Monitoring the Risk of Electric Power Systems in Norway

Bjørnar Heide, Jan Erik Vinnem and James Lambert

PSAM9, Hong Kong, May 2008

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Motivation

- Increasing demand for risk management of the sector.
- Recent occurrences show that risk management of this sector is challenging.
- The scientific community has called for further development of risk management tools for this sector.

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Outline of presentation

1. Review of a new approach to monitor risk in another sector.

2. Review of currently used methods in the Electric Power Sector.

3. Suggestions to improve the risk monitoring of the Electric Power Sector.

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A new approach to monitor risk

- Norwegian petroleum industry:
  - Strong disagreement between stakeholders about risk levels and trends.
  - Difficult to find credible sources of information about the risk level in the sector.
- The “Risk Level Project” was created to:

> Establish a realistic and jointly agreed picture of risk levels and trends.

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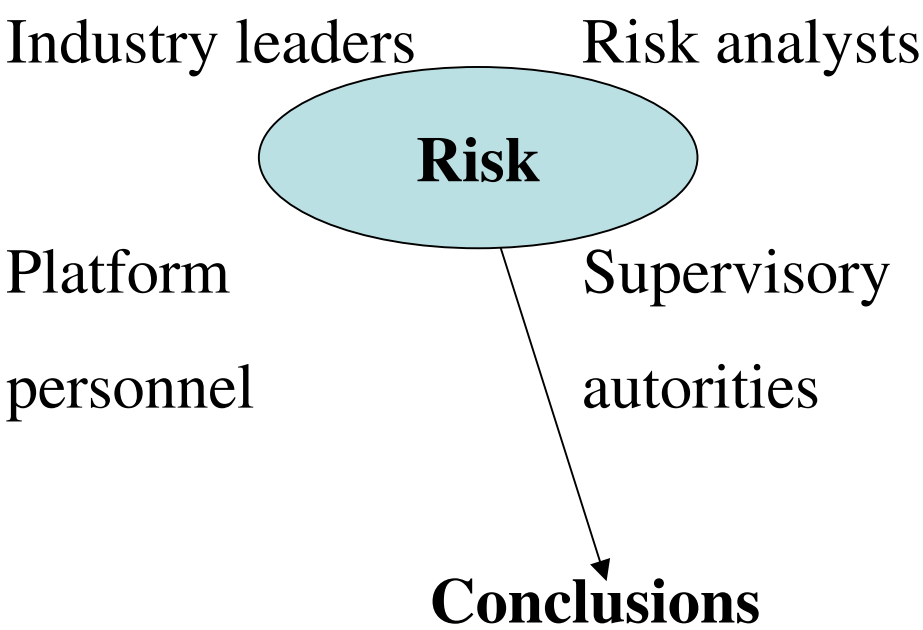
Reflection

- What is risk?

- Measure risk objectively?

The preferred approach



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’Risk Level’ method

- The parties present their views on the situation.
- Statistical, engineering, social science and expert judgment methods to provide a *broad* illustration of risk levels.
- Systematically collect and analyze data, produce summarizing risk indicators, detect trends.

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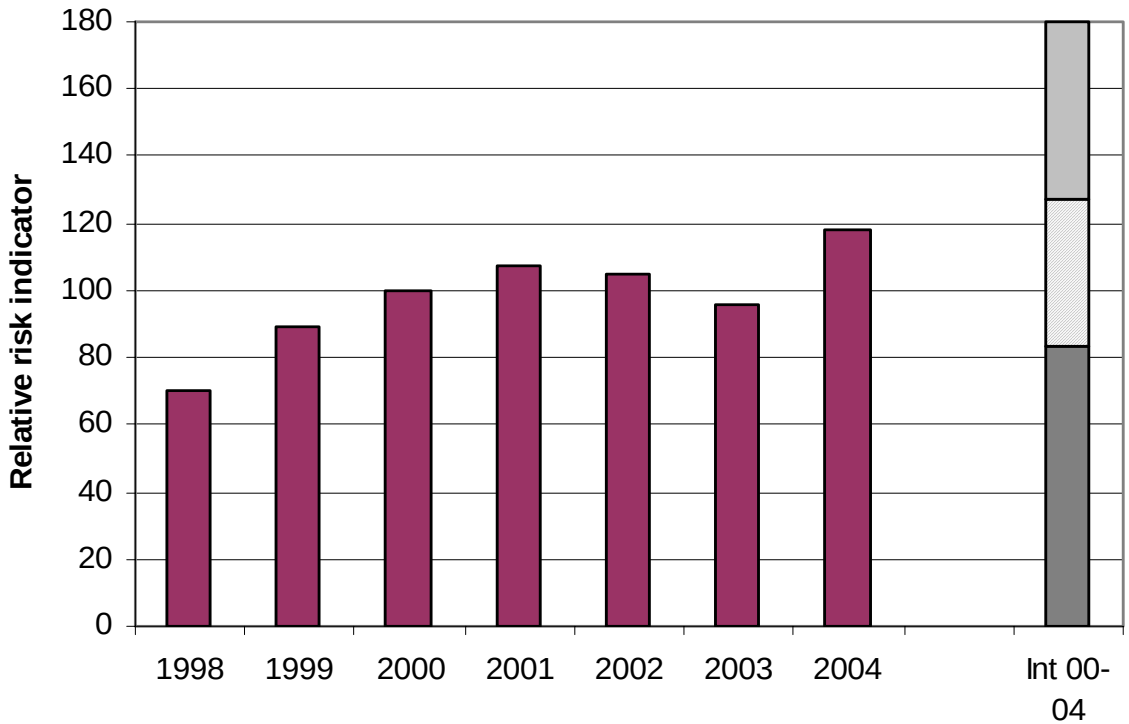
'Risk Level' method

- The parties present their views on the situation.
- Statistical, engineering, social science and expert judgment methods to provide a *broad* illustration of risk levels.
- Systematically collect and analyze data, produce summarizing risk indicators, detect trends.
- View the indicators from a large variety of angles.
- A broad group makes conclusions.

Example: An incident indicator

Normalized on manhours, 3-yr rolling average, 2000 = 100



No. of incidents multiplied with expected no. of fatalities given the incident for each incident group.

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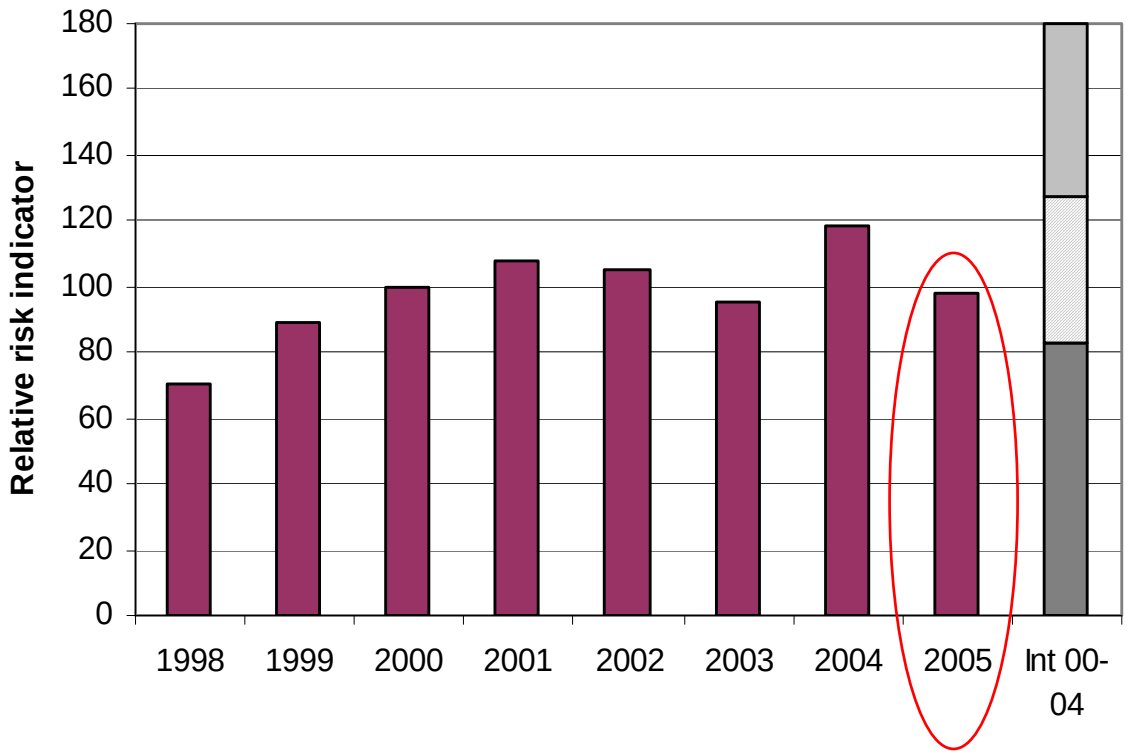

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Result of 'Risk Level' method

- Discussions about the risk level and trends are more constructive.

- Easier for the parties to agree on safety priorities.

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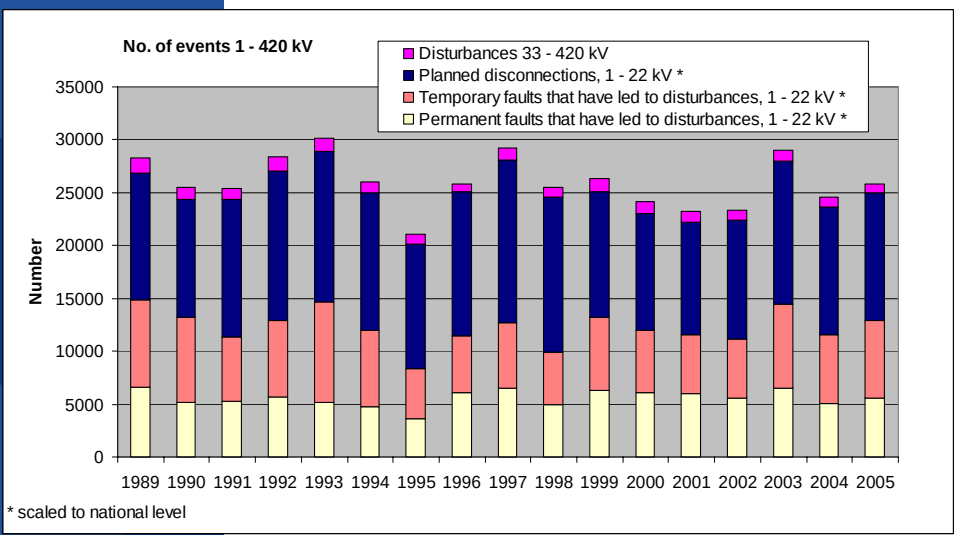
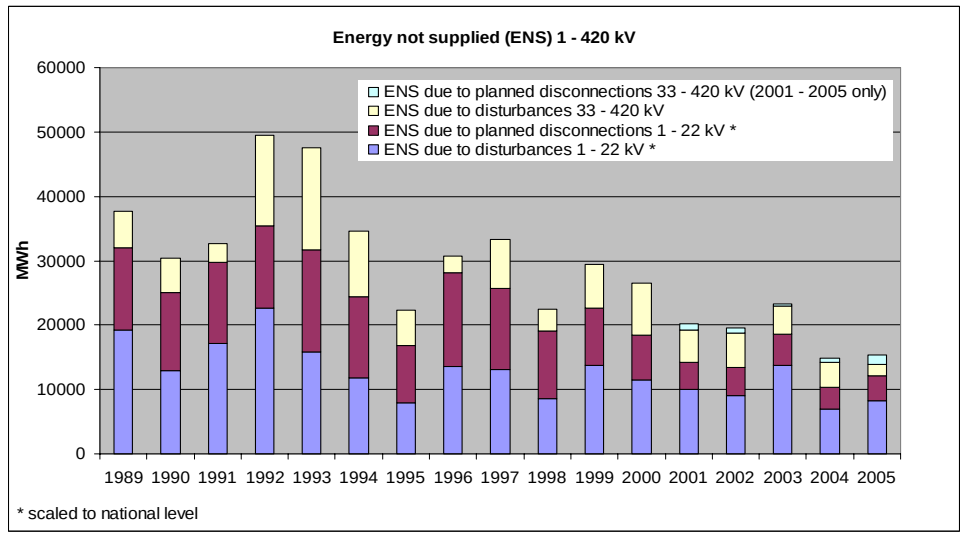
Norwegian Electric Power System sector

- No complete method developed.
  - But several relevant reports are available.
  - Main focus on quality of supply.
- Regulation 1557 specifies data to be reported annually.

Currently used indicators

- Number of events
- Energy not supplied



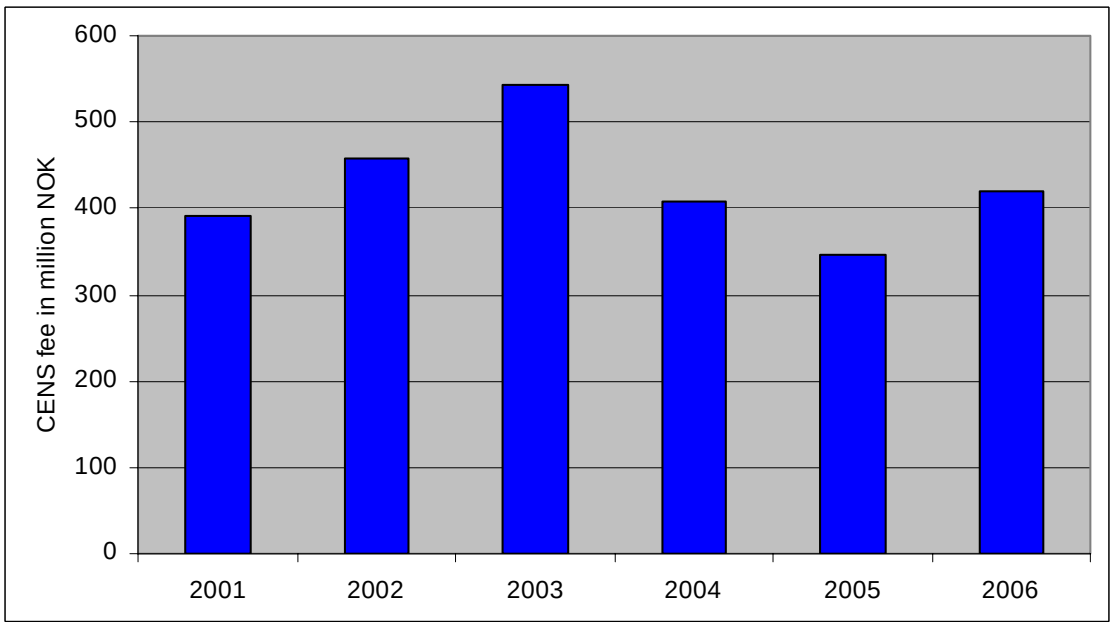


SAIDI: System Average Interruption Duration Indicator

•Good indicator of operational and design stress.

Cost of Energy Not Supplied, CENS

- Risk indicator R: $$R_{CENS} = \sum_i x_i \cdot f_i$$
  - x_i: non-delivered energy [kWh] to sector i.
  - f_i: Fee per x_i.



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Room for improvement?

- “Credible info about the supply quality”

- “Large scale risk not fully addressed.”

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General suggestions

- Avoid a purely quantitative approach
- Triangulation of
  - parties' views
  - Indicators
  - Scientific approaches
- Conclusions made by a group
  - All parties are represented.
  - Leads to larger confidence in the results.
- Stronger focus on large-scale accident risk
  - Incident indicators. Manageability. Network perspective.

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1) Incident indicators

- IEEE1366: “Remove ‘Major Event Days’ from SAIDI indicator”.
  - “Noise” in the SAIDI quality indicator.
  - Major Events have a potential to severely impact a region.

- We suggest Major Event Days as incident indicator.

2) Focus on manageable factors

- Number of incidents: quite stable per year.
  - mostly caused by environmental factors
  - Not easily manageable
- However, the *durations* are manageable
  - Influenced by management decisions:
  - Planning, operating, maintenance, preparedness
- We propose to closely monitor the SAIDI indicator.

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3) Network perspective

- The effect of outages are heavily dependent on
  - Grid structure
  - Preparation for outages
- The network perspective should be addressed.
  - Qualitative approaches
  - Quantitative approaches

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Summary

- From quantitative focus to a triangulation approach.

- From quality of supply indicators to broader view on risk, including severe events.