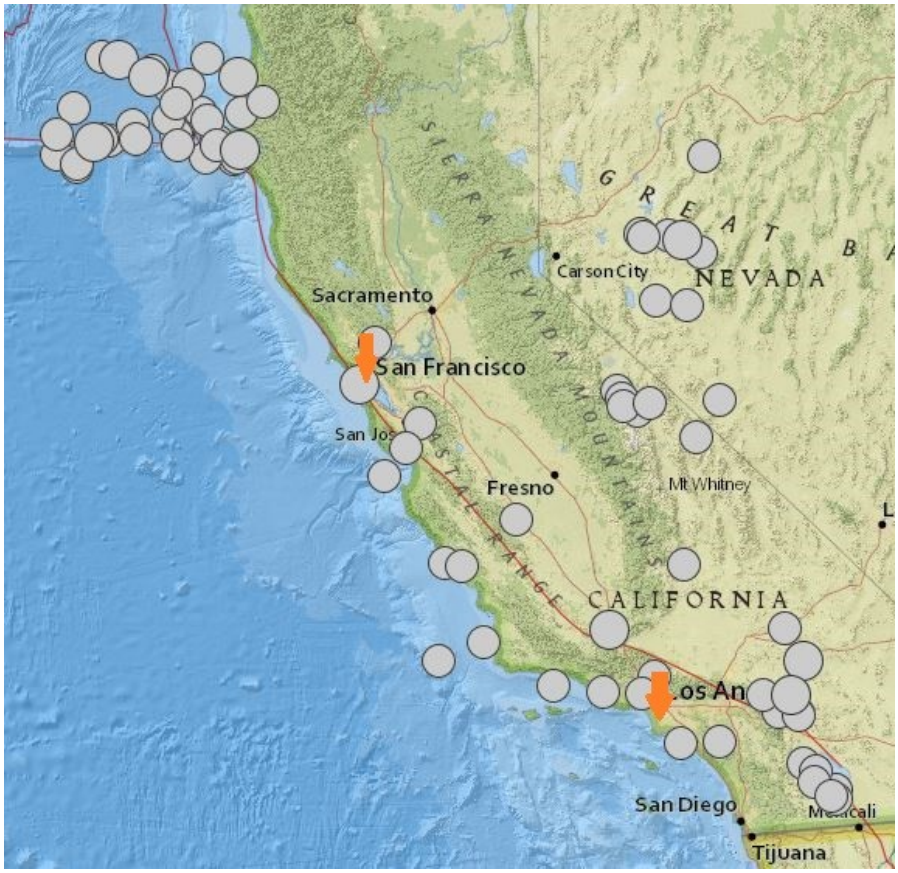
7.4 Earthquake Early Warning at Oil Refineries and Oil Producing Facilities (USA)

OECD GP Activity	UN SF Activity	UN SD Goals / Targets
7. Consideration of Natech risks in risk communication, Natech warning systems	3. Investing in disaster risk reduction for resilience	3.D Strengthen the capacity of all countries … for early warning, risk reduction and management of national and global health risks

Classification according to OECD Guiding Principles, UN Sendai Framework Priorities/Activities, and UN SDGs and Targets

Figure 1: Earthquakes with a magnitude of 6 and higher in and around California since 1900 (from USGS catalogue) with Chevron facilities indicated by orange arrows



Source: after Nunn & Rubin, 2018 © U.S. Geological Survey

Short Facts:	Natural Hazard(s) Considered:
Governance approach: Early warning **Source:** Chevron Corporation **Entry into force:** **Targeted Stakeholders:** Operators of oil refineries and oil producing establishments **Scope of applicability:** Regional, enterprises, sites	• Earthquake **Climate change:** Not relevant

Description

Chevron is one of the largest oil companies in the world, producing primarily gasoline, jet fuel, and diesel. Amongst others, it operates oil refineries in the earthquake-prone states of California and Oregon, with each refinery containing more than a thousand miles of pipeline and more than a hundred large storage tanks.

Due to transversal plate movement, the region frequently experiences earthquakes. Most of are undetectable by the people, but there are also bigger events – in fact, over 100 up to a magnitude of M6 and 12 of a magnitude of M7 since 1900. Three M7+ events have taken place, causing immense damage.

Early warnings are possible for earthquakes because of the time gap between the faster moving P waves (primary waves), and the slower S waves (shear waves). The time of warning depends on the distance from the epicentre. At distances of hundreds of kilometres, tens of seconds of early warning are possible. For example, an evaluation of two historical earthquakes (the Loma Prieta in 1989 and the Landers in 1992) gives 20 seconds of warning time for the city of Richmond and 40 seconds for El Segundo.

When ground motion occurs, the 400 seismic motion detectors in California send information to the ShakeAlert Center at Caltech, where timing and magnitude are quickly estimated using a Ground Motion Prediction Equation (GMPE). This information is then transmitted to specific users.

Depending on the expected magnitude, Chevron distinguishes two types of action schemes:

Lower-tier responses for lower-magnitude seismic events include:

- Opening of fire house doors
- Stop all ingress to facilities, e.g. the gates at the refineries
- Secure and evacuate elevators at nearest available and safe floor
- Issue warnings to all office workers to get in a secure location, away from windows etc.
- Issue warning and instruction to move to a more secure location for all people working at height, in confined spaces, or in other high risk locations
- Issue warning to all labs, instructing workers to either evacuate and reduce risk in the lab

Higher-tier responses are given for higher-magnitude expected events including:

- All of the lower tier responses, plus
- Depressurization or emergency shut-down of major equipment or processes (to be determined)

Chevron plans to build an application to transform information sent from ShakeAlert and make it usable for the emergency management staff who know about the locations of Chevron's personnel and facilities and who will then decide what actions are to be taken.

Link/Contact:

From Nunn, Jeffrey A. & Rubin, Tod (2018): 'Earthquake early warning: Opportunity to prevent/limit damage to people and property at California refineries and oil production facilities', SEG International Exposition and 88th Annual Meeting, SEG Technical Program Expanded Abstracts, p. 4875-4879, URL: https://doi.org/10.1190/segam2018-2997173.1

Comments by the UN/OECD Natech-Steering Group:

The abilities of large and complex facilities to shut down quickly and safely in case of earthquake alarms into a safe state may be limited.

Imprint

Publisher

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Completion: September/2019

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