



# Natural Hazards Risk Assessment

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## Natural Hazards

- Earthquakes  
(Geology – landslides)
- Tsunamis
- Volcanoes  
(Geology – landslides)
- Coastal Erosion
- Permafrost Thawing  
(Permafrost Thawing/  
Climate Change)
- Severe Storms  
(Severe Storms, Ice,  
High Winds)
- Floods  
(Floods, Ice)
- Severe Currents  
(Underwater Currents)
- Avalanche
- Forest Fires

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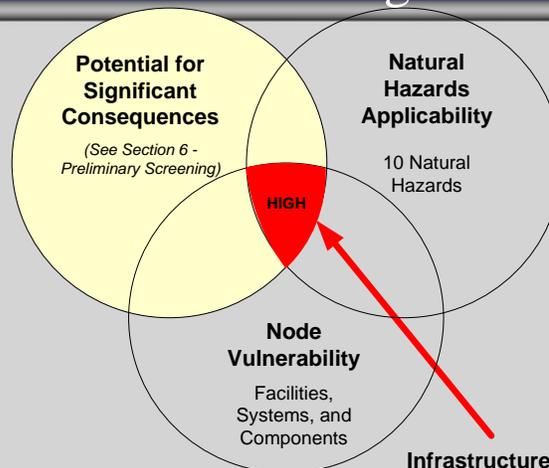
# Natural Hazards

- List of hazards from public outreach
- Hazards to be considered is very broad
- Hazards are not uniform in geographic distribution
- Importance are not uniform to all the O&G assets
- Vulnerability is not uniform to the assets
- Methodology is focused on finding the important events to the important assets

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# Natural Hazard Screening Venn Diagram



**Infrastructure Nodes Identified with Potential for:**  
Significant Consequence, High Applicability, or High Vulnerability will go to detailed natural hazard assessment

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## Natural Hazards Risk Assessment

- Estimate the infrastructure risks attributed to structures and equipment failures from natural hazards events
- Examine structures and equipment in those nodes that could potentially have significant impacts, based on three step process:
  - Preliminary screenings
    - Consequence screening
    - Natural hazards screening
  - Detailed risk assessments

Natural hazards screening will use:  
*American Lifeline Alliance "Guideline for Assessing the Performance of Oil and Natural Gas Pipeline Systems in Natural Hazard and Human Threat Events"*

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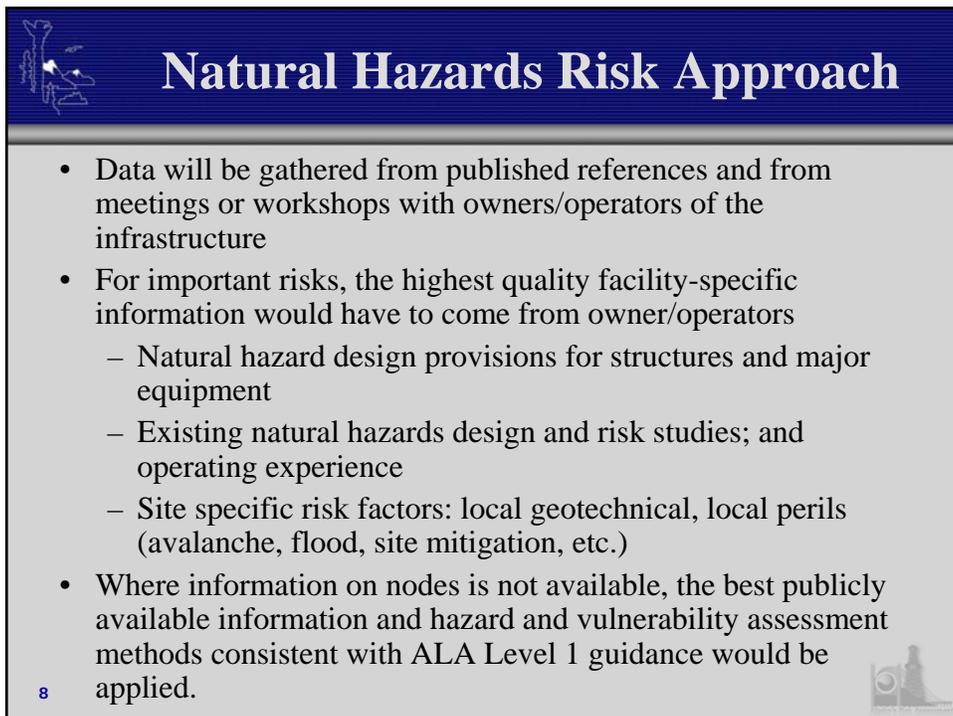
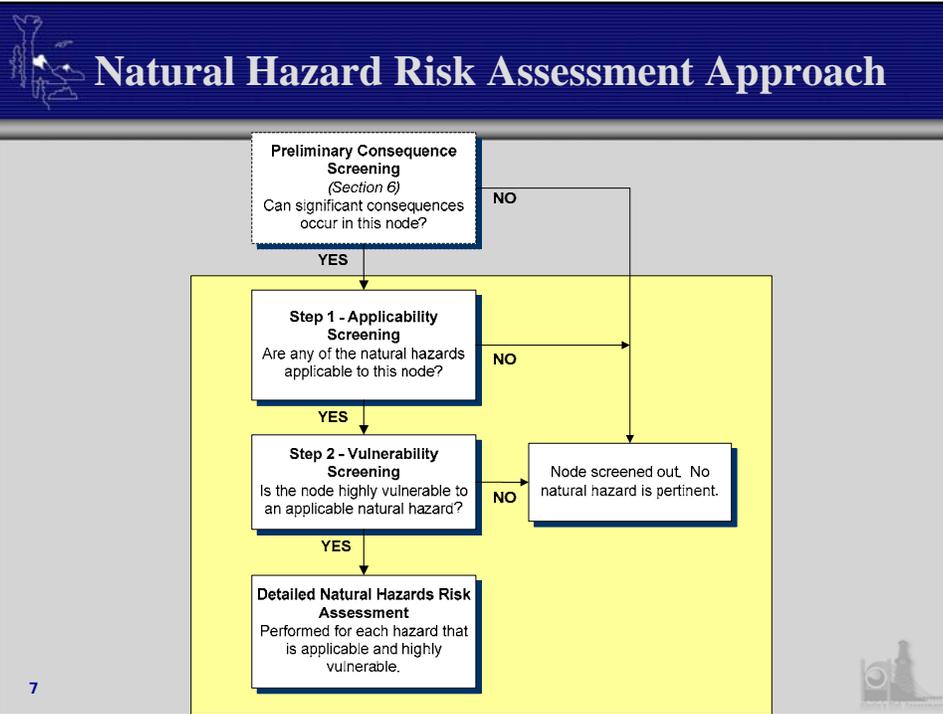
## American Lifeline Alliance Methodology

Performance of Oil and Natural Gas Pipeline Systems Relies on:

- Publicly available natural hazards maps
- Historical performance of O&G assets
- Provides guidelines for screening of hazards
- Provides guidance for screening of vulnerability of O&G assets
- Provides guidance on analysis of important risks

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## Event Risk Analyses

- The likelihood of consequential event risk is comprised of these major parts:
  - Estimation of the frequency (i.e., likelihood of occurrence) of events with intensity great enough to cause node damage
  - Estimation of the frequency of significant damage to node critical structures, system or components given the event intensity
  - Estimation of protection provided by any designed mitigation measure(s)
- Characterization of the node, critical structures, system, and component failure(s) and frequency

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## Natural Hazard Event Analyses Results

- Input to consequence model to estimate event consequence, accounting for unique natural hazard impacts
- Result is natural hazard occurrence frequencies and consequences for each consequence category (i.e., safety, environmental, and reliability)
- Combined with operational risk results to estimate risk for the node

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# QUESTIONS?

