VulPro – Risk and vulnerability prognosis for power system development and asset management

Challenge and objective

- Power system planners need information about the risk exposure of the system and how it may develop in the future, for informing decisions on both mid-term asset management (AM) and long-term power system development.
- AM decisions focus on single components in the power system but do not properly account for their importance for the reliability of supply. System development, on the other hand, does not account for component condition when analysing risk to reliability of supply.
- Primary objective of the VulPro project: Develop methodologies for risk prognosis that can be used to inform decisions in power system asset management and system development, accounting for the condition of power system components.

What have we learned? (new knowledge and methods)

- Methodologies for integrating component condition and component reliability models in reliability of supply analysis, demonstrated for SINTEFs transformer health index model.
- Methods for estimating how important individual components' condition is for the reliability of the power system.
- An open-source model for estimating the outage duration of transformers, its uncertainty, and how it depends on risk-influencing factors such as accessibility and spare strategies.
- Component reliability models (failure rate and outage duration models are compatible with existing analysis tools for reliability of supply (such as Statnett's MONSTER tool)
- Most components are well maintained and in good condition and have a low probability of wear-out failure. If condition deteriorates, however, the probability may increase.
- The impact of high-voltage circuit breaker condition on reliability of supply is investigated through the PhD study in the project.

Implications and recommendations

- Component age should not be primary basis for asset management decisions.
- Data can be used to estimate if condition deteriorates and the probability of failure increases.
- Grid owners should collect and manage relevant component condition and reliability data.
- Transformer condition data should be collected in a common data base both for operational transformers and scrapped transformers, together with historic load and temperature data.
- Risk-based asset management strategies can give considerable lifecycle savings on reinvestment and maintenance costs while keeping the reliability of supply at a satisfactory level.
- Mid-term asset management decisions should be made in accordance with the future system development alternatives. Correspondingly, system development plans should consider the needs of the existing assets and mid-term asset management decisions.
- Decision processes within the grid owners must be updated to better consider risk.
- Competence on risk-based and probabilistic approaches should be improved.