Prospects in developments of seismic risk analysis for the process industry

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On one hand, it is acknowledged that earthquakes are typically concentrated in time and space, meaning they occur in clusters. It is also generally recognized that direct damage to assets (i.e., structures) can accumulate in multiple earthquakes when there is no sufficient time for repair between events. On the other hand, consolidated NaTech risk assessment relies, in the seismic case, on the classical performance-based approach to earthquake engineering, where hazard refers to mainshocks only (i.e., the prominent magnitude event in a cluster), and structural fragility contemplates failure in one event only. As a consequence, quantitative risk analysis for industrial facilities exposed to natural hazards necessarily refers to the long term and also does not enable to address multi-hazard situations, such as those including tsunamis.

Earthquake engineering has recently developed probabilistic models to account for damage accumulation in the quantitative characterization of seismic structural vulnerability, especially for buildings. The key elements are the so-called state-dependent fragility curves. Similarly, probabilistic models to describe the clustering behavior of earthquakes are available and relatively easy to apply for risk assessment purposes.

The keynote will present these issues as they are addressed in the structural engineering context, the extent to which they can be exported to the NaTech fields, and the persisting challenges, including the effect of continuous deterioration, also called structural aging, on the seismic fragility. Examples will refer to non-building-like structures relevant to industrial risk, such as oil storage tanks and/or distillation towers.