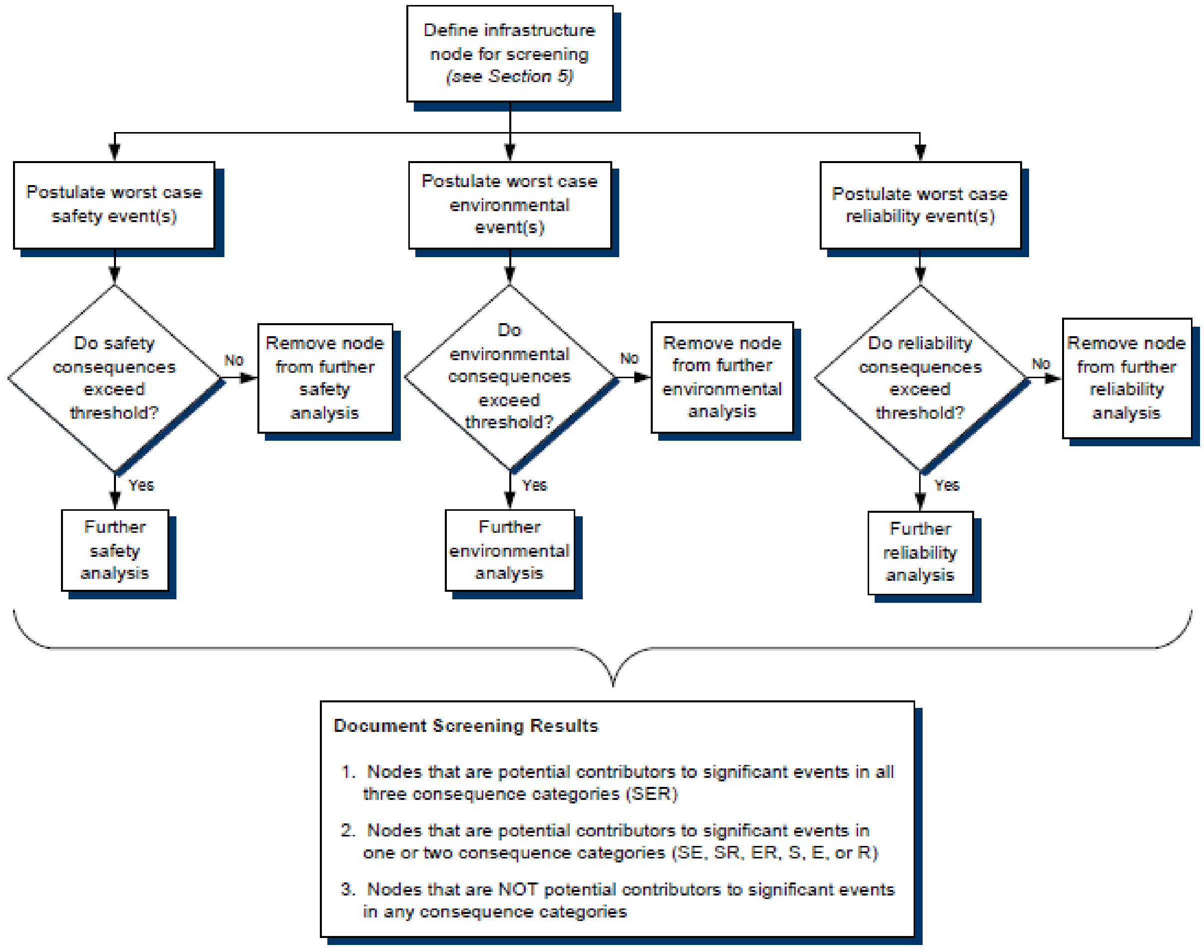
Methods

- Risk Analysis
- Screening
- Reliability
- Environmental Spill Calculations
- Environmental Consequences
- Operational Hazards
- Safety

Risk Analysis



Screening


Define infrastructure node for screening (see Section 5)
Postulate worst case safety event(s)
Postulate worst case environmental event(s)
Postulate worst case reliability event(s)
Do safety consequences exceed threshold?
No
Remove node from further safety analysis
Do environmental consequences exceed threshold?
No
Remove node from further environmental analysis
Do reliability consequences exceed threshold?
No
Remove node from further reliability analysis
Yes
Further safety analysis
Yes
Further environmental analysis
Yes
Further reliability analysis
Document Screening Results
1. Nodes that are potential contributors to significant events in all three consequence categories (SER)
2. Nodes that are potential contributors to significant events in one or two consequence categories (SE, SR, ER, S, E, or R)
3. Nodes that are NOT potential contributors to significant events in any consequence categories

Reliability

Table 6-3 Reliability Consequence Levels for Preliminary Risk Screening

Category	Category Production Loss Boundaries	Explanation (see Note)
3	>42,000,000 bbls	Corresponds to about a two month full outage for TAPS
2	4,200,000 to 42,000,000 bbls	Corresponds to an outage range which includes an approximate 30 day outage for TAPS or a two week outage for a production source that is half of the TAPS throughput
1	<4,200,000 bbls	Corresponds to less than a week outage for TAPS or a 60 day outage for a production source that is 10% of the TAPS throughput.

Note: Outages assume 700,000 barrels per day TAPS throughput

Environmental Spill Calculations

Table 7-3 Release Quantity Categories

Release Quantity	Category Index Number	Explanation
Large release (>10,000 barrels)	6	Release quantities will be assessed based on normal process flow, the nature of the worst-case release considered, and the expected detection and isolation time.
Medium Release (1,001 to 10,000 barrels)	5	
Small Release (10 to 1,000 barrels)	4	

Note: The release quantity categories are assigned numbers from 4 to 6 in order to reflect the overall importance of the spill size compared to the other contributing categories (i.e., release quantity is more heavily weighted than the other factor categories, which have an index range from 1 to 3). This also allows the environmental impact to reflect an approach that adjusts spill size by expected recoverability (i.e., subtracting the recoverability category from the release quantity category) to represent the impact of the material which may actually remain in the environment long term.

Table 7-4 Release Recovery/Remediation Factor Category

Recovery/Remediation Capabilities	Category Index Number	Explanation
Little to no ability to recover/remediate this type of release	1	This category includes: • Direct spills to moving bodies of water other than contained entirely on ice (such as ocean/sea, river systems, and tributaries) • Spills to subsurface areas • Other situations assessed as difficult to recover (including requiring input from State and remediation experts
Limited to moderate capability to recover/remediate this type of release	2	This category includes: • Spills to land and tundra in other than frozen conditions • Spills to unprepared surfaces (i.e., prepared surfaces include gravel pads which have been laid for remediation ease) • Other situations assessed as limited to moderate to recover (including requiring input from State and remediation experts)
Very effective capability to recover/remediate this type of release	3	This category includes: • Spills in winter conditions contained on ice or recovered from frozen land or tundra (i.e., limited migration) • Spills to gravel pads or other prepared surfaces where recovery can be accomplished by direct removal of contaminated materials.

Table 7-5 Local Environment Sensitivity Categories

Type of Environment	Category Index Number	Type of Environment
Waterways	3	This category includes: • Waterways or direct pollution routes to waterways that support commercial fishing, aquaculture, or subsistence activities
Sensitive Lands (including surface and subsurface areas)	2	This category includes: • A land area that supports unique flora and fauna or wildlife breeding and migratory areas, which may support subsistence hunting activities (e.g. tundra or wetlands) • An area that encompasses a cultural or historical site • A Recreational Area (defined as an area that supports hunting, fishing, hiking or other outdoor recreational activities) • Areas that have been branded based on pristine conditions and which support tourism activities
Other Lands	1	This category includes: • A land area (surface or subsurface) not defined as "sensitive" in Category 2 above.

Environmental Consequences

Calculating Environmental Consequence Categories

An environmental consequence score will be calculated for each of the release events that are considered, based on the index values that are assigned in each of the above contributing factor categories. The overall environmental consequence score will be calculated using Equation 7-2:

$$\mathcal{N}_i = M_i * (Q_i - R_i) * S_i$$

Equation 7-2 Environmental Consequence Scoring Calculation

Where:

- $\mathcal{N}_i$ = Event i Calculated Environmental Consequence Score (1 to 45)
- $\mathcal{M}_i$ = Event i Material Composition Index (1 to 3)
- $\mathcal{Q}_i$ = Event i Release Quantity Index (4 to 6)
- $\mathcal{R}_i$ = Event i Recoverability/Remediation Index (1 to 3)
- S_i = Event i Environmental Sensitivity Category Index Number (1 to 3)

Example calculation:

A significant release of crude oil (M = 3) that is 2,000 barrels in size (Q = 5) in an area of very high sensitivity (S = 3), but where recovery and remediation efforts can be highly effective (R= 3), would be scored as:

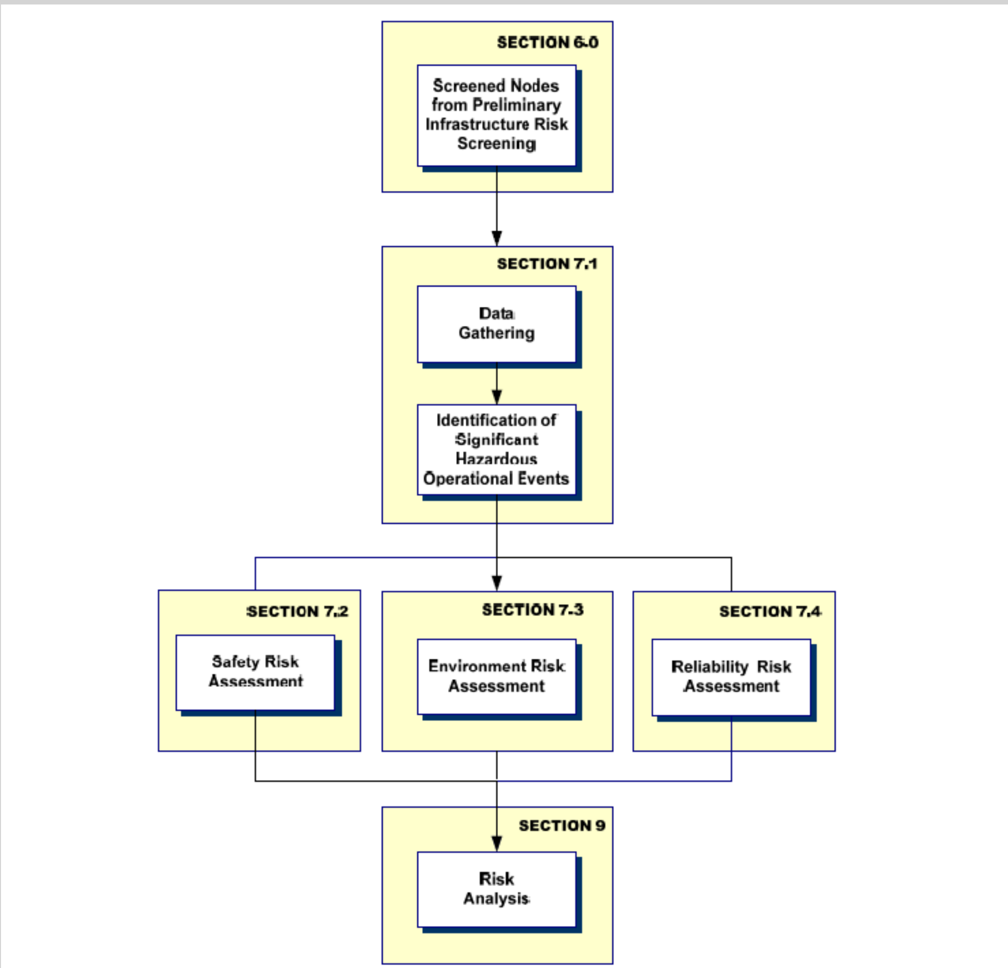
$\mathcal{N}_i$ = 3 x (5-3) x 3 = 18

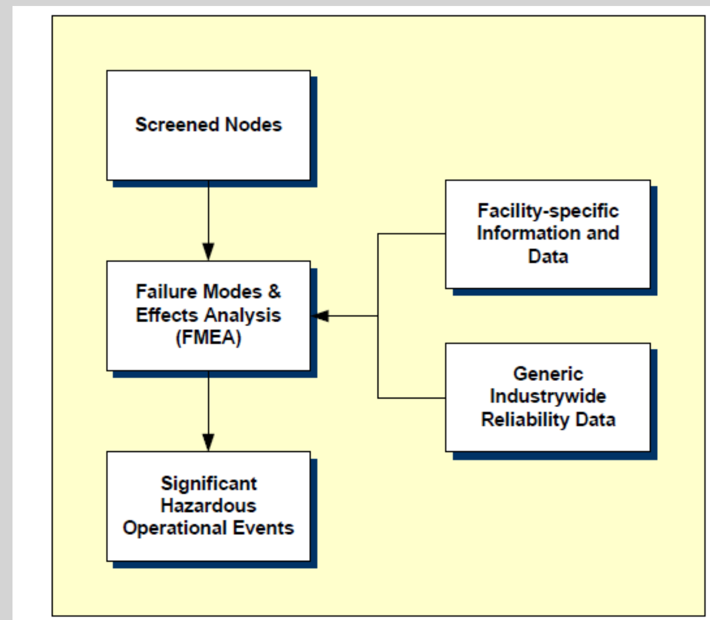
This approach represents a relative ranking of releases; it cannot be correlated to any physical meaning based on the absolute value of the numbers or index that is assigned to each factor. The value of the overall environmental consequence score can range from 1 to 45, depending on the assigned values of the contributing factor categories. Ranges of the environmental consequence score will then be used to categorize the relative environmental impacts of the potential release scenarios. See Appendix G for example scenarios that have been processed through this model.

Table 7-6 presents preliminary values that will be used for assigning the environmental consequences to each of the potential release events. The definitions and descriptions for the qualitative range of significant environmental consequences for this project in Table 7-6 were derived from input from the stakeholder consultation process that was executed at the commencement of the project.

Category Number	Environmental Impacts	Consequences Score
3	**Catastrophic** – A significant release to an area of extremely high environmental consequence that causes large-scale, widespread, non-recoverable, irreversible, and long-term damage that is severe. The damage would be considered to be extensive enough that the area would be considered unusable for the foreseeable future. The loss would prevent a return to normal life support and access for the conduct of normal activities that were once supported by the area's resources.	Greater than or equal to 30
2	**Challenging** – A significant release to an area of high environmental consequence that causes widespread and persistent damage to the area, which would cause a disruption in life support and would limit normal use and activities in the area for some time. Remediation would be required and some damage to the area may be irreversible.	Greater than 15, but less than 30
1	**Manageable** – A release to an area of some environmental consequence that results in localized and reversible effects on the environment. Results in some initial disruption of activities in the area, but normal usage can resume in a very short time frame once remediation/recovery activities have been completed.	Less than or equal to 15

Operational Hazards





Safety

After the incident scenarios for each node have been identified, the safety risk calculation will entail three major tasks:

1. Consequence Analysis – Evaluation of physical effects of incidents on people
2. Likelihood Analysis – Estimation of incident frequencies
3. Risk Calculation – Calculation of risks, which are a combination of likelihood and consequences/impacts, and presentation of results

Risk is then calculated using the "risk triplet" model, shown in Equation 7-1:

$$\mathcal{R} \equiv \langle \mathcal{E}_i , C_i , \mathcal{L}_i \rangle_n$$

Equation 7-1 Risk Triplet Model

Where:

$\mathcal{R}$ = Calculated risk

$\mathcal{E}_i$ = Significant Incident Scenario i (from the FMEA Hazard Events Identification process)

C_i = Event i consequence (from the Consequence Analysis)

$\mathcal{L}_i$ = Event i Likelihood (from the Likelihood Analysis)

n = Number of significant incident scenarios