

Safety Corner

What are external events in QRA?

Quantitative risk assessments (QRA) are used to assess the operational risk of complex engineering systems, where the risk of system damage and personnel injury resulting from inadequate or failed internal processes, human and organisational factors, and system interfaces, are identified, evaluated, assessed, and controlled in a structured manner.

Often, systems are designed with multiple safety barriers of functional redundancy but the physical separation between redundant systems is ignored. Environmental hazards, such as fires and floods, can exploit this design weakness and disable multiple systems and redundant systems in a single incident. For example, a single fire can damage redundant emergency battery banks co-located in the same area, as evidenced in the 1994 Los Angeles telephone exchange fire where redundant backup batteries located in the same room were disabled by one fire. Another example is the 2011 Tohoku earthquake and the subsequent tsunami, which disabled all backup emergency generators at Fukushima Daiichi Nuclear Power station, resulting in failure of multiple reactor units. Thus, a comprehensive QRA must include the analysis of environmental hazards, which are also known as external events.

External events are often misinterpreted as events occur outside the facilities instead of outside the system process. External events include natural disasters and other environmental hazards that are not part of the normal, internal process of a system. Examples of external events are:

- Fires, including fire spread from outside of the facility such as forest fire
- Floods, including internal (e.g., inadvertent actuation of sprinkler system) and external sources (e.g., ruptured water mains)
- Strong wind, Typhoon/ hurricanes/tornadoes
- Earthquakes and tsunami
- Missiles (flying objects) associated from strong wind (like dislocated light pole)
- Lightning strikes
- Extreme hot/cold weather, etc.

An external event QRA typically includes the assessment of the threats' occurrence frequency, duration and magnitude, their effect on system operation, the response of safety systems, system loss and impact, recovery actions, and the uncertainties associated with the analysis.

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