A RISK BASED APPROACH TO DISTRIBUTION SYSTEM ASSET MANAGEMENT AND A SURVEY OF PERCEIVED RISK EXPOSURE AMONG DISTRIBUTION COMPANIES

Dag Eirik NORDGÅRD
NTNU / SINTEF – Norway
dag.e.nordgard@elkraft.ntnu.no

Kjell SAND
SINTEF Energy Research - Norway
kjell.sand@sintef.no

Oddbjørn GJERDE
SINTEF Energy Research - Norway
oddbjorn.gjerde@sintef.no

Maria Daniela CATRINU
SINTEF Energy Research - Norway
maria.d.catrinu@sintef.no

Jukka LASSILA
Lappeenranta University – Finland
jukka.lassila@lut.fi

Jarmo PARTANEN
Lappeenranta University – Finland
jarmo.partanen@lut.fi

Sylvie BONNOIT
EdF R&D - France
sylvie.bonnoit@edf.fr

Jean AUPIED
EdF R&D - France
jean.aupied@edf.fr

ABSTRACT

There is an increasing trend towards using the concept of risk assessment as an important tool in distribution system asset management. The paper presents a framework of three main stages in the process of risk management for distribution companies being 'Risk Study Planning', 'Risk Scenario Identification', and 'Risk Modelling – Analysis – Decision Making – Communication'.

A description of risk related challenges for distribution companies is also presented – based on a survey performed among distribution companies in Norway, Finland and France. The results show six main categories of challenges which contribute to the total risk picture.

INTRODUCTION

The distribution system companies are facing diverging requirements from different stakeholders – owners, local authorities, regulatory bodies and customers – making distribution system asset management a task of balancing between contradicting inputs and decision criteria. Distribution system asset management also relates to different decision levels within company organisation - from the strategic to the operational level. Decisions must further be evaluated over different planning horizons (short, medium, long term) which add further complexity to the decision problem. To be able to meet the requirements of the different stakeholders and to make decisions under uncertainty is a critical part of the asset management scheme.

The electricity distribution industry increasingly regards the concept of risk assessment as an important tool in distribution system asset management [1,2,5], but there are still challenges related to establishing a common understanding of the subject and to implementing and making operational the concept of risk.

This paper first gives a presentation of risk management in distribution systems. It further presents results from a survey among distribution companies in Norway, Finland and France concerning what risk related challenges they experience as being the most relevant.

RISK MANAGEMENT IN DISTRIBUTION SYSTEMS

The concept of Risk

Risk analysis attempts to answer three fundamental questions [3]:

1. What can go wrong?
2. How likely is it to happen?
3. What are the consequences?

The answer to the first question is called a risk scenario (S) which is a description of considered threats or hazards. The answer to the second question is a probability statement of the scenario (p). The answer to the third question is a qualitative or quantitative description or evaluation of the consequences (C) of the scenario. The consequences will typically have a multidimensional outcome.

Each risk scenario might hence be described by three parameters: $<S,p,C>$ and the total risk picture is given by listing all risk scenarios with their associated probabilities and consequences.

Risk scenarios can include threats or hazards, events and trends. Adverse weather, aging overhead lines, overloading of components and lack of maintenance, are all examples of inputs which affect the risk scenarios.

Risk management

Risk management can be defined as *coordinated activities to direct and control an organization with regard to risk*, and there exists a general terminology framework which covers the different aspects of risk management, [4].

For distribution companies the risk management framework illustrated in Figure 1 is proposed as a concept of the distribution system risk management process, [1].

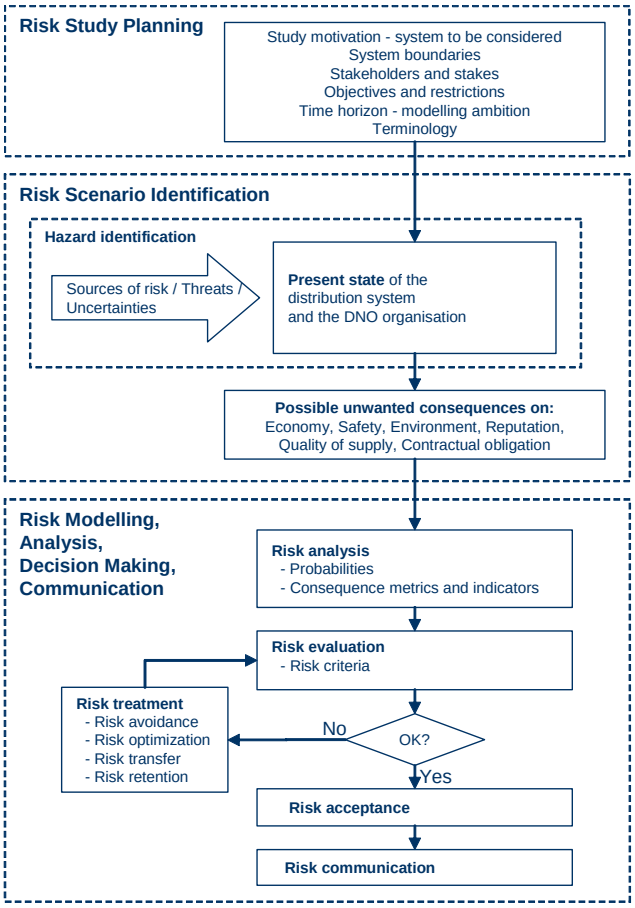

Figure 1 Distribution system risk management process

Figure 1 illustrates three main stages of the risk management process:

- Risk study planning
- Risk scenario identification
- Risk modelling – Analysis – Decision Making - Communication

which are commented in the following.

Risk Study Planning

As the first stage in any problem solving, problem formulation is a key success factor. To identify what motivates the study is hence important, and equally who are the stakeholders and what are their preferences.

The risk study planning includes clarifying:

- Motivation for the study
- System boundaries
- Stakeholders
- Objectives and restrictions
- Time horizon.

As an overall background for the analysis, a common understanding of terminology is essential for communication concerning the study.

Risk Scenario Identification

In the risk scenario identification the threats and sources of risk which affect the system are elaborated. This includes items, events or activities having a potential for a harmful consequence.

The threats and sources of risk will be addressed closer in the next chapter, as the categories of challenges and threats (see Table 1) describe the situation as perceived by the distribution companies.

Risk Modelling – Analysis – Decision Making - Communication

The final stage of the aspects:

- Risk assessment
- Risk treatment
- Risk acceptance
- Risk communication

where

- ***Risk assessment*** is the overall process of risk analysis and risk evaluation, included usage of different tools for qualitative and quantitative risk analysis.
- ***Risk treatment*** is the process of selection and implementation of measures to modify risk.
- ***Risk acceptance*** is the decision to accept a risk.
- ***Risk communication*** covers exchanging or sharing of information about risk between the decision maker and other stakeholders.

In the risk assessment there are several consequence categories which are relevant for distribution companies:

- Economy
- Safety issues (professional and public)
- Reputation
- Environmental issues
- Quality of supply
- Fulfilling of contractual obligations.

There will be interdependencies between the different consequence categories – and unwanted events will often have impact on more than one category at the time.

PERCEIVED RISK EXPOSURE

The challenge of risk assessment in distribution companies has many facets – covering different types of challenges at different organisational levels within the companies, with importance for different external and internal stakeholders, [1,2,5].

In order to structure the challenges regarding risk for distribution companies, a survey has been performed covering the experience in Norway, Finland and France on what the distribution companies perceive as risk related challenges in their range of activities, [1].

The survey is carried out by interviews of nine distribution companies. The results show that there are substantial similarities in what the respondents in the three countries point out as being their most important challenges.
The following main categories of threats and / or challenges have been identified, see Table 1:

- Challenges regarding operational/legal framework
- Organisational challenges
- Technical challenges
- Environmental challenges
- Reputation challenges
- Societal challenges.

Table 1 Categories of challenges and threats – and keywords describing them

Category	Challenges / threats
Challenges regarding operational/legal framework	- Unpredictable regulatory framework – regulatory risk - Contractual obligations towards local authorities / customers - Changes in quality of supply regulation - Changes in safety / environmental regulation - Changes in owner demands with increasing profit expectations
Organisational challenges	- Outsourcing of services: Having control and making sure that rules and regulations are complied with, and that safety is sufficiently handled - Possible threats regarding an inactive service market: (Locked-in situation). With outsourcing, there will be a risk that service market does not work as expected. In some rural areas far a way from main markets there has not been enough competition - Cases with in-house contractors: The interface between owner and contractor may become a challenge with regard to responsibilities during operation. There are also potential problems related to "bottlenecks" in workflow in the o/c interface - Mergers of companies with diverging history and culture. Both the increased size of the companies and the process to achieve similar routines and documentation in the entire organization has been a great challenge, taking care of risk handling in a transition period - Degrading / vanishing competence and local knowledge due to cuttings in working staff and retirements - Lack of competence regarding the use of new methodology within several areas of asset management, such as risk assessment and condition monitoring of different components - Cooperation with other infrastructure services e.g. in term of sharing infrastructure paths - Possible threats regarding disappearance of manufacturers of the aged components (lack of spare parts)
Technical challenges	- Generally ageing infrastructure which is getting nearer its estimated useful lifetime - Reinvestment decisions on whether to still maintaining existing components or the replace with new. A key issues here is end-of-life estimation - Wrong handling of components - Uncertainty in load development in the network - Reduction in load in rural areas - Introduction of distributed generation such as wind and small hydro power - Introduction of new end-user technologies of questionable quality that give power quality challenges
Environmental challenges	- Land use problems - Potential local pollution, e.g. oil spill from distribution transformers or other oil filled components, and possible run-off from imbued wooden poles - Other types of pollution, e.g. SF6-gas leakages from switchgear
Reputation challenges	- Disputes regarding land use - The aesthetics of power grid components - Decreasing reliability in parts of the grid - Decreasing voltage quality in parts of the grid - Safety of professionals and the general public - Bad relationship with media
Societal challenges	- Increasing vulnerability due to adverse weather, severe faults, increased utilisation of the network, etc. - Increasing reliability and voltage quality demands

CONCLUSION

There is an increasing trend toward using risk assessment as an important tool in distribution system asset management.

A risk management framework of distribution companies has been established, presenting three main stages in the process:

- Risk Study Planning
- Risk Scenario Identification
- Risk Modelling – Analysis – Decision Making - Communication.

Further a survey has been performed among distribution companies in Norway, Finland and France, showing a set of risk related challenges regarding what contribute to the total risk picture.

The risk management framework presented shows good compliance with the perceptions of the distribution companies. There are still challenges related to making the framework operational in terms of practical use – through developing tools, methods and key performance indicators for asset managers in distribution companies.

These challenges are [6] and will be further addressed in the on-going RISK DSAM project in the years to come.

ACKNOWLEDGEMENTS

This paper is written as part of the reporting from the project *Risk Based Distribution System Asset Management* (RISK DSAM) The project is a KMB project (Competence Building project) sponsored by 10 companies within electricity distribution in Norway and France, and the Norwegian Research Council as part of the RENERGI programme.

The main objective of the project is to increase competence by developing methods, which can be used to describe the risk exposure for a distribution company, on planning, operative and physical level as well as on strategy level, i.e. how alternative maintenance and reinvestment strategies affect the risk exposure.

More information about the project can be found on the web-page: *www.energy.sintef.no/Prosjekt/RISKDSAM/*.

REFERENCES

[1] K. Sand, O. Gjerde, D. E. Nordgård, M. D. Catrinu: ”Current risk exposure in the distribution sector. Initial study” *Technical Report, SINTEF Energy Research, 2007*

[2] D. E. Nordgård, K. Sand, B. Stene: ”Risk based distribution system asset management” *Nordic Distribution and Asset Management Conference, NORDAC, Stockholm 2006*

[3] S. Kaplan: ”Risk assessment and risk analysis – basic concepts and terminology” *Risk management: Expanding horizons in nuclear power and other industries, pp 11-28, (1991)*

[4] ISO/IEC Guide 73: “Risk management – Vocabulary – Guidelines for use in standards”, *ISO/IEC 2002*

[5] R.E. Brown, J. H. Spare: “Asset management, Risk and distribution system planning” *IEEE PES Power System Conference and Exposition 2004*

[6] M. D. Catrinu, D. E. Nordgård, K. Sand, J. K. Nordhagen: ”Multi-criteria decision support in distribution system asset management” *19th CIRED conference, Vienna 21-24 May 2007*