Alaska Risk Assessment of Oil & Gas Infrastructure

ANCHORAGE PUBLIC WORKSHOP
MAY 5, 2009

Alaska's Risk Assessment

PROPOSED RISK ASSESSMENT METHODOLOGY OVERVIEW

Version: v.0.01

Meeting Objective

- Provide an Overview of the Proposed Risk Assessment Methodology
- Provide an Opportunity to Ask Questions
- Receive Public Comments

Presentation Topics

- ARA Project Background
- Stakeholder Consultation and Methodology Inputs
- Risk Assessment Methodology
- What's Next?
- Avenues for Public Input

Project Background

- **Alaska Reliance on Oil & Gas Production Revenue**
- **3-year Initiative Launched in May 2007 by Governor Palin**
- **Alaska Department of Environmental Conservation (DEC) Initial Planning Period**
- **Emerald/ABS Consulting Selected in June 2008**
- **ADEC Project Manager Assigned in August 2008**

Project Team

- **State of Alaska**
  ADEC Project Manager - Ira Rosen
  State Agency Oversight Team (SAOT)
- **Emerald / ABS Consulting**
  Project Manager - Bettina Chastain

Project Objectives

- Assess the Current State of Oil & Gas Infrastructure and Systems
- Identify and Rank Areas of Greatest Risk in Terms of Safety, Environment, and Reliability
- Present Results for State Decision Makers

Project Timeline

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

Phase 1 Tasks

- ☑ Develop a Project Plan
- ☑ **Consult with Stakeholders** (August – November, 2008)
- ☑ Review Best Practices to Consider in Methodology Design
- ☑ Develop Interim Report
- ☑ Propose a Risk Assessment Methodology (December – January 2009; Draft Issued February 2009)
- ☑ **Public and Peer Review of Proposed Methodology** (March – July 10, 2009)
- ☐ Proposed Final Risk Assessment Methodology (Due By August 7, 2009)

Overview of Phase 2 & 3

- Implement the Risk Assessment according to the Risk Assessment Methodology
- Analyze Risk Assessment Results
- Produce Draft and Final Reports

Basic Infrastructure Scope

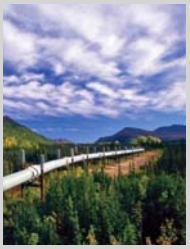
Included:

- **North Slope Infrastructure**, *including production facilities and pipelines up to Pump Station 1*
- **Trans Alaska Pipeline System (TAPS)**, *including the Valdez Marine Terminal (VMT) up to the marine terminal loading arms*
- **Cook Inlet Infrastructure**, *including production facilities, the Cook Inlet Gas Gathering System (CIGGS) up to the Nikiski LNG Plant and the Cook Inlet Pipeline (CIPL) up to the Drift River Marine Terminal loading arms (Cook Inlet will be considered in the initial phase of this project.)*

Excluded:

- **Areas of future oil and gas development** *(i.e., areas where production operations begin after the commencement of this project, July 1, 2008)*

Basic Project Scope



Infrastructure Components

Included:

- **Production wells**
- **Gathering lines** *(flowlines from wells upstream of processing center)*
- **Facility piping**
- **Crude oil pipelines**
- **Gas and water injection systems** *(including wells)*
- **Gas transport pipelines integral to operating infrastructure** *(Cook Inlet)*
- **Oil and gas processing and treatment**
- **Waste management and disposal** *(re-injection materials)*
- **Storage tanks**
- **Terminals**
- **Marine loading facilities**
- **Support systems** *(e.g. utility systems, electric power, fuel systems, water supplies, control/communications systems)*

Excluded:

- **Marine transportation** *(e.g., tankers and other marine infrastructure)*
- **Refineries and product distribution lines not integral to operating infrastructure**
- **Exploration and other future development infrastructure** *(e.g., drilling rigs)*
- **Reservoir maintenance**
- **Future facilities or projects** *(i.e., production operations with planned start-up after the commencement of this project, July 1, 2008)*

Basic Project Scope

Factors / Considerations for the Engineering Study

Included:

- **Original design/operating life**
- **Natural aging process** *(corrosion, abrasion, wear, and fatigue)*
- **Operating procedures and standards**
- **Maintenance and management**
- **Regulations and agency oversight**
- **Foreseeable changes in operations** *(such as changes in throughput and heavy oil production)*
- **Natural hazards** *(earthquake, tsunami, severe weather, ice, volcanic, etc.)*

Excluded:

- **Market conditions** *(e.g., commodity prices that drive the economics of shutting in operations)*
- **Security issues / Intentionally man-made hazards** *(e.g., terrorist attacks or sabotage)*

Significant Consequence Areas

Safety:
Consequences to the safety of life and health of both the general public and industry employees.

Environment:
Consequences to the natural resources of the State.

Reliability:
Events that result in disruptions of the production of oil & gas, from which the State receives the majority of its revenues.

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 a relative risk level.

Alaska Risk Assessment of Oil & Gas Infrastructure

STAKEHOLDER CONSULTATION / METHODOLOGY INPUTS

Purpose of Stakeholder Consultation

- Help to Develop Customized and Fit-For-Purpose Risk Assessment Methodology
- Refine the Project Scope (Infrastructure Components)
- Develop Project Specific Definition of Unacceptable Consequences
- Communicate Project Information to Stakeholders

Stakeholder Outreach

- Regional Stakeholder Public Meetings
  - Anchorage (Statewide)
  - Barrow (North Slope Region)
  - Fairbanks (Interior Region)
  - Kenai (Cook Inlet Region)
  - Valdez (Prince William Sound/Copper River Basin Region)

Key Stakeholder Consultation

- 200 Individuals and 39 Meetings
- Key Stakeholders
  - General Public
  - Local Governments
  - State and Federal Agencies
  - University of Alaska
  - Non-Governmental Organizations (NGOs)
  - Native Organizations

Stakeholder Questions

1. **What is the primary reason you are interested in the Alaska Risk Assessment of Oil & Gas Infrastructure Project?**
2. **What components of the existing oil & gas industry infrastructure warrant the most attention from the project team?**

Stakeholder Questions

3. **Within the categories of impact to human safety, impact to the environment, and production/revenue loss, what kinds of events would you consider to be the most significant?**
4. **Do you have any other specific concerns or priorities in the areas of safety, the environment, or production that should be considered in the risk assessment study?**

Project Reports to Date

- ✓ Interim Report – January 2009
  - Results and Documentation of Stakeholder Consultation Process
  - Best Practice Data
  - Infrastructure Description
  - Initiating Events
  - Unacceptable Consequences
- ✓ Proposed Risk Assessment Methodology Report – March 2009
  - Methodology Inputs
  - Infrastructure Scope
  - Technical Methodology
  - Risk Assessment Results

Alaska Risk Assessment of Oil & Gas Infrastructure

SCOPE OF INFRASTRUCTURE COMPONENTS, PROCESSES, AND SYSTEMS

Basic Infrastructure Scope

Included:

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- **Trans Alaska Pipeline System (TAPS)**, *including the Valdez Marine Terminal (VMT) up to the marine terminal loading arms*
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Excluded:

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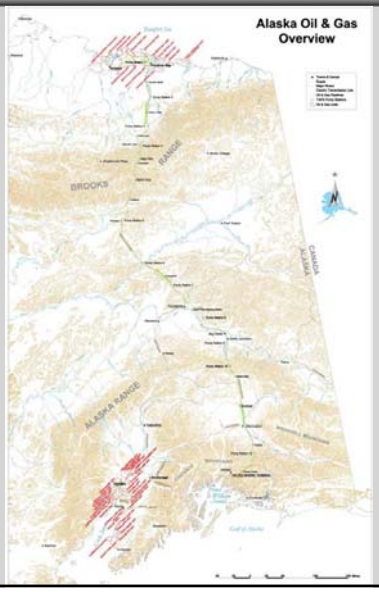
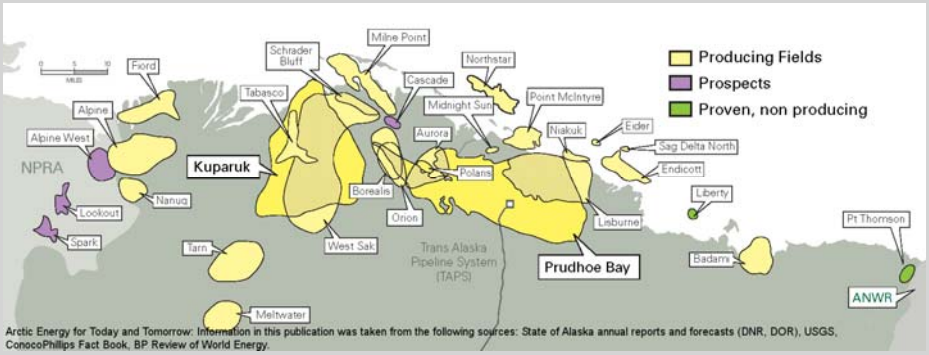
Infrastructure Scope



North Slope Infrastructure

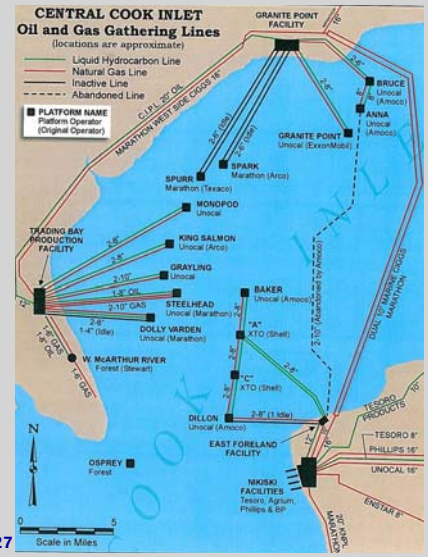


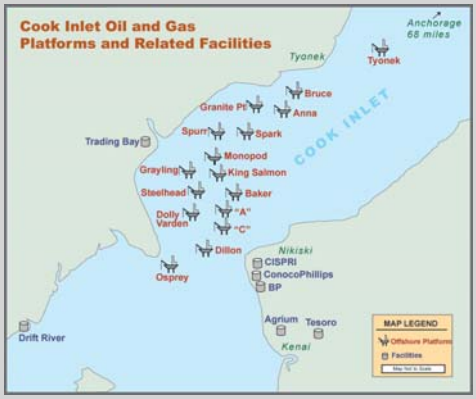
Arctic Energy for Today and Tomorrow: Information in this publication was taken from the following sources: State of Alaska annual reports and forecasts (DNR, DOR), USGS, ConocoPhillips Fact Book, BP Review of World Energy.

North Slope Infrastructure

- Major Operating Areas/Units – 8
- Major Processing Facilities – 17
- Major Support Facilities – 11
- Pipelines – 17
- Well Pads – 133
- Wells – 3,671

Cook Inlet Infrastructure

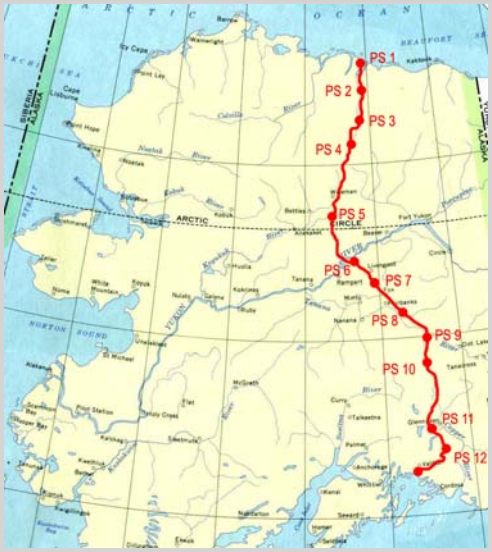




Cook Inlet Infrastructure

- Offshore Oil & Gas Production Platforms – 16
- Onshore Production/Processing Facilities (Platform Support) – 5
- Onshore Central Oil & Gas Production Facilities – 22
- Terminals – 1
- Pipelines – 8
- Offshore and Onshore Wells – 573

TAPS Infrastructure



TAPS Infrastructure

- TAPS 48-Inch Pipeline – 800 Miles
- Fuel Gas Pipeline – 144 Miles
- Active Pump Stations – 5
- Inactive Pump Stations – 6
- Major Valdez Marine Terminal Components – 6

Stakeholder Input

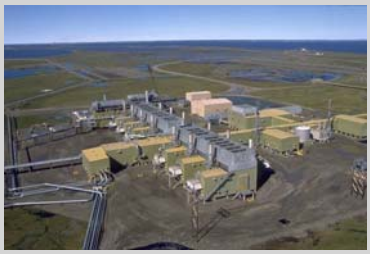
- Stakeholder Common Themes and Focus Areas
- Initiating Events
  - Operational Hazard Events
  - Natural Hazard Events
- Input for Definition of "Unacceptable" or Significant Consequences
  - Safety Considerations
  - Environmental Consequences
  - Reliability Consequences
- Information Sources and Data Recommendations

Statewide Infrastructure Themes

- Aging Infrastructure
- Corrosion
- Changes in Process Conditions
- Industry Workforce
- Spills to Water
- Lack of Regulatory Oversight

North Slope Infrastructure Themes

- Subsea Pipelines (N*) and Multiphase Pipelines
- Pipeline Inspection and Pigging
- Loss of Critical Utilities/Support Systems
- North Slope Fire Safety
- Well Concerns
- Industry Culture
- Coastal Erosion
- Spills to Rivers and Beaufort Sea



TAPS Infrastructure Themes

- Strategic Reconfiguration Project
- Station Manning and Response Capabilities
- Pump Station 1 and VMT Tanks
- Loss of Power to Pump Stations/Black Start Conditions
- Loss of Communications
- Spills to Copper River Basin and Port Valdez

Cook Inlet Infrastructure Themes

- Subsea Pipelines in Cook Inlet
- Natural Hazards - Volcanoes
- Spills to Rivers and Cook Inlet
- Aging/Abandoned Infrastructure
- Loss of Southcentral Alaska Gas Production

Initiating Events

- Initiating Events Considered:
  - Operational Hazard Events – Related to the Operating Processes that Make Up the Infrastructure System
  - Natural Hazard Events – Caused by Naturally Occurring Phenomenon in the Environment

Initiating Event Input

- Operational Hazard Events
  - Fire
  - Explosion
  - Loss of Integrity (spills and leaks) (e.g., due to natural aging process – corrosion, abrasion, wear and fatigue)
  - Equipment Malfunction
  - Loss of Infrastructure Support Systems (e.g., power)
  - Changes in Process Conditions (e.g., composition– heavy oil, increased quantities of sand, throughput decline)
  - Human Error (due to fatigue, not following proper procedures, resource availability, etc.)

Initiating Event Input

- Natural Hazard Events
  - Earthquake
  - Tsunami
  - Volcanoes (including ash, lahars, etc.)
  - Coastal Erosion
  - Permafrost Thaw/Climate Change
  - Ice
  - Severe Storms
  - Flooding
  - Underwater Currents
  - High Winds
  - Geology (e.g., subsidence, landslides)
  - Avalanches
  - Forest Fire

Defining Unacceptable Consequences

- "…the analysis will utilize an "unacceptable consequence" approach; beginning with the identification of the nature and extent of oil and gas infrastructure failures that would create unacceptable consequences or impacts to the environment, overall safety, and system reliability… consider wide-ranging stakeholder input before identifying an unacceptable consequence."
- Three Consequence Categories -
  1. Reliability of State Revenue Due to Loss of Production
  2. Safety (Occupational and Public)
  3. The Environment

Defining Unacceptable Consequences

- Determining What's "Significant"
- Structured to Support State Risk Management Decisions
  - Are we as a State willing to spend any more money directly or indirectly to reduce these identified risks?
  - If we are willing to spend additional money, where should those additional resources be focused to add the most value?
  - If there are different types of risks, how do we feel about each of them (i.e., how do we prioritize the risks so that we can make decisions on which ones should be addressed first?)

Reliability (Revenue) Consequences

Category	Magnitude of Revenue Loss (Compared to Annual State Budget Forecasts)
5	**Catastrophic** – Revenue losses that severely affect the State's ability to fund and provide basic or essential State services (e.g., law enforcement, fire protection, public health services, education support, welfare programs, and basic infrastructure safety programs).
4	**Extremely Challenging –** Revenue losses that have a very significant impact on the State's ability to fund non-essential but expected core State services. Note: This category will be further defined based on future detailed discussions with the State Department of Revenue and an understanding of core State services and associated funding requirements as outlined in the annual State budget forecast and the State Emergency Response Plan.
3	**Challenging** – Revenue losses that have a significant impact on the State's ability to fund non-essential but expected core State services (such as long term support to recreational/outdoor activities, plans for increased educational opportunities for State citizens, etc.). These kinds of services are expected and strongly desired by the citizens of the State, and if the State is unable to provide these services due to budget shortfalls, there is an expectation of public outcry from the citizens of the State.
2	**Moderately Challenging –** Revenue losses that have a moderate impact on the State's ability to fund non-essential but expected core State services. Note: This category will be further defined based on future detailed discussions with the State Department of Revenue and an understanding of core State services and associated funding requirements as outlined in the annual State budget forecast and the State Emergency Response Plan.
1	**Manageable** – A loss of State revenue that is of concern but does not necessarily threaten critical or core State services, but would impact optional services such as additional investment in programs to increase cultural or entertainment activities, recreational activities, etc.; or a loss in revenue that would eliminate discretionary spending and cause deferral of optional capital projects, upgrades to existing infrastructure, or services.

Environmental Consequences

Category	Environmental Impacts
5	**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 "condemned" and 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.
4	**Extremely Challenging** – A significant release to an area of very high environmental consequence that causes large-scale, widespread, long-term, severe damage to the environment. The damage would result in a long-term disruption of life support and normal use of the area, and some damage to the area may be irreversible.
3	**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.
2	**Moderately Challenging** – A release to an area of some environmental consequence that results in localized but irreversible or widespread damage to the area. Results in short-term effects on the area's environmental conditions, which causes damage to life support and a disruption in normal activities that are supported by the area. Remediation would be required and some sections of the area may or may not be restored to their original condition over time.
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.

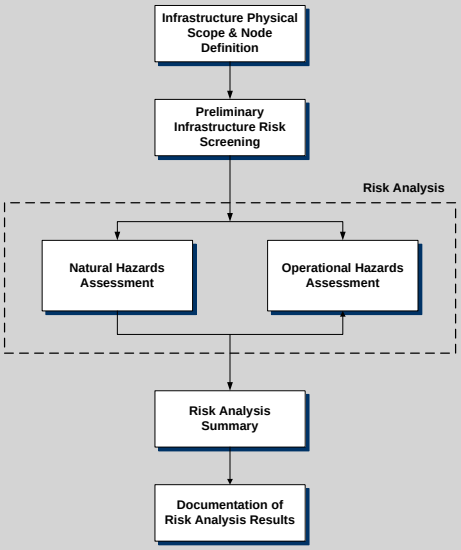
Safety Consequences

Category	Occupational Safety Impact (Number of Potential Fatalities)	Public Safety Impact (Number of Potential Fatalities)
5	> 100	>10
4	51 to 100	6 to 10
3	11 to 50	2 to 5
2	5 to 10	1
1	< 5	No public safety impact

Alaska Risk Assessment of Oil & Gas Infrastructure

PROPOSED METHODOLOGY

Risk Assessment Methodology

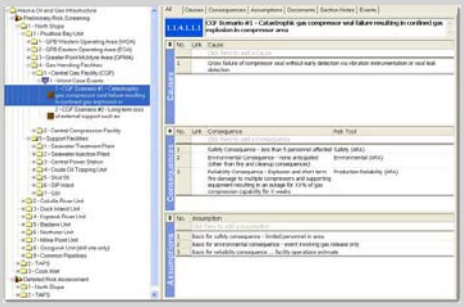


Methodology Activities

- Nodal Breakdown
- Preliminary Infrastructure Screening
- Risk Analysis
  - Operational Hazards Assessment
  - Natural Hazards Assessment
- Risk Analysis Summary/Documentation

Structure and Data Management

- Nodal Analysis Approach
- Project Specific Infrastructure Segmentation and Terminology Developed
- Customized Data Management Tools



Structure and Data Management

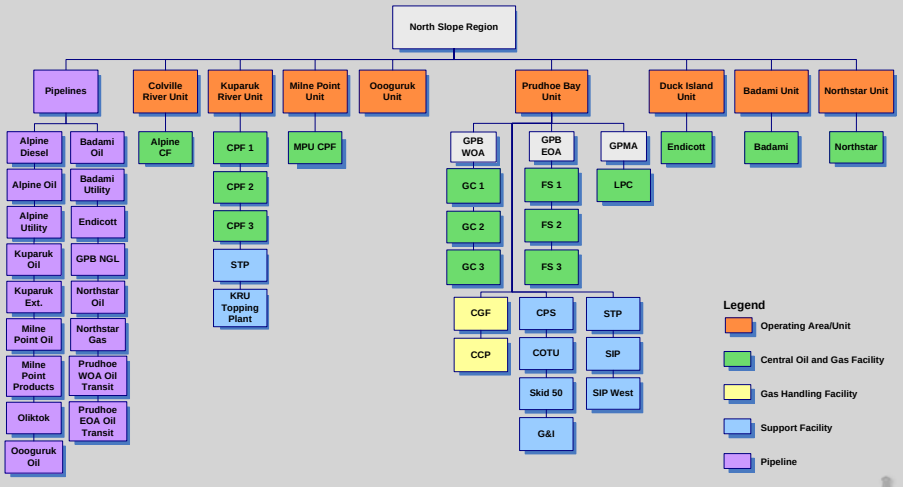
- Infrastructure Facility Definitions
  - Infrastructure Region
  - Operating Area/Unit
  - Facility
  - Components
  - Node
- Specific Component Definitions
  - Wells, Well Site, or Well Bay
  - Gathering Lines
  - Flowline
  - Transmission Line
  - Common Carrier Pipeline
  - Other Associated Pipelines

See Section 5.1 of Proposed Risk Assessment Methodology

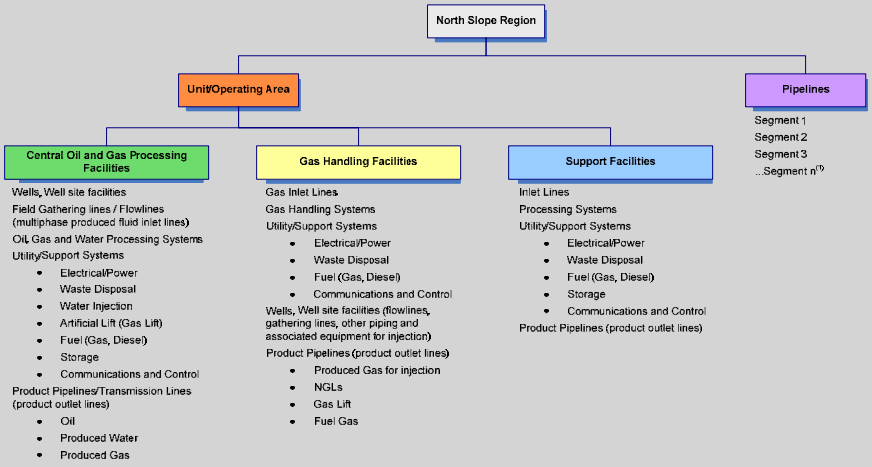
Nodal Breakdown

- Different Node Types by Region
  - Specific Types of Facilities
    - Common Systems
    - Typical Equipment
    - Common Failure Modes
  - Different Pipeline Types
    - Segmented by Topography, Geography, and Isolation Ability

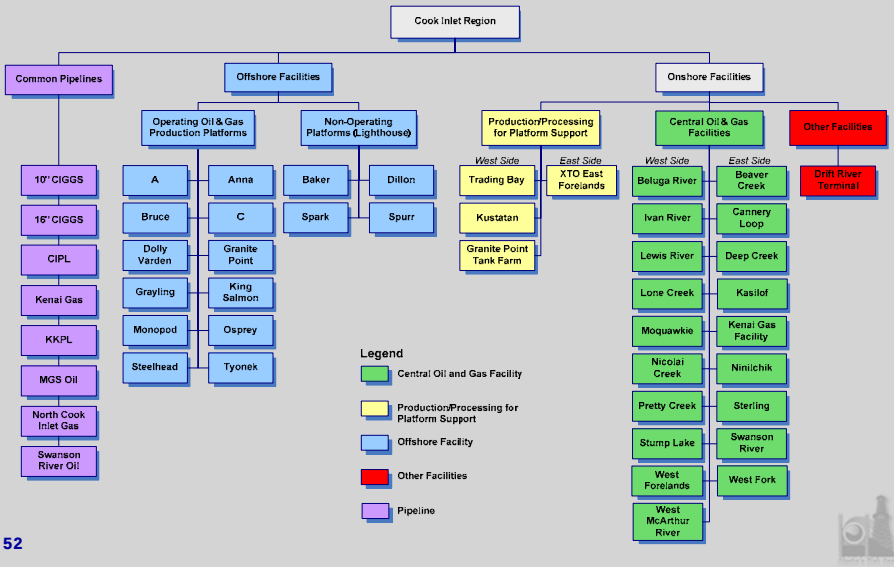
North Slope Infrastructure



North Slope Nodal Breakdown



Cook Inlet Infrastructure



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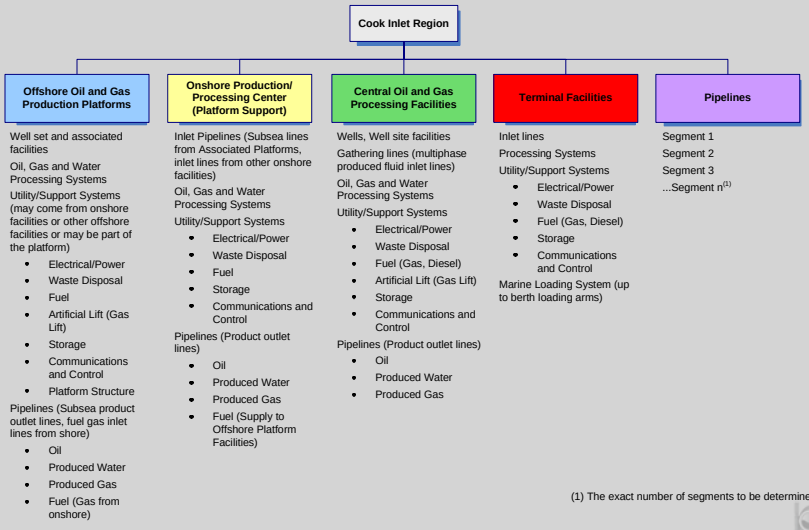
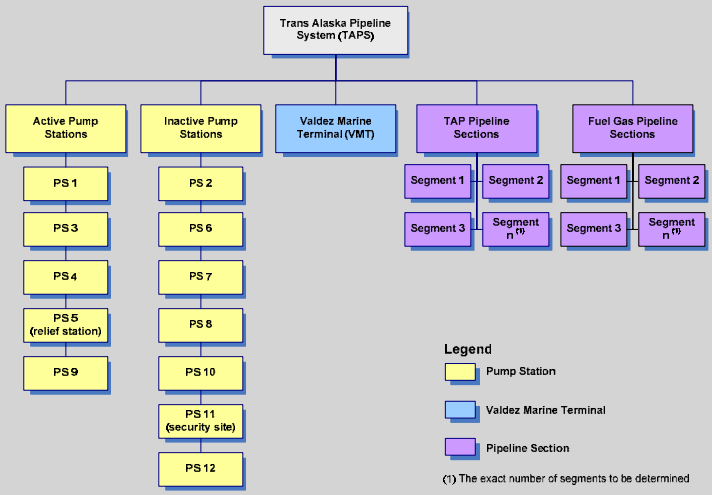


(1) The exact number of segments to be determined

TAPS Infrastructure



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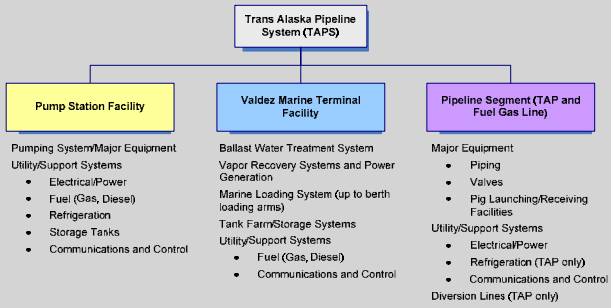
TAPS Nodal Breakdown



Nodal Diagram

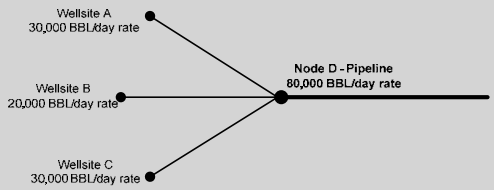
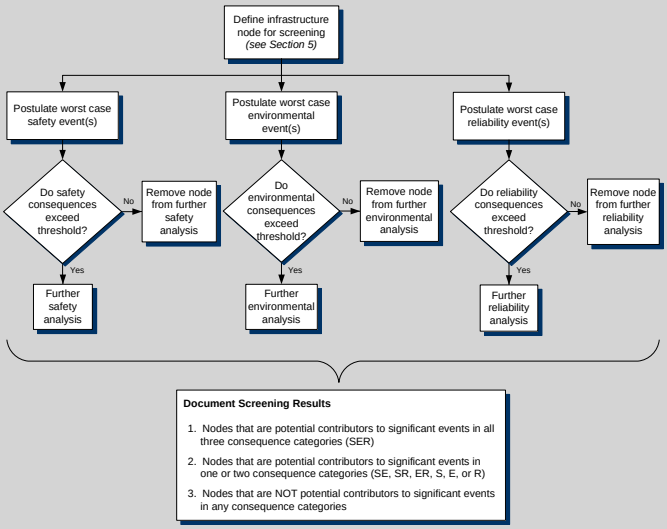


Figure 6-2 Example from Nodal Diagram for Common Cause

Preliminary Screening

- Manage and Focus Scope of Review within Project Constraints
- Tied to Significant Consequences Identified by Stakeholders
- Consequence-Based Screening Approach
  - Safety
  - Environmental
  - Reliability

Preliminary Screening



Scenario Development

- Reasonable Worst Case Scenarios
  - Safety Consequences
  - Environment Consequences
  - Reliability Consequences
- Postulated Using HAZID and Basic Knowledge

Safety Consequence Category

Table 6-1 Safety Consequence Levels for Preliminary Screening

Category	Occupational Safety Impact (Number of Potential Fatalities)	Public Safety Impact (Number of Potential Fatalities)
5	> 100	>10
4	51 to 100	6 to 10
3	11 to 50	2 to 5
2	5 to 10	1
1	< 5	No public safety impact

Worst Case Safety Scenario

- Hydrocarbon Release Scenario (Leak or Rupture)
- Ignition of Uncontained Hydrocarbons
- Consideration of People Within Direct Vicinity of Release (Fire & Explosion)

Environmental Consequence Category

Table 6-2 Spill Levels for Preliminary Screening

Category	Volume (bbls of fluid)
4	> 10,000
3	1,001 to 10,000
2	10 to 1,000
1	< 10

Worst Case Environmental Scenario

- Loss of Containment of Liquid Containing Hydrocarbons or Seawater
- Spill Not to Secondary Containment
- Spill Size (Release Volume) Determined by Normal Production Flow Rate and Estimated Time for Shutoff

Reliability Consequence Category

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.

Worst Case Reliability Scenario

- Worst Case Loss of Production Scenarios Similar to Loss of Containment for Environmental Screening
- Loss of Production from Major Equipment Failure Considering Rate and Outage Duration

Preliminary Screening Results

- Screening Results Documented in Database for Information
- Nodes Passing Through Screening for any Consequences will be Carried Forward for Detailed Assessment

What's Next?

- Input on Proposed Risk Assessment Methodology
  - Public Review
  - National Academy of Sciences (NAS) Peer Review
- Finalize Risk Assessment Methodology
- Implementation Phase

Alaska Risk Assessment of Oil & Gas Infrastructure

ABS PRESENTATION:
OPERATIONAL HAZARDS ASSESSMENT
NATURAL HAZARDS ASSESSMENT
RISK ASSESSMENT RESULTS