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Lessons Learned and Recommendations For Oregon Seismic Safety Policy Advisory Commission (OSSPAC) Following the Great East Japan Earthquake of March 11, 2011

Chair Williams and Earthquake Commission Members:

The March 11, 2011 Great East Japan earthquake was a magnitude 9.0 subduction zone earthquake that triggered a devastating tsunami. This quake had a massive societal impact: human casualties are estimated at 29,000 fatalities and missing, plus tens of thousands more injured. Over 200,000 homes were damaged, and many thousands of other buildings were damaged including 7,735 school buildings and over 300 hospitals.

The scope of the damage was likely amplified by the apparently inadequate tsunami protection mitigation and preparedness measures that followed from a severe underestimation of the scale of earthquake hazard and the resulting much larger than expected tsunami inundation flooding.

(Tsunami arriving in Sendai, Japan; photo by Japan MLIT)

Lifeline infrastructure damage hindered the immediate emergency response efforts. Managing 25 million tons of debris is but a part of the total clean up effort. Recovery and rebuilding efforts may take 7 or more years. Economic damage and recovery costs have been estimated to be in excess of $600 billion.

Earthquake ground shaking and tsunami flooding resulted in damage to lifeline infrastructure including bridges, highways, railways, ports, airports, oil and gas facilities, power plants, dams, and systems involving water, waste-water, electrical, and telecommunications, as well as buildings including schools, hospitals, and industrial plants. Severe damage occurred at several nuclear power plants resulting in uncontrolled radioactive releases (Fukushima Daiichi). Numerous coastal communities and inland areas had extensive liquefaction and landslide damage. Emergency response efforts were delayed due to fuel shortages, telecommunication disruptions, and damage to transportation systems, hospitals, and fire and police stations. Large aftershocks caused additional damage.

As impacted communities have learned from previous subduction zone earthquake events, concentrated damage occurred commonly in three areas:

1) tsunami inundation flood zones,
2) places with weak underlying soils that are prone to liquefy, amplify shaking, or have permanent ground movements (settlement, lateral spreading and landslides),
3) locations with weak infrastructure, such as unreinforced masonry (URM) and other non-ductile buildings and non-building structures.

A vital lesson to be learned from this natural disaster is that critical facilities, such as nuclear power plants, require safeguards that will ensure public safety in the case of earthquake-triggered failures so as to mitigate the risk of these high-consequence collateral events. Critical facilities built long before our current understanding of seismic hazards was reflected in building code should be evaluated for public safety. By applying lessons learned from recent earthquakes, such as the Great East Japan earthquake, we can increase the effectiveness of risk reduction measures, and keep Oregon safe and prosperous.

DOGAMI notes these five issues that OSSPAC specifically could further explore to help manage Oregon's significant earthquake exposure and risks:

- Schools and emergency facilities including fire stations, police stations, and hospitals, especially those on weak soils prone to liquefaction, landslides, or amplification or in tsunami zones, should meet modern building codes and should be able to withstand strong earthquakes. Existing important facilities at high risk should be mitigated, replaced or re-purposed. Cost effective mitigation to eliminate structural collapse hazards is a top priority for high risk schools. *[We note that in our 2007 Statewide Seismic Needs Assessment report, 1,360 schools and emergency response buildings are at high or very high seismic risk.]*

- Critical facilities with large occupancies, that may contain significant hazardous materials, which serve important functions to society (e.g., energy and telecommunication facilities), or have other consequential parameters should meet modern building codes and should be able to withstand strong earthquakes. Existing critical facilities at high risk should be mitigated to prevent severe socioeconomic and environmental impacts following an earthquake. *[We note that there is not a singular database source of Critical Facilities. Various established databases (such as Oregon Fire Marshall's extremely hazardous substances database, Oregon Corrections correctional facilities inventory, and the Oregon Department of Water Resources high risk dam database) and other information at DOGAMI could be all collated, validated and compiled.]*

- Major lifelines that are co-located and/or are interdependent with other lifelines may require special performance consideration to avoid multiple and/or cascading failures. Each Oregon community depends on many lifelines, such as water, waste water, electricity and communication systems. Existing lifelines at high risk should be mitigated to meet performance standards judged acceptable. *[As discussed with the Oregon Transportation Commission, the DOGAMI Governing Board believes that Oregon should have a functional seismic hazard-resilient transportation backbone to assure socio-economic security.]*

- Review Resiliency Plan options and work with appropriate parties to assemble an integrated view of current state and community capabilities and gaps in state-wide resilience planning to make recommendations on policy direction to protect lives and keep commerce flowing.

- Develop Sister states/prefectures and city-type relationships to augment learning and facilitate exchange to help Oregon prepare for Cascadia earthquakes. As examples, Oregon could develop such a relationship with Miyagi Prefecture (pop. 2.3 million), Portland with Sendai (pop. 1 million), Seaside with coastal Rikuzen-Takata (pop. 23,000; 2,266 dead and missing), Cannon Beach with Onagawa (pop. 10,000; 1,469 dead and missing).

This information was prepared by Yumei Wang, on behalf of DOGAMI
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