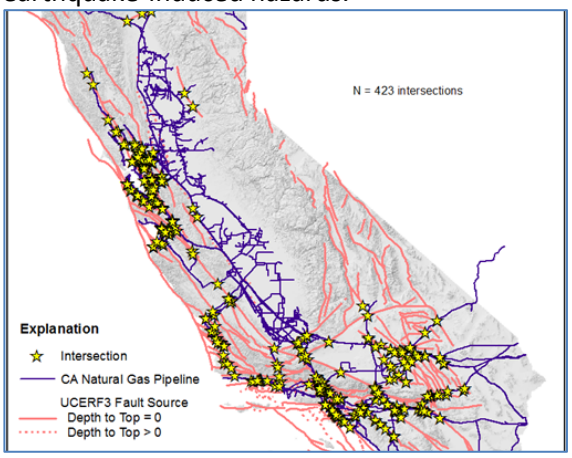
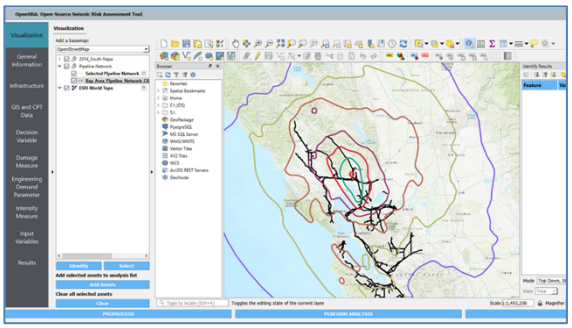
Seismic Safety through Enhanced Risk Management
https://peer.berkeley.edu/openSRA

OpenSRA – Open-source Seismic Risk Assessment Tool – SOFTWARE

Earthquakes directly impact the safety and reliability of gas utility storage and distribution systems. System operators need a way to reliably prioritize the most impactful seismic retrofits for natural gas infrastructure. *OpenSRA* is a new open-source seismic risk assessment software tool for gas utility regulators and owners that will enable them to strategically address challenges posed by the risk from earthquake-induced hazards.



Earthquake faults and gas systems.


OpenSRA software interface.


OpenSRA improves natural gas systems' safety, reliability, and service. (Photo: Socalgas.com)

***OpenSRA* - Advantages for Users**

- **Free open-source software.** *OpenSRA* can be accessed from a public website supported by PEER - Pacific Earthquake Engineering Research Center.
- **Confidential inputs and results.** Analyses of scenarios can be performed on a desktop computer – user input and results remain confidential.
- **Site-specific analyses.** The user can input information about specific earthquake hazards and specific systems.
- **Risk forecasting using past earthquakes and estimated ground motions.** *OpenSRA* is designed to incorporate information about geologic hazards due to past earthquakes and estimated ground motions (i.e., fault displacement, landslides, and liquefaction).
- **Visualize scenario results.** A graphical user interface for input and output enables the user to visualize scenario results.

Public Benefits

- Mitigation decisions based on robust quantitative data can be directed to focus efforts, resulting in effective disbursement and *lower overall costs*.
- System-wide fragilities and prioritization of mitigation will provide *greater reliability* of the overall system. A methodical and rational approach to implementing mitigation *increases safety.*
- Vulnerable system components can be repaired or strengthened before failure, avoiding adverse *environmental impacts*.
- *Energy security* achieved through enhanced seismic risk management

The *OpenSRA* software models and inputs are based on quantitative research modeling and testing data, with the goal of reducing uncertainties for seismic demand and fragility of a natural gas system and its components. With this approach, *OpenSRA* provides more reliable estimates of risk, which enables regulators and owners to better assess system risk and to direct mitigation efforts to the most vulnerable components. *OpenSRA* is an open-source seismic risk assessment tool that supports prioritization of implementing appropriate mitigation efforts.

Read about *OpenSRA* **INNOVATIONS** →

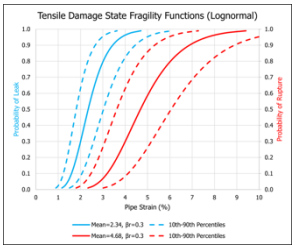
OpenSRA – Open-source Seismic Risk Assessment Tool – INNOVATIONS

Before the development of *OpenSRA*, risk assessments of natural gas infrastructure were based on subjective and qualitative interpretations. *OpenSRA* provides an analysis framework grounded on a methodical performance-based quantitative approach instead of an ad hoc qualitative approach. With *OpenSRA*, assessments are built from robust quantitative data for seismic demand and seismic capacities of natural gas storage, pipeline systems, and components. Research innovations include expanded ground motion hazards, state-of-the-art quantitative data for system limit states, the application of a highly efficient computational method, and a validation process which results in more reliable assessments.

Ground motion hazards - expanded

Seismic hazard input incorporates up-to-date ground motion models from NGA-West2 and UCERF 3.1. Additionally, new research methods were used to assess the following hazards at regional and site-specific scales:

- Liquefaction triggering
- Liquefaction-induced lateral spreading and vertical displacement
- Seismic slope instability and displacement

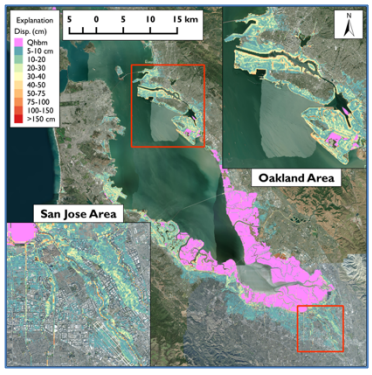


Pipeline fragility functions

Scientific quantitative information – new fragility functions

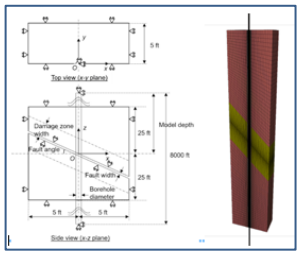
New quantitative data for damage and limit states (i.e., fragility functions) are produced for pipe strain due to permanent ground displacements, above-ground storage facility infrastructure, and gas storage wells and caprocks.

State-of-the-art research in computational modeling is used to quantify damage and limit states (i.e., fragility functions) for pipe strain due to permanent ground displacements, and for surface infrastructure components and systems. Laboratory experimental testing validates computational models of system components as well as subsystem assemblies.



Lateral spreading displacement map

Advanced full-physics numerical modeling is used to assess the seismic performance of underground wells and caprocks from ground shaking and direct fault shear displacement.


Impacts from direct fault shear modelled on wells

Evaluate more "what-if" scenarios

Either general regional data or site-specific data can be used in an assessment. A highly efficient computational method significantly reduces analysis time – more scenarios can be evaluated to inform prioritization of actions and decisions.

Validation

OpenSRA assessments were validated at four sites in California, and scenario assessment outcomes correlate well with observations from past earthquakes at the sites.


Sub-system testing

Read about *OpenSRA* **SOFTWARE** →