

## Learning organisations for nuclear safety (LearnSafe)

B. Wahlström<sup>1</sup>, B. Wilpert<sup>2</sup>, S. Cox<sup>3</sup>, R. Solá<sup>4</sup>, C. Rollenhagen<sup>5</sup>, M. Ibanez<sup>6</sup>, Y. Canaff<sup>7</sup>, M. Friberg<sup>8</sup>, O. Andersson<sup>9</sup>, R. Scheuring<sup>10</sup>, P. Gerdes<sup>11</sup>, H. Rycraft<sup>12</sup>, E. Dunge<sup>13</sup>, K. Egnér<sup>14</sup>

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|---|---|
| 1) VTT Industrial Systems, Espoo (FIN)  | 8) Teollisuuden Voima Oy, Olkiluoto (FIN)       |
| 2) Technische Universität Berlin, (DE)  | 9) Forsmarks Kraftgrupp AB, Östhammar (SE)      |
| 3) Lancaster University, Lancaster (GB) | 10) E.ON Kernkraft GmbH, Grafenrheinfeld (DE)   |
| 4) CIEMAT, Madrid (ES)                  | 11) Kernkraftwerk Krümmel GmbH, Geesthacht (DE) |
| 5) SwedPower AB, Stockholm (SE)         | 12) British Nuclear Fuels Ltd., Warrington (GB) |
| 6) UNESA, Madrid (ES)                   | 13) OKG Aktiebolag, Oskarshamn (SE)             |
| 7) WANO, Paris (FR)                     | 14) Ringhals AB, Väröbacka (SE)                 |

### SUMMARY

LearnSafe is a Cost Shared Action that began on 1.11.2001 and will run for a total of 30 months [1]. The objective of the LearnSafe project is to create methods and tools for supporting the management of change and organisational learning at participating nuclear power plants (NPPs) across Europe. Such tools have become increasingly important for the nuclear industry in its adaptation to changes in the political and economic environment, changing regulatory requirements, a changing work force, changing technology in the plants, and changing organisations of plants and power utilities.

The focus of the project is on senior managers at NPPs and power utilities who are responsible for strategic choice and resource allocation. This focus was selected with the understanding that senior managers decisions, approaches and attitudes have an important influence both on the safety and the economy of NPPs. The LearnSafe project has gathered data on the challenges that face NPPs now and in the future. Further work within the scope LearnSafe will investigate features and attributes that characterise learning organisations. LearnSafe will also collect and document good practices of safety management from NPPs across Europe.

### A. INTRODUCTION

The nuclear power industry is currently experiencing a period of major change, which has brought with it a number of challenges [2]. Changes in the political and economic environment, changing regulatory requirements, and a changing work force, changing technology, and changing organisations within the nuclear industry have resulted in a need to adapt. Adaptation must however occur without compromising safety within NPPs at any time. During a rapid process of change there is a danger that minor problems may trigger a chain of events leading to a degrading of safety and/or diminishing political and public trust in the safety of a particular NPP, utility or corporation. Organisational learning has been identified as an important component in ensuring the continued safety and efficiency of high reliability organisations [3], [4].

On a general level, LearnSafe aims to create a better understanding of how issues connected to organisation and management influence safety and efficiency within participating NPPs. More specifically, the objectives of the project are to create methods and tools for supporting the management of change and organisational learning at the NPPs. The focus of LearnSafe is

on senior managers of NPPs and power utilities who are responsible for strategic choice and resource allocation. This focus was selected with the understanding that their decisions, approaches and attitudes have an important influence on both the safety and economy of the NPPs.

## **B. WORK PROGRAMME**

The LearnSafe project builds upon a previous EU funded project [5] and was designed to incorporate two major phases of empirical investigations and theoretical considerations. The first phase is concerned with the management of change and the second with organisational learning. During the first phase of the project, senior management views related to current and future challenges facing NPPs have been collected and analysed. Data was collected from ten NPPs in five European countries and at one international organisation [6]. The analysed data was used as a basis to identify and assess strategies, plans and actions that NPPs are using to cope with the challenges.

The second phase of LearnSafe focuses on the features and attributes of learning organisations. The research questions addressed during this phase of the project are aimed at identifying characteristics of learning organisations and the most common hindrances to organisational learning. Findings will include descriptive characterisations of organisational learning together with methods and tools that can be used by NPPs to assess and improve their work practices. LearnSafe researchers will also collect and document good practices of safety management used at the participating NPPs across Europe.

The two phases of the research are illustrated by the following six research questions:

- Q1: What are the perceived emerging challenges in the management of NPPs?
- Q2: How do senior managers cope with emerging challenges in the management of NPPs?
- Q3: What improvements could be made in respect to coping with emerging challenges in the management of NPPs?
- Q4: What kind of features and attributes characterise learning organisations?
- Q5: What are the most common hindrances to organisational learning and how can they be removed?
- Q6: How are various company cultures and sub-cultures influencing organisational learning?

The main challenge for the project will be to create an understanding of how organisational structures and work practices contribute to safety and efficiency. This aim is built upon the assumption that it is possible to create methods and tools that plants can use to assess their performance and suggest ways to improve. This challenge can only be met and achieved in a multi-disciplinary research project, which combines a thorough understanding of the nuclear industry with deep insights from psychology, sociology and the management sciences.

## **C. MAIN ACHIEVEMENTS**

The first phase of the LearnSafe project has now been completed. Deliverables include a theoretical framework of organisational factors, methods and tools for organisational descriptions, data collection methods and tools, and a description of approaches to the management of change. The theoretical framework gives a description of models that has been used to guide the research work. The deliverable gives a brief introduction to major issues within the field of organisational factors and models for understanding them. The research frame is defined through the five interacting systems of *technology*, *individuals*,

*groups, organisation and environment*. The model stresses the need to take different views of the organisation, an *administrative*, a *political* and a *cultural view*. It gives an account of organisational failures and discusses generic dilemmas of management.

Practices used to define authorities and responsibilities in organisations are described in the second deliverable. The planning cycles of *defining goals, setting priorities, planning, operation* and *follow up* are important components of the formal organisation. Formal ways of discussing work processes, activities and tasks are described briefly. The treatment of organisational factors and the concept of organisational culture are introduced. More specifically safety management activities such as the *quality system, safety analysis, feedback of operational experience, analysis of events and deviations, human resource management, and regulatory oversight* are described. Finally drivers of change, such as changes in the political and economic environment, a changing work force, the changing technology in plants, and the changing organisations of NPP and utilities are discussed.

The LearnSafe research team selected several methods to be utilised to gather data in response to research question Q1. Safety, health and environmental professionals (n=35) were selected using an opportunity sampling method, to become part of an expert group. Two questionnaires were utilised to gather data from the expert group in relation to the urgency and importance of challenges faced by the management of NPPs. Questionnaires were completed and returned to the research team. Semi-structured interviews were conducted with top utility management (n=12) within each of the participating countries. Interviewees were asked to talk freely around research question Q1 and share their thoughts on a number of challenges generated by the LearnSafe research team from past research. Detailed interview notes were taken during the course of the interview. Senior managers (n=63) and functional managers (n=85) at participating sites were asked to participate in so called Metaplan sessions, which were designed to create an opportunity for mapping the challenges.

The Metaplan technique was developed to encourage individual involvement by all participants and it facilitates group interactions and discussion. Metaplan is an active data collection technique during which the researcher acts as a moderator to the process. The moderator would typically begin the session by introducing the topic for discussion. Each member of the group was asked to consider at least 4 emerging challenges in the management of their NPP and record their answers on cards provided. The cards were then collected from each member of the group. Each card was read aloud and stuck to the board in random order. The group was then asked to sort each of the challenges by content, to create clusters of cards with the same or similar meaning. Once participants had finished sorting the cards the moderator proceeded by asking participants to find a title for each of the clusters that was able to encompass all contributions within the particular cluster.

Two complementary methods were used to analyse the data. The first method involved data being analysed via the qualitative technique of Content Analysis. Content analysis is a phase of information processing in which communication content is transformed, through the objective and systematic application of categorisation rules, into data that can be summarised and compared. One of the benefits of content analysis is that it allows researchers to generate frequencies from qualitative data, whilst at the same time maintaining the richness of the data. The method involves the generation of key words and phrases, from the Metaplan session transcripts, being listed, counted and categorised.

The second method was based upon fuzzy set theory. An underlying model consisting of five components of *money, people, technology, practices* and *environment* was used during the

coding of the challenges. The collected challenges were coded by three independent assessors and analysed using cluster analysis. Eight clusters were selected for the collection of responses to the research question Q2 in terms of strategies, plans and actions used for coping with the challenges. These clusters were: 1) Economic pressures, 2) Human resource management, 3) Nuclear know-how, 4) Rules and regulation, 5) Focus and priorities, 6) Ageing, modernisation and new technology, 7) Public confidence and trust, and 8) Climate and culture.

Research question Q2 was further elaborated in several case studies in which the challenges within the eight clusters were addressed during interviews and discussions at the participating NPPs. At the Mid-Term seminar the research question Q3 was addressed during group and plenary discussions to generate sets of actions by which the situation could be improved.

One important feature of LearnSafe has been the close interaction between researchers and senior managers in addressing issues of organisation and management that are important for safety and efficiency at NPPs. This has been facilitated further by various spin-off tasks in which participating NPPs, with the support of researchers, have expanded some of the early results from the project to answer interesting questions of their own. Generic results of these activities have been reported to LearnSafe participants. These activities include the following:

- Participation in the evaluation of a Behavioural Safety Process.
- A benchmarking exercise on quality activities and operations management.
- A discussion and assessment of peer review activities.
- A study of the merging of two cultures in an organisational change.

In the light of the information collected so far, there is no doubt that issues connected to management and organisations are very important for both safety and efficiency. It also seems evident that NPPs today place a far higher focus on leadership and other soft issues connected to organisation and management as compared to a situation some years ago. These findings confirm assumptions laid out in the original project proposal.

The collected data has so far verified the assumptions of the LearnSafe project that senior managers today are faced with more and also new challenges compared to the situation when plants began operating. The operating environment of the NPPs has become more dynamic and the nuclear power industry has to search for new strategies to cope with emerging challenges. The challenges identified by senior managers at the participating NPPs are very similar across Europe, but there are also some differences that are linked directly to the situation of the nuclear power programme within each specific country. In discussions with senior managers at the nuclear utilities it has become very obvious that they are actively searching for approaches to find feasible adaptations to the changes.

One interpretation of the challenges and the strategies in use is that they can be reduced to form one major challenge of maintaining the necessary human resources at the NPPs. This challenge is related to the other challenges and strategies, because economic pressures may make it difficult to hire new staff when needed. Furthermore, due to a hollowing out of nuclear know-how, it may be difficult to find individuals with specific competencies and so on. One specific issue in which a concern has been raised is the selection and training of senior managers for the future, because the nuclear field is in many ways different compared with other safety oriented industries.

Discussions with senior managers at participating NPPs have provided many useful insights connected to different components of safety management. A broad definition of safety management includes all tasks and activities that are important for safety, but the concept is

often interpreted to involve only activities connected to quality assurance, safety analysis and feedback of operational experience. Additional components involve strategic and operative planning as well as human resource management. Another way of looking at safety management is to say that there should be several feed forward planning and feedback analysis loops at all levels within the organisation. To be functional these loops should be the target of continuous managerial attention.

In considering the current situation at the NPPs the largest concern is that individuals tend to be overloaded with the tasks they have. The main reason for this is connected to adaptations to the economic realities of a deregulated electricity market together with all consequential influences of changes the industry has been exposed to. This situation has forced the nuclear industry to rethink their organisational solutions to find more efficient ways to work. Thus today there is a need within the nuclear industry to have managers with skills to handle new demands within the operational environment of the NPPs. All adaptations should be achieved without any shortcomings that could cause disturbances in the political environment. Also the interfaces to regulatory oversight have to be approached with care and prudence with a focus on practical operational issues and not to pursue only safety formalities.

Further work of the LearnSafe project will focus on identifying the facilitators and hindrances to organisational learning. The empirical part of this work will again use a triangulation of methods similar to those used during the first phase of the project. The project is also expected to have an impact through the collection and documentation of managerial experience from the participating NPPs. During the course of the project such information will be fed back to participating NPPs in the form of seminars and training courses.

The project has established an open web-site <http://www.vtt.fi/virtual/learnsafe/>, which was developed to provide information about the project to outsiders and to invite comments on preliminary results of a generic nature. The web-site has been well visited since its establishment. A closed web-site has also been developed during the project to facilitate communication between LearnSafe partners.

#### **D. DISSEMINATION AND EXPLOITATION OF THE RESULTS**

A safety problem at a NPP, real or perceived, is always a risk to the business of the utility or corporation and the nuclear sector as a whole. In a serious case there would be regulatory intervention with the threat of licence revocation, loss of production income, remedial investment costs and potential or actual damage to their reputation, all on a massive scale. A serious incident within a European NPP would impact the whole nuclear sector in Europe and beyond. It is believed that LearnSafe can provide an important contribution to making it possible to safely operate NPPs in Europe during their remaining technical life-time. The intention is therefore to make generic findings available to the nuclear community as broadly as possible. An open final seminar, tentatively arranged to be held 28-29 April 2004, will be used to collect comments to a draft final report. It is the intention to place the completed final report in the public domain after due review by project partners. Preliminary results from LearnSafe have shown to be of interest also for other safety critical industries.

Project partners will use results in their research and consultancy work both within and outside the nuclear field. The participating NPPs will use project results in their own work in their continuous quest for safety and efficiency. A collection of best/ promising practices observed at the participating NPPs will assist partners in finding practical solutions to various challenges. Courses and seminars in organisational factors at participating NPPs are planned to facilitate a dissemination and exploitation of project results. The participation of WANO

gives a channel for dissemination of project results far beyond the original LearnSafe partnership. Results are also expected to initiate new research initiatives and to support safety education and training.

## **E. CONCLUSIONS**

Preliminary results for the LearnSafe project include an inventory of organisational challenges at NPPs and approaches for their resolution. Further results are expected to give additional understanding of crucial components of safety management at the NPPs. Descriptions of facilitators and hindrances for organisational learning can help NPPs in developing their work practices. Methods and tools for assessment and reviews of organisational efficiency and safety culture can furthermore help them in ensuring continuing safety and efficiency in all work activities.

LearnSafe has brought together a unique blend of researchers and practitioners. The involvement of NPPs in five European countries has made it possible to address similarities and differences in organisational structures and work practices. The partnership has been close and has benefited from very open internal communication.

A better understanding of systemic issues connected to human errors and organisational deficiencies can have a large influence on safety and economic competitiveness on a broad scale. These issues will be crucial in achieving a successful lifetime management of existing nuclear installations. Finally an understanding that safety cannot be built just as a collection of good practices also mounts a challenge on senior managers. Practices have to be tuned to local conditions, they have to be adapted to each other, and they have to fit into the overall economic frames that are given. This creates a tricky balance between requirements that sometimes are conflicting. To resolve these balances senior managers have to create awareness and understanding of all issues that are important in maintaining a safe and efficient operation.

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