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*2004
Krško Nuclear Power Plant
annual report
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annual report 2004

Krško Nuclear Power Plant

The Krško NPP continued to implement its mission in 2004 in a balanced way in three basic sectors:

- Providing safe and stable operation in line with state-of-the-art standards, based on critical assessment of the actual situation;
- Providing competitive production of electricity to partners on the basis of the Intergovernmental Agreement and the Articles of Association;
- Providing public acceptability on the basis of transparent and responsible operation and a positive attitude to environmental factors.

Safety and stability of operation

From the point of view of safety and stability, the power plant exceeded the planned target values expressed by standard performance indicators. The electricity produced was 5.2 TWh, with the availability of the power plant of 92% and with only one automatic shutdown. Exceptional results were also achieved in the area of radiological protection (total annual collective dose 0.66 man.Sv), treatment of radiological waste (quantity of low and medium radioactive waste ~36 m^3), safety at work, preparedness of safety systems, integrity of nuclear fuel and environmental parameters. Results achieved are undoubtedly based on a high level of safety culture, which is promoted by management and present throughout the organisation and subcontractors. An awareness of the importance of nuclear safety, high operating standards, obtaining and upgrading knowledge and a conservative decision-making process are characteristic of our common approach. In the period in question, people throughout the organisation put significant efforts into achieving the target objectives. In addition to the plant performance achieved, there was also critical assessment of individual processes, recognised as areas for further improvements. These are the fields of work organisation and human resources management, with emphasis on forming appropriate behavioural patterns in employees.

Production competitiveness

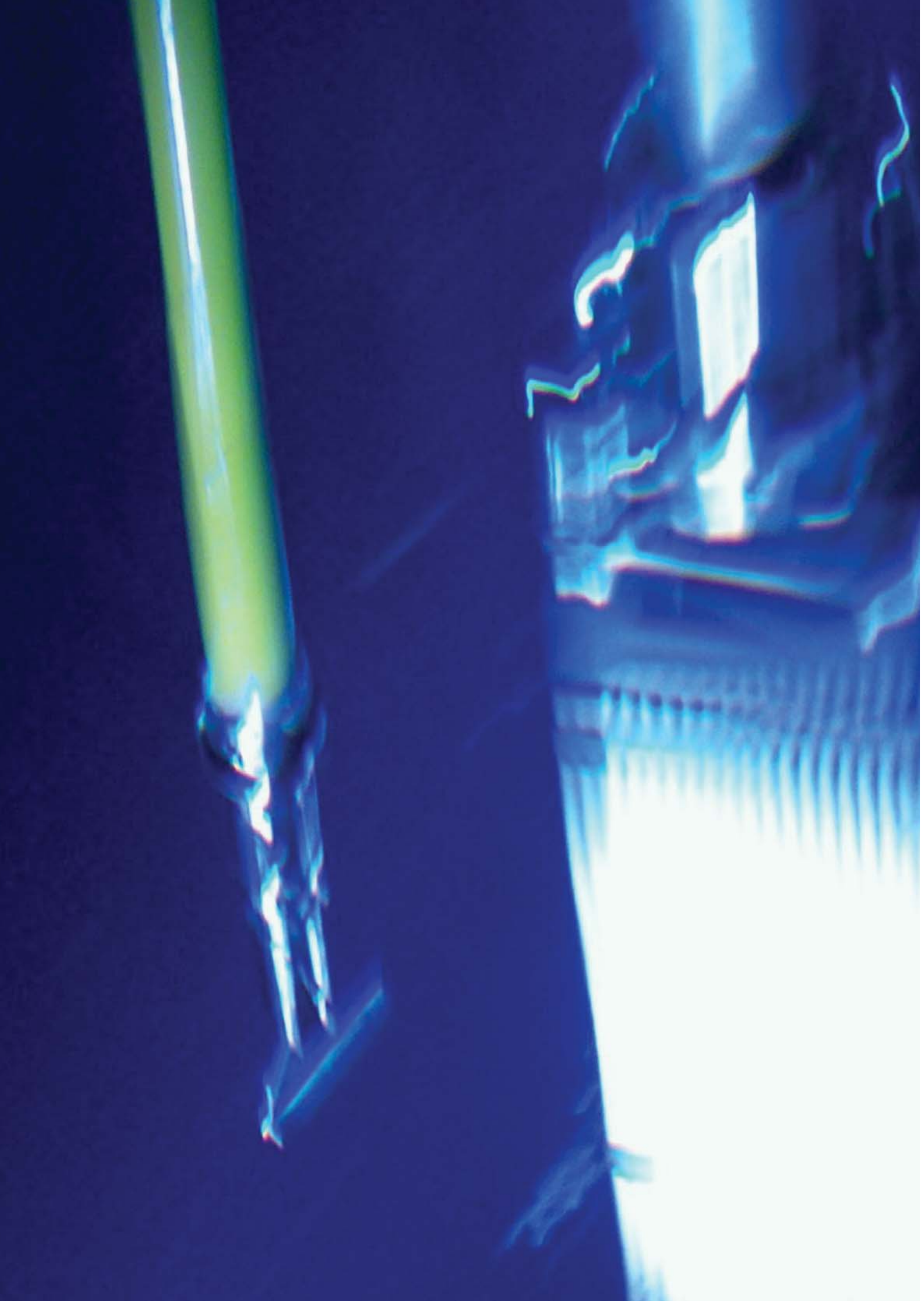
The competitiveness of the electricity produced is assessed at the level of partners, and formulated at the level of the Krško NPP through joint operating costs. Due to the high level of fixed costs in the cost of a kilowatt-hour (≈80%), the key factor affecting the price of energy is the quantity of electricity produced. This primarily depends on the frequency and duration of outages (28 days in 2004) and the duration of forced shutdowns (0.1% in 2004). A crucial step was taken in that regard in 2004 - a transition to an 18-month fuel cycle. Permanent orientation towards reducing costs additionally contributed to competitiveness of production at the Krško NPP. Costs of services and consumed materials were lower than planned. The total business results were positive, as the planned costs were lower by SIT 1,243 million.

Ensuring public acceptability

Ensuring public acceptability remains a significant priority within our responsibilities. It is present in various aspects of our operations: operational stability, human resource stability and recognisability, employee satisfaction, work ethics and transparency, localisation of industrial support, consistency in administrative regulations ... The operational stability in 2004 was at an enviable level, without any contravention of administrative regulations. As regards internal relations, the Company Collective Agreement of NEK d.o.o. was signed, whereby positive changes regarding motivation of employees were achieved. The continuity of key employees and partnership with service providers were maintained. Independent monitoring of the environment again showed minimal impact resulting from operations of the NPP. Last but not least, the year 2004 was marked by responsible and efficient operations of management bodies of the company NEK d.o.o. in accordance with the Intergovernmental Agreement or Articles of Association.

Hrvoje Perharić

Stane Rožman



longer fuel cycle

The impact of market forces regarding energy supply was clearly evident in recent years, resulting in lower prices of electricity.
For nuclear power plants this development is reflected in the need for increased economic efficiency while maintaining nuclear safety and public acceptability. The origin and linking of these three objectives are basically the same, namely in safe, stable and reliable operations. Stable operation of the power plant means that it has adequately qualified staff for operational control, maintenance and technical support, as well as high quality and reliable equipment, which is ensured by maintenance and replacement.

A step towards improving operational economics and consequent adaptation to market conditions is a longer fuel cycle (18 months) thus reducing the period of outages, power uprate and increasing efficiency. Further steps should be introduced when technical capabilities of equipment and fuel warrant them and when sufficient reliability of equipment and operations without any unplanned shutdowns have been demonstrated in practice. The technical capabilities of the NPP have been ensured by replacement of key equipment and safety analysis as a part of the modernisation package entitled "Analysis regarding replacement of the steam generators and power uprate" (also as regards an 18-month cycle), and replacement of the nuclear fuel cladding material. Performance indicators after the replacement of the steam generators and power uprate point to the quality of the replacement performed and the good working order of the equipment. Such a high level of nuclear safety, good condition of the equipment and excellent operational results have resulted in a smooth transition to an 18-month cycle and further improvements in the economics of the NPP.

In order to maintain appropriate financial sources for long-term and quality maintenance of the power plant, priority should be given to utilising all the technological possibilities which have been tested and introduced into practice in similar facilities around the globe, so as to maintain the profitability of operations of the NPP in the new conditions of a free market.

A detailed examination of interdependent factors which to various degrees affect the economics and finally the cost of each kilowatt-hour produced, was made for the purpose of a comprehensive assessment. These factors are the technical capabilities and economics of nuclear fuel, nuclear safety, the condition of equipment and maintenance programmes, operational stability, long-term profitability of operations and anticipated market conditions.

Nuclear fuel

Transition to an 18-month cycle makes less economic sense with regard to nuclear fuel, as it requires more fuel elements and a higher level of enrichment than a 12-month cycle. The load placed on fuel is also higher. The management are fully aware of the complexity regarding planning of an 18-month cycle. On the basis of the results of risk analysis for each cycle, a plan shall be prepared or a corrective programme introduced aimed at reducing any operational problems.

Safety and safety analyses

The longer cycle primarily affects the operational and safety parameters of the core. The main changes regarding fuel management are a higher reactivity at the beginning of the cycle (more fresh fuel elements with a higher level of enrichment) and a higher level of burnt-up in the elements at the end.

Should any input safety parameter regarding a particular cycle change in the existing analyses, additional analyses will be required.

Equipment reliability

Transition from a 12-month operational cycle to an 18-month cycle has required changes regarding equipment maintenance, replacement and upgrading. From the point of view of maintenance and condition of equipment, transition to the longer cycle makes sense when the good working order of key equipment and the quality of programmes (maintenance programme, operational supervision programme and equipment replacement, modification and upgrading programmes) are proven in practice by stable operation without any equipment-related interruptions.

If it is desired to maintain the present outage duration of 25 days in the new 18-month cycle, more maintenance work on equipment will be required, where possible during operations of the power plant - at full power. The on-line maintenance programme - OLM - is already operational in the NPP.

In order to prevent unplanned shutdowns, the maximum will have to be achieved by diagnostic maintenance (measurement of vibrations, temperature, oil characteristics, general observation).

Stability of operations

Operations were very stable in the period 1997-2003. We had four automatic shutdowns as evident from the "number of unplanned automatic shutdowns" performance indicator. The above shows that during operation in the 18-month cycle we can also expect reliable and safe operation of the power plant without unplanned shutdowns due to breakdown of crucial equipment.

Because of the quite conservative initial calculation, doses to the people living in the surroundings as a result of liquid and gas discharges will remain unchanged, even after the power uprate and prolongation of the operational cycle.

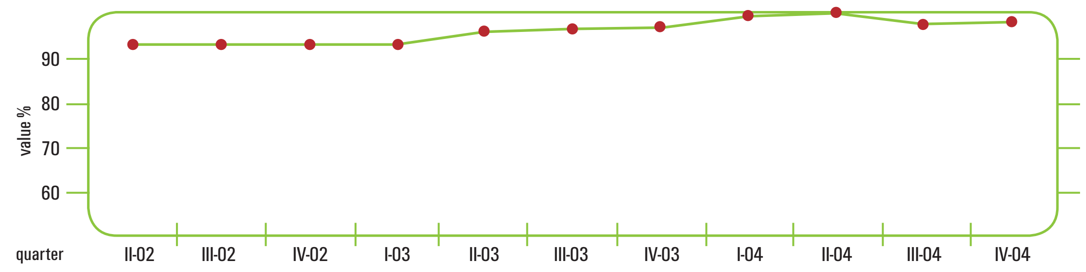
The number of planned outages will be reduced by prolonging the operational cycle, while their duration will not change significantly. It is reasonable to expect that this will have a favourable effect on the average annual collective dose.

Economic effects

Transition to an 18-month cycle will result in an additional 5.43 tera-watt hours of electricity between 2002 and 2023. The economic effects over the entire planned useful life of the facility are positive, regardless of the selected variant for maintenance work.

Conclusion

Examination and analysis of the relevant factors have revealed that transition to an 18-month cycle should be carried out via an intermediary cycle (cycle 20). All necessary actions should be carried out so as not to reduce the level of nuclear safety and to provide for the possibility of further upgrades. Substantial economic benefits will appear over the entire useful life of the facility.



overall performance indicator *

The Krško NPP is the only nuclear power plant in Slovenia. It is situated approximately 100 kilometres south-east of Ljubljana and 60 kilometres north-west of Zagreb.

The power plant is equipped with a two-loop Westinghouse pressurised light water reactor of 2.000 MW thermal power. The plant's net electric power is 670 MW.

The power plant is connected to the 400kV grid for supplying power to consumer centres in Slovenia and Croatia. It generates approximately 5 billion kWh of electrical energy per year.

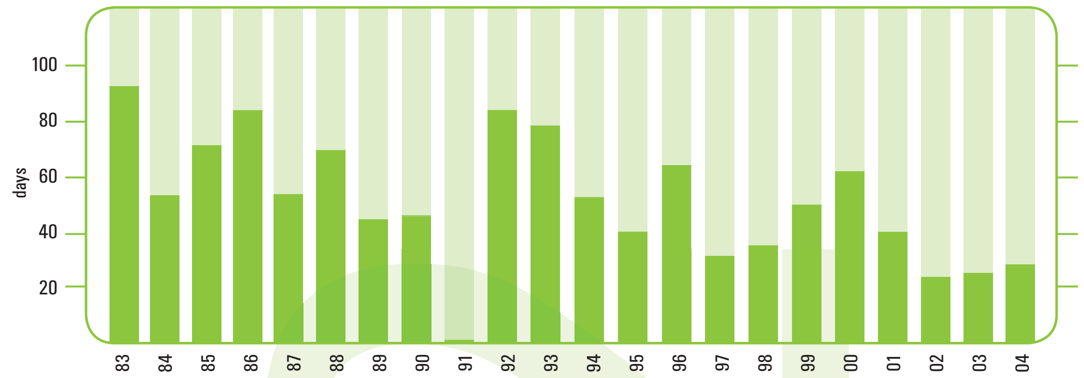
Availability, safety

During its safe and reliable operation, the Krško NPP transmitted a total of 97.39 TWh of electrical energy to the power distribution network from 1 January 1983 (the beginning of its commercial operation) to 31 December 2004.

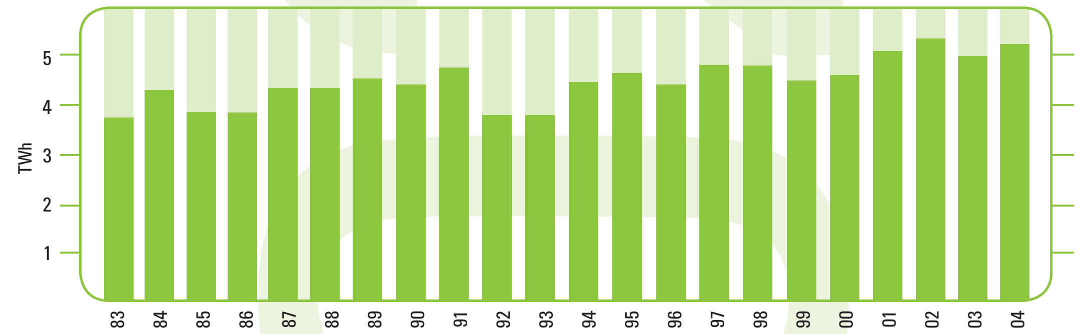
For easier comparison among power plants, a performance indicator index has been introduced. It includes several individual indicators, each of which has a certain contribution. It is calculated every three months. The Krško NPP has constantly maintained high values in a positive trend for the last five years of its operation.

Efforts toward optimisation of work processes, leading to lower radiation doses to employees and/or higher competitiveness on the electricity market, are best shown by the constant trend of shortening annual outages.

Some annual outages were longer in the last ten years because more time was needed for major technological upgrades, which provide long-term reliability, safety and cost-effectiveness of operation.



annual outage duration *

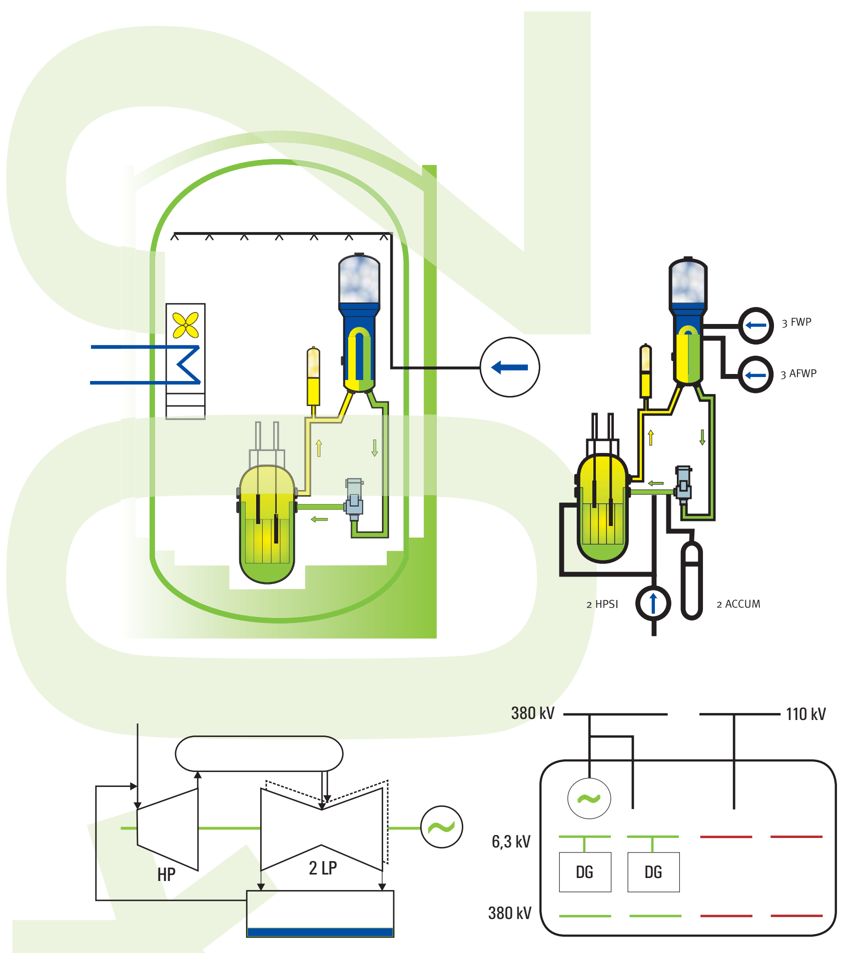


annual electrical energy output *

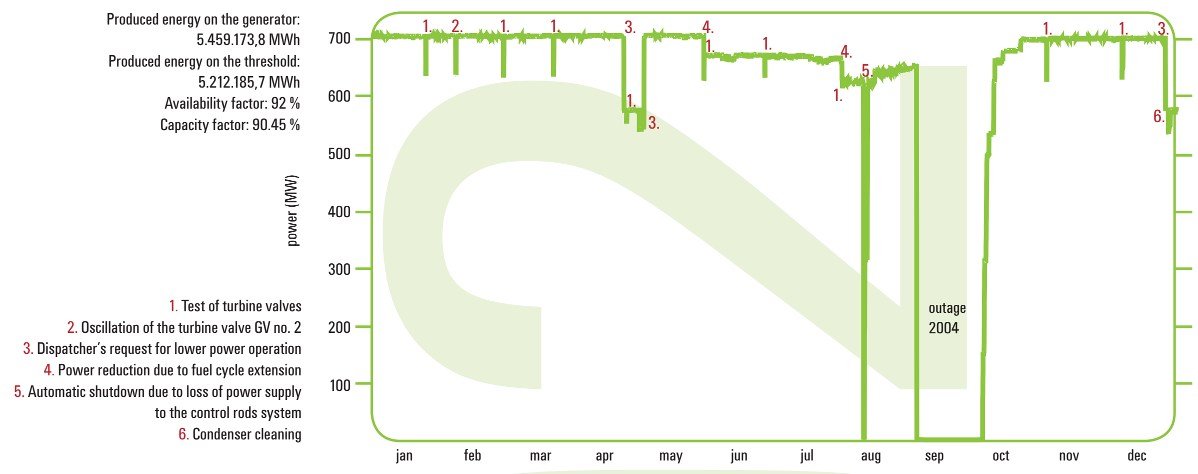
The year 2004 was a successful one as regards operation of the NPP.

A total of 5.46 TWh of gross electricity was produced at the generator output or 5.21 TWh of net electricity.

The annual production exceeded the planned production by 0.72% (5,175,000 MWh). The supply of electricity was uninterrupted for both the Slovene and Croatian side.



basic characterisics of the Krško NPP *



production diagram *

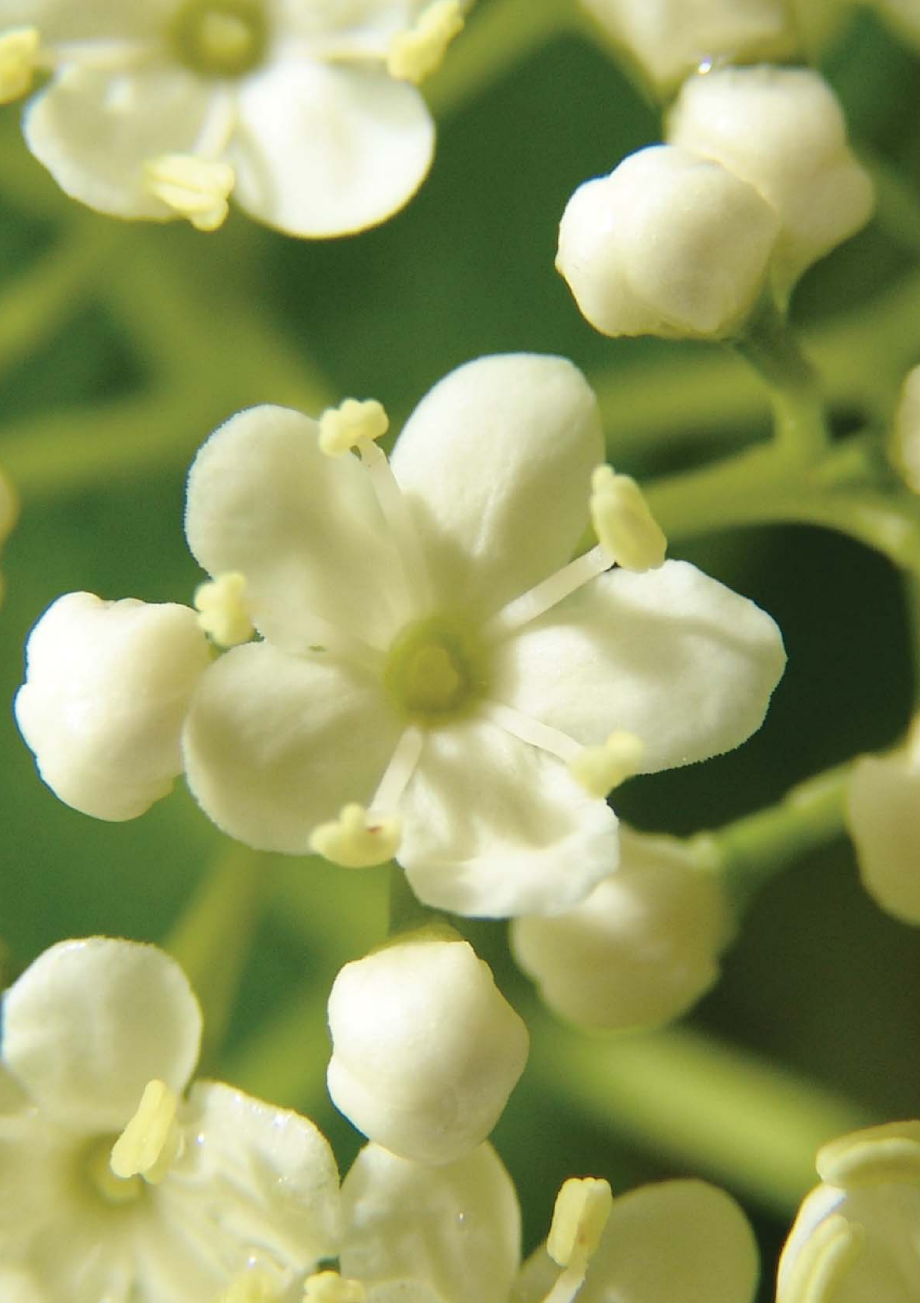
Operational events

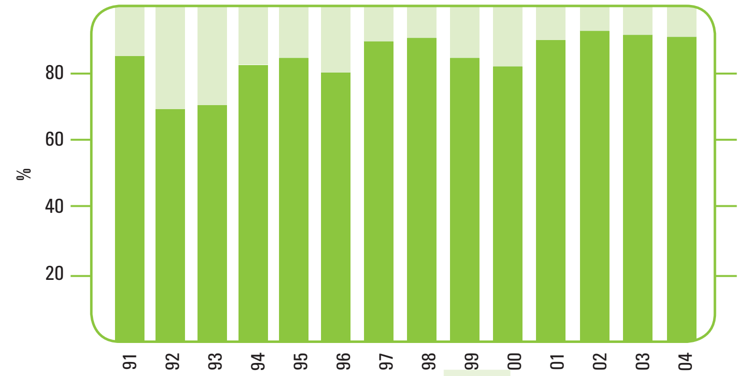
The power plant had only one automatic shutdown in 2004, which was due to loss of power supply to the control rods system. The plant's power was reduced several times during annual operation. The plant operated at 80% for some time in April and December at the request of the dispatcher, and 95% in May and August due to prolongation of the fuel cycle. The power was also reduced owing to testing of turbine valves and oscillations on regulation turbine valves.

Events relevant to safety

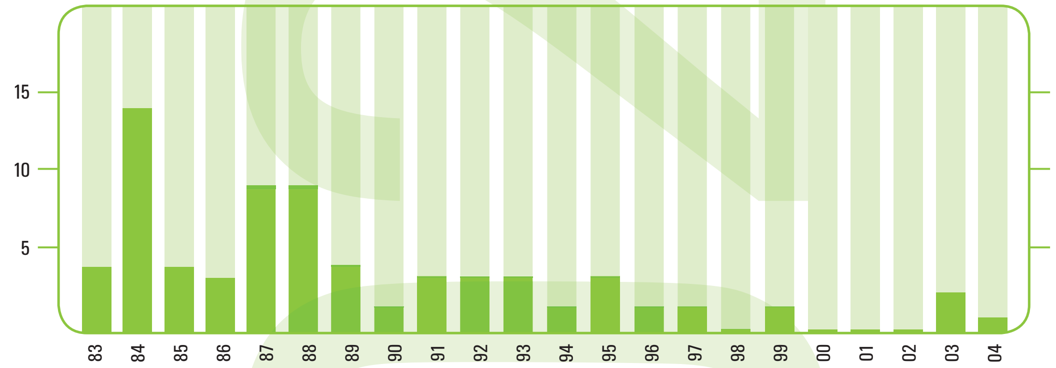
In the year 2004 we had one automatic shutdown.

On 10 August 2004, the main power supply to the control rod regulation system failed. During its replacement, the back up power supply broke down which caused automatic plant shutdown.

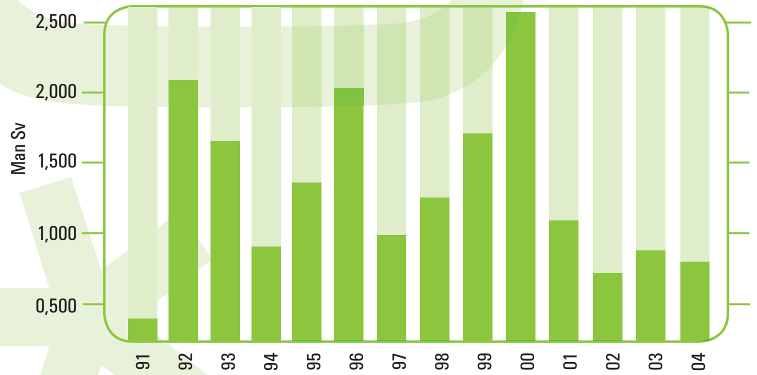




The annual production of electricity in 2004 exceeded the planned production by 0.72%. unit capability factor *



One automatic shutdown occurred in 2004. unplanned automatic shutdowns *



Doses in 2004 were lower than the envisaged collective dose of 0.7 man.Sv. collective radiation exposure *

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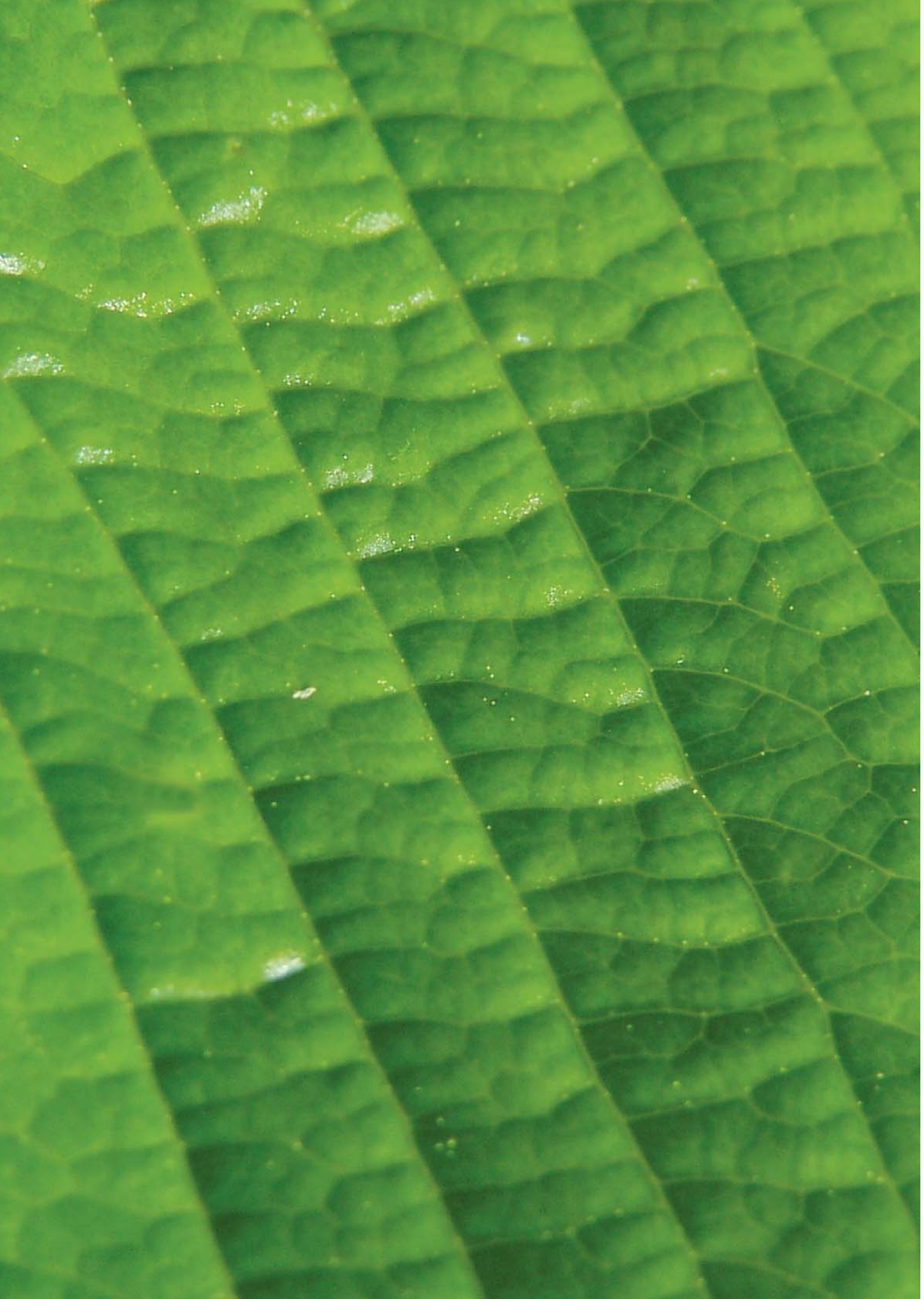
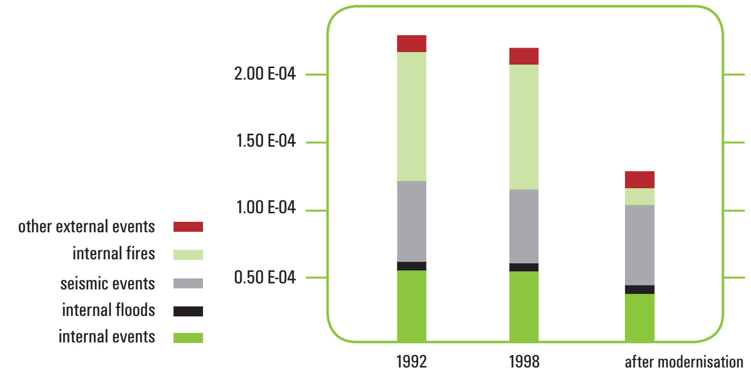




Profile of the expected total core damage frequency 1.1 *

The Krško NPP was designed in accordance with US safety regulations and technical specifications and the power plant operates in accordance with them. The Krško NPP systematically observes the regulations and industrial standards of the United States of America, which is the supplying country. On the basis of any modification of American regulations and by applying our own know-how, we are continuously upgrading the equipment, work processes, and control over operation.

1.1 Main regulations and standards adhered to in design, construction and operations

The regulations followed in the design, construction and operation of the Krško NPP can be divided into the following categories:

- US 10CFR50 legislative regulations observed in designing the Krško NPP;
- regulatory guidelines (Regulatory Guides, NUREG`s etc.) issued by the US regulatory authority;
- US Industrial standards: ANS/ANSI, ASME, IEEE;
- IAEA safety standards and guidelines;
- the existing laws and standards of the former SFRY and the Republic of Slovenia;
- the new Slovene Ionising Radiation Protection and Nuclear Safety Act (ZVISJV).

The bases for these regulations are derived from the contract with Westinghouse, from the licences issued, and from the agreement on the Krško NPP project between IAEA and SFRY. Compliance with the regulations and safe operation are constantly monitored by the Slovenian Nuclear safety Administration and by some authorised institutions, occasionally also by the International Atomic Energy Agency (IAEA).

1.2 Continuous improvement of nuclear safety

Probabilistic safety assessment (PSA) is a risk assessment instrument that can be used for assessing the risk to which an individual and the entire community are exposed due to nuclear power plant operation. The purpose of probabilistic safety assessments is to evaluate the expected frequency of reactor core meltdown, which represents both the basic risk criterion used in PSA and the expected frequency of fast release of large amounts of radioactive material into the environment.

The graph shows the distribution of single groups of initial events contributing to the total value of the core meltdown frequency expected. The given values reflect the power plant status at the end of the year 1992 (initial WA-study, IPE/IPEEE), the conditions prior to the modernisation at the end of the year 1998, and the conditions after the modernisation in 2000.

Today the Krško NPP WA-model is used for various purposes, e.g. in plant equipment maintenance support, in planning system overhaul, and in assessing the importance of modifications. Particular emphasis is placed on nuclear safety assurance and / or on possible risk monitoring.

1.3 Periodical inspection and safety evaluation programme

The purpose of the ten-year periodical inspection of safety is to monitor safety in power plant operation with regard to the current safety requirements and practice. The importance of carrying out the ten-year periodical inspection at Krško has been ascertained in the light of the current safety control trends.

The above-mentioned programme was carried out and all the pertinent documents produced during the period 2001-2003. The next step is to take certain measures and to make some modifications over the 2004-2010 period.

Within the framework of the safety inspection of the Krško NPP, the following safety factors were examined:

1. operational experience;
2. safety analyses;
3. equipment qualification and aging;
4. safety culture;
5. emergency preparedness program;
6. radiological safety and environmental impacts.

After all safety factors had been thoroughly examined by various inspections, a categorisation of ascertained defects was made. The latter were evaluated by prioritisation according to their importance and an elimination schedule. The inspection revealed no weaknesses, which might cause an immediate power plant shutdown or a reduction in power. Certain shortcomings require minimum effort to be eliminated.

Other shortcomings are divided into two basic groups: the first group of shortcomings may have a direct impact on operating safety; the second group of shortcomings requires additional assessment of safety principles. Action plan, which includes measures for safety improvements, is made on the basis of the categorisation of the results. These activities are harmonised with the Slovenian Nuclear Safety Administration.

radioactive materials	annual limit	activity released (Bq)	percentage of annual limit
fission and activation products	200 GBq	0.241 GBq	0.12%
tritium (H-3)	20 TBq	10.8 TBq	54%

data on radioactivity of liquid discharges in the year 2004 table 2.1*

The annual radiation dose to the population in the surroundings resulting from operations of the power plant taking into account liquid discharges and food chain via fish from the River Sava is estimated at less than 0.1% of the dose received by an individual from natural sources of radiation.

Compliance with the annual limits specified in the location permit, i.e. 50 microSieverts (μSv) at a distance of 500 m from the reactor, is checked monthly as regards releases in air. The least favourable monthly average dispersion in the atmosphere for a particular wind direction and for release above the ground is taken into account. The annual dose of a constantly exposed adult in the previous year equalled 0.85 microSievert (μSv).

In addition to the limits on dose, the limits of the total quantity of radioactive substances, which can be emitted to the environment in a year are also specified.

Liquid radioactive discharges

Wastewater can contain fission and activation products. The activity of fission and activation products (excluding tritium H-3, carbon C-14 and alpha particle emitters) amounted to around 0.1% of the annual limit for liquid discharges in the year 2004. The activity of discharged tritium was half the prescribed limit. Tritium is a hydrogen isotope, which can be found in water. Despite being more active than other contaminants, it is less important due to its low radiotoxicity.

The technical norms governing the power plant were adhered to. They require that whenever wastewater is even briefly discharged, the concentration of radioactivity in the discharge outfall should not exceed the prescribed limits.

radioactive materials	annual limit (equivalent)	activity released	percentage of annual limit
fission and activation gases	110 TBq (Xe-133)	0.151 TBq	1.7%
iodine radioisotopes (I-131 and other)	18.5 GBq (I-131)	8.4 MBq	0.0454%
dust particles (cobalt, caesium, etc.)	18.5 GBq	0.335 MBq	0.00181%
tritium (H-3)	–	2.42 TBq	–
carbon (C-14)	–	0.123 TBq	–

data on radioactive release into the atmosphere in the year 2004 table 2.2*

Radioactive release into the atmosphere in the year 2004

The total annual activity of discharged noble gases was slightly over two percent of the limit for the Xe 133 activity equivalent.

The activity of discharged radioactive iodine with regard to the limit on the iodine I-131 activity equivalent was insignificant.

Radioactive isotopes of cobalt and caesium, which can be found in the form of dust particles, were detected in extremely low concentrations. Table 2.2 gives detailed information.

Measurements of the River Sava and ground water

The prescribed measurements of temperature, flow rate and oxygen concentration in the River Sava, and monthly measurements of biological and chemical consumption of oxygen were carried out in 2004.

The increase in the River Sava water temperature at the mixing point downstream of the power plant did not exceed 3° C. Not more than a quarter of the Sava flow can be diverted for power plant cooling.

The ground water inspection on a regular basis, i.e. continuous measurements of ground water level and temperature are carried out in three boreholes and two locations along the River Sava as well as in ten boreholes in the Krško-Brežice Plain on a weekly basis.

Plant sewage is treated by a special sewage treatment plant.

Data on radioactive waste and spent nuclear fuel

In 2004, 133 two hundred-litre drums of radioactive waste were produced. The total number of units stored in the interim storage area at the end of 2004 was 4878, i.e. drums and tube-type containers (the latter have a volume of three standard 200-litre drums). The total volume of the waste was 2,289 m^3 and the total activity was 19 TBq.

The spent fuel storage pool contained 763 spent fuel elements from the previous twenty fuel cycles. The overall mass of the spent fuel material was 298 tonnes.

3.1 Production process control and management

All activities associated with production process control and management were performed in accordance with procedures and plans of on-line activities, the outage plan and forced shutdown plans. The three-shift teams, which manipulated the nuclear fuel during the outage in 2004, were previously trained on fuel replacement systems at the Westinghouse Centre. As usual, all fuel element manipulations were carried out during the 2004 annual outage. We also co-ordinated the activities related to opening and closing the reactor, and to fuel replacement.

Through clear definition of the scope of work and tasks of the work supervision co-ordinator, performed by the auxiliary senior operator, the morning shift saw implementation of administrative-technical support to the shift engineer supervising the safe and reliable operation of the power plant, and consequently improved support to other staff performing activities in the plant.

Upgrading of computer-aided preparation and management of isolation of equipment and devices and computer managed records on deviations has been continued. As regards devices having a special position assigned to them by the project, marking by green cards, representing optimisation in preparation, set up and removal of isolations, has been introduced. The implementation of continuous self-assessment of operating activities has started. In accordance with the revised procedure for marking the measurement areas of indicators of process parameters, local indicators were marked and the marking of indicators on control panels in the main control room began. The ownership of operational procedures was transferred to shift teams and a systematic verification of new reviews of procedures, including simulations, was initiated. The new review of abnormal operating procedures (AOP) was also checked on the simulator. A software application for monitoring working time and control of working hours in line with legislation was developed.

measuring of leakage of the containment isolation valves 3.2*

In 2004, implementation of a large scale on-the-job training programme was continued in order to ensure that all operators are trained for the duties of reactor operator, operator of other systems and auxiliary operator of other systems, and that all equipment engineers are trained for all areas of work. Four operators were trained for the auxiliary work post and a further four are in the process of training. Two equipment operators were trained for auxiliary areas of work and training for a further seven equipment operators is currently underway. Additionally, one operator was trained for the duties of senior operator, and one senior operator with the temporary assignment of simulator instructor assumed the position of shift engineer.

Other work processes were supported by local know-how and experience. In rotation, two shift engineers performed the duties of weekly co-ordinator, who supervised the carrying out of on-line activities, and one licensed senior operator performed the duties of simulator instructor. The new water-treatment facility became operational, which will enable reduction of the number of equipment operators on shift.

3.2 Carrying out surveillance tests

In 2004, the entire planned programme of surveillance tests was carried out to ensure fulfilment of all surveillance requirements of technical specifications and ASME standard, section XI, for valves and pumps. The programme included the testing of all power plant safety components. The capability of safety and other important systems and devices was checked to ensure their faultless operation within the acceptability criteria required for failure-free and safe operation of the power plant. In order to ensure smooth and qualitative execution of surveillance tests, it is necessary to provide for planning, carrying out and independent inspection of all surveillance tests. It is also necessary to continuously upgrade the entire test programme, which also includes upgrading all the procedures for carrying out surveillance tests.

The total number of on-line tests performed was 2334 and 431 tests were carried out during the annual outage.

A programme was also prepared for planning and monitoring the testing of penetration of the containment, which enables control over optimisation of testing with regard to the results of individual tests. Additionally, the surveillance testing plan for cycle 21, which was the basis for planning of all other on-line activities until the 2006 annual outage, was prepared. By daily examination of activities the need for surveillance testing after maintenance, was determined.

fire protection 3.3*

3.3 Fire protection

Thanks to providing a high level of fire protection, no fire broke out at the Krško NPP in 2004. Fire protection was provided by reviewing the planned activities at weekly and daily meetings, by organising regular and extraordinary patrols, by issuing permits for performing fire risk work, by providing fire guards, by monitoring the operability of fire protection systems and devices for detecting, extinguishing and prevention of the spread of fire. In 2004, we issued 373 hot work permits. 250 of them were issued during the annual outage. During the annual outage, the frequency of patrols through all engineering sites and presence in the reactor building was increased.

The entire surveillance test programme, intended for fire protection systems and devices, was carried out in accordance with technical specification requirements and the national law.

The replacement of the outdoor hydrant network was continued and its capacity tested. The fire detection system was improved by adding smoke detectors on certain panels in the control building. The fire fighting plan was also supplemented.

The fire protection training programme was carried out in its entirety. In addition to the scheduled training, subcontractors and the fire guards working for contractual workers were trained. Twelve fire drills were performed by the Krško NPP firemen of which four were carried out together with the professional fire brigade from Krško and one fire drills with the Krško NPP's own fire protection squad. These firemen of the NPP Krško fire squad performed fifty hours of fire drills, thus preparing them for a successful appearance in the electrical energy organisations. Fire competition by means of an in-house redeployment programme, a worker performing the duties of water-treatment engineer was trained to become a fireman to replace an employee who had retired.

3.4 Planning and monitoring the implementation of activities

On-line activities for cycles 20 and 21, pre-annual outage activities for the 2004 annual outage, the 2004 annual outage plan and the forced shutdown plan were prepared and successfully carried out in 2004. In the on-line activity plan for cycles 20 and 21, 7395 activities were harmonised and then co-ordinated at weekly and daily meetings. The 2004 annual outage plan included 7330 activities, which were monitored and co-ordinated 24 hours a day with the assistance of emergency co-ordinators of the annual outage. By providing a high level of safety during the shutdown period, the annual outage was carried out in 28 days and 22 hours, which was unfortunately 46 hours more than planned due to problems in maintenance work.

In 2004, one forced shutdown in the hot-standby state was carried out lasting 9 hours and the number of activities during the shutdown was 49.

The plan of pre-annual outage activities for the 2006 annual outage has been prepared and its implementation is being monitored. The 2006 annual outage plan is being prepared on the basis of specific information about the 2004 annual outage. The work of the majority of ALARA groups is being coordinated.

In 2004, preparation for transition to the PRIMAVERA ENTERPRISE planning tool was initiated. One employee was trained for working with this tool.

We implemented minor improvements of software application for the job order process and self-assessment of the work activity process, from which several actions for renewal of the process originated.

Support of long-term planning in the power plant has been provided.

3.5 Providing reliability and availability of systems and devices

In order to improve and to make more efficient monitoring of the performance capability of systems and devices, in 2004 we continued to develop programmes to monitor the performance capability, maintenance efficiency, and system status. A quarterly joint report was prepared as a means of quick status and capability assessment of certain systems, determination of necessary corrective measures, their priority and inclusion into the long-term plan, and monitoring the efficiency of implementation of corrective actions at the Krško NPP. The report includes all significant activities, deficiencies and improvements of systems in the underlying period. Joint and individual reports on the status of systems were prepared quarterly and 50 corrective measures for improving reliability and availability were proposed. Proposals for review of the long-term plan for the period of cycle 21 and the 2006 annual outage were prepared. The group participated in preparing and implementation of all major modifications, analysed and solved system problems in the power plant operation, reviewed operating procedures and surveillance test procedures, prepared 49 temporary modifications, prepared and managed 9 important periodical activities, reviewed and entered work orders in the annual outage plan and participated in carrying out more complex surveillance and start-up tests during the annual outage.

important maintenance activities

stud tensioners 4.1*

4.1 Maintenance concept

Good maintenance practice is of key importance for safe and reliable power plant operation. Good maintenance practice also implies that activities are carried out to the optimum extent, at optimal time intervals, based on familiarity with the equipment status and criticality. Within the framework of the maintenance concept, preventive maintenance activities are identified and carried out in accordance with the programmes at certain time intervals. Techniques of predictive maintenance are applied, on the basis of which the equipment status (diagnostics) is defined, as well as corrective maintenance activities, related primarily to equipment not crucial to the availability and safety of the power plant.

4.2 Regular maintenance

Maintenance activities were carried out during the power plant operation and annual outage. The activities carried out during operation are those not decreasing the power plant safety and reliability. Most activities were pursued in accordance with the preventive maintenance programmes. Some corrective actions were also performed, which did not affect safety of the facility. The summary given below includes the main maintenance activities.

Mechanical equipment maintenance included: service inspection of fuel hoisting and transporting equipment, opening and closing the reactor, activities carried out on primary system pumps, interventions on approximately 70 valves of the primary system, overhaul-inspection of primary hangers and shock absorbers, overhaul of ventilating equipment, inspection of secondary system hangers, inspection of intake screens on the River Sava, cleaning the condenser tubes and inspection of Taprogge and Amertap filters, overhaul of the diesel electric generating unit, inspection / overhaul of approximately 220 valves in various secondary systems, overhaul of the high-pressure turbine, etc.

Electrical equipment maintenance included activities carried out on low-voltage stable devices (battery charging and capacity testing; inspection of electrical switch boards, checks on heaters and other low-voltage devices; maintenance carried out on low-voltage devices of trains A and B), activities carried out on high-voltage stable devices (jobs done on 400 kV, 21 kV and 6.3 kV devices), activities carried out on low-voltage motor drives (low-voltage electric motors, testing and preventive actions performed on motor-operated valves, limit switches, hoisting devices); activities carried out on the generator, diesel generators and high-voltage motors (main generator check-up, diesel generator and electric auxiliary systems check-up, overhaul and check-up of various electric motors, RCP 01 motor overhaul and RCP 02 motor check-up; activities relating to relay protection, measurements and voltage regulation.

bolt tensioning of the reactor vessel head 4.2*

Instrumentation maintenance included activities related to calibrating and testing approximately 1,700 instrumentation components (control loops, converters, indicators, sensors, switches, executing components, etc.) in all systems relevant to power plant safety and availability, servicing the electrohydraulic equipment on the dam, activities associated with calibration of the primary systems, inspection of nuclear instrumentation, testing the reactor protection systems, measuring the time responses of monitoring instrumentation, software maintenance and development for process computers, and corrective and preventive maintenance of process computer systems.

Construction engineering included activities related to remediation of the third overflow field of the dam; inspection and remediation of the CT high-pressure tunnel; corrosion protection of component cooling system piping in the reactor building, and high-pressure turbine rotor and housing sandblasting. Predictive activities were intended for ascertaining equipment status. For that purpose, various techniques were used, which were not a part of the primary maintenance programme: thermovision inspection, vibration control of vital rotating components, and oil control.

4.3 Special maintenance activities during outage

In accordance with the maintenance schedule, special activities, which by their nature are not a part of the regular short-term programmes of preventive servicing of the components, systems and structures, were carried out. These primarily concern carrying out strategic activities, inspection, reconstructions, repairs and replacements.

The damaged stator and rotor blades of the LP turbine were repaired, the heat exchangers of the secondary system examined using the eddy current method, the DRPI system (the control rod position display system) checked, the actuator of the 21137 block valve of feedwater (FW) replaced and serviced, the stator of the reactor cooler pump (RCP1) motor repaired and the block valves and instrumentation pipes - which serve as guides for the pressuriser replaced.

4.4 External support

Several external contractors, trained to carry out work in accordance with the requirements and standards specific to nuclear technology, assisted in performing the annual outage work. Even during the phase of preparation for the annual outage, great effort was invested. Diverse training was performed, e.g. specialised training for work management, training for servicing specific components, and training for detailed planning of individual activities. All scheduled and additional tasks were competently carried out.

After an unscheduled pressure test on welded parts of the instrumentation pipes of the pressuriser, a leak on the welding seam at the operational pressure of the reactor cooling system (RCS) was detected. As isolation was unsuccessful, the welded seam had to be repaired at lowered pressure which prolonged the annual outage.

radiological protection from preparation to execution of work

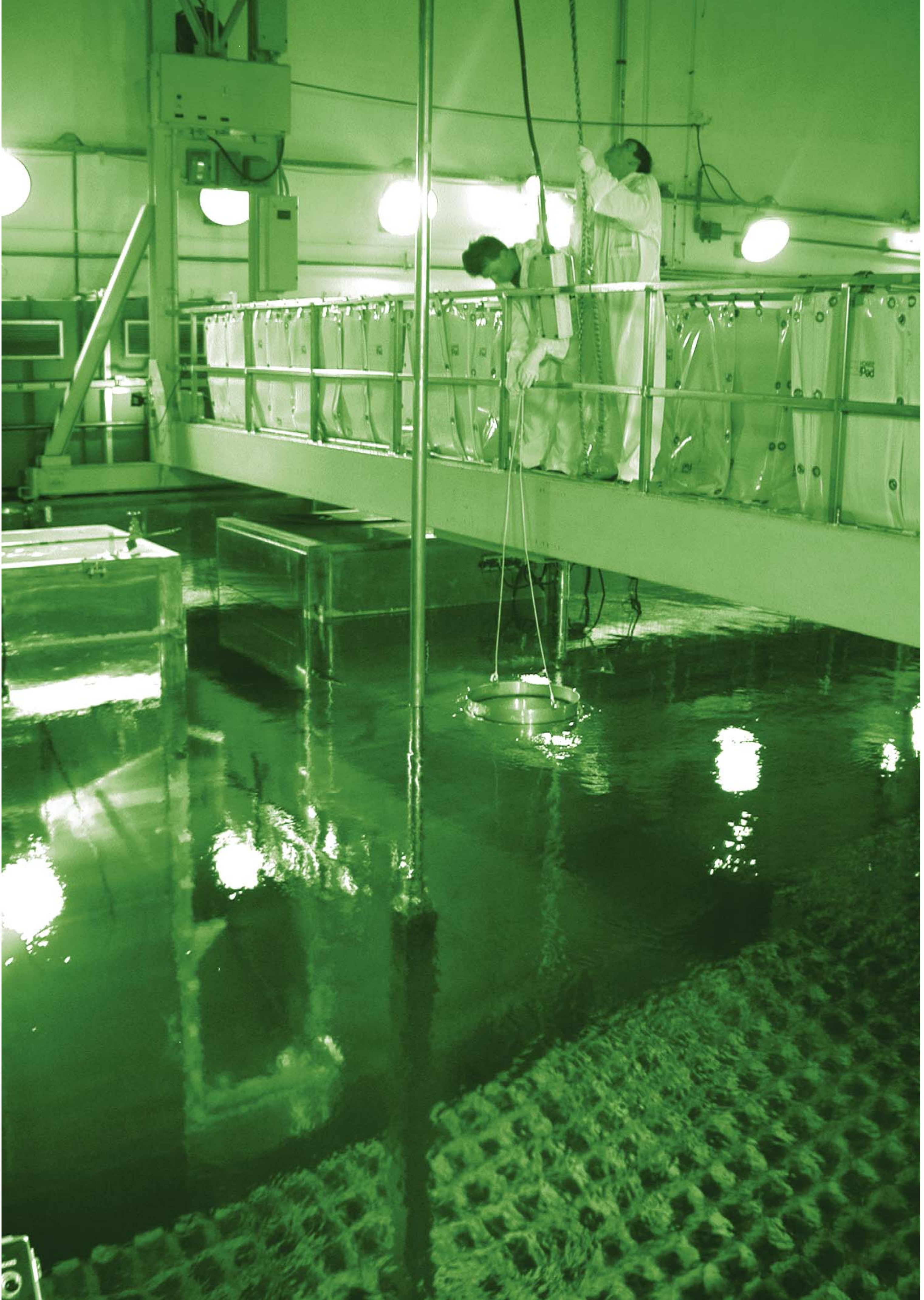
Radiation protection is implemented and promoted by the Radiological Protection unit. Work in restricted zones with sources of ionising radiation is controlled and supervised in order to achieve appropriately low exposure to radiation.

Measures aimed at reducing radiation exposure include co-operation of the responsible engineers and section heads in planning and preparing the work. Good preparation of work requires detailed time planning of individual tasks, which thus reduces the time required for the work and at the same time prevents unnecessary exposure to radiation. The duration of annual outages has in recent years been reduced by roughly ten days as a result of improved preparation and implementation of work in restricted zones and by carrying out of certain maintenance work throughout the year. An exception was the year 2000, when in addition to the annual outage, two steam generators were replaced.

Technological changes are also assessed from the point of view of the exposure of workers to radiation resulting from long-term operation and subsequent decommissioning of the facility.

The total collective dose during the annual outage of the power plant and fuel replacement was 0.6 man.Sv, while the respective value for the entire year was 0.69 man.Sv. Employees of outside contractors received 68% of the total collective dose.

The total number of persons working in the radiologically controlled zone in 2004 was 816, of whom 462 were external workers. The average dose received by an individual was 0.84 mSv. The highest dose received by a worker employed by external contractors was 7.17 mSv during installation work on the reactor. The highest dosage received by an employee of the Krško NPP was 13.82 mSv during welding work on the primary system. Only 26 workers received doses exceeding 5 mSv in 2004, of whom one received more than 10 mSv.



chemical parameters of cooling agents

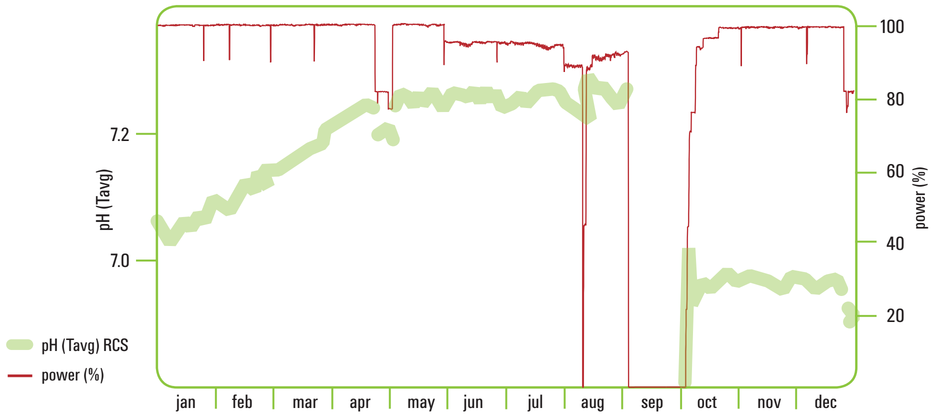
monitoring of the secondary system 6.1*

The prescribed chemical parameters of the primary and secondary circuit and all closed auxiliary cooling systems and their strict implementation in practice is one of the important requirements for the good condition of components, systems and nuclear fuel. It contributes to lower operational costs, increases the availability of the power plant and operational safety and reduces doses.

Numerous power plants around the globe have been putting much effort and making substantial investments into optimisation of the chemical programme, which is the result of stricter principles in providing the required safety and availability, quality and quality control, controlling ageing of components and a transition to prolonged fuel cycle. Some power plants after more than two decades of operation have been facing the first consequences of materials fatigue, which requires co-ordinated monitoring of parameters, repair of certain components or even their replacement altogether.

Being aware of the significance of quality and strict limitation of corrosion processes on components and fuel, the Krško NPP has also been participating in the system of knowledge exchange through international institutions. Our efforts related to optimisation of the chemical process are based on the experience and recommendations of global practice, as well as the knowledge and experience gathered in previous cycles at the Krško power plant.

In 2004, chemical and radiochemical parameters of the primary and secondary cooling circuit and all auxiliary cooling systems were in line with the chemical programme and the prescribed administrative and operational procedures, programmes of the power plant and other documents prescribing the methods of operation of electrical energy facilities. No events which would have a significant impact on the increase of corrosion processes on components and nuclear fuel occurred. We have been monitoring and assessing the release and transport of corrosion and above all, erosion products in the secondary circuit. We have been intensively concerned with the possibilities for reducing the occurrence/ deposition of deposits in the steam generators. The supplier of the new steam generators has also been participating in the search for and evaluation of possibilities for limiting the release and transport of particulates. A group for monitoring the condition of evaporators in the Krško NPP has been appointed, in which representatives from other units participate, in addition to two representatives from the Chemistry Unit. Two new programmes of the Krško NPP: the supervision and limiting of corrosion programme and the steam generator programme have been prepared.



pH regime of the RCS for 2004 6.2*

The transition to an 18-month fuel cycle also represents a challenge to the staff of the Chemistry Unit, as it brings some changes in the chemical regime of the reactor cooling system. The chemical regime of the reactor cooler affects the corrosion and integrity of fuel, release and deposit of corrosion coatings, the integrity of the system and activity of radioisotopes. In the transition to a longer cycle, the concentration of boric acid and lithium are higher at the beginning of the cycle, changing the pH regime of the reactor cooler, which has been co-ordinated with the fuel supplier for cycle 21 and is in line with recommendations of the EPRI. The increase of integral exposure of lithium to the fuel as the result of a longer cycle has been evaluated in a technical evaluation, and experience from comparable power plants which already underwent the transition to the 18-month cycle have been taken into account. The pH regime of the primary cycle implemented in cycle 21 is that used in the majority of PWR nuclear power plants operating with 18-month cycles.

During the annual outage following the end of cycle 20, co-ordinated activities were implemented, where chemistry played an important part. Wet conservation of steam generators was co-ordinated and implemented. The Hide Out Return Test was performed during the shutdown and cooling of the power plant and its results used to assess the quantity of deposited ionic impurities and establish corrosion processes in the steam generators. Corrosion products - mostly ^{58}Co, nickel, nickel ferrites and nickel oxides were successfully removed from fuel and components of the primary circuit.

Upgrading of existing equipment was carried out regarding monitoring of chemical and radiochemical parameters. In 2004, chemical analytical system for continuous measurements of certain parameters in the secondary system (pH value, dissolved oxygen concentration, specific and cationic conductivity) was upgraded. The ion chromatograph, an analytical instrument, used for determination of anions, was upgraded with the new and tested method, which is now being routinely carried out. This enables lowering of the detection limits and provides acceptable results even for samples where a low concentration of aggressive anions is determined in the presence of higher concentrations of corrosion inhibitors, e.g. in closed auxiliary cooling systems.

After the conclusion of the annual outage, the Chemistry Unit was put in charge of the chemical analysers in the new water treatment system, the chemical monitoring of which has been significantly extended and improved compared to the previous system.

fuel integrity

inspection of the movement sequence of fuel elements 7.1*

7.1 Nuclear core project

The nuclear core project needs to fulfil a number of requirements related to burn up of nuclear fuel and control of reactivity. The project determines the positioning of fuel elements, the number of fresh fuel elements and their enrichment. The power density and other physical parameters of the reactor core are limited by limit project values. Compliance with these limits ensures the stability of the reactor and safety in all project stages of the power plant.

The operating cycle 20 was concluded and the 18-month fuel cycle 21 began in 2004, which will last until 8 April 2006. The length of operation in the cycle required replacement of 56 spent fuel elements. All fuel elements for cycle 21 were produced by Westinghouse. The characteristics of this fuel of the Vantage+ type are replaceable upper nozzle, a modified lower entry nozzle and hoop enriched fuel pellets in axial curtains of fuel rods. The state-of-the-art material ZIRLO™, which is distinguished by its great corrosion resistance, is used for producing fuel rod cladding, control rod guides and instrumentation guides.

In 2004, the reactor operated in line with the project calculations and prescribed limits. Total produced heat energy corresponded to operation at full power for 323 days. After the end of 2004, the total reactor operation amounted to the equivalent of 18.16 effective full power years.

7.2 Control and optimisation of reactor core operation

Design values and prescribed physical parameter limits of the nuclear core are continuously monitored. Safe core operation is checked and verified by testing, measuring, calibrating nuclear instrumentation and by calculation. Data on neutron fluxes in the core are measured using the INCORE core instrumentation. Movable fission detectors accurately measure peak power factors. The result of analysis of the measured values of neutron flow is a three-dimensional chart of distribution of power and temperatures in the reactor. Results of the INCORE measurement are, among other things, used for setting up the operational values on control and safety systems and calibration of the nuclear instrumentation.

7.3 Nuclear fuel condition

One of the principles of the Krško NPP is operation without leaking fuel. In this way radiological impact on the population and the environment is prevented, and also operational costs and doses to employees are reduced. The integrity of nuclear fuel is continuously monitored. It is assessed on the basis of the evaluation of measured specific activities of iodine isotopes, noble gases and certain radionuclides of solid particles in the primary coolant. The value of the fuel reliability indicator (FRI) in 2004 did not exceed the prescribed limit of 5E-4 µCi/g specified in the international INPO standard, and furthermore, - values were typically at least ten times lower. The basic indicators of fuel condition show that the fuel integrity is very good and is in the top rank of comparable nuclear facilities.

Three types of inspections of spent fuel elements were carried out in 2004 during the annual outage when fuel is physically accessible. During the repositioning of fuel in the reactor, all 121 fuel elements were examined using the cladding tightness examination method. Measurements showed that one fuel rod was leaking. Ultrasound inspection of fuel was performed for examination the leaking fuel rod and characterisation of the defect. The results obtained showed that a minor leak had occurred in one fuel rod of a highly spent fuel element, which was not planned for use in cycle 21. A routine underwater visual inspection of two elements planned for the core in cycle 21 was carried out. By taking into account that fresh fuel elements are also subject to strict control and final inspection at the Krško NPP, all fuel elements forming the core 21 were shown to be suitable.

8.1 Inspection of primary components

The power plant carries out a continuous in-service inspection programme, also called the ISI programme (In-Service Inspection). The inspection is conducted according to NDE methods (non-destructive examination) that do not affect the equipment measured. The basic purpose is to detect component degradation that might have occurred during operation. In accordance with the appropriate standards and requirements of Technical Specifications, the inspection programme is applied to the components which represent the primary system's boundaries - the so-called safety classes I, II and III. In accordance with the ISI schedule for the programme for the year 2003, all the planned activities were carried out by applying non-destructive methods (visually, by means of penetrants, magnetically and by means of ultrasound). Additionally, the following activities were carried out: the RB inner steel shell was visually inspected in accordance with the programme requirements, inspection of possible locations of borated water leakage and inspection of consequent corrosion of carbon steel components, inspection of steam generator tubes, inspection of reactor vessel head penetrations, and visual inspection of instrumentation piping on the bottom of the reactor vessel.

The inspections carried out during the 2004 annual outage indicated that the condition of the components is perfect. This verifies the integrity of the primary pressure boundaries.

8.2 Inspection of secondary system components

The basic purpose of this monitoring is timely detection of any decrease of wall thickness of components caused by erosion and corrosion. Therefore component inspection is carried out according to the erosion / corrosion programme, and inspection of pressure vessels. Within the erosion / corrosion programme, 128 components, seven lines on the extraction steam system (EX) and three lines on the heater drainage system (HD) were inspected. The term "line" refers to the inspection of a certain length of piping, which includes several components. Measurements of wall thickness of pressure vessels were performed on twenty-two vessels. No wall thickness losses below permissible values were detected in any inspection. The wear previously detected on the pressure vessels was merely confirmed by the inspection in the year 2004. The results of inspections revealed that the condition on the secondary side deteriorates in accordance with the ageing of equipment. A trend to increased wear can be seen in individual systems. Thus permissible ageing appears mainly on the same systems and locations. Under the erosion/corrosion programme, these are the extraction steam system (EX), main steam system (MS), main feedwater system (FW) and the heater drainage system (HD).

a part of the demineralised water treatment system - reverse osmosis 9.1*

In 2004, we continued with intensive implementation of the technological upgrades which were envisaged in the long-term investment plan adopted in 2003. Important investments concluded in 2004 included the following:

Replacement of the system for preparation and treatment of technological water

The modification was decided on because the old water preparation and treatment system (PW and WT) was worn out, shortage of spare parts, reduced capacity of the system and adverse effects of acidic vapours - resulting from regeneration of ionic exchangers - on equipment in the turbine building. First a temporary softening unit was installed, which replaced the old water preparation system. The PW system was removed from the water treatment facility, the facility was appropriately reconstructed and the new joint system (PW/WT), based on state-of-the-art membrane procedures, was installed. Central computer-aided management of the system and operation in five regimes with minimal waste is provided.

After successful start-up of the new system and connection to existing systems of the power plant, work was begun on removing the old system for treatment of demineralised water and also the station for regeneration of ionic exchangers from the turbine building. The bulk of the work was performed before and after the annual outage and the most complex part of the connection was carried out in a limited period of four days during the annual outage.

Replacement of voltage regulators of the main transformers and thermo-imaging of GT2

The worn-out voltage regulator of the main transformers GT1 and GT2 were replaced during the annual outage. Voltage regulation, handling the transmission of the main transformers, was unreliable, and spare parts were no longer available for the regulators. In order to unify the control of cooling of both main transformers, the old thermo-imaging on GT2 was replaced. In the DEH area the previous voltage regulation switchboard was replaced with a new one and work was also performed in the control room on the electronic control board (ECB).

Replacement of the system for controlling levels of the heater drainage system HD

As a modification the entire measurement (level switches and meters) and regulation equipment on the heater drainage system HD was removed. A new system was installed, based on redundancy measurement of the level (two level meters for each heater and reservoir) and a centralised control system based on Simatic PCS7 redundancy programmable logical controllers. The centralised control system consists of four independent controllers, which have modulated control and protection logic for all twelve heaters and reservoirs HD and six drainage reservoirs MSR. In order to improve management of the drainage valves of the heaters, the position units of all 34 drainage valves were replaced, which will enable accurate adjustments of drainage valves, their additional diagnostics, as well as an overview of their status. The system will continue to operate automatically, so that the control room will have no additional control-management components, but will enable monitoring of the actual levels of heaters and reservoirs, as signals will also be linked to the PIS. Access to control applications is also enabled via the control and engineering station (with control of level access), and control of the operation of the application is also enabled on personal computers in the main control room, as the HD application is linked to the technological computer network.

Replacement of the heat exchanger for cooling secondary cycle components

Due to degradation of the piping and problems in operation and maintenance, the heat exchanger TC was replaced with a new one, having roughly 16% larger area for heat transfer. A bypass piping with a regulation valve, level indicator and valves was also installed, and ventilation vessels of the ventilation system for the condenser's cooling water system.

Replacement of the Krško NPP's alarm system

During the annual outage the outdated alarm system in the main control room was replaced with a technologically advanced, digital and fully doubled alarm system. This enables program configuration, standard and advanced functions of filtering and suppression of alarms, advanced online diagnostics and testing, and covers previously separated alarm subsystems: the main control board, the ventilation control board and the electronic control board.

personnel training 10.1*

Professional Training is organised as an independent organisational unit, closely co-operating with other organisational units of the power plant. The mission of the Professional Training is to ensure quality preparation and execution of training programmes and thus contribute to a high degree of personnel proficiency and professionalism, and to safe and reliable power plant operation.

The training of the Krško NPP personnel is executed on the basis of approved programmes and the annual plan, prepared in co-operation with the heads of organisational units. The annual training plan is prepared in accordance with ascertained needs for the purpose of providing the required number of adequately trained personnel.

Training programmes are largely prepared and executed within the activities of the Professional Training Unit and other organisational units. However, the training is partially implemented in collaboration with both national and foreign institutions.

Training of operating personnel

The initial training for groups of new reactor operators continued in 2004 with training on the simulator and on work posts in the main control room. Seven participants of the training programme came from the Krško NPP and one from the Slovenian Nuclear Safety Administration. All eight participants have successfully concluded their training. All seven candidates successfully satisfied an expert panel in the written, practical and oral parts of the examination for acquiring the licence as a reactor operator.

Ongoing professional training for licensed personnel was conducted in accordance with the two-year plan, applicable legislation and internal procedures in the Krško NPP. The annual training was executed in four weekly sessions. It was attended by all operating teams and other licensed personnel. The training was conducted through classes and simulator scenarios. In the last annual session, nineteen candidates successfully passed exams for licence renewal, of which five and fourteen were for reactor operators and senior reactor operators, respectively, and three candidates acquired the licence for senior reactor operators for the first time. The exams, including written, practical and oral parts, were carried out by a panel of assessors, consisting of the examination board members of the Slovenian Nuclear Safety Administration, the Production Management Department and the Professional Training instructors.

The ongoing professional training for equipment engineers proceeded in parallel with the training for licensed personnel, i.e. four weekly training sessions were implemented. The programme included courses on preserving and upgrading skills and knowledge needed by equipment engineers at work. The emphasis was on practical training of equipment engineers by using system operating procedures. The training was partly conducted together with the licensed personnel, because the equipment engineers participated in implementation of certain classes and simulator scenarios. In the training of equipment engineers, a novelty was introduced in 2004, namely the classroom was actively linked with the simulator, which improved practical training.

In accordance with well-established practice, the refuelling team training was executed prior to the annual outage. Additionally, training of personnel for accepting fuel and practical training of three shift teams on the refuelling equipment in the Westinghouse Waltz Mill Centre was carried out.

In addition to training the simulator was also used for preparing the operating personnel prior to implementation of important activities at the power plant and for testing operating procedures.

Training for maintenance personnel and for those performing other support functions

The professional training of technical personnel includes courses in which the aim is for candidates to acquire or refresh the general and specialist skills needed for performing maintenance and support functions.

Within the framework of initial training for technical personnel, a course in the fundamentals of nuclear power plant technology was carried out in 2004. In accordance with the previous experience, it was executed in collaboration with the Training Centre for Nuclear Technology. The course consisted of four weeks of theoretical fundamentals and four weeks of classes on systems of the power plant.

As regards training of maintenance personnel, the programmes of specialist and legally required training, which were prepared on the basis of matrices of required skills, were continued. Some courses were implemented in co-operation with external institutions, partly abroad and partly in the Maintenance Personnel Training Centre. In 2004, the process of implementing specialist courses, which include the practical part of training were completed. Some practical training was also implemented during preventive on-line maintenance of equipment. The preparation and implementation of professional training of maintenance personnel included, in addition to Professional Training personnel, engineers and specialist technicians of the Maintenance Unit.

Three sessions of ongoing professional training of maintenance personnel, intended for refreshing of general and legally prescribed skills, were carried out. Maintenance personnel was also familiarised with new developments regarding processes and systems of the power plant and operating experience.

Prior to the annual outage, an additional general training for ensuring quality work during the annual outage was implemented for a larger number of Krško NPP employees. The implementation of established programmes of initial and refresher courses related to areas of legally prescribed skills, such as safety and health at work, fire protection, dangerous substances, emergency planning, first aid, work in explosion endangered premises and movement in electricity operational premises were continued. A drill at the Krško NPP related to measures in case of an extraordinary event was organised in October.
Initial and refresher training related to radiological protection was implemented in accordance with legislation. On the basis of Article 39 of the Rules on the Obligations of Persons carrying Out Radiation Procedures and Persons Possessing an Ionizing Radiation Source, and with the approval of the Ministry of Health no. 594-8/2004-2-B02 dated 8 July 2004, the Krško NPP obtained approval for a programme for independent implementation of the RZ-3 training programme.

Training of external contractors personnel

During preparations for the annual outage in 2004 implementation of initial and refresher courses of general training for external contractors and their heads was carried out. The courses were implemented in line with the internal procedures of the Krško NPP for the purpose of providing safe and efficient work during the outage.

Several courses on radiological protection and specifics of the Krško NPP were implemented for external contractors performing work in the radiologically controlled zone.

quality system activities

Assuring and checking the quality of buildings, systems, equipment and services in order to provide for the safety of the population and employees is not only the task of Quality System personnel, but is also the task of all employees. Our job is to make sure that the prescribed requirements for buildings, equipment, services and work processes are met.

11.1 Quality assurance

The Quality Assurance Department carried out the following activities in 2004:

- Inspection of the existing power plant procedures and making comments on them;
- Documentation relating to modifications;
- Monitoring modifications;
- Monitoring of the purchasing process;
- Following activities according to work orders;
- Monitoring of surveillance tests;
- Monitoring of annual outage work;
- Control over work and execution of modifications;
- Audits.

Several procedures, modified documents and modification implementations were examined. As a part of monitoring of the purchasing process, requests made by the Technical Department and the Engineering Department were examined.

Within NUPIC organisations, inspections were carried out and several revisions of suppliers' QA Manuals received. On the basis of the 2004 audit plan, several internal and external audits were carried out, including an audit of fuel production.

11.2 Quality control

The Quality Control Department carried out the following activities in 2004:

- Acceptance of materials, parts and dedication received;
- Activity control within the framework of work order (QC requirement);
- Carrying out and developing the QD4 secondary system inspection programme (Erosion / Corrosion Programme and Pressure Vessel Inspection Programme);
- Carrying out and developing the QD5 Fire Safety System Inspection Programme;
- Writing and reviewing new programmes and procedures, QCP series;
- Work process control at the manufacturer's premises in accordance with the plan; Monitoring (fuel inspection, CY tank diaphragm, containers for radiological waste);
- Collaboration with other departments within the framework of projects, where the Quality Control Department can collaborate by offering its experience;
- Personnel training;
- Calibration of measuring equipment;
- Carrying out training courses in dimension control and visual control for TO.VZ needs.

Among the many materials and parts accepted, a couple of hundred led to claims under warranty or dedications. Within the framework of the primary tasks of the Department, more than a thousand job orders were processed and as many reports were issued. The Special Process Control Department was engaged in monitoring welding jobs, dimensional control, and control of materials using non-destructive methods. Several hundred work orders were processed and more than five hundred reports issued. The Department's range of activities also included secondary system inspection, related to the Erosion / Corrosion Programme, Pressure Vessel Inspection Programme, and the QD5 Fire Protection System Inspection Programme. Wall thickness losses, caused by erosion / corrosion, were detected on several components, which were replaced.

purchasing

In 2004, we successfully implemented purchases of goods and services, to the value of SIT 6 billion in Slovenia and SIT 7.7 billion abroad. In accordance with the Agreement Regulating The Status of KNPP and Other Legal Relations between the Government of the Republic of Slovenia and the Government of the Republic of Croatia, suppliers and contractors from both parties were treated identically. Work was carried out timely, correctly and in line with requirements of internal ordering parties and the applicable legislation.

As regards imports, some problems arose with certain American suppliers, which are relinquishing their support of the nuclear industry as they are included in other large national projects and lack interest for often complex specific work abroad with foreign business partners. The Purchasing Department will attempt to solve these problems by renewing visits to important strategic suppliers, which has proven successful in the past. Where possible, the Department will attempt to do business on the European and Slovene market.

For the purpose of the annual outage, requirements for work and living permits for foreign contractors, working on the annual outage of the Krško NPP were processed, and a number of temporary imports and exports of equipment, internal transport and supervision of the customs warehouse handled. No operational problems were recorded to date, which would result from errors in the purchasing process. Some requirements of the corrective programme related to inappropriate support of foreign suppliers - delivery deadlines, duration of bid preparation and completeness of bids.

As a result of the transition to an 18-month fuel cycle, the time schedule of nuclear fuel supply is changing. As only the order for uranium hexafluoride was placed in 2004, the scope of purchasing was significantly lower compared to 2003. The successful purchase of uranium hexafluoride from the supplier GNSS, which has problems with honouring contracts because of cancellations by its supplier - the Russian company Tenex - saved more than eleven million US dollars to the Krško NPP as market prices have changed. By purchasing fuel, region 23, ahead of schedule prior to accession to the EU, savings in customs costs alone amounted to more than 1.2 million US dollars.

The accession to the EU represents for the power plant additional tasks of seeking certificates, verifications, recording and reporting on supplies from the EU by using the Intrastat system and reporting to the Euratom Supply agency on supplies of nuclear fuel.

safe work 13.1*

The purpose of safety at work is to protect the life, health and working capability of all the employees at the Krško NPP (the Krško NPP's employees and all contractual workers). In addition, the company makes sure that statutory requirements and regulations governing health and safety at work are observed.

The relevant activities listed below were successfully carried out:

- The company's safety philosophy was successfully implemented, and a sense of responsibility for health and safety at work developed. By doing so, the group contributed to raising the level of safety culture of all the power plant personnel;
- On the basis of the document MD-1 "Commitments and Goals of the Krško NPP", a programme for improving the situation regarding safety and health was prepared and its implementation commenced;
- Novelties and amendments to legislation on health and safety at work were carefully monitored in order to include them in the work process;
- New personal protective equipment was purchased to provide greater safety in areas with special working conditions and for safe work at heights;
- A programme of measures for employees working with computer monitors;
- The OSART measures action plan was implemented;
- Progress was made in monitoring specially dangerous work, it was ensured that safety at work increased;
- New safety signs and warnings were placed where appropriate;
- The use of basic personal protective equipment in the technological part of the power plant was monitored;
- Regarding personnel training, the plan was fully implemented - the professional training of the group itself was also successful;
- "Safety requirements at the work site" cards were introduced;
- Measures required by the Decree on Safety and Health Protection at Work at Temporary and Mobile Construction Sites were implemented;
- Particular attention was paid to work under voltage and work at heights and depths;
- Safety meetings, attended by personnel from different departments were conducted. Possible shortcomings were eliminated in collaboration with the meeting participants.
- The review of work posts risk assessment was prepared.

In 2004, fifteen injuries were reported to the Department, of which two were directly the result of performing work. Due to injuries, 888 hours were lost. All injuries were reported to the appropriate institutions. The Department also implemented certain measures for reducing the number of injuries at work.

Experience of others - guidance for our work

At the Krško NPP there is a real awareness that it is important to be closely involved in international organisations and in international monitoring of plant operation. Only in such a way can internationally comparable operating and safety results be achieved.

WANO

The Krško power plant joined the World Association of Nuclear Operators (WANO) already in 1989 to promote the highest safety and availability standards and the operational excellence of nuclear power plants. The purpose of the Association is to promote the highest standards of safety and availability and excellence of nuclear power plant operation. As the public attitude towards nuclear energy is extremely sensitive at the global level, any error committed by an individual is the error of all, which was confirmed in Chernobyl in 1986.

The WANO maintains five programmes for information exchange, promoting mutual communications, fostering mutual comparisons and copying good solutions:

- Mutual examinations on equal professional basis (WANO missions);
- Sharing of operating experience;
- Performance indicators - a series of standardised parameters for comparison of power plants;
- Co-operation among members and visits;
- Preparation and dissemination of good operating solutions.

INPO

Krško power plant has been a member of the Institute of Nuclear Power Operations (INPO) in the United States of America since 1988. This institute was established in 1979 after the accident at the Three-Mile Island Nuclear Power Plant. Its objective is to increase the safety and reliability level of nuclear power plants. All American nuclear power plants and their operators are members of this organisation. The membership is also extended to individual operators of nuclear power plants from other countries and to the manufacturers and designers of nuclear facilities.

The basic activity of the Institute is evaluation of power plants on the basis of operational results. By using these evaluations, the personnel of the Institute and other power plants compare the operational quality with the standards based on good operational practice and experience from the entire nuclear industry.

The Institute supports its members by organising quality educational programmes for power plant personnel. The programme for analysis of events identifies the causes and allows the nuclear power plant operators to prevent the same or similar events from being repeated. The Institute provides support to its members to allow them to fulfil the requirements of the nuclear industry. This is carried out through visits, working meetings, seminars, technical documentation and personnel exchange.

IAEA

The International Atomic Energy Agency (IAEA) is an independent intergovernmental organisation that operates within the United Nations Organisation. Its primary objective is to help the members in planning and using nuclear technology for various peaceful purposes. These include electricity generation and technology / know-how transfer in this sphere. The IAEA develops safety standards that promote achievement of a high level of safety in the use of nuclear energy and in protection of the population from ionising radiation.

The organisation operates on the basis of various programmes such as control over nuclear material, nuclear technology application, nuclear energy, nuclear safety and technical co-operation.

Krško power plant has actively been cooperating with the IAEA for many years. Within this cooperation, the IAEA inspectors visit us on a regular basis to exercise control over nuclear fuel.

NUMEX

Krško power plant has been a member of the NUMEX organisation (Nuclear Maintenance Experience Exchange) for over ten years. This organisation is engaged in exchange of experience in the sphere of nuclear power plant maintenance. The organisation has its head office in France and compiles a database that includes frequently asked questions and answers related to nuclear power plants. NUMEX unites the majority of European nuclear power plants. The organisation enables its members to exchange various information on problems and solutions in a timely manner. In addition, it ensures establishment of personal contacts, and familiarisation with achievements and identified problems.

EPRI

The EPRI - Electrical Power Research Institute - is a non-profit-making and independent organisation for research in the area of production of electricity and protection of the environment. It was established in 1973 in support of the development of the electrical industry. The Institute currently covers all aspects of the production, transmission and use of electricity. At the present, 90% of electricity producers in the USA are members of the Institute. International membership covers ten percent of the financial investments in its activities. EPRI offers its members answers to critical questions related to safe, reliable and economically efficient operation of facilities.

Krško NPP also actively participates in certain significant areas of the Institute's activities: NMAC - Nuclear Maintenance Applications Center - a section of EPRI dealing with issues related to maintenance of equipment in nuclear power plants, with emphasis on certain equipment installed at the Krško NPP; and NDE - Non Destructive Examinations - the section for research, development and implementation of non-destructive examinations (NDE), training of NDE personnel and ultrasound (UT) systems (procedures, equipment, staff).

NRC

The NRC (Nuclear Regulatory Commission) is an independent agency in the USA in charge of safety and protection of the population against the effects of radiation from nuclear material, reactors and facilities for processing of nuclear material. Together with the Slovenian Nuclear Safety Administration and the Jožef Štefan Institute, the Krško NPP is a member of the programmes COOPRA (International Cooperative PRA Research), CSARP (Cooperative Severe Accident Research Programme) in CAMP (Code Applications and Maintenance Programme). These programmes enable the Krško NPP access to information and literature related to various fields.

WOG

The WOG (Westinghouse Owners Group) is the association of all Westinghouse customers and the Westinghouse company itself. The organisation offers various programmes related to equipment improvement, optimisation of technical specifications, reducing the number of unplanned shutdowns, increasing the power of power plants, simplifying systems of power plants, production and use of nuclear fuel, performing analyses by using state-of-the-art programs and analytical methods, etc.

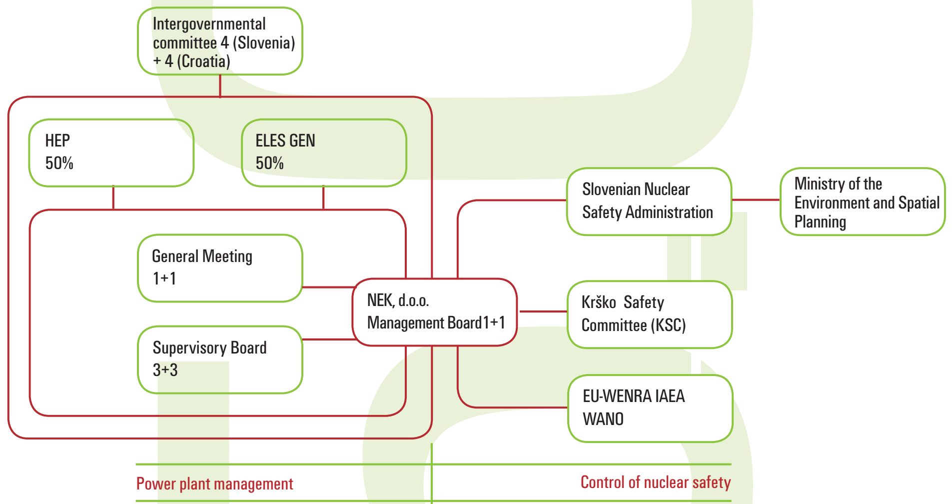
Co-operation in 2004

Within the co-operation with international organisations in 2004, the Krško NPP hosted a technical mission from WANO on the topic of human performance & root cause analysis. Krško NPP participated in international inspections of WANO: in the area of production at the Beznau power plant in Switzerland and in the area of maintenance at the Dungeness power plant in Great Britain. Krško representatives also participated in final international inspections of WANO at the Torness and Sellafield power plants in Great Britain. Within the regular additional training of the Krško NPP staff, two employees participated at seminars for managerial personnel organised by the Paris Centre of WANO. Since last year, the plant also has a representative in Paris, who is actively involved in the work of the WANO Paris Centre as a member.

The Krško plant received a technical mission of INPO on the topic of process computer configuration control. The Krško representative participated at seminars of the Professional Development organisation of INPO in the fields of training, engineering and production.

The plant also participated in the international inspection (OSART) of the German power plant at Philippsburg, which was organised by the International Atomic Energy Agency (IAEA).

company organisation



control and management of the power plant 15.1*

In accordance with the Agreement concluded between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on regulating the status and other legal issues related to investments in the Krško Nuclear Power Plant, its utilisation and decommissioning, and the Articles of Association, the Krško NPP is organised as a limited liability company.

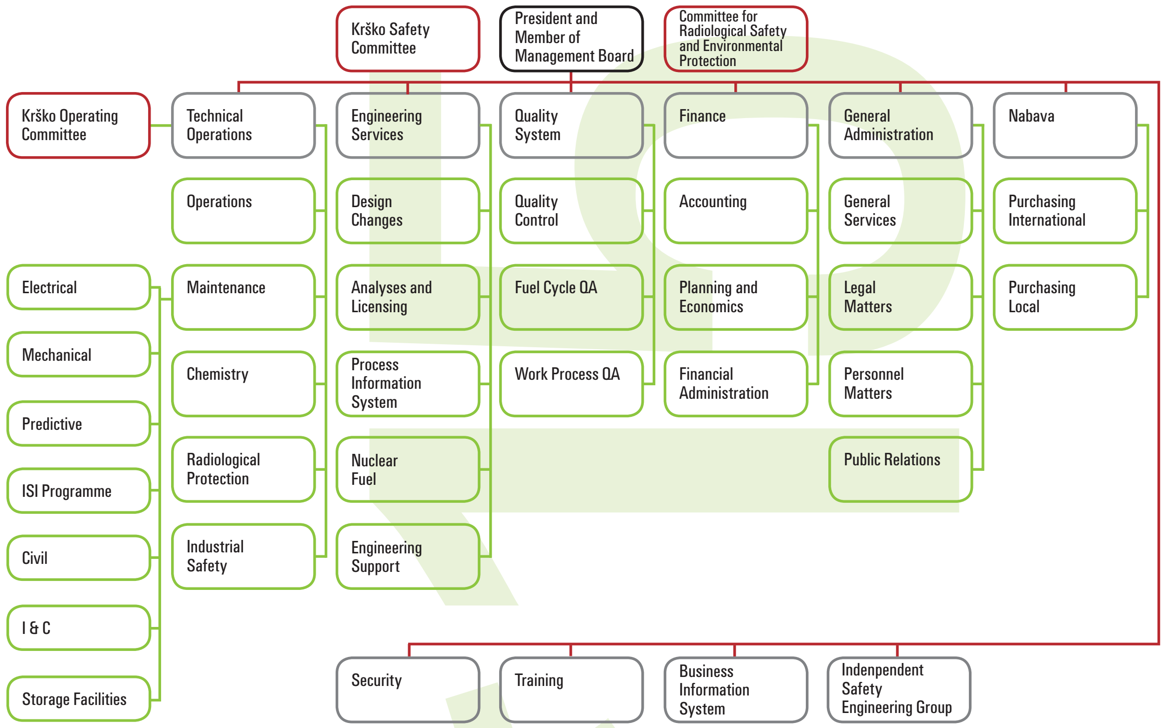
The equity capital of the Krško NPP is divided into two equal business shares owned by the members ELES GEN, d.o.o. Ljubljana and Hrvatska elektroprivreda, d.d. Zagreb. The bodies of the company, having parity membership, are the General Meeting, the Supervisory Board and the Management Board.

The organisational structure of the Krško NPP follows modern standards of organisation of companies managing nuclear facilities. It has special functions important for nuclear safety and a system for independent evaluation of key operational safety aspects.

The Krško NPP is also distinguished by a high level of organisational and staff stability and favourable educational structure, as one third of employees has high school or university degrees.

Standing from the left:
Darko Kavšek, Quality System Director,
Rudi Mlinarič, Financial Director,
Ivan Špiler, General Administration Director,
Zoran Heruc, Purchasing Director,
Ferdo Androjna, Maintenance Manager,
Janez Krajnc, Production Manager.

Sitting from the left:
Martin Novšak, Engineering Director,
Hrvoje Perharić, Member of the Krško NPP Management Board,
Stane Rožman, President of the Krško NPP Management Board,
Predrag Širola, Technical Director.



company organisation 15.2*

Summary of the financial report

In accordance with the Companies Act and the Articles of Association of the Krško NPP, a summary of the Financial Report of the Krško NPP for 2004 is given below. The summary includes the main characteristics of operations in 2004 and an abbreviated version of the complete financial statements. The complete financial statements are disclosed in the Annual Report of the Krško NPP for 2004 which was submitted to the organisation authorised for processing and publishing of data in accordance with the prescribed deadlines, and which is published on its website. The Annual Report also presents accounting policies, annotations and explanations of the financial statements.

The plant performed successfully in 2004. The organisation achieved all its business and operational objectives set out in the Business Plan for 2004. The year 2004 was at the same time the first year of implementation of the Agreement concluded between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on regulating the status and other legal relations related to investments in the Krško Nuclear Power Plant, its utilisation and decommissioning (hereinafter: the Intergovernmental Agreement), and the Articles of Association of NEK d.o.o. (hereinafter: the Articles of Association) concluded between ELES GEN, Podjetje za financiranje in upravljanje družb, d.o.o. and Hrvatska elektroprivreda d.d. Zagreb. In accordance with the Intergovernmental Agreement the power plant must supply the electricity produced to both members, namely to each member one half.

In 2004, thanks to good operation of the power plant and favourable hydrology, the planned production was exceeded and the partners supplied with 5,212k MWh of electricity at a competitive price, which was lower than planned. In accordance with the Articles of Association, the price of power and electricity supplied at the annual level covers all costs and expenses. Hence, revenues were aligned with expenses in 2004 and the net operating result equalled zero. Total revenues amounted to SIT 26,344 million. The bulk of revenues (98%) related to revenues from electricity supplied to the partners and a small part to revenues from auxiliary activities and financial revenues. As stated above, expenses are equal to revenues, namely SIT 26,344 million. The largest share in the structure of expenses is represented by costs of services and consumption of material (27%), depreciation costs (24%), labour costs (20%) and nuclear fuel costs (15%). It should also be noted that in 2004 the power plant performed a transition to an 18-month fuel cycle and that the depreciation method for tangible fixed assets was changed. The newly applied method sets the annual depreciation cost at the average of planned repayment of long-term loans and approved investments.

Investments were performed in line with the plan as regards investments in modifications of technological systems, as well as the replacement of the low-pressure rotors of the main turbine. Additionally, in line with the amortisation plan a part of the principal of the loan raised for modernisation of the Krško NPP was repaid, thus reducing indebtedness. The financial position of the Krško NPP in 2004 was adequate. Long-term liabilities cover all long-term assets and also all inventories.

Business results in 2004 are also evident from the abbreviated form of the complete financial statements for 2004, presented below.

Balance sheet	31.12.2004	31.12.2003
		in millions of SIT
Assets		
A. Fixed assets	108,654	110,939
Intangible long-term assets	–	–
Tangible fixed assets	108,338	110,577
Long-term financial investments	316	362
B. Current assets	19,738	19,434
Inventories	12,992	14,094
Operating receivables	1,460	2,021
Short-term financial investments	5,270	3,308
Goodwill with banks, cheques and cash in hand	16	11
C. Deferred expenses and accrued revenues	96	74
Total assets	128,488	130,447
Off-balance sheet assets	841	424

Balance sheet	31.12.2004	31.12.2003
		in millions of SIT
Liabilities		
A. Capital	105,974	105,974
Capital and reserves	105,974	105,974
B. Provisions	255	264
Financial and operating liabilities	22,228	24,134
I. Financial liabilities	18,195	19,995
II. Operating liabilities	4,033	4,139
Accrued expenses and deferred revenues	31	76
Total liabilities	128,488	130,447
Off-balance sheet liabilities	841	424

balance sheet as at 31 December 2004 16.1*

Investments were performed in line with the plan as regards investments in modifications of technological systems, as well as the replacement of the low-pressure rotors of the main turbine.

a	version 1		in million of SIT
	Profit & loss account	2004	2003
1.	Operating revenues	26,116	29,552
2.	Operating expenses	25,015	26,913
3.	Financial revenues	222	390
4.	Financial expenses	1,310	3,316
5.	Net operating profit or loss from ordinary activity	13	(287)
6.	Extraordinary revenues	6	8,738
7.	Extraordinary expenses	19	14
8.	Operating profit or loss from extraordinary activity	(13)	8,724
9.	Corporate income tax	–	–
10.	Net operating profit or loss for the period	0	8,437

b	direct method		in million of SIT
	Profit & loss account	2004	2003
	Cash flow from operating activities		
1.	Cash receipts from operations	30,912	36,875
2.	Uses of cash for operations	22,003	25,917
3.	Surplus cash receipts (payments) from operations	8,909	10,958
	Cash flows from investment activities		
4.	Cash receipts from investments	30,397	26,695
5.	Uses of cash for investment activities	36,434	31,738
6.	Surplus cash receipts (payments) from investments	(6,037)	(5,043)
	Cash flows from financing activities		
7.	Cash receipts from financing	0	8,830
8.	Uses of cash for financing	2,867	14,774
9.	Surplus cash receipts (payments) from financing (1-2)	(2,867)	(5,944)
	Closing balance of cash and its equivalents	16	11
10.	Cash flow for the period	5	(29)
	+		
11.	Opening balance of cash and cash equivalents	11	40

profit and loss account for the year ended on 31 December 2004 16.2*

Additionally, in line with the amortisation plan a part of the principal of the loan raised for modernisation of the Krško NPP was repaid, thus reducing indebtedness.

The financial position of the Krško NPP in 2004 was adequate. Long-term liabilities cover all long-term assets and also all inventories.

in million of SIT

Capital elements	Called-up capital	Profit reserves		Retained net profit or loss		Net profit or loss for the financial year	Capital revaluation adjustments	Total equity
	Called-up capital	Legal reserve	Statutory reserve	Retained net profit	Retained net loss	Profit after taxes	General capital revaluation adjustment	
Opening balance as at 1.1.2004	84,723	8,472	4,249	93	–	8,437	–	105,974
Capital increase	–	–	–	–	–	–	–	–
Capital restructuring	–	–	–	–	–	–	–	–
Distribution of net profit to additional reserves based on a decision of the annual meeting	–	–	8,530	(93)	–	(8,437)	–	–
Closing balance as at 31.12.2004	84,723	8,472	12,779	–	–	–	–	105,974
Opening balance as at 1.1.2003	30,630	258	–	4,903	–	–	44,492	80,283
Capital increase	17,253	–	–	–	–	8,437	–	25,690
Entry of net profit or loss for the period	–	–	–	–	–	8,437	–	8,437
Other increases of equity capital components	17,253	–	–	–	–	–	–	17,253
Capital restructuring	36,840	8,214	4,249	(4,810)	–	–	(44,492)	0
Distribution of net profit based on the resolution of the management and the supervisory board	–	8,214	4,249	(4,810)	–	–	(7,652)	0
Other reallocations of capital elements	36,840	–	–	–	–	–	(36,840)	0
Closing balance as at 31.12.2003	84,723	8,472	4,249	93	–	8,437	–	105,974

KPMG

Auditor's Report for the Purpose of Reporting to the Public

We have audited the financial statements of Nuklearna elektrarna Krško d.o.o., Krško, for the year ended 31 December 2004 in accordance with International Standards on Auditing and International Auditing Practice Statements issued by International Federation of Accountants. The summary of financial statements is based on the financial statements, and consists of the summary of the balance sheet as of 31 December 2004, the summary of the income statement, of the cash flow statement, and of the statement of changes in equity for the year then ended. We expressed an unqualified opinion in our report issued on 31 March 2005 on the financial statements from which the summary originates.

In our opinion, the attached summary of the financial statements complies, in all material aspects, with the financial statements from which it originates.

For a better understanding of the financial situation of the Company as of 31 December 2004, the results of its operations, its cash flows and the changes in equity for the year then ended, and the scope of our audit, it is necessary to read the summary of the financial statements together with the financial statements from which it originates and our auditor's report on these financial statements.

KPMG SLOVENIJA,
podjetje za revidiranje, d.o.o.

Vera Menard, B.Sc.Ec.
Certified Auditor

Marjan Mahnič, B.Sc.Ec.
Certified Auditor
Managing Partner

Ljubljana, 20 May 2005

KPMG Slovenija, d.o.o.

*17.0 list of abbreviations

ANS	American Nuclear Society
ANSI	American National Standards Institute
AOP	Abnormal Operating Procedures
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CAMP	Code Applications and Maintenance Program
CAP	Corrective Action Program
COOPRA	International Cooperative PRA Research
CSARP	Cooperative Severe Accident Research Program
CY	Condensate System
DEH	Digital Electro-Hydraulic
DMP	Design Modification Package
DRPI	Digital Rod Position Indication
ECB	Electrical Control Board
EOF	End-of-Life
EPRI	Electrical Power Research Institute
EX	Extraction Steam
FRI	Fuel Reliability Indicator
GLP	Good Laboratory Practice
HD	Heater Drain
HOP	Hand Over Package
IAEA	International Atomic Energy Agency
IEEE	Institute of Electrical and Electronics Engineers
INPO	Institute for Nuclear Power Operations
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination for External Events
ISI	In-Service Inspection
NMAC	Nuclear Maintenance Applications Center
NUID	Emergency Planning and Preparedness
NUMEX	Nuclear Maintenance Experience Exchange
NUREG	Nuclear Regulatory Guidance
MS	Main Steam
MSR	Moisture Separator Reheaters
OLM	On-line Maintenance
OMEG	Operations and Maintenance Expert Group
PCN	Process Computer Network
PLC	Programmable Logic Controller
PW	Pre-water Treatment
QA	Quality Assurance
QC	Quality Control
RB	Reactor Building
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
SX	Local Sampling
TC	Turbine Building Closed Cycle Cooling
TB	Turbine Building
URSJV	Slovenian Nuclear Safety Administration
WANO	World Assoc iation of Nuclear Operators
WENRA	Western Europe Nuclear Regulators Association
WOG	Westinghouse Owners Group
WT	Water Treatment
GT	Glavni Transformator (Main Transformer)
HEP	Hrvatska Elektroprivreda (Croatian Electricity organization)
IJS	Institut Jožef Stefan (Jožef Stefan Institute)
NEK	Nuklearna elektrarna Krško (Nuclear Power Plant Krško)
NUID	Načrt ukrepov u primeru izrednega dogodka
RZ	Radilоška Zaščita (Radiation Protection)
URSJV	Uprava Republike Slovenije za nuklearno varnost (Slovenian Nuclear Safety Administration)
VVA	Verjetnostne varnostne analize (Probabilistic Safety Assessment-PSA)
ZVISJV	Zakon o varstvu pred ionizirajočimi sevanji in jedrski varnosti (Act on Ionising Radiation Protection and Nuclear Safety)

Krško Nuclear Power Plant

Vrbina 12
SI-8270 Krško
tel +386 7 480 20 00
fax +386 7 492 15 28

www.nek.si