RISK-BASED OPERATIONAL SECURITY: EXTENDING CSA WITH PROBABILISTIC RISK ASSESSMENT

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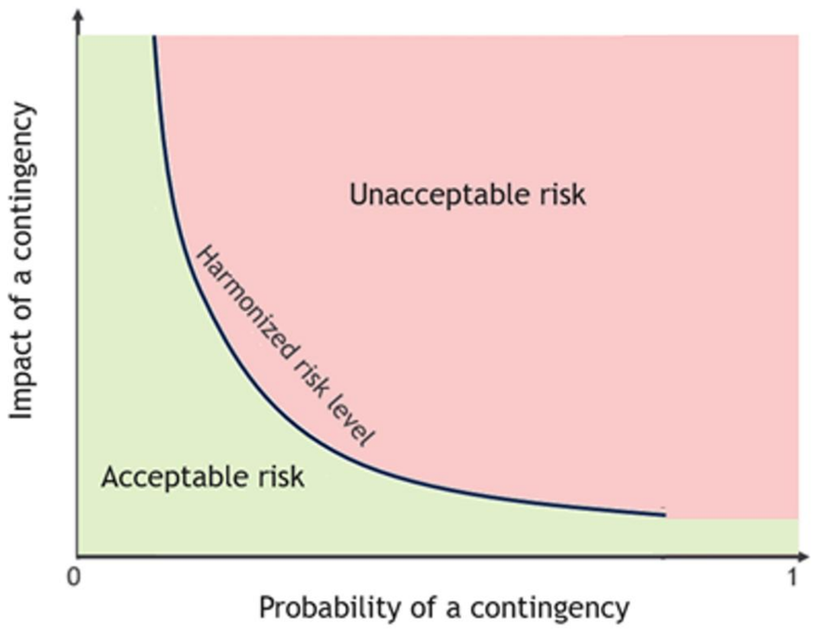
NORDIC RCC
BRIDGING NORDIC POWER SYSTEMS TO ENABLE THE GREEN ENERGY TRANSITION

Background

The Nordic power system is a highly interconnected and renewable-heavy system, making its secure operation increasingly complex. This makes it important to anticipate risks and incorporate uncertainty to ensure effective and economically efficient operational planning. The security analysis performed by Nordic RCC is therefore essential to ensure reliability under both normal and disturbed conditions. The Probabilistic Risk Assessment (PRA) methodology being developed by ENTSO-E in collaboration with TSOs and RCCs is particularly relevant, as it moves beyond deterministic criteria to quantify the likelihood and impact of disturbances, enabling more informed decisions on which contingency cases to focus on a day-to-day basis.

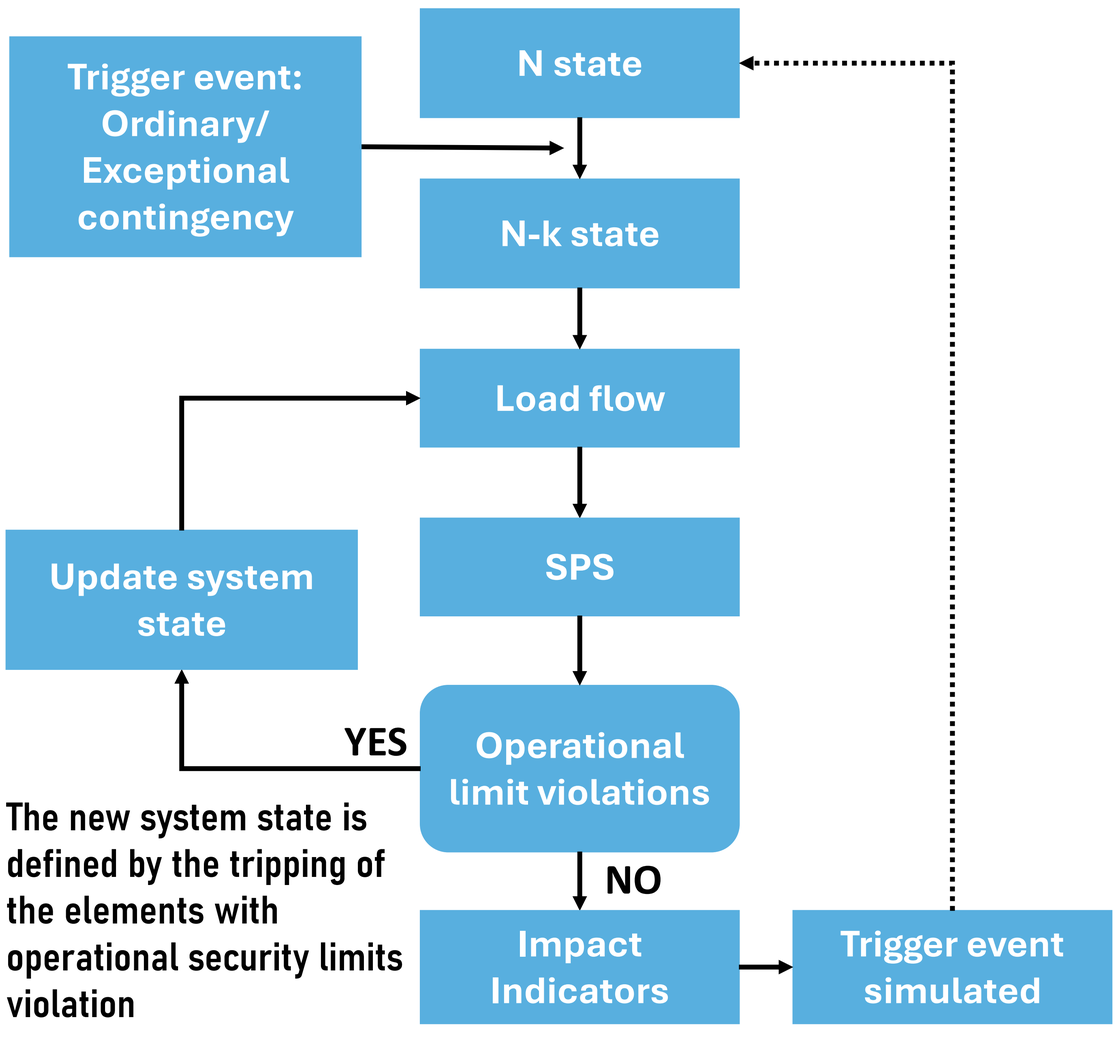
Objective

Assess how PRA can complement the deterministic N-1 criterion by combining the likelihood and impact of contingencies into a unified risk metric, allowing TSOs and RCCs to focus their security analysis on the most risk-relevant contingencies.



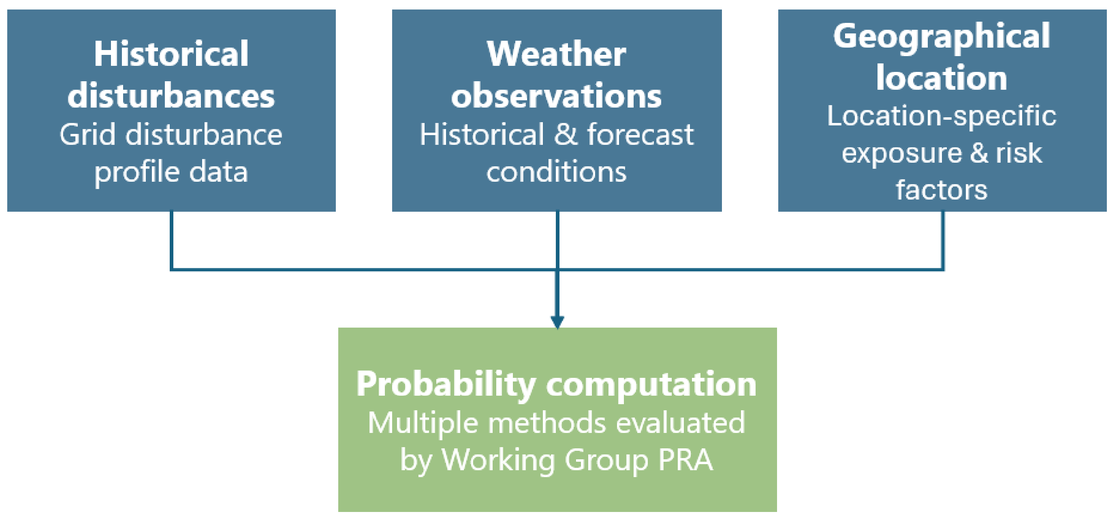
Methodology – Impact calculation

Impact is assessed through iterative post-contingency simulations. Starting from the N state, contingencies are applied and system response is evaluated via load flow. If operational limits are violated, the system state is updated, and corrective actions (e.g. SPS) are simulated. Final impacts are quantified using indicators such as ENS and VOLL.



Methodology – Probability Calculations

PRA moves beyond the N-1 criterion by assigning distinct probability weights to each contingency. Failure probability accounts for incident history, weather, geography, technical condition, and maintenance schedules. Methods such as VAFFEL developed by the Norwegian TSO Statnett — which estimates overhead line failure probabilities from wind and lightning forecasts — are being evaluated by Working Group PRA. These probability weights feed directly into the risk assessment of a contingency.



Challenges

Risk assessment methodology
Risk is probability × impact, but standardized calculation methods and harmonized risk thresholds have yet to be formally established.

Trust in algorithmic decision-making
Moving from the well-established N-1 criterion to a probabilistic approach requires a cultural shift within TSOs

Data Quality and Availability
Many TSOs lack sufficient historical fault data to reliably compute failure probabilities

Expected Results

- ✓ More targeted (potentially reduced) list of contingency to run security analysis on for TSOs and RCCs.
- ✓ Understanding risk enables more efficient operation and higher utilisation of grid capacity
- ✓ Harmonised risk thresholds enable consistent security assessment across all European TSOs.

ENTSOe. (2025) Operational Probabilistic Coordinated Security Assessment and Risk Management