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Seismic Risk Assessment of Underground Natural Gas Storage and Pipeline Infrastructure

See attached PDF ...

Additional submitted attachment is included below.

Two observations based on the *Notice of Request for Comments on Draft Solicitation on Natural Gas Infrastructure Safety and Integrity (Docket No. 19-ERDD-01)* and the briefing materials from the September 17, 2018 CEC Workshop:

1. The focus appears to be in two areas: underground natural gas storage, and gas transmission lines. The seismic performance of distribution mains and services is largely ignored, and
2. There is a lack of attention given to systems-related issues. Both from safety point of view (failures to distribution mains and services) and serviceability point of view (continuity of service)

While the current focus on underground gas storage and transmission pipelines is well deserved, ignoring the performance of gas mains and services, and the performance of the entire gas system leaves important and significant seismic risks unaddressed --- risks that in many cases have helped to drive the need for more comprehensive assessments of the reliability of natural gas systems. A brief summary of damage to natural gas mains/services in past California earthquakes is provided below.

1971 San Fernando Earthquake

181 breaks in mains were reported after this earthquake (U.S. Dept. of Commerce, 1973) almost all in oxyacetylene welds (pre WWII steel pipe) and 199 breaks in services or service-to-main connections. It took roughly 2 weeks to restore service to all customers.

1989 Loma Prieta Earthquake

Over 1,000 pipeline leaks in the gas distribution system were reported after this event, with significant damage in the Marina District where liquefaction effects were observed (National Research Council, 1994). It took roughly one month to completely restore service to the Marina District.

1994 Northridge Earthquake

154 breaks were observed in gas distribution mains (where no corrosion was observed) and 536 leaks (where corrosion was a factor). As in the San Fernando earthquake, cracks in oxyacetylene welds were a factor. Service was restored to 84,000 customers within a week, and to over 119,000 within a month (TCLEE, 1995).

There have been a number of studies performed for California natural gas utilities where the performance of the larger network (transmission and distribution) has been evaluated in credible earthquake scenarios. Standardization of these models and the implementation of IOT-based sensors and system damage modeling capability within an **online platform** environment would provide an important tool for the CPUC, DOGGR and IOUs in California to assess current and projected risks to the entire natural gas system.

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