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CEC Research Area:
Natural Gas Infrastructure Safety and Integrity

MEHRSHAD KETABDAR, SE
Principal Structural Engineer
Proposed Research

1. Develop seismic design models and mitigation options specifically for natural gas pipelines
   Transmission and Distribution pipelines
   Note: Pipeline Research Council International (PRCI) guideline used in Gas industry.
   Water/Oil industries use flexible connection, not used in gas industry.

   » 1.1 Design - Angle of crossing over fault
      ▪ Compression vs Tension
      ▪ Bending and shear in pipe
      ▪ Location of the bend

   » 1.2 Non-Linear Finite Element Analysis (FEA)
      ▪ Software such as ANSYS widely used in the Gas industry

   » 1.3 Different backfill materials
      ▪ Low Friction materials
      ▪ New materials and technologies should be tested and evaluated in labs

   » 1.4 Performance Based Design and Failure Mitigation Strategies
      ▪ Automatic Shut-Off Valves
Proposed Research

2. Seismic fault rupture displacement models for Transmission and Distribution Pipelines

» 2.1 Deterministic Analysis vs Probabilistic Analysis
  ▪ California Building Code/International Building Code use probabilistic models, Oil and Gas uses deterministic models

» 2.2 Advancing Hybrid Analysis
  ▪ Published\(^1\) approach by SoCalGas, PG&E, and Scott Lindwall

» 2.3 gathering data such as slip rate and information on probabilistic analysis
  ▪ Calibrating new models by measuring the seismic parameters needed

\(^1\) Fault Displacement Hazard Analysis Methods and Strategies for Pipelines; 11th U.S. National Conference on Earthquake Engineering Integrating Science; Engineering & Policy; June 25-29 2018; Los Angeles California
Proposed Research

3. Design and mitigation for soil movement during flood or earthquake

» Current activities
  ▪ Updating maps of faults and floods.
  ▪ Hydrology analysis
    • such as Army Corps software HEC RAS
  ▪ Developing design and mitigation guidelines for rock falling events
    • Rock Falling example – Montecito land slides
    • Lateral Spreading example - Northridge earthquake

» 3.1 Identifying risks and updating maps for landsliding, mud-sliding, rock falling and lateral spreading

» 3.2 Mitigation plan for rock falling and design criteria

» 3.3 New techniques such as FEA analysis for landsliding and lateral spreading and mitigation design.
Questions?