Implementation of an Indicator-Based Safety Management System for the EnKK NPP`s

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Abstract:

This presentation at the Eurosafe Berlin 2004 will give an overview of the activities on Safety Management of EnBW Kernkraft GmbH taken up with a notifiable event in August 2001 at KKP 2 nuclear site. After this event EnBW announced the development and introduction of an indicator-based safety management system (SMS) at all sites of its nuclear power plants. A SMS Team with members from all NPP sites was built which had to analyse all processes based on the DIN EN ISO 9000 philosophy and to controll them by indicators. The regulatory authorities and their experts would accompany this process in a suitable fashion and monitor and review it after its introduction.

This presentation shows the process during the development of the system, the status of its introduction and the general involvement of the Regulator.

1. Introduction

Triggered by the notifiable events in KKP 2 in the autumn of 2001, EnBW announced the development and implemantation of an indicator-based safety management system (SMS) at the sites of its 5 nuclear power plants. The regulatory authorities and their experts would accompany this process in a suitable fashion and monitor and review it after its implementation.

At the TÜV Symposium in Munich on October 30, 2004, a presentation had already been given on the concept of the an indicator-based safety management system (SMS).
The following presentation shows the process during the development of the system, the status of its introduction and the general involvement of the Regulator.

This presentation describes 5 major stages:

- The SMS project concept
- The inclusion of model processes
- The preceding reference processes
- The classification and capture of indicators
- The implementation process.

At the end, there will be some conclusions and perspectives for the planned completion of the project.

2. The SMS project concept

The indicator-based safety management concept (SMS) is based of the introduction of a process structure in accordance with the specifications of DIN EN ISO 9001:2000 and DIN EN ISO 9004:2000.

The process-oriented approach promotes:

- Thinking in terms of processes and effects instead of functions
- An opportunity to measure the process performance
- High transparency and thus a better understanding with regard to:
    - Interfaces between sections / departments
    - Interfaces between processes
    - Functional and formal responsibilities.

Furthermore, suitable indicators should be used to measure the process performance. For this purpose, the process steps, which are of particular significance for the smooth course of the process as well as the provision of the expected process performance are monitored by indicators, if possible. They are captured and subsequently evaluated using a computer-based evaluation system. Deviations from the target values can be detected immediately and timely corrective actions can be performed. The evaluations also provide the basis for the regular management review. In this step, all results are collected and new targets are defined.

The SMS concept is described in a concept report, which contains:

- The definition of the SMS
- The definition of requirements
- Examples of processes and indicators, and
- An implementation schedule.

The experience of the past two years has shown that the definitions in the concept report are only of a general nature. The experience gained in the development phase such as the presentation of the process model, the process scope to be covered and the definition of the safety management system has been included in the revision process and resulted in an optimisation of the initial concept.

This has also been apparent during the review of the concept report by the Regulator. This review was performed by GRS and a working group of TÜV experts as well as the Institut für Arbeitswirtschaft und Organisation (Institute for Labour Management and Organisation) of the Fraunhofer Association in Stuttgart. The mission and the outcome of the review are part of the report by the Ministry for the Environment of the State of Baden-Württemberg, which will be presented at this symposium.

A major specification for the development and introduction of the SMS system is that the three sites of the future EnKK will work on the same basis and employ comparable processes, indicators and capture, processing and presentation tools.

Plant-specific features of individual sites such as an imminent decommissioning activities, IT systems and organisation are taken into account in the process scope and the process design.

The implementation schedule contains the following main stages:

- Definition of a project organisation
- Identification of relevant processes, verification of the process model
- Compilation of model processes with a definition of indicators
- Simultaneous introduction of reference processes
- Designation and training of process mentors
- Discussion of indicators
- Introduction of adapted processes
- Verification of the set of indicators.

The establishment of the Project Organisation unit started in August 2002. It initially included the General Project Manager, one project manager for each of the three sites, supporting staff from the plants and mentors from the concept group. This project team now consists of 9 permanent and 5 temporary support staff.

In intervals of approx. 4 months, it reports to the steering committee, which is composed of the Boards of Management of EnBW Holding, EnBW Kraftwerksgesellschaft as well as the Directors of the plants involved.

Every 6 months, the project team draws up a status report, which forms the basis for the status discussions with the Regulator and the associated technical experts.

The first major task was the definition of the (safety-relevant) processes concerned as well as the verification of the process model.

2.1 Process Model

In the process model, processes are broken down into

- Management processes
- Core processes (implementation processes)
- Support processes.

Management processes include all processes, which are used to determine specifications and targets for strategy, resources, the structural and functional organisation and assess the effectiveness of the overall management system.

Core processes include all (operative) processes, which are directly required for production (in this case: of electric energy). Because of the special significance for power plant operation, these processes also include maintenance processes and the purchasing and disposal of fuel elements.

Support processes include all processes, which are not directly involved in production, but which are important for smooth operation.

In the EnBW-SMS, 68 processes are devided in these three groups. The process model is shown in the following illustration:

(For the illustration, please refer to the original chart of the process model)

2.1 Inclusion of model processes

A process manual provides for the relevant process aspects. It describes the development and translation of the strategy into measurable operative targets and the link to the safety-related structural and functional organisation, which is required to implement the strategy and achieve the objectives. It describes the SMS together with its processes and workflows, its review for functionality and effectiveness and the method for a continuous improvement of the SMS.

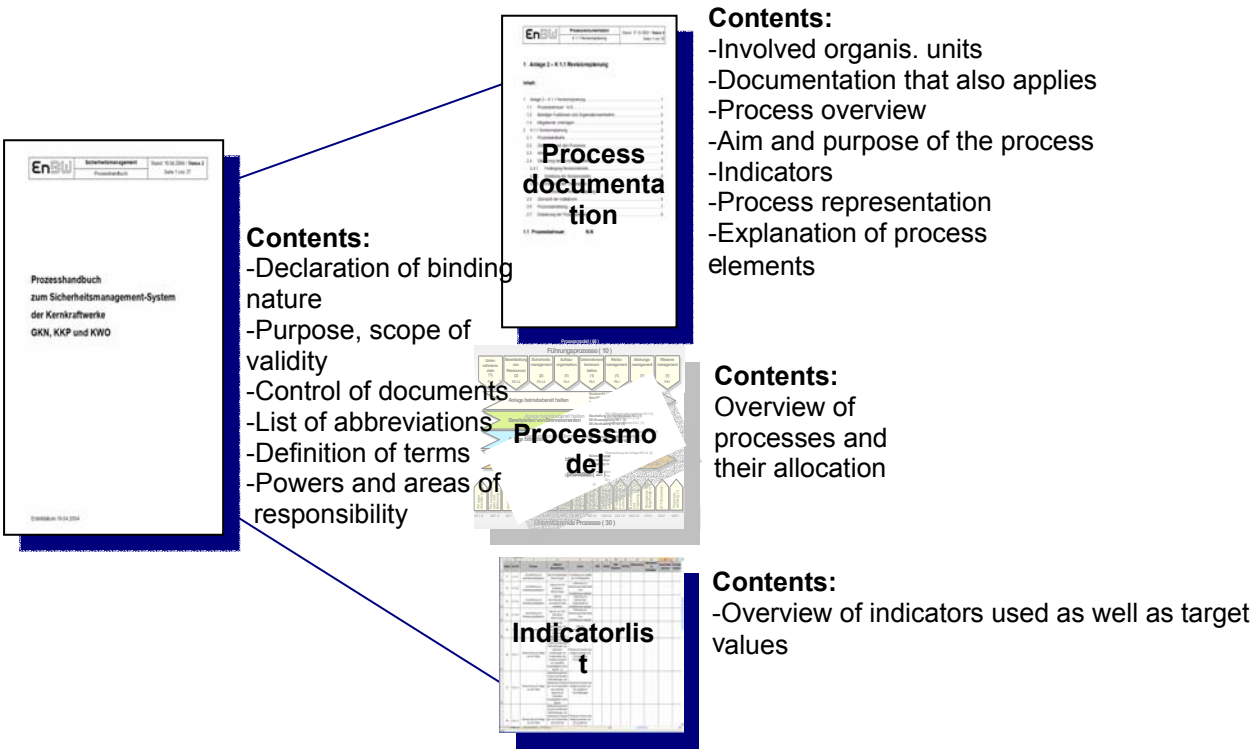
The first area of the process manual deals with the safety principles or guidelines as well as their derived safety targets. As a result of the statement of applicability by the ENKK Directors they are binding in terms of the practical application of the processes.

A second area describes the link with the existing structural organisation as well as the management system documentation and the concrete responsibilities of the organisation within the SMS, supplemented by the description of the elements utilised for process illustration.

The process documentation of the test cases and established processes together make up the third complex, which contains detailed auxiliary data that may not be represented in the process illustration. Among others, these are data referring to the desired performance and objectives of the process, to the indicators and process links with the referenced documents, such as e.g. sections of the operation manual, a.s.o. Certain parts of this scope are location-specific. The object is to link the processes with the existing regulations.

The last part included is a list of valid indicators, stating definitions, purpose, frequency of measurement and evaluation, responsibility for measurement. This list provides an overview of the currently applicable scope.
The documentation structure of the process manual is displayed in the following illustration.

2.1.1 Documentation Structure of the Process Manual



2.1.2 Continuous Improvement of the Safety Management – PDCA Cycle

The continuous improvement of the SMS and therefore ultimately the continuous improvement of the safety performance of a system / process is controlled by the safety management process in co-operation with a process monitoring process, allocated to each process. The safety management process together with the corporate objectives, the management review and the process monitoring represents a closed PDCA cycle (Plan-Do-Check-Act) and thus affects the entire SMS.

It ensures that the experience gathered in the operative sector in dealing with the SMS – and particularly the system of indicators – is systematically measured, evaluated, and assessed in view of its suitability and performance in the context of the Management Review.
In doing so, an assessment is made in order to determine if the indicators are suitable for accomplishing their function or if they will have to be modified.

These modifications could comprise:

- The deletion of indicators that are not meaningful (illustrative, difficult to measure)
- The introduction of new indicators, provided that this is required for the identification of deviations and the measuring of the performance of a process
- The adaptation of the setpoints of the indicators to new experimental values obtained or a different general setting.

The PDCA problem should be identified in the process structure and illustration.

2.1.3 Process Illustration

The process-based layout illustrates the process of a power plant transparently and in the form of logical processes, irrespective of departmental boundaries. Due to this it differs from the traditional view, where the operational functions are functionally broken down into individual areas, such as e.g. departments and sections.

All processes are broken down into process steps and graphically illustrated. The underlying notation of the process illustration is based on the Swimlane representation and was illustrated with the help of a Standard Business Profess Management Software (COREL iGrafix®Process™). In order to provide a better understanding of the operating sequences, each process is described in a process documentation, stating the process target and purpose in detail together with additional explanations referring to the content of the process.

The level of detail, i.e. the number of steps illustrated within a given process is specified by the following criteria:

- Not more steps than necessary to make the process transparent and clear
- All steps, which represent links to other processes
- All steps, which represent points of interface between different organisational units
- All steps, backed up by indicators (cf. below).

Depending on the complexity of the process, the level of detail of the processes is between 20 and 70 individual steps. Each process illustration contains information on the links to other processes, the organisational units involved, and the indicators (allocated to the respective steps.

2.1.4 Structure of the Process Illustration in COREL iGrafix

“Process sponsors” were appointed in the SMS team for the acquisition of process data. Their function was the development of a prototype process on the basis of known and accessible information.

This suggestion was discussed and optimised during the team meeting. The basis for data acquisition was the sponsor’s knowledge of process sequences or the information gathered from the experts at the individual locations. Additional information obtained from IAEA, WANO, VGB and others were taken into account for the process layout.

Based on this, best practises were developed for the process sequences and “prototype processes” were outlined in an illustration. Current events of the plant and of other plants were compared against this prototype process.

Focussing on the topics, such as optimal process sequence, degree of details, points of interface, and specification of indicators, was – in view of a transfer of knowledge – just as important as the result as such, i.e. the process illustration and the indicators.

2.2 Introduction of Reference Processes

The board of directors of EnBW Kraftwerke AG – subject to co-ordination with the regulatory authority – suggested the introduction of three initial processes as reference processes. The objective of this measure was the gathering of experience for the design and introduction of the processes. The following processes were selected:

- Management review
- Technical clarification (from maintenance processes)
- Recording of events and feedback of experience

The processes are currently being introduced. The operational instruments affected, e.g. the control system, are adapted to the requirements of the SMS. The findings obtained were taken into account in the following project phases

2.3 Classification and Acquisition of Indicators

Indicators are reference figures that are used to asses whether or not a system, a process, or an activity achieves the expected objective.

They are relative variables, usually derived from the ratio between actual and setpoint value.
Resulting from this:

- Indicators may be used as a reference figure for early warning purposes by specifying the setpoint value in such a way that corrective action may be taken in time before the specified limit value is reached, prior to the process or system entering a state that is not desirable resp. may no longer be corrected.
- In order to allow for the targeted utilisation of indicators (e.g. in an early warning system), the setpoint and limit values will have to be defined accordingly.

Indicators may generally be defined “top down” or “bottom up”. In a bottom up approach, the point of departure are setpoint values that a process or system is to provide as final result (“output”) – without necessarily focussing on the details of individual processes or activities that will bring about the result. The indicators listed in the TECDOC 1141, the so-called VGB indicators – developed by the SMS team of VGB and based on the TECDOC indicators, together with the indicators of the UVM (Ministry of Environment) in Stuttgart, are largely such indicators.

In a “bottom up” approach, primarily used in the SMS of EnKK, the processes are analysed in view of safety-relevant process steps or activities, and indicators will be linked with these steps or activities. The advantage of this approach is the fact that indicators are obtained that, on account of their direct link to the processes, point out deviations from the setpoint state more specifically than the indicators created in a “top down” process.

According to our experience the “bottom up” approach requires considerable efforts.

The following will have to be taken into account:

- The first step is to specify a procedure that allows for a systematic analysis of the steps within a process with respect to their significance for ensuring the process performance
- This procedure is used to identify the steps in each process that are particularly important in view of the process performance
- The “critical” steps thus identified are then analysed in order to determine if setting an indicator will actually be *possible* here.
  Here, *possible* means: May the respective process step actually be “measured” with a suitable indicator?

The next step is to select those indicators that are the most meaningful - combined with an acceptable level of efforts required for their acquisition - from the range of all possible resp. desirable indicators.
This selection of indicators is highly significant in order to establish a clear, meaningful and acceptable system of indicators. It is not the quantity but rather the quality of indicators, which will be decisive.

The first step towards a selection was taken for the known scope of processes in a workshop in late July of 2004.

If each establishment of a number is interpreted as an individual indicator, based on an initial set of indicators of approx. 150 indicators, then the range will be expanded to approx. 230 indicators, if the specifications of the regulatory authority, of VGB and WANO are taken into account. They are distributed to 68 processes. Approx. 50 indicators of EnKK were either deleted or neglected due to their similarity with UVM or VGB. The result is a “proprietary” set of 104 indicators.

During the further course of the project the data will be streamlined and summarised in an illustration. The intention is to treat the indicators that refer to reportable events, categories of discrepancy

reports, or run-time of work permits accordingly. The current assessment is that the number of resulting illustrations will be reduced to less than 100.

Data required for the indicators will have to be acquired continuously or discontinuously. This may ideally be realised on the basis of existing systems (e.g. control system, RP measurements, ZMA, etc.), using electronic systems or databases. It is imperative to verify if retrofitting to or modifications of new systems are meaningful. EnKK will verify if the changing from IBFS to BFS-nuclear may be used for the manual and automated acquisition of indicators.

Approx. 77 % of the indicators will have to be acquired manually from existing reports, the activities of supervision, walkdowns or the like. Until the introduction of a common IT-supported user interface for data acquisition, this will be done using EXCEL indicator acquisition forms that are based on the VGB masters. The EnKK locations have been acquiring the indicator sets agreed upon since early September, the objective being their assessment in the management review. A selection of indicators will then be submitted to the regulatory authority.

A pilot system for the electronic evaluation of indicators is currently being developed in parallel to the manual acquisition, which allows for the reporting of data and the continuous tracking and analysis of the indicators for the process managers.
Indicators resp. a selection of indicators are to be summarised for individual target groups (e.g. management, safety management officer, process officers) in such a way that they allow for obtaining a quick overview of the system condition in the form of a clear but informative information system (“cockpit”). The objective of the system is a reduction of the response time in order to be able to respond even quicker to system changes than is possible with the previously used system that are already highly sophisticated.

2.4 Process Implementation

Plant-specific implementation of the SMS at three locations started after the process workshop in July. To the extent required, both the processes and the process manual were adapted to suit the specific requirements at the location. Specific requirements may mean, for example:

- Fundamental differences between individual processes, but where each viewed individually reaches the safety objectives.
- Other applicable documents that are part of the process
- Changes in the operating conditions (e.g. dismantling of an installation)

For each location, specific persons responsible for the process have been designated by the power station management in each case. At this stage of the project, the persons concerned are managment personnel, i.e. proper authority for the purpose of introduction and for changes is assured. The co-ordinate the collection and analysis of data, indicators and changes in the process descriptions and indicators as required. This may happen, if procedures are modified, or if it becomes necessary to make changes to the indicators as a result of the Management Review. The tasks of the process oficers are described in the Process Manual:

During the introductory phase:

- Familiarisation with the sample process concerned
- Comparison of lived plant processes with the sample process
- Determination of the differences
- Discussion of the differences with the SMS team
- Incorporation of possible changes into the plant-specific adaptation
- Approval by the responsible body in each case of plant-internal introduction.

After implementation:

- Process monitoring, measurement and verification by reference to indicators

- Provision of process data for the management review
- Co-ordination of the preparation of proposals for correction, for example in response to breakdowns, or optimisation of the process in agreement with all those involved in the process

In order to prepare the staff involved and the process co-ordinator for their future duties, a training programme has been developed. Since September, these members of staff have been informed in small groups of up to ten (10) persons. The emphasis of the training program is on the following points:

- Process fundamentals
- Distinction from existing systems
- Tasks and duties of the process co-ordinator
- Demands the process co-ordinator may make on the officer nominated for safety management

The processes have been introduced into the information network as an HTML version in their current state. Hence both the employees and the process co-ordinators have the opportunity to inform themselves of the development state.
The constant dialog within the SMS group and early discussion of critical questions with the future process co-ordinators and specialists are designed to ensure a high degree of acceptance at the (various) locations.

3. Experience gained during implementation

The following experiences have been gained so far during the implementation:

- Insufficiently accurate definitions led to discussions on basic principles in the team and with other staff members.
- The bottom-up approach required a lot of staffing and time in the presentation of processes and the identification of indicators.
- Stand-alone indicators rarely provide a clear statement whether a process works well or is poor. In almost all cases they have to be assessed under the aspect of Engineering Judgement. A “traffic-light representation of these indicators seems too simplistic.
- In order to prevent a duplication of rules and a multiplication of documents, the existing management systems and rules must be merged.

4. Conclusion

The SMS project started in mid-2002 and, based on our present knowledge, it will be completed in mid-2005. The creation of model processes and their associated indicators has been in progress since September 2004. The preparation of process managers for their tasks in connection with the SMS has started and the individual sites have completed or plan for the completion of these preparations in the near future.

The adjustment of the model processes to the plants has started across a wide spectrum and these activities are accompanied by a discussion and capture of indicators. At the end of October 2004, there will be an initial communication between the Regulator and EnKK on this basic set of 58 indicators.

At the end of 2004, 35 of the 68 processes will be implemented at our three sites. A pilot system for the capture, processing and presentation of these indicators will be developed simultaneously.

The fact, that the Regulator has accompanied the project in the past as well as the associated discussions were often beneficial for the project, as they contributed to clearer presentations and definitions. In case of the additional safety performance indicators of the Ministry for the Environment

(UVM), the ministry opted for a top-down approach. This did not facilitate the project activities, as far as the acceptance of indicators is concerned.

The effect of the project work may be that, based on the information gained by the SMS, the level of supervision can be reduced to a sensible level.

The project will end in mid-2005 with the introduction of all plant-specific processes; it is expected to make a significant contribution to the self-monitoring capability of the EnKK nuclear power stations.