SRA-E 2013 paper no: 214

Monitoring vulnerability

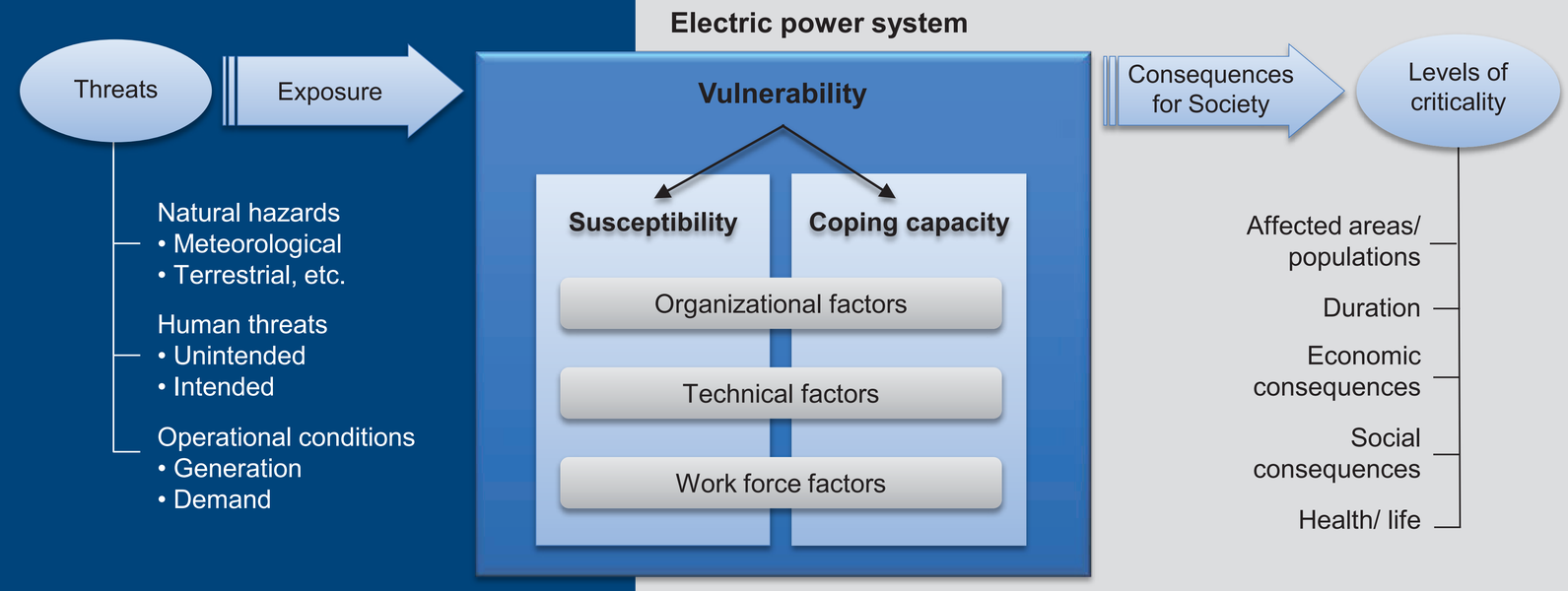
Monitoring vulnerability in electric power systems

Challenge

- Society is critically dependent on electricity
- The power system is an ageing infrastructure, exposed to increased strain due to
  - increased utilization
  - climate change
  - integration of intermittent generation
- Increasing interdependencies on ICT (smartgrids)
- How will this affect the vulnerability of the system?

Conclusion

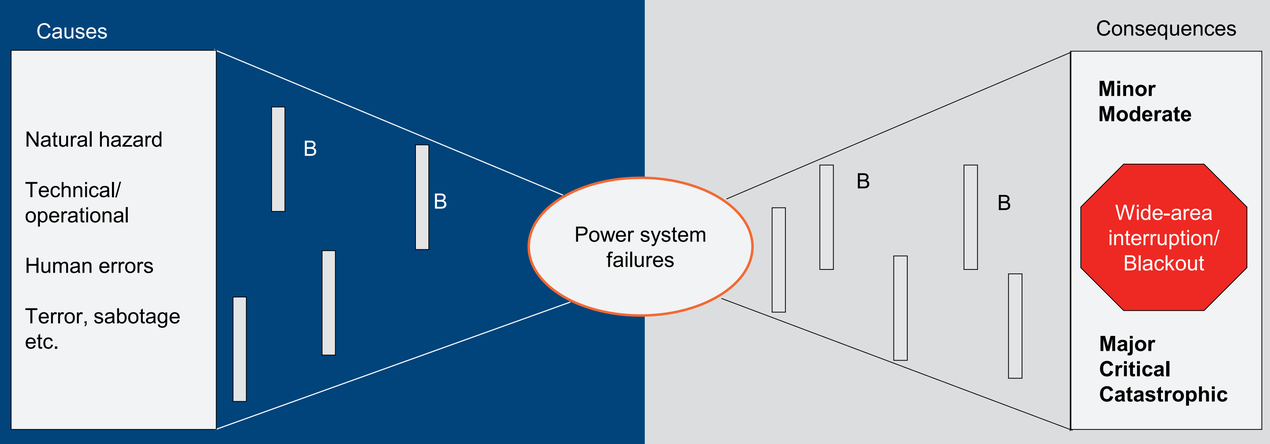
- New knowledge regarding vulnerabilities in the changing power system:
  - a scientific basis for monitoring vulnerability
  - a methodical framework for vulnerability analyses
- These results contribute to improvements in inspections, long-term planning of investments, emergency preparedness planning, etc.



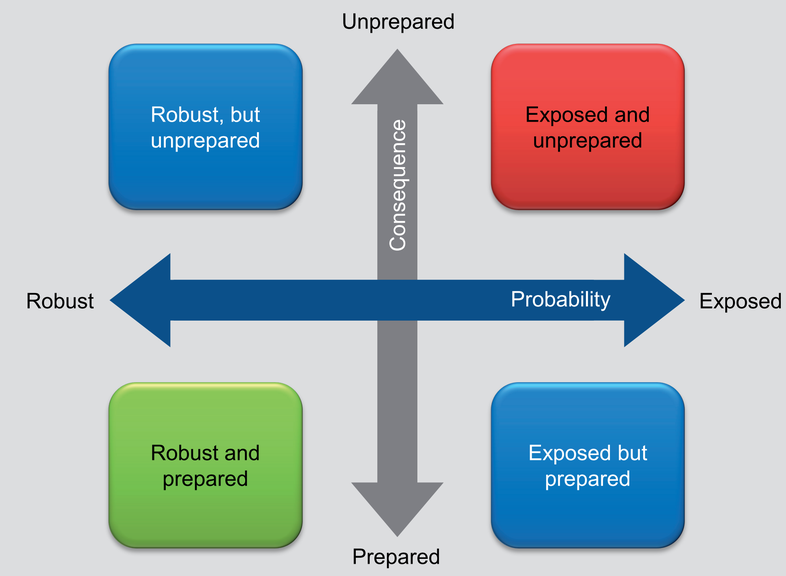
Framework for electric power system vulnerability and vulnerability influencing factors

Project focus

- Main stakeholders: energy authorities, system operators and network companies
- Extraordinary events: High impact, low probability (HILP)
- Failures and disturbances potentially leading to wide-area or long-lasting interruptions with severe impact on society
- Vulnerability divided in susceptibility and coping capacity, related to various threats
- Dedicated vulnerability analysis and indicators



Basis: bow tie model
Threats, unwanted events, consequences and barriers

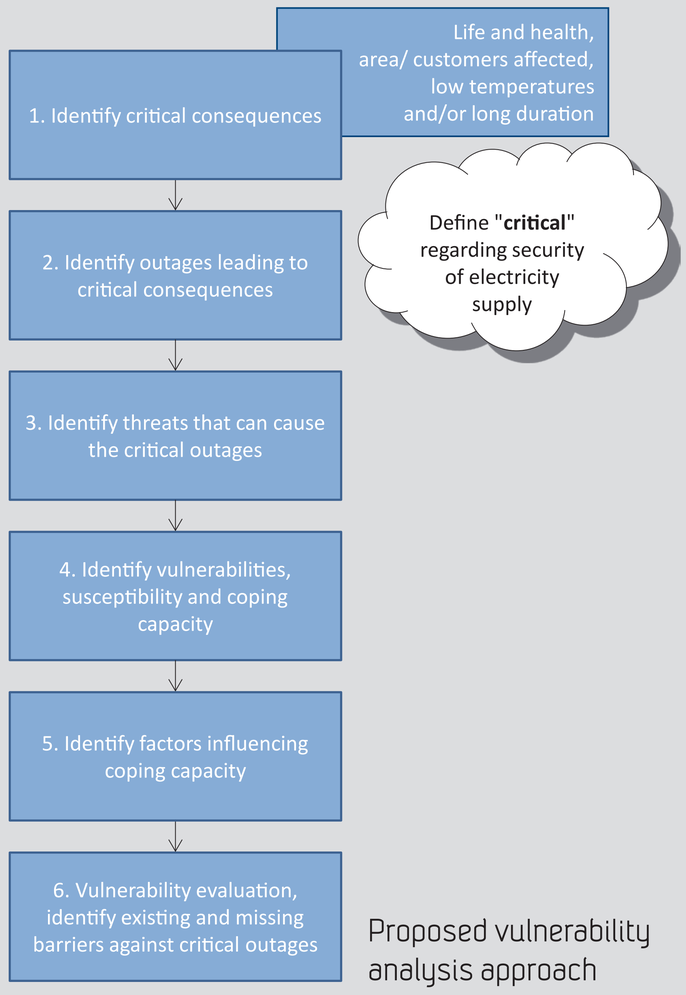


Vulnerability affects the probability and consequence of extraordinary events

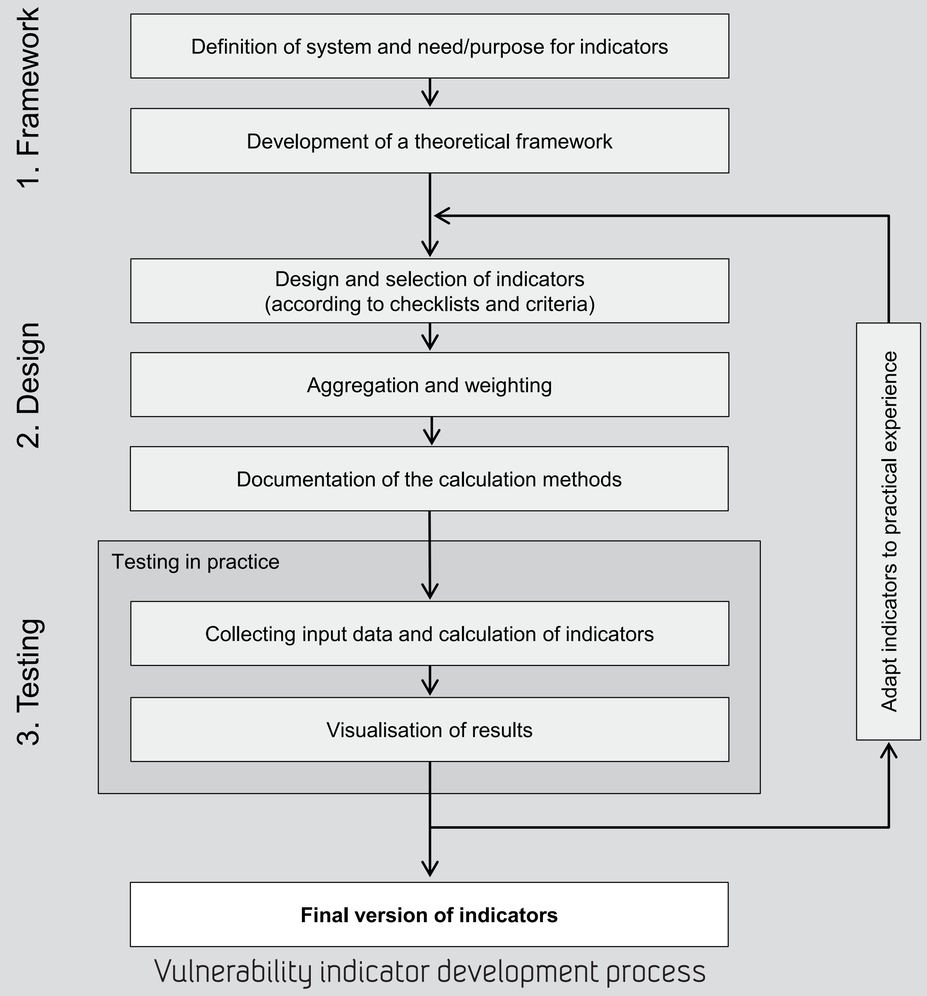
Results and findings

Results are obtained in three different areas:

- A framework of definitions, indicators and methods that can be used to monitor and classify vulnerabilities
- Methods and tools for enhanced power system risk and vulnerability analysis, with particular emphasis on extraordinary events
- Case studies to illustrate the development and use of vulnerability indicators and methods. Analyses of historic blackouts to learn from past events.



Proposed vulnerability analysis approach



Vulnerability indicator development process

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This work is sponsored by the knowledge-building Norwegian project Vulnerability and security in a changing power system, granted by the Research Council of Norway.

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