NUMEX 2002: Excellence rewarded

BY DICK KOVAN

The winner and four other finalists in the NUMEX competition developed effective, cost-efficient solutions to a variety of maintenance problems at their nuclear power plants in Europe.

While annual maintenance outages and large renovation projects make good use of experienced contractors, keeping the plant safe and operating day after day—a plant's main priorities—depends on the skills of its own maintenance staff. The hands-on knowledge of these workers is being tapped at the best plants to reach the levels of performance demanded in today's competitive deregulated markets.

Sharing experience is common practice among the nuclear maintenance community. To acknowledge and reward their achievements, NUMEX, the Nuclear Maintenance Experience Exchange—an organization of plant maintenance managers and engineers launched in 1986 and sponsored exclusively by utilities, most of them European—holds a competition to promote a proactive approach to safety matters by maintenance teams at nuclear power plants. NUMEX is administered by Brennus SA, a group of consulting engineers based in France.

The teams are encouraged to come up with ideas and new ways of keeping plants safe. The work presented by the NUMEX Trophy finalists for 2002 focused on a wide range of challenges faced by maintenance workers—from problems that impede normal-type activities to major threats that could shut down plants if they are not dealt with in a timely manner.

This year, five teams nominated by their plant maintenance managers were selected to take part in the finals of this contest. The winner of the 2002 competition was British Energy's Sizewell B, for its identification of safety concerns associated with maintenance activities. The other teams were: CEZ's Dukovany (Czech Republic); Electricité de France's Paluel (France); Kernkraftwerk Leibstadt AG's Leibstadt (Switzerland); and Vattenfall AB's Ringhals (Sweden). The judges looked at achievements based on the following four criteria:

1. Showed effective teamwork.
2. Challenged old and established methods, solutions, or behavior.
3. Can be used by many plants now and in the future.
4. Showed a good safety culture in the plant.

The following accounts describe the submissions of the winner and other finalists.

How maintenance groups took on safety at Sizewell B

Sizewell B NUMEX Trophy competition presentation team: Adrian Jones, Safety Liaison Officer; Colin Murphy, Maintenance Team Leader; and Stephen Ford, Maintenance Group Head.

When the Heavy Team in the Maintenance Group at British Energy's Sizewell B pressurized water reactor raised several safety concerns, it had little idea that this would develop into a prize-winning entry for the NUMEX Trophy 2002. Early in 2001, the Heavy Team brought to its team leaders particular concerns over the way certain maintenance operations were carried out. The team leaders threw the idea back to the Heavy Team, asking its members to propose solutions to the problems. At the same time, the Light Team brought forward concerns about a number of tasks that it performed, and was also asked to develop solutions. (The teams' names—Heavy and Light—reflect the type and size of components each deals with.)

Among the concerns presented by the Heavy Team and the Light Team and solutions developed to address those concerns were the following:

The turning rig for the ESW (essential service water) strainer lid developed by staff at Sizewell B (BE)

A tripod lifting frame for removal of sump pumps from cable tunnels (BE)

■ *Essential service water (ESW) strainer lid removal—lifting slings cut when turning lid.*

During removal of the ESW strainer lid, lifting slings were being cut when the lid was turned. The problem was that when using the crane to turn the strainer lid, bolt holes had to be used as lifting points, and the slings were rigged to them, since there were no designed lifting points.

The solution was to design a purpose-built mechanical means to hold the strainer lid so that it could be turned in a controlled manner. The turning rig was made to accommodate the strainer lids from both the ESW system and the auxiliary cooling water (ACW) system. The rig allows mechanical work to be completed, as well as new coatings to be applied on the underside of the lid in a safe manner.

■ *Feedwater strainer removal—lifting an unbalanced load.*

Previously, when the main feedwater system strainer for maintenance was being disassembled, the strainer had to be lifted clear of the body and turned from a vertical to a horizontal position. Because the top of the strainer is very heavy, there was an unbalanced load when turning it was attempted.

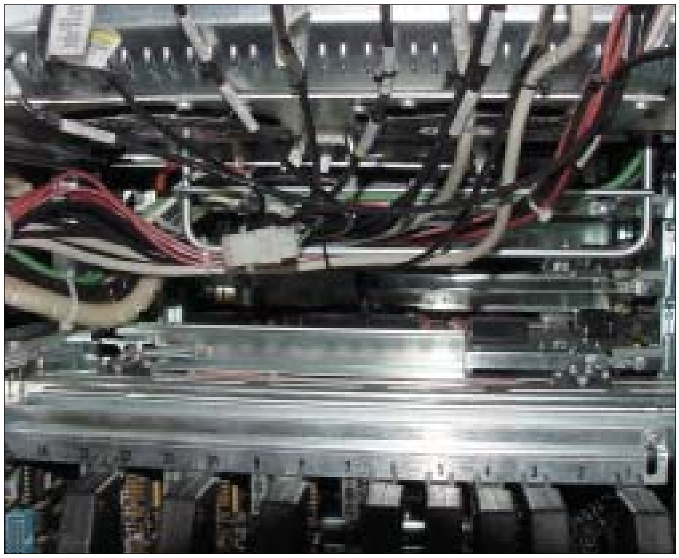
The team proposed removing the top of the strainer while it was still in the strainer body, simplifying the whole disassembly operation. This could be achieved by manufacturing supports for the strainer that would hold it in position while the top was removed. The systems engineer agreed to the solution, and produced a new lifting procedure for the task.

Sizewell B: Solutions to maintenance operations concerns lead to a win

■ *Circulating water (CW) wash water pump removal—fitting of chain blocks; and powered access platform transfer—too heavy to handle manually.*

Continued

A team identified the solution of using purpose-built ramps to enable lifting trolleys for SPS/PPS (secondary protection system/ primary protection system) circuit breakers to be moved over a high-integrity fire door with a large step built into it. (BE)



As a result of a team suggestion, during an M-chassis fan change in the HIS/PPS (high-integrity system/primary protection system), exposed 110-V live connections were shrouded using a modified socket from a redundant fan (BE).

These two concerns were resolved using the same piece of equipment. First, the CW wash water pump needed to have a chain block fitted to a runway beam in order to lift and move it. Access to this beam had previously required either erection of a scaffold, which obstructed the work area, or access via a ladder.

Second, the station had a powered access platform designed to be used in large clear areas where vertical access is required. When needed, this unit had to be maneuvered through fire doors by tipping it backward; on one occasion it nearly fell onto an electrician. A vertical access platform was identified by the Heavy Team and its Team Leader after reading an article in a trade magazine. The access platform did not require any power source, and would fit through the station's fire doors. After getting approval from the safety section, a unit was bought and is currently in use, including for fitting the chain blocks. In addition, the station traded in existing chain blocks for new lighter units to further reduce manual handling concerns.

■ *Sump pumps' removal from cable tunnels—manual handling.*

Some of the cable and pipe tunnels at Sizewell can only be accessed via vertical ladders. The tunnels have installed sump pumps that can be removed only by lifting up through access hatches. Previously the lifting was carried out manually. The team identified a tripod lifting frame after seeing a television program on work being carried out within sewers, where the tripod was used as a rescue aid. The tripod was successfully tested at the site, and a unit was purchased.

■ *Cable riser access hatch removal—manual handling.*

The cable risers are fitted with a fire detection system that requires the detector heads to be tested at a regular frequency. Access to the detector heads requires the removal of inspection covers, which can weigh as much as 75 kg and present a manual-handling risk, especially as a number of them are located within stairwells, which presented an uneven footing. The team identified a modular access system that could be used for lifting applications up to 250 kg. This system can be built on different levels allowing it to be used in stairwells.

■ *High-integrity system/primary protection system (HIS/PPS) M-chassis fan change—live connectors exposed.*

When changing the cooling fans within plant control cubicles, the processor cards must not be disturbed, as this could affect plant controls. The procedure asked for the 110-volt supply to the fans to be disconnected. When the plug is removed, the 110-V connections are exposed. The previous solution was to tape over the plug while work was in progress. The team suggested using a modified socket from a redundant fan to shroud the connections on the plug. The procedure was changed to reflect the use of the new shroud.

■ *Secondary protection system/primary protection system (SPS/PPS) circuit breaker lifting trolley—transferring between rooms.*

For seismic concerns, the lifting trolleys for the SPS/PPS circuit breakers are not stored in the circuit breaker rooms. When moving the trolleys in the rooms, it is necessary to pass through a high-integrity fire door that has a large step built into it. The trolleys are heavy and had to be manually lifted over the step to get them into the breaker room. The team identified a simple solution of having purpose-built ramps made that could be removed after use, thus removing the manual-handling issue.

These examples show that the maintenance teams have developed solutions to a wide range of safety issues. Some solutions were simple to achieve, while others were more complex. The teams designed, built, or purchased equipment to remove risks and identified changes to procedures that also eliminated them. Most important, said Steve Ford, maintenance group head, "they owned the problem and made the solution happen."

The basic concept—teams identifying their own safety-related concerns and working to remove them—has changed the way safety issues are managed at the plant. Not only are these developments discussed at safety forum meetings, where safety representatives and safety liaison officers (SLOs) try to resolve safety issues at a working level, but the Health and Safety Committee (HESAC) has also taken an interest. HESAC was impressed by how the groups developed their own solutions to problems that they themselves identified. The committee decided to extend the idea more widely.

Now, all work groups including contractors are invited to identify their safety-related concerns to the HESAC. The initial results of measures adopted are placed in a report by each group. This report is now a HESAC agenda item, and progress is reported at each meeting by the groups themselves. The report is a live document allowing each group to add a new issue or remove one when a satisfactory solution has been implemented.

"Progress to date has been positive," said Ford, "and the example of maintenance groups owning their safety concerns and providing the solutions is an example to the rest of the station."

Section continued

A new sealing for SG header covers at Dukovany

Maintenance manager: Zdenek Linhart; team members: Lubomir Charvat, Libor Soukal, and Oldrich Hlavka, at Dukovany, and Jaroslav Bartonicek, from Neckarwestheim, Germany.

After 10 years of operation of CEZ's Dukovany station in the Czech Republic, cracks were discovered in two steam generators, necessitating replacement of the upper part of two headers. The cost of such an operation is significant, and the problem had to be resolved as quickly as possible to avoid having to replace more of these components, which are vital to the economics of VVER 440 pressurized water reactors.

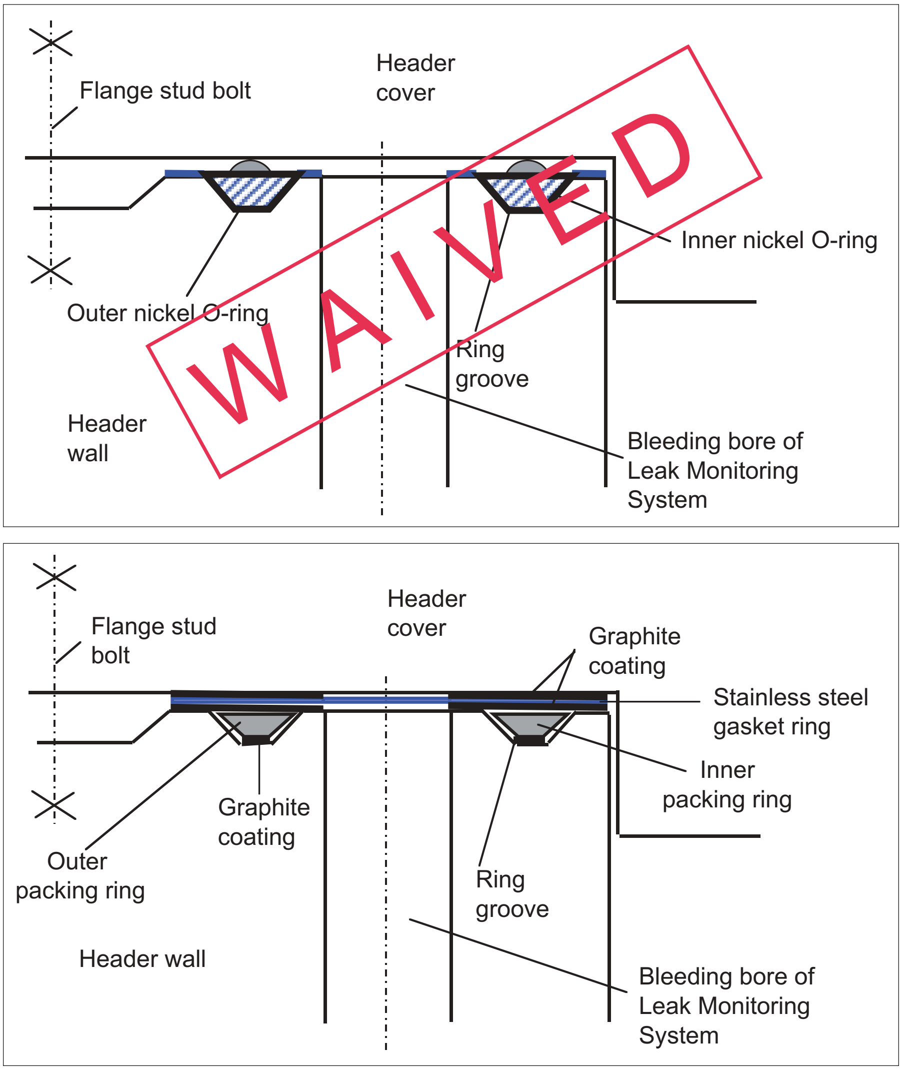
Dukovany has four of these Soviet-supplied reactors, each having three horizontal steam generators. Each steam generator has about 5500 U-shaped tubes connecting the two primary headers—intake and outlet—which are accessible through manhole covers sealed with flange joints. An inspection found that cracks had developed at the bottom of the threaded bolt holes used to hold down the flange joints on two steam generator headers. As these cracks were beyond specification tolerances, the affected parts had to be replaced. Besides the cost of the new parts, this operation involves an extended outage and an additional collective dose burden to maintenance workers of about 55 person-mSv/header.

The flange joints were originally sealed with a pair of nickel O-rings (6 mm in diameter) pressed down by the cover and tightened by 20 stud bolts. In order to achieve a sufficient sealing tightness, the bolts have to be tightened with a considerable force (272 kN). Leak tightness of the flange joints is monitored in the interspace between those two rings. A material analysis performed on part of one of the removed steam generators identified stress corrosion cracking due to the high tightening force in the presence of corrosive media as the cause.

To resolve the problem, a team was set up, composed of plant staff plus an expert in materials and sealing brought in from Germany. After looking at various options, the team concluded that it was necessary to design a new sealing system using graphite to ensure a good seal.

The approach taken by the designers was to make full use of the original geometry of the sealing surface of the flange joint, including the atypical trapezium grooves. This would avoid the need to machine new grooves or modify the original ones, which would introduce thermal energy into the sealing surface with a danger of cracks developing in the repaired area.

A new stainless steel gasket ring was de-



Original configuration (top) and modified configuration (above) of steam generator header flange sealing at Dukovany (CEZ)

Testing of the new stainless steel gasket ring that seals the steam generator header covers at Dukovany (CEZ)

veloped having a ridge-shaped top and bottom surfaces with graphite foils covering both sides. There is also an interspace for a leak monitoring system.

Using this gasket ring, however, required a certain minimum width of sealing surface, which was not provided by the existing configuration of the flange face due to the ring grooves on it. One alternative considered was to weld in the existing grooves and then machine a new sealing surface of sufficient width. The team waived that idea for the following reasons:

■ Welding would introduce additional thermal energy in the material, which could result in cracks.

■ Welding in the groove would make a nonreversible change—in case of unsatisfactory operation results, there would be no possibility to revert to the original type of sealing.

The solution chosen was to insert stainless steel packing rings of trapezoidal cross section in the grooves to achieve the required flat sealing surface. The bottom side of the packing ring also was coated with the graphite foil. With the packing in place, it was then possible to use the new gasket ring.

A seal was then made and tested on a full-scale test bench, which used one of the replaced headers. For all tests, the bolts were tightened by a force of about 200 kN, about 26 percent less than the force required for the original nickel rings. Different sizes of the graphite foils and different modifications of the packing ring were also tested.

The test results confirmed that the new sealing system meets the requirements of leak-tightness. In fact, the measured leakage at the reduced force indicated that the modified sealing was approximately twice as leakproof as the original sealing. In addition, calculations of the sealing behavior during all possible operating conditions (including emergency) were performed by the Institute of Applied Mechanics.

After obtaining the regulatory authorities' approval, the new sealing system was installed on both primary headers of one of Unit 3's steam generators in May 2001. After the first nine months of operation, the system fully met expectations.

The alternative chosen also provided substantial savings. The project team calculated a cost savings of €1.450 million (now about $1.450 million) by avoiding the replacement of the upper parts of the headers, plus the extra costs had the alternative solution been adopted (for modifying the sealing surfaces and using a different metal packing).

This modification also provides a good basis for considering other measures, including an extension of the steam generator inspection interval from four to six years since, unlike nickel, graphite does not harden under high pressure and temperature.

Never in crisis—the Paluel way

Maintenance manager: Pascal Maugey, Deputy Director for Technology and Finance; nominated team members: Alex Cresson, Head of the Technical Evaluation Committee, and Tony Bizet, assistant to Cresson (plus one organization adviser and some 25 engineers and technicians belonging to various departments for implementation).

For Pascal Maugey, technical director at the Paluel station of electricité de France, crises not only compromise safety, they also prevent the plant from achieving its primary goals: continuing to produce and improving production. Furthermore, notes Maugey, these goals can be put at risk by a variety of threats, due often to a lack of awareness as to technical faults.

In 2000, his plant was almost shut down by the French Safety Authority for an environmental infringement. At the same time, Maugey discovered a disturbing lack of cooperation among the station's three engineering groups. He also found a dissatisfaction among staff that their achievements in resolving problems and implementing improvements at the plant were not visible.

These attitudes could cause problems for the plant. As he was well aware, there are numerous examples everywhere in the world where staff had ignored or been unaware of rules and regulations, which have led to shutdowns. An example is the D. C. Cook plant, in the United States, which had implemented several safety modifications without providing the regulator with the necessary analyses. The Blayais station, in France, came very close to being shut down

Paluel: Minimizing potential threats to plant priorities (EdF) because management did not respect its commitment to provide certain documents for the safety case of the breakwater protecting the site from river floods—which it failed to do on one occasion.

After considering what he found and the implications of those findings, Maugey asked the engineering department to consider ways for dealing with potential threats to the plant priorities. This led to what in English he calls NICS—Never in a Crisis Situation—which is designed to foresee threats, treat them at the appropriate level, and provide a clear assessment of the risk, in order to ensure that "the plant can continue to produce and continue to improve," said Maugey.

Working with the engineering groups, Maugey soon noted a change in the people. They became highly motivated, overcame any resistance they felt toward change, and worked hard to develop the idea and implement a workable system.

This was the starting point of NICS. One of the first steps was to determine the types of threats that existed. These were categorized as:

■ Rules and regulations not being complied with.

This not only includes legal and regulatory requirements, but also technical specifications and demands imposed at corporate level, such as its preventive maintenance programs. (Maugey noted that in France, since Napoleonic times, decisions have been and continue to be taken in Paris.)

■ Commitments made to the Safety Authority not kept.

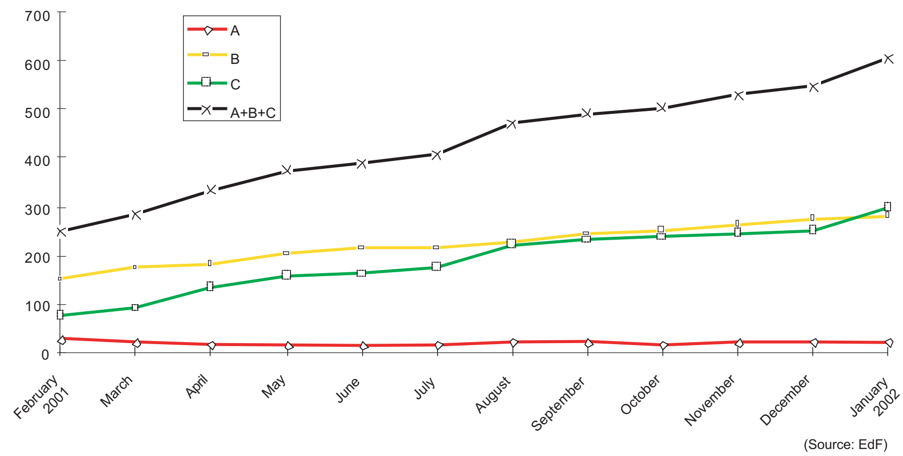


Fig. 1. Number of files at each status level at Paluel

For example, vibration problems on the safety injection primary circuit pumps at Paluel-1 were discovered during the 2001 outage. The plant then made a commitment, after negotiations with the Safety Authority, to resolve this problem during the next outage. If they didn't do so, the reactor would not be authorized to start up.

■ Unforeseen breakdowns because signs not recognized.

There are often only minimal warning signs of potential problems. Maugey particularly cited corrosion and aging phenomena, which can go unrecognized, putting the plant at risk. For example, Paluel faces the English Channel, which presents a highly corrosive environment for many important systems, such as cooling systems, threatening their ability to withstand earthquakes.

■ Lack of surveillance of evolving nuclear context.

Maugey noted that in France, regulatory requirements, safety standards, and environmental rules are changed fairly frequently, and it is necessary to keep aware of what government and regulatory agencies are doing. The nuclear context also refers to the wider world, such as what is occurring at other nuclear plants and what is happening in the media.

NICS requires constant watchfulness and dealing with potential threats in a proactive manner. The NICS process comprises four "actions":

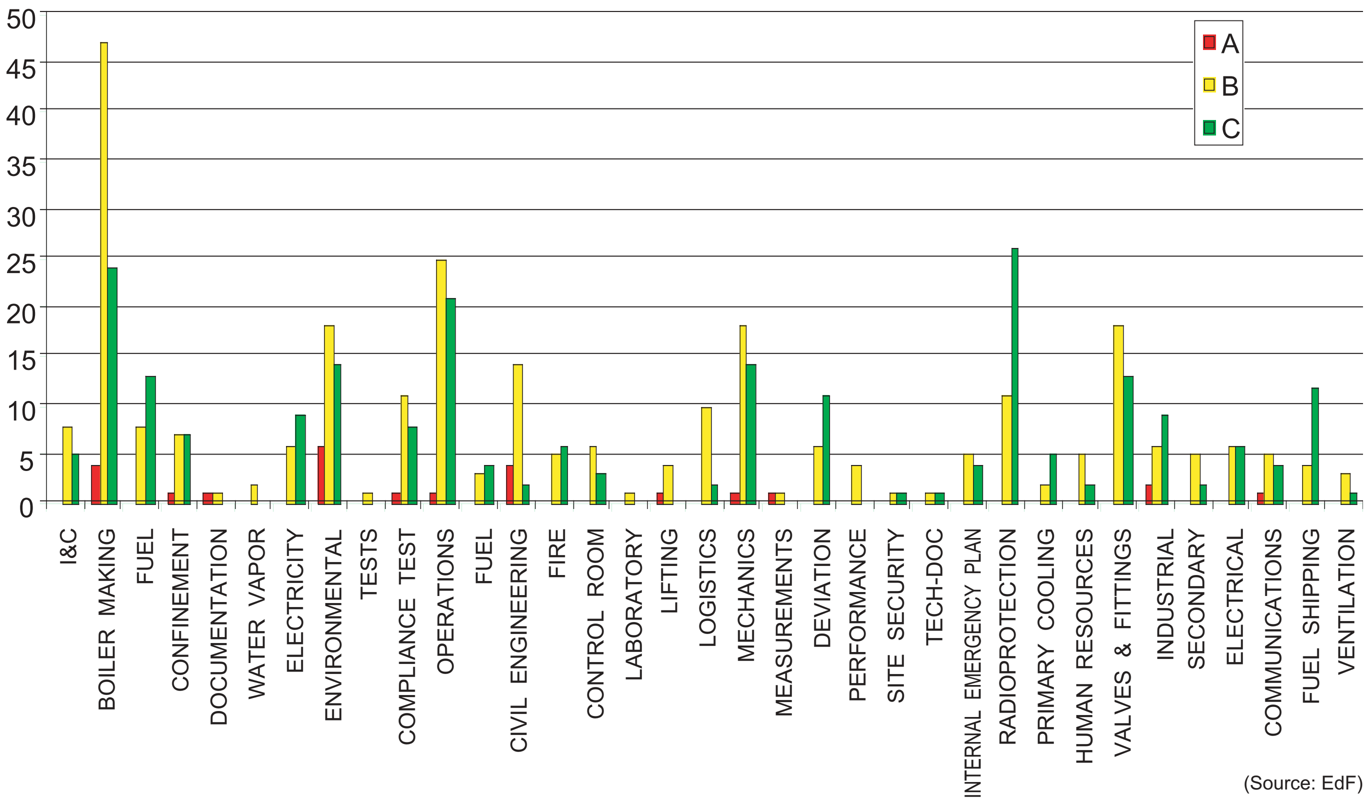


Fig. 2. Number of files at each status level in each Occupational Activity Sector at Paluel

—Identifying potential threats.
—Analyzing the information available and relevant observations made.
—Putting together files on the threat and actions undertaken: It documents the risk assessment, the priority level, proposed strategy and associated treatment, action plan timetables, resources needed, what has been completed, follow-up procedures, etc.
—Implementing and monitoring the treatment.

The Technical Assessment Committee (TAC) has been put in place to provide the necessary assessments. It considers the risks and develops a strategy to resolve them. It also distributes the relevant information. It meets every two weeks.

For each file, TAC will ascribe a status level—A, B, or C—indicating where in the process it is: A. Alert (red)—an alert is called when potential threat is identified; B. Begun (yellow)—treatment has begun; C. Closed (green)—corrective actions completed.

With the implementation of the NICS process, plant management also wanted to have an indication of the site's status at any time. This led to the development of three indicators: Site Alert Level; Number of files/Alerts per Occupational Activity Sector; and a file summary diagram (RASTA). These will help managers to monitor progress and to report and communicate information to staff.

First indicator: Site Alert Level gives the percentage of alert projects to the number of files in process—A/A+B. It is now generally agreed that a Site Alert Level of less than 10 percent is a satisfactory site status, 10 to 30 percent implies a need to improve and over 30 percent indicates a serious slide in the state of the plant. The number of files at each status level at Paulel over the year ending on January 31, 2002, are shown in Fig. 1. At that time, 7.84 percent of files were in A status. Within about a year and a half, more files have been closed than there are files in progress.

Second indicator: The number of files and red alerts in each Occupational Activity Sector is a measure of its status. There are 35 Sectors (for example, I&C, fuel, tests, security, deviations). As Fig. 2 shows, boilermaking (components including steam generators, piping, and tanks that are under high pressure) has the largest number of files (basically it is subject to the largest number of requirements), followed by environment, operations, and radiation protection; the environment is the most critical sector with 25 percent of the A alerts.

The first two indicators give a global overview of the site's weaknesses.

Third indicator: RASTA (Review of Activity Sector Technical Alerts) is an inventory of files listed by alert level. It is updated monthly. There is also a database, accessible to everyone at the plant, that provides a summary of the status of all files.

Continued

Corrosion and aging phenomena—as shown in the photos above—if unrecognized, can put the plant at risk. (EdF)

This is particularly helpful to shift workers, who need to know the condition of systems and components. Any staff member can input information into the database.

Maugey explained that NICS has had many significant effects, not all immediately apparent. It reinforces site safety through the rigor of the methods used to follow up on files, as well as the identification of "red" threats. It has also facilitated better cooperation among the engineering section, helping to rebuild team spirit on site: Employees appreciate that the system provides a measure of how successful they have been in avoiding problems. Other EdF plants have looked at this system and many have devised their own versions.

NICS is also used to assess performance improvement proposals at the station, as well as threats to safety. These have included, for example, suggestions to reduce the scope of maintenance, increase productivity, upgrade equipment, and others.

Already there has been a wide range of achievements, said Maugey, including:

Avoiding crises: Until now, the total number of threats has been about 600, of which about 300 have been solved. The list of "red alerts"—which could put the plant in a crisis situation—now stands at under 30. None of the "red alerts" has led to a crisis.

Optimizing production: The process of identifying and fixing potential threats can improve operation and provide cost savings. In one case, preventive maintenance of the main turbine generator was optimized, resulting in a saving of €40 000 per refueling outage. Another example is a change in material of condenser circulating pump impellers, providing expected savings over 40 years of €1.4 million.

Optimizing management: Site management and corporate headquarters are now better informed about the status of the plants and what the threats and potential problems are, which should facilitate how they are managed.

Upgrade of decontamination facilities at Leibstadt

Maintenance Manager: Ludwig Nedelko; nominated team members: Peter Kaiser (Project Manager), Gerhard Meier (Leader–Fitting Shop), and Rainer Pohl (Leader–Design and Drafting Office).

The original decontamination area at Kernkraftwerk Leibstadt AG's (KKL) Leibstadt nuclear station, in Switzerland, was built in 1984. Over recent years, the design and technology used had become unsatisfactory—dose rates were relatively high, contaminated water had leaked into lower-level rooms, crane capacity was insufficient, and large components could not be easily handled, along with other problems. Besides the costs involved, this facility certainly did not adequately support the plant's outage performance, which remains one of the best in the world.

In 2001, the plant set up an internal

New Decontamination Box facility at Leibstadt (Photo: Kernkraftwerk Leibstadt AG, Switzerland) project team to consider ways of improving the facility, which was used not only for decontamination, but also as a transportation path for equipment and as a staging area for fuel transportation and storage casks. Having also looked at how other plants dealt with decontamination, the team concluded that it was necessary to design, manufacture, and install a completely separate facility, a Decontamination Box, that could provide more efficient, safer and user-friendly handling of equipment, particularly heavy items, and reduce radiation dose to maintenance workers.

The new Deconbox was designed in close collaboration with the decontamination workers to ensure that all requirements and applications were considered from the point of rates and helping achieve the company goal of outage durations of only 16 days. The designers came up with the following dimensions for the Deconbox: area, 6 × 4 m; height 4 m; a dressing room of 2 × 4 m; and loading platform of 3 × 4 m.

Before deciding to construct the Deconbox in-house, the plant put out a call for offers, which resulted in a contractor bid of around €300 000, considered to be too high by the project team. In comparison, using Leibstadt staff would leave only material costs of around €75 000. Besides being cheaper, the team felt that completing the project in-house would bring other benefits.

The overall goals of the project were:

- To develop an efficient, tailor-made solution for Leibstadt using the plant's own resources.
- To optimize the use of decontamination processes and equipment using the staff's own experience, expertise, and know-how.
- To optimize the cost/benefit of facility operation.
- To improve outage and maintenance performance.
- To create an experienced team able to continue to develop the facility.

The types of components at the plant that have to be decontaminated include valves, internals, pumps, impellers, scaffolding, etc. The average volume of components to be decontaminated each year is about 15 metric tons. The main decontamination techniques that will be used in the new Deconbox are two high-pressure water jets (one 240-bar and the other 2400-bar) and sandblasting.

The design offers high flexibility in size, location, and extendability by using modular construction, and, with a minimum of moving parts, maintenance is easier. Its use provides a higher standard of safety inside the decontamination facility, as well as outside. The Deconbox has two security windows, a two-way communication system, and emergency exits. Its construction provides extensive noise reduction outside the box as well as inside. It is able to use an existing hall crane that provides substantial lifting capacity.

The Deconbox has many features to reduce dose rates, including:

- A decontamination-friendly design.
- Inside surfaces all of stainless steel.
- A 5-cm lead shield inside the 10-cm-thick wall (reducing outside dose rates by a factor of 7).
- Back-flushing equipment.
- Special transport wagon, making handling and decontamination of components easier.
- Short transportation track to the site radwaste building.

Apart from the cost savings, other benefits are being achieved, including:

- Providing a baseload for welding shop and other staff activities outside outage.
- Motivating the employees to carry out big projects in-house.
- Retaining know-how in KKL.
- Facilitating efficient communication between design engineers, project-team, operators, and workshops.

The new Deconbox was successfully used for the first time during the 2002 summer outage.

Continued

Ringhals sets out new Operation and Maintenance handbook

Maintenance Manager, Unit 4: Ulf Johansson; nominated team members: Lars Widen, Quality Engineer, Unit 4; Mats Ackring, Maintenance Engineer, I&C Units 1 to 4; Bo Hansson, Assistant Operation Manager, Unit 1; Stig Andersson, Maintenance Engineer, Unit 1; Ola Hansson, Operation and Safety Engineer, Unit 4; Sven-Anders Andersson, Operation Engineer, Unit 2.

At Vattenfall AB's four-unit Ringhals station in Sweden, operation and maintenance activities are subject to 5000–6000 instructions and enjoy an extensive document hierarchy. Knowing which are applicable for each task has been a big problem. While the maintenance department had a handbook to define its activities, the operations department did not. The new handbook not only describes all operations and maintenance activities clearly and comprehensively, but also provides simple connections between requirements and the detailed performance instructions. Besides being a reference book, it will inform staff in a variety of ways.

The handbook has about 150 pages divided into five chapters: 1. Introduction; 2. Responsibilities and management of operation and maintenance; 3. Operative activities; 4. Fundamental requirements; and 5. Index, definitions and abbreviations.

Chapter 3 contains some 30 sections, including all activities involved in operation and maintenance, organized by: P–planning; D–implementing; A–evaluating; and C–developing (for example, optimizing complex activities). It lists all requirements, standards, and recommendations that control activities, referencing them to technical specifications, and other relevant documents and to the requirements listed in Chapter 4. It also describes all jobs, referencing the relevant performance instructions.

Chapter 4 contains 14 sections that describe all requirements that are included in "FOD" and "VDD" documents: FOD documents identify all requirements (nuclear safety, environmental, etc.) of the various authorities and regulators that govern activities at the plant; the VDD documents interpret the requirements in the FODs. A person is appointed to monitor changes in requirements and update each FOD.

Chapter 5 provides an encyclopedic description of all important terms and abbreviations. These are cross-referenced to other chapters, and also reference all relevant documents, such as directives, technical specifications, instructions, and other handbooks (for example, on construction, environment, conventional safety).

The handbook was published at the beginning of this year. Since then, about 100 instructions have been identified for removal. This includes identical instructions on different units, redundant instructions that should have been removed before, and some overlapping ones. NN

– **Chapter 1 Introduction**

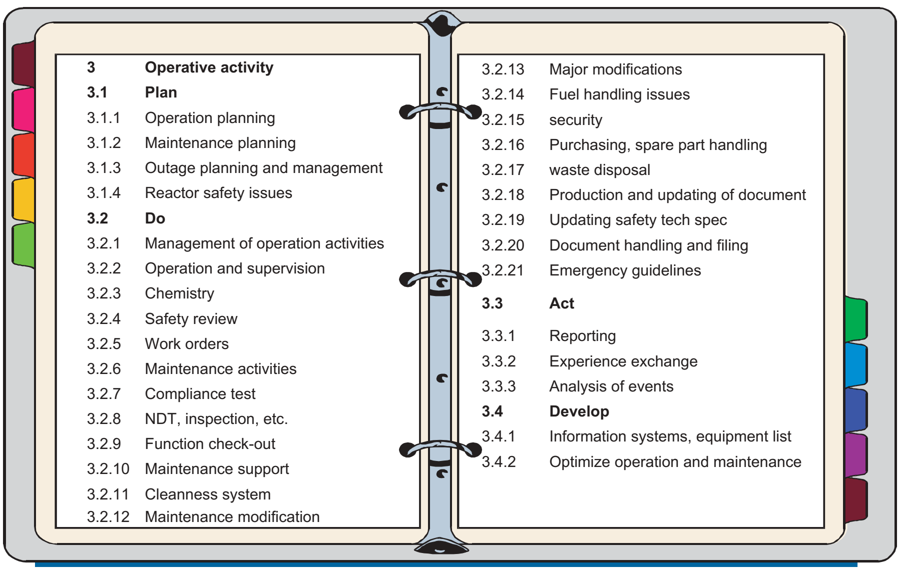
– **Chapter 2 Management of operation and maintenance process**

– **Chapter 3 Operative activity**
  » General description
  » Demands and recommendations
  » Job descriptions

– **Chapter 4 fundamental demands**
  » All external demands have been identified in (FOD) and interpreting in (VDD) directions. In sector 4.1 all FOD/VDD applicable to maintenance and operation is mentioned and generally described. Sector 4.3 describes how the plant's specific demands in the safety tech spec is handled

– **Chapter Definitions, acronyms, and index**
  » To use the handbook as an encyclopedia all important words have been listed in an index. A list is included of all acronyms and definitions used.

Structure of the new operation and maintenance handbook at Ringhals (Vattenfall ABB)



Content of Chapter 3 of the new Ringhals operation and maintenance handbook (Vattenfall ABB)