framatome

Seismic Margin Assessment - SMA

Plant-Level Safety Assessment for Extreme, Beyond-Design Seismic Events

Framatome offers comprehensive seismic safety and risk evaluation, integrating multi-disciplinary expertise and state-of-the-art analysis tools.

Challenge

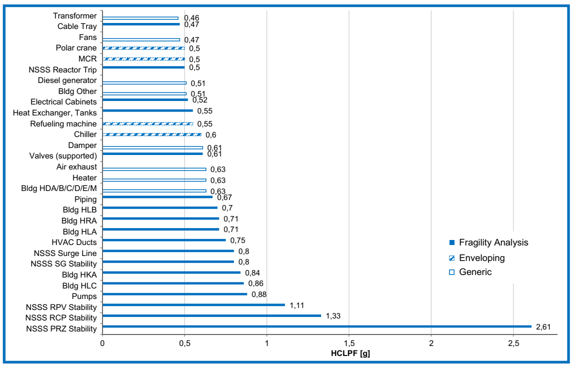
In many countries, the safety authorities have reviewed their requirements with respect to the **seismic hazard.** Therefore, safety authorities are now pushing either for a re-evaluation of the design requirements or for the plant-specific analysis of the consequences of beyond-design-basis seismic conditions. In particular, utilities are requested to provide margin assessments taking into consideration possible **cliff edge effects.**

Solution

Seismic margin assessment (SMA) is equivalent to a **seismic stress test** at plant level. The objective is to determine the strongest earthquake that the plant can resist, without experiencing core damage (Level-1 SMA) or a large early release (Level-2 SMA). Failure of individual components is acceptable, as long as the remaining components are sufficient to avoid core damage / large release.

Two approaches are used in the industry: the PSA-based SMA and success-path-based SMA. In both cases, the seismic stress test is cascaded to **individual** safety-relevant systems, structures and components (SSCs). The capacity of each SSC is estimated in terms of the so-called **HCLPF-value** (high confidence of low probability of failure). The estimate can be based on engineering judgment (supported by visual inspection → walkdown), review of design calculations or specific re-analysis.

Integration of fragility / capacity data with system analysis permits the evaluation of the plant capacity.



One of the results of SMA (exemplary): ranking of structures / components, from weakest (transformer) to strongest (pressurizer)

Customer benefits

- **Multi-disciplinary expertise** in building dynamics, vibration analysis / testing of equipment, probabilistic safety analysis (PSA)
- Multiple recent SMA **reference projects** (Europe, South America)
- Synergies between technical disciplines, combining analytical experience with know-how specific to **individual component classes**
- **Economic performance:** allocate actions (hardware improvements or additional analyses) to safety-critical components with narrow margin
- Extension to PSA-based risk quantification (CDF, LERF), including analysis of **uncertainty factors** (seismic hazard curves, fragilities)

Technical information

- Seismic fragility / robustness assessment for key SSCs: civil works, nuclear steam supply system (NSSS), reactor pressure vessel internals, fuel, safeguard systems, pumps, tanks, spent fuel pool, electrical and I&C systems, distributed systems (piping, heating, ventilation and air-conditioning systems, cable trays), special equipment (fuel racks and fuel handling machine, cranes)
- Integration with PSA for fault tree / event tree based evaluation of plant-level margin
- Specific tools for each link of the analysis chain (e.g. SASSI, SOFiSTiK, ANSYS, Risk-Spectrum, HarzardLite)
- Compliance with international codes, guidelines and standards (e.g. IAEA, ASCE, ASME, RCC-CW, EPRI)

Your performance
is **our** everyday **commitment**

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