INTRODUCTION

This Report gives account of activities in 1996 of the State Office for Nuclear Safety („Státní úřad pro jadernou bezpečnost“, „SÚJB“) as the Czech regulatory authority responsible for supervision of nuclear safety of nuclear facilities and supervision of radiation protection in the Czech Republic.

Major nuclear facilities currently operated in the Czech Republic and falling under nuclear safety and radiation protection supervision included the 4 operated units of the Dukovany nuclear power plant equipped with VVER 440/213 reactors, two research reactors (the LVR 15 reactor with a maximum power of 10 MW and the zero-power LR-0 reactor) at the Nuclear Research Institute in Řež, and the VR-1P teaching reactor at the Faculty of Nuclear Science and Physical Engineering, Czech Technical University in Prague.

Under the authority of nuclear safety and radiation protection supervision by the SÚJB is also the construction of the Temelín nuclear power plant. Inspection activities at the Temelín site were mainly concerned with the quality of the construction and installation work, personnel training, safety documentation reviewing, and overall preparedness of the nuclear power plant for commissioning and start-up.

In addition, the SÚJB is responsible for supervision of the radioactive waste repositories at the Dukovany site and in the „Richard“ mine near the town Litoměřice, the interim spent fuel storage facility at the Dukovany site, and the high level radioactive waste storage facility operated by the Nuclear Research Institute at Řež.

With respect to radiation protection, the SÚJB executes supervision of over 5000 workplaces where ionizing radiation sources are handled.

SÚJB's activities with respect to the state supervision of nuclear safety are based on applicable legislation, in particular the State Supervision of Nuclear Safety of Nuclear Facilities Act No. 28/1984 and the State Office for Nuclear Safety Responsibilities Act No. 287/1993, as amended by Act No. 85/1995. SÚJB's attention has been primarily aimed at safety review of nuclear facilities and the level of radiation protection in the Czech Republic. This was based on analyses of the documentation and information on the operation of nuclear facilities and workplaces handling ionizing radiation sources, results of SÚJB's own inspection visits and missions and evaluation of the level of compliance with the terms, conditions and requirements laid down by the supervision body. Where analysis had shown that the compliance was inadequate, the SÚJB specified requirements and conditions for continued operation of the facility concerned. Adequate attention was also paid to the level of physical security of nuclear facilities and nuclear materials. Within its role in the inspection regimes in support of the Treaty on Non-Proliferation of Nuclear Weapons (NPT), the SÚJB performed periodical inspection of nuclear materials and satisfied additional requirements following for the Czech Republic's commitment to the international safeguards agreement based on the NPT.

No serious accident causing radioactivity leak into the environment, above-the-limit radiation endangerment of the professional staff or the public, or increase in contamination of the environment and the food chain by artificial radionuclides

occurred in 1996. At none of the facilities or workplaces inspected by it, the SÚJB identified any basic shortcoming or deficiency calling for suspension or withdrawal of the licence granted by the SÚJB.

Of particular importance in 1996 was the safety review of the Dukovany-2 nuclear power plant unit in 10 years of operation, based on which the SÚJB granted licence for a continued operation of this unit. Additional SÚJB's important decisions concerned licences for a permanent operation of the interim spent nuclear fuel storage facility at the Dukovany site and permanent operation of the high level radioactive waste storage facility of the Nuclear Research Institute at Řež.

STATE OFFICE FOR NUCLEAR SAFETY

The State Office for Nuclear Safety is a governmental body with its own budget. In SÚJB's head is the SÚJB Chairman, appointed by the Government of the Czech Republic. The SÚJB Chairman is also the Nuclear Safety Inspector General.

The authority and responsibility of the SÚJB is stipulated by Act No. 85/1995, amending the State Office for Nuclear Safety Responsibilities Act No. 287/1993, and associated legislation. Responsibilities of the State Office for Nuclear safety include:

- State supervision of nuclear safety of nuclear facilities, radioactive waste management, and spent nuclear fuel.
- State supervision of nuclear materials, including accountancy and control.
- State supervision of selected materials, facilities and technologies used in the nuclear field, as well as double-purpose materials and facilities.
- State supervision of ionizing radiation protection.
- Coordination of the Radiation Monitoring Network of the Czech Republic and international exchange of radiological data.
- Professional cooperation with the International Atomic Energy Agency.

In 1995, the authority of the SÚJB was extended to cover state supervision of protection against ionizing radiations. To this end, the structure of the Office was modified adequately, as described in detail in the Annual Report 1995. No additional changes in the SÚJB structure were effected in 1996. In accordance with the responsibilities, the Office is divided into three Sections, which are all headed by the SÚJB Deputy Chairmen, and an independent Department:

Section of Nuclear Safety, which includes the Nuclear Safety Assessment Department, Components and Systems Department, and Nuclear Materials Department;

Section of Radiation Protection, which includes the Radiation Source Applications Department, Natural Radiation Sources Department, Department of Radiation Protection at Nuclear Facilities and in the Environment, and an independent Department of the Health Aspects of Radiation Protection,

Section of Management and Technical Support, which includes the International Cooperation Department , Financial Department, and Office Bureau.

Independent Department of Emergency Preparedness (reporting directly to the SÚJB Chairman), which fulfils the function of the Crisis Coordination Center and coordinates the Radiation Monitoring Network.

The SÚJB also incorporates its **Regional Centers** in Prague, Plzeň, České Budějovice, Ústí nad Labem, Hradec Králové, Brno, and Ostrava, as well as two local offices at the Dukovany and Temelín nuclear power plants.

The SÚJB is also the managing authority of the **National Radiation Protection Institute (**SÚRO) in Prague.

DUKOVANY NUCLEAR POWER PLANT

No event resulting in intolerable radioactivity leak into the environment occurred at the Dukovany nuclear power plant in 1996. The operation of all reactor units was classified as safe and reliable by the SÚJB. From among the 76 failures and events that occurred at Dukovany in 1996, only 4 were classified as level „1“ on the 8-level International Nuclear Event Scale (INES), hence, as anomalies beyond the authorized operating regime with no impact on the nuclear safety of the facility. The remaining 72 events were classified as level „0“, i.e. as deviations of no safety significance.

In 1996, the SÚJB reviewed the nuclear safety of Unit 2 in 10 years of operation and granted approval for a continued operation. As in the case of Unit 1, this approval is conditional on a number of requirements being satisfied, as specified by the relevant SÚJB Decision.

During the whole year, the units were periodically put in trial operation in the primary frequency control regime, which is a precondition for connecting the Czech power system to the Western UCPTE network. Within the feasibility testing of the secondary and tertiary frequency control, these control modes were tested at Unit 2. The tests, associated with more rapid changes in the output of that unit, gave evidence that after minor modifications in the unit Instrumentation & Control system, the Dukovany reactor units can be engaged in secondary and tertiary frequency control should the need arise.

Scram due to intervention of the HO-1 emergency protection system occurred 6 times in 1996. This is a higher figure than experienced the previous years. Although the number is low from the statistical point of view, the State Supervision regards this fact as a worsening of one of the safety indicators reviewed by it. It is noteworthy that from among the total 18 indicators, adverse development trends were recorded for 3 of them in 1996, while the remaining indicators were at levels virtually identical with those of the previous years or even better.

The HO-2 emergency system intervened once, viz. at Unit 2. Due to a failure, the HO-3 protection intervened first, and subsequently, when the signal lasted longer than 10 seconds, the HO-2 emergency protection system was triggered as designed.

The HO-3 emergency protection system was triggered five times, including the transition of HO-3 to HO-2 as described above.

Dukovany nuclear power plant
Photo: ČEZ, a.s. – Dukovany NPP archives

Intervention of the reactor protection systems in 1996

No.	Date	Power	Type	Cause
Unit 1				
1	18 Feb 96	100 %	HO-3	Late shutdown of the MCP during remediation of a failure
Unit 2				
1	30 Mar 96	100 %	HO-1	Closing of the quick-closing valve of the last TG due to the signal of +200 mm water level in the SG
2	6 Jul 96	Regime 2	HO-3	Defective contact of the power controller of the interzone at the 2nd subsystem of the reactor protection system
3	6 Jul 96	Regime 2	HO-2	Transition of HO-3 to HO-2 in 10 s of action
4	1 Sep 96	99 %	HO-1	Failure of the last active TG
5	14 Sep 96	100 %	HO-3	Intervention of the reactor power limiter control after shutdown of the MCP during failure of the SG feed control
6	11 Nov 96	100 %	HO-1	Outage of all MCPs during the „MSH Rupture“ signal testing
Unit 3				
1	9 Jun 96	Regime 3	HO-1	False „MSH Rupture“ signal at the RPS Subsystem 1
2	8 Jul 96	99,8 %	HO-1	Minimal feedwater pressure following closure of discharge of all electric feedwater pumps
3	10 Jul 96	100 %	HO-3	Automatic reactor power increase in the N mode with a simultaneous control rod assembly drop
4	26 Dec 96	100 %	HO-3	MSH pressure drop during a false opening of the bypass valve to condenser
Unit 4				
1	6 Oct 96	93 %	HO-1	Operator's mishandling of the power control facility

Events classified as level „1“ on the INES scale:

1. *16 April 1996: the Limits and Conditions for Normal Operation of the Dukovany NPP („Limits and Conditions“) were violated due to control room personnel failure to test within the specified period the remaining safety system pumps after putting the diesel generator out of operation, hence, with one safety system disabled.*
2. *21 April 1996: „Small LOCA“ signal was activated at Unit 3 from a false pulse due to poor communication of the instrumentation and control personnel during the adjustment of the indicators and due to a poor technical condition of the latter. In view of the causes, the failure was classified as level „1“.*
3. *8 July 1996: the Limits and Conditions were violated by the control room personnel at Unit 4: after disabling the diesel generator following rupture of the hose feeding fuel to the*

pressure gauge (presumably as a result of a manufacturing defect), the remaining spray pumps failed to be tested.

4. *6 October 1996: Unit 4 reactor operator handled in an improper manner the emergency power control facility, whereupon the HO-1 system was activated. Analysis of causes of this failure revealed deficiencies in the applicable section of the operating regulations. As remedial provisions, the procedures were modified, operating personnel underwent dedicated training, and the simulator training programme was modified as well.*

All of the 76 failures that took place in 1996 were discussed by the Dukovany Event Committee in the presence of representatives of the SÚJB, conclusions were made and provisions adopted. Based on analysis of the causes, the Event Committee concluded that 9 of them had been due to human error, 3 had been due to mistakes of personnel of the supplier organizations, 54 had been due to defects of the equipment, and 5 had been associated with errors in the operating documentation; for 10 failures, not all of their causes could be identified reliably. The number of identified causes of failures was higher than the number of the failures themselves because some failures had more than one cause.

Limits and Conditions for Normal Operation of the Dukovany Nuclear Power Plant

As compared to the year before, there were fewer violations of the Limits and Conditions, viz. only 3 against 5 in 1995.

On the utility's request and based on review of the documentation submitted by it, 4 short-term changes in the Limits and Conditions were authorized by the SÚJB in 1996. These concerned some necessary complex repair activities, where the SÚJB came to the conclusion that the risk was not increased intolerably by the changes. Two such short-term changes had been approved by the SÚJB the year before.

Violation of the „Limits and Conditions“ at the Dukovany NPP in 1996

No.	Cause	Note
Unit 2		
1	Emergency core cooling system pump failed to be tested while the dieselgenerator was disconnected	16 Apr 1996
Unit 3		
2	Non-reported opening of the spent fuel storage pool	27 Mar 1996
Unit 4		
3	The remaining hermetic compartment spray subsystems failed to be tested while the dieselgenerator was disconnected due to failure	8 Jul 1996

Dukovany reactor hall
Photo: ČEZ, a.s. – Dukovany NPP archives

Supervisory activity of the SÚJB at the Dukovany plant

Safety review of Unit 2 in ten years of operation was among major events among SÚJB's supervisory activities. The review was based on applicable regulations, which formed the criterial basis, as well as recommendations of the IAEA and international safety missions.

Continued operation of Unit 2 was licensed by the SÚJB based on the review of:

- Safety Report documenting the nuclear safety status of the unit in 10 years of operation;
- results of special inspection visits concerned with the level of non-destructive testing, technical and review inspections, equipment operability inspections, and quality assurance in the implementation of selected design changes;
- checks of compliance with the requirements laid down by previous decisions;
- results of the completed major overhaul of and refuelling at Unit 2.

The operating licence for Unit 2 was granted for the next two refuelling cycles and incorporates 28 requirements to be met by the operator as a condition for renewal of the licence.

SÚJB inspections at the Dukovany plant in 1996 have been documented in 35 protocols and 225 decisions.

Major attention was paid to the examination of failures and continuous monitoring of how the remedial provisions specified by the Event Committee had been implemented to prevent the failures from repeating; this is of particular importance for failures classified as INES level „1“. Additional specialized inspection activities of the SÚJB at the Dukovany plant were concerned with checking how the requirements specified by the decisions, inspection protocols, and approved documentation and regulations were being met. Based on the results of the inspection activities it can be concluded that the SÚJB requirements were satisfied within the specified time schedules.

Periodical routine inspections during the whole year were aimed at checking the limiting and safety parameters as specified by the „Periodical Inspection Programme“. The activities were accomplished by the SÚJB resident inspectors. The inspections revealed that during the period in question, all of the selected operating rules were adhered to and the parameters were within the specified limits. As required by the Programme, the preparedness of the units for refuelling was checked, including the refuelling schedule. The inspection found that the preparedness of the units for refuelling was documented in compliance with applicable regulations.

The tests of operability of the safety systems along with the automatic start-up of the standby diesel generators for the standby 2nd category power supply were monitored systematically. The scope of the tests complied with the in-service inspection programme and programme of testing the automatic start-up of the standby diesel generators for the standby 2nd category power supply.

During outages of the units for major overhaul and refuelling, the inspections were concerned with quality assurance during inspection and repair of the technological equipment, development of technological procedures for repairs including their inspection during the repair and after its completion, with tests performed before renewed start-up of the reactor unit, attainment of the minimal controlled reactor power, and selected tests of the physical and power start-up.

Before the units were started up following their refuelling and general overhaul, inspections had been performed to verify compliance of all the performance tests with the requirements of the „Limits and Conditions“, with the criteria of success, in particular the results of leaktightness testing of the hermetic rooms and their integral strength testing. The leaktightness of the hermetic zone complied with the requirements of the „Limits and Conditions“ for all the units inspected.

Quality assurance during the implementation of safety-related modifications and repairs at selected facilities was another field of interest of the SÚJB inspections. Some shortcomings in meeting the requirements of the internal quality assurance documentation of the Dukovany plant were identified. As a consequence, the SÚJB specified some remedial actions to be taken by the plant operator; these are being implemented.

Events at the Dukovany NPP Unit 1 in 1996

1	10 – 11 May	TG 12 shutdown due to secondary circuit repair
2	26 Jun – 16 Aug	Unit 1 annual maintenance and refuelling
3	13 – 18 Aug	Physical and power-generation start-up tests
4	24 Aug	TG 11 shutdown for repair
5	28 Oct	Unit power reduction to enable lubrication of the MCP 3 clutch
6	3 Nov	Power reduction due to unsuccessful remedy of MCP 3 vibrations
7	7 Nov	TG 11 failure due to a false signal of bearing overheating
8	1 Dec	Identification of causes of increased vibrations of MCP 3
9	20 – 28 Dec	Unit outage due to MCP 3 repair

Events at the Dukovany NPP Unit 2 in 1996

1	1 Jan	Power increase after load following
2	9 Jan	TG 22 trip from a spurious signal
3	25 Feb	Planned outage of TG 21 for repair of the exciter collector ring
4	7 Mar	TG 21 trip due to switch short circuit caused by impurity
5	31 Mar	TG 21 trip caused by the +200 level in SG 6, followed by HO-1 intervention
6	11 Apr	TG 21 power decrease due to power limiter intervention, loss of excitation
7	26 Apr – 9 Jul	Annual maintenance and refuelling
8	15 Jul	Power reduction to eliminate leak from the pressure air system
9	24 Aug	Planned TG 21 repair, power reduction
10	1 Sep	Trip of both TGs, subsequent HO-1 due to „trip of last working TG“
11	11 Nov	trip of all MCPs while testing the „MSH Rupture“ signal (HO-1)
12	16 – 17 Nov	Testing the secondary and tertiary unit control
13	3 – 5 Dec	Primary frequency control
14	27 Dec	TG power reduction due to need of steam for Unit 1 in the shutdown state

Events at the Dukovany NPP Unit 3 in 1996

1	1 Jan	Planned outage of TG 31 – load following
2	13 – 14 Jan	Repair of subsystem 3 of the service water system
3	21 – 23 Jan	Planned switching-off tests
4	23 Feb – 20 Apr	Annual maintenance and refuelling
5	18 – 20 May	Primary circuit leak repair
6	5 – 10 Jun	Pilot Operating Relief Valve leak repair
7	8 – 9 Jul	HO-1 due to uncontrolled closing of discharge of all electric feedwater pumps
8	5 – 6 Oct	TG 31 shutdown for steamline leak repair

Events at the Dukovany NPP Unit 4 in 1996

1	15 Mar	TG 42 trip due to failure of the stator water flow meter and intervention of HO-4 due to unmoving control assembly 12-49
2	6 – 10 May	Primary frequency control
3	6 – 7 Aug	Unit operation in the primary frequency control mode
4	23 Aug	Annual maintenance and refuelling
5	5 Oct	Unit start-up following annual maintenance and refuelling
6	6 Oct	Intervention of HO-1 due to human error
7	7 Oct	100% power output reached
8	26 – 28 Oct	Unit operation in the primary frequency control mode
9	20 – 25 Nov	Unit operation in the primary frequency control mode
10	27 Nov – 9 Dec	Unit operation in the primary frequency control mode
11	11 – 19 Dec	Unit operation in the primary frequency control mode

TEMELÍN NUCLEAR POWER PLANT

Construction and installation work and work aimed at preparing the nuclear facility for commissioning (start-up) continued at the Temelín nuclear power plant in 1996.

At **Unit 1**, civil engineering modifications were being completed in rooms where the Instrumentation & Control system of the Westinghouse Electric Corporation (WEC) will be installed. Similar work was under way in rooms which accommodate systems that pass over to the start-up stage.

Installation work at Unit 1 primarily included completion of welding in the steam generator boxes and continued welding on the service water systems. Reconstruction of steam generator internals (steam separators and feedwater piping) was performed with a view to improving parameters of the steam to be generated and life of the steam generators. Finishing work on the steel structures for cabling and cable laying work in the segments ready for that continued as well.

Activities aimed at preparing the nuclear facility for commissioning and start-up were extended from the auxiliary structures to the technological equipment of Unit One. The oil systems of the main circulation pumps, make-up pumps, and turbogenerator were flushed. The mechanical operation of the 1000 MW turbogenerator was tested successfully by using foreign steam, whereby the mechanical behaviour of the prototype set in conjunction with the associated mechanical technology facilities (cooling water pumping station, auxiliary boiler station as a source of steam, steam and feedwater pipelines) was verified. Tests of the fresh fuel storage facility were performed, as necessary for starting up the trial operation; this included checking the preparedness of the facility for fresh fuel acceptance. Tests of the cooling system and of the spent fuel storage pool water purification system were also started up.

At **Unit 2**, transports of the principal primary circuit components into the containment were completed and welding of the components was commenced. During the year, the main circulation piping components were welded to the remaining primary circuit units (reactor pressure vessel, steam generators).

Installation of technological components, including the turbogenerator, continued on the secondary cooling circuit of Unit 2.

Installation and prestressing of the containment ropes at Unit 2 was started and successfully completed in 1996. Based on experience gained during similar work at Unit 1, modifications and improvements were made at Unit 2, owing to which no major problems were encountered.

Licensing process

The SÚJB activities in relation to the licensing of the Temelín nuclear power plant were mainly concerned with the review of the Supplement to the Preliminary Safety Report („Supplement“), whose developed had been compelled by changes in the plant design.

Those parts of the „Supplement“ prepared by Czech organizations were reviewed, and basic comments were conveyed to the utility, ČEZ, a.s.

Temelín nuclear power plant
Photo: ČEZ, a.s. – Temelín NPP archives

The four chapters (out of a total of 18) prepared by the Westinghouse Electric Company (WEC) had been submitted gradually to the SÚJB in their draft versions since 1994. So, the SÚJB had the opportunity to monitor the development activities in the fields of both the nuclear fuel the Instrumentation & Control System. Owing to this, the SÚJB could inform the utility about shortcomings in the design proposed as well as in the evidence documentation. Review of the chapters prepared by WEC continued in 1996 and primarily concerned the following chapters: Chapter 4 – Reactor (fuel description), Chapter 7 – Automatic System of Technological Process Control (system description and performance), and Chapter 15 – Safety Analyses (design basis accident calculations). So far, the SÚJB has demanded over 1400 pieces of supplementary information concerning the above chapters to be submitted. To date, about 75% of the technological information requested has been provided by ČEZ.

Apart from the review of the „Supplement“, the quality assurance documentation and facility commissioning (start-up) documentation was being reviewed piece by piece as submitted to the SÚJB for approval.

An IAEA mission visited the Temelín site in March 1996. The goal of the mission was to review the proposed design changes and the approach to the operation in view of the shortcomings of the VVER-1000 design in general, as identified previously by international review teams. The IAEA mission found no major drawbacks, and stated that in some respects the Temelín design was even better than as stipulated by internationally recognized standards.

Supervisory activity

Apart for the regular on-site activity of the resident inspectors, 25 specific inspection visits were performed in 1996, mainly concerned with the quality of the construction, installation and start-up work, relevant documentation and implementation.

The SÚJB issued 115 decisions for Temelín in 1996, largely dealing with and approving contractors' and subcontractors' quality assurance programmes and selected plant commissioning documents.

From among the commissioning activities at Unit 1, the SÚJB inspectors monitored in particular preparatory work for mechanical operation tests of the 1000 MW turbogenerator driven by foreign steam, which tested the mechanical behaviour of the prototype set. The associated machinery (cooling water pumping station, auxiliary boiler station as a steam source and the piping) was operated within this test as well. The machinery was partly controlled by dedicated control instrumentation set up specifically for this purpose by WEC. Furthermore, inspection activity was aimed at pre-complex testing, particularly of the spent fuel storage pool water cooling and purification system and electrical systems of the home consumption feeding of the technological equipment of the plant.

Based on the results of the SÚJB inspections with respect to the commissioning of 1 unit it can be concluded that the required harmonization of the builder's quality system with applicable legislation has been achieved. At large, the approved programmes of pre-complex testing of the components and systems and the operative programmes were adhered to by the utility – ČEZ, a. s. – as well as by its major contractors. In compliance with the conclusions of the inspections in 1995, the SÚJB pushed in 1996 for completion of the lacking chapters of the Commissioning Documentation developed jointly by ČEZ-Temelín

and Škoda Praha, a.s. This documentation was nearly complete by the end of 1996, and the remaining parts should be submitted to the SÚJB in 1997 as laid down by the binding procedure.

The SÚJB inspection activities at Temelín Unit 2 were mostly concerned with technological discipline in the welding of the main circulation piping, compliance with the quality assurance programmes, technical specifications and guidelines for installation work and reconstruction of the separation facility and the steam generator feedwater manifold.

As concerns the quality of installation work at the two Temelín units, a few cases were identified (as in the previous years) where the individual quality assurance programmes and technical specifications failed to be adhered to perfectly. These included, for instance, quality assurance during welding and stainless steel materials handling, and cleanness during the installation of important components and systems. A better level of cleanness and lower dustiness in the working rooms, as well as improved labour discipline during installation work are imperative. In this sense, the SÚJB has been exerting constant pressure on the utility.

Fresh fuel storage facility at the Temelín site

ČEZ-Temelín applied for permission to start trial operation of the fresh nuclear fuel storage facility. To assess the overall preparedness of the storage facility for trial operation, the SÚJB accomplished four inspection visits.

Based on the results of the inspections, favourable results of review of the relevant safety documentation, the Limits and Conditions for Operation of the Fresh Nuclear Fuel Storage Facility, and results of inactive tests, the SÚJB granted licence for storage of fresh nuclear fuel and for starting the trial operation of the fresh fuel storage facility.

A fuel assembly dummy is being handled at the Temelín fresh nuclear fuel storage facility
Photo: ČEZ, a.s. – Temelín NPP archives

NUCLEAR RESEARCH FACILITIES

LVR-15 reactor

The LVR-15 reactor run by the Nuclear Research Institute at Řež produced 14 825 MWh in 1996; the facility was mainly operated to satisfy foreign customers' needs.

In 1996, the operating organization submitted to the SÚJB a new safety documentation set for review. The initial documentation had been reviewed extensively to comply with internationally recognized practice, recommendations by the IAEA, and applicable Czech legislation. The SÚJB reviewed the safety documentation and approved the Limits and Conditions for Permanent Operation of the LVR-15 Reactor.

The SÚJB inspection activities at this nuclear facility were concerned with operational safety and compliance with the „Limits and Conditions“, completeness of the safety documentation relating to the permanent operation, and training, qualification and fitness for work of selected operating personnel. No major shortcomings were identified. The reactor operation was safe and reliable, the „Limits and Conditions“ were adhered to, and experimental work was carried out as planned.

Other research facilities

The LR-0 reactor of the Nuclear Research Institute at Řež and the VR-1P teaching reactor at the Faculty of Nuclear Science and Physical Engineering, Czech Technical University in Prague, operated safely and reliably in accordance with the approved „Limits and Conditions“. No shortcomings in the operation of the reactors were identified by the SÚJB within inspection visits. The VR-1P teaching reactor is exploited extensively for educational purposes and plays an important role also beyond the Czech educational sector. The LR-0 reactor has a specific field of applicability and currently is not very extensively used.

In the late 1996, safety documentation was submitted to the SÚJB for review to enable the ŠR-0 reactor, belonging to the Škoda Plzeň – Nuclear Machinery company, to be safely shut down and eventually decommissioned. In this connection, nuclear materials were transferred from that company to the Nuclear Research Institute at Řež.

LVR-15 reactor at the Nuclear Research Institute at Řež. Model of the VVER 440 boundary zone
Photo: Nuclear Research Institute archives

VR-1P teaching reactor at the Faculty of Nuclear Science and Physical Engineering in Prague
Photo: Faculty of Nuclear Science and Physical Engineering archives

RADIOACTIVE WASTES

Dukovany nuclear power plant

The SÚJB granted permission for implementation of the technological design of solid radioactive waste treatment by high-pressure compaction. Based on review of the radioactive waste treatment process and on-site inspection it was concluded that the radioactive wastes so modified satisfy requirements of the Limits and Conditions for Storage in the Radioactive Waste Repository at the Dukovany NPP Site.

Changes in the technology of radioactive waste bituminization have been proposed and substantiated, and some supplementary requirements stipulated by the SÚJB have been met. The SÚJB reviewed the documentation and visited the facility, and ultimately granted permission for extended trial operation of the radioactive waste bituminization line, valid till 31 May 1997.

When inspecting how the „Limits and Conditions“ are adhered to and the data of radioactive wastes accepted for storage in the repository are recorded and maintained, shortcomings were identified in the operating documentation. The shortcomings were eliminated within terms laid down by the SÚJB protocol.

Temelín nuclear power plant

Inspection activities in the field of radioactive waste management at the Temelín NPP were concerned with the installation of the radioactive waste solidification facility in the active auxiliary operations building. No major shortcomings were found.

Nuclear Research Institute at Řež

The Nuclear Research Institute applied for licence to start trial operation of the fragmentation and decontamination center for radioactive waste treatment prior to its storage/disposal. After the requirements specified by the SÚJB based on inspection visits had been met and the submitted safety documentation reviewed by the SÚJB, licence to start the trial operation of this technological facility was granted; the licence is valid till 31 October 1997.

„Richard“ radioactive waste repository

The SÚJB granted permission for storage of 35 580 kg of iron scrap contaminated by ^{60}Co, supplied by the Ross company in the town of Roudnice nad Labem, at the „Richard“ repository. On-site inspection was accomplished to check whether the requirements, on the fulfilment of which the permission was conditional, had been met, and no non-compliances were identified.

The „Richard“ repository was operated by the company NYCOM, a.s., in 1996. An inspection visit was organized on the premises of the company to check how the radioactive wastes were treated before storage/disposal in the repository. Identified non-compliances were rectified by the organization within the schedule stipulated by the SÚJB protocol.

In November 1996, the operator submitted to the SÚJB safety documentation evaluating the condition of and situation at the repository, based on an the SÚJB requirement dating back to 1995. The SÚJB, however, found the documentation incomplete and required additional work to be spent on its completion.

Other radioactive waste repositories

In 1996, the SÚJB inspected the Central Radioactive Waste Repository „Bratrství“ at Jáchymov for compliance with radiological protection principles. Operated by the company ARAO, s.r.o., this repository is designed to host radioactive wastes containing natural radionuclides. No serious non-compliances were found.

ALKAZAR near the town Srbsko is another radioactive waste repository. This repository was closed in 1965 by decision of the Central Bohemian Regional Hygienist. Monitoring of drain waters, including water in the Berounka river, and soil near the entrance for contamination by radionuclides is the responsibility of NYCOM, a.s., based on a monitoring programme which was consulted with the SÚJB in 1996. The repository was violently opened several times in 1996, which the SÚJB also investigated.

INTERIM SPENT FUEL STORAGE FACILITY AT THE DUKOVANY SITE

The interim spent fuel storage facility at the Dukovany NPP site was in trial operation in 1996. Additional ten CASTOR-440/84 casks full of spent nuclear fuel were stored in the facility. As of 31 December 1996, eleven casks containing 924 spent fuel assemblies were stored by the facility.

Within the trial operation, selected physical parameters of the facility were monitored throughout 1996; these included, in particular, the temperature of entering cooling air, surface temperature of the casks, pressure between the primary and secondary lids, and radiological situation inside the storage facility and in its surroundings. The values measured lay within tolerable limits as specified by the Limits and Conditions of Trial Operation, approved by the SÚJB. Based on a requirement laid down by the SÚJB, photon and neutron spectra were measured by an independent organization. In relation to the results of measurement, the task was imposed upon the operating organization to introduce, in addition to personnel gamma dosimetry, also personnel neutron dosimetry with the aim to obtain a complete dose equivalent mapping for the storage facility personnel.

Three complex SÚJB inspection visits were accomplished in 1996, mainly to review compliance with the Limits and Conditions of Trial Operation and with the Interim Spent Fuel Storage Facility Trial Operation Programme. SÚJB inspectors found no non-compliances with the principles of nuclear safety, physical security, or radiation protection.

Based on a preliminary review of the trial operation, findings of the inspection visits, and the safety documentation submitted, the licensing process was finalized by the end of 1996 and the SÚJB granted the facility a permanent operating licence.

NUCLEAR MATERIALS TRANSPORT

Seven international transports of spent nuclear fuel were accomplished in 1996. Six were spent fuel transports from the Bohunice nuclear power plant in Slovakia, the seventh was transit from the Greifswald nuclear power plant in Germany to the Paks nuclear power plant in Hungary. Furthermore, four international transports involved uranium concentrate; three were from industrial plants of the company DIAMO, a.s., to France, one was headed for Russia. Seven international transports of fresh nuclear fuel were also implemented. Six were combined transports by aircraft, trucks, and train, transferring fresh fuel from Russia to Dukovany, one transported fuel from Russia to the Nuclear Research Institute at Řež. In addition, there were two inland transports of uranium concentrate and five in-plant transports.

During the year, the SÚJB accomplished five inspections of nuclear materials transport, which revealed that the requirements of nuclear safety and radiation protection as well as the requirements stipulated by the SÚJB decisions issued for the individual transports were satisfied.

The SÚJB reviewed and subsequently type-licensed five transport containers certified abroad, and validated two such containers.

Wagon for railway transportation of CASTOR casks
Photo: ČEZ, a.s. – Dukovany NPP archives

STATE SYSTEM OF NUCLEAR MATERIALS ACCOUNTANCY AND CONTROL

In 1996, the SÚJB accomplished 47 inspections of nuclear materials; out of these, 39 were performed in cooperation with inspectors of the IAEA. The goals were attained during all inspections. A new field of materials balance was prepared for the Temelín nuclear power plant.

The SÚJB granted 31 new permissions for possessing nuclear materials in 1996. Old permissions were withdrawn from 29 organizations based on their application on the grounds of no nuclear material being in their possession any more and no such possession being planned for the future. For 16 organizations the permission to possess nuclear materials expired.

Within its authority in the inspection regimes in support of the Non-Proliferation Treaty, the SÚJB granted permission for 43 imports and 12 exports of controlled items; the SÚJB also issued 17 permissions for user change within the Czech Republic. Permission for exports and temporary use of nuclear materials abroad was issued by the SÚJB in 4 cases.

The SÚJB contributed actively to the preparation of the Protocol supplementary to safeguards agreements, which is under way under the auspices of the IAEA as a response to the illicit nuclear activities disclosed in Iraq. This Protocol should strengthen the authority of the IAEA in the field of inspections to ensure peaceful use of nuclear energy and an overall improvement in the efficiency of the international safeguards system.

Review of inspection activities in 1995

MBA code	Number of IAEA inspections	Number of SÚJB inspections	IAEA inspection effort[1)] (man-days)
CZ-A	1	2	1 (3)
CZ-B	5	5	10 (6)
CZ-C	1	2	2 (3)
CZ-D	2	3	6 (5)
CZ-E	1	1	1 (1)
CZ-F	1	2	1 (3)
CZ-G	1	2	4 (3)
CZ-J	7	7	24 (26)
CZ-K	12	12	53 (42)
CZ-L	5	5	11 (7)
CZ-V	1	1	2 (1)
CZ-Z	1	5	2 (9)
Total	**39**	**47**	**117 (109)**

[1)] Inspection efforts permitted by the relevant Facility Attachment.

Review of material balance areas (MBAs) in 1996

MBA code	MBA name	Type of material[4]	Amount after PI[5] (SQ[6])
CZ-A	ŠR-0 research reactor		0
CZ-B	LVR-15 research reactor	HEU, LEU, N	2.3
CZ-C	LR-0 research reactor	LEU, N, D	4.2
CZ-D	NRI laboratories	all types	1.1
CZ-E	Škoda Plzeň Bolevec	P, HEU, LEU, N, D	0.1
CZ-F	ŠKODA-ÚJP, Praha	LEU, N, D	1.0
CZ-G	HLW storage	HEU, LEU	0.4
CZ-J	Dukovany Unit 1	P, LEU, D	266.2
CZ-K	Dukovany Unit 2	P, LEU, D	243.4
CZ-L	Dukovany ISFSF	LEU, P	122.6
CZ-V	VR-1P teaching reactor	HEU, LEU	0.2
CZ-Z	Total of 239 organizations	all types	0.7
material exempted from accountancy due to its non-nuclear use			1.5
Total of 258 organizations			**approx. 644**

1} HEU - highly enriched uranium, LEU - low enriched uranium, P - plutonium, D - depleted uranium, N - natural uranium, T - thorium

2} Physical inventory

3) SQ - amount of safeguards significance: 1 SQ equals 8 kg for plutonium (with respect to the total mass of the element); 25 kg of total ^{235}U isotope mass for HEU; 75 kg of total ^{235}U isotope mass for LEU, N and D; and 20 t of total element mass for thorium.

PERSONNEL QUALIFICATION AND TRAINING

In 1996, the SÚJB licensed a revised scheme of theoretical training of selected Dukovany and Temelín NPP personnel.

After checking that all requirements had been met and based on an inspection visit, the SÚJB licensed the Human Resources Department of the Dukovany NPP management to organize practical training of selected personnel operating nuclear power facilities of the plant.

Furthermore, the SÚJB paid attention to the continuing preparation and re-qualification of selected personnel for the Temelín reactor Unit 1 and to the development of a VVER 1000 simulator.

The State Examining Commission to examine special professional qualification and competence of selected nuclear facilities personnel sat 14 times in 1996. Based on successful results of examination by the State Examining Commission, 72 new nuclear facility operator licences were issued and 11 licences were renewed.

Within the IAEA Project CZR/005-07, an IAEA mission concerned with the human factor aspects within the Temelín project took place at the SÚJB. The following documents served as underlying information for this mission: Preliminary Safety Report of the Temelín Nuclear Power Plant, Chapter 18 (Engineering Aspects of the Human Factor), and an expert opinion on that Report prepared on a contractual basis by the organization ORGREZ SC, a.s., Brno. The conclusions of the mission and the expert opinion were employed by the SÚJB when reviewing the Report and preparing requirements to be imposed on the utility, ČEZ, a.s. Meeting those requirements is a prerequisite for continuation of the review of the Temelín safety documentation by the SÚJB.

In the field of professional education and training of nuclear facility personnel in the Czech Republic, the SÚJB is a member of an international working group of the IAEA. Conclusions made by this group during its meetings, in which the SÚJB has been participating regularly, are mainly concerned with the implementation of a systematic approach to the training of selected personnel of nuclear facilities, improvements in the training scheme for maintenance personnel, including contractors, the role of the management in the process of training scheme preparation and implementation, and improvements in the safety culture. All recommendations made by the working group are respected by the Czech Republic, and the SÚJB is making efforts for the recommendations to be gradually introduced into the system of preparation and training.

Whole-body counter at the National Radiation Protection Institute – determining low-energy gamma and X emitters in the skeleton
Photo: National Radiation Protection Institute archives

RADIATION PROTECTION SUPERVISION

Activities associated with radiation protection supervision by the SÚJB concentrated in 1996 primarily on the licensing of ionizing radiation sources handling and on inspections at workplaces where ionizing radiation sources were handled, and on the assessment of exposure to natural sources, radon in particular. In this context, the SÚJB granted permits and issued statements as specified by Act No. 85/1995 and Decrees No. 59/1972 and No. 76/1991.

Over 2100 inspection visits at workplaces where ionizing radiation sources were being handled were accomplished in 1996, and 2272 decisions and 1299 radioactive contamination certificates were issued for agricultural products (foodstuffs and feeding stuffs) exported to the EU member states as stipulated by the relevant EU directives.

Overview of ionizing radiation sources

Privatization of the Institute for Research, Production. and Application of Radioisotopes brought about discontinuation of the national system of ionizing radiation source accountancy. Therefore, the SÚJB began setting up a new Ionizing Radiation Sources Registry. As a first step, an extensive inventory of ionizing radiation sources and institutions possessing them was carried out. In this manner it has been ascertained that the following were registered and legally used by the end of 1996: 3734 sealed sources (in these, 1100 with activities in excess of 10 GBq; over 3400 sources were used for contactless measurements of physical quantities – pressure, density, ... – in the industry), and 5998 X-ray sources (in this: 5766 in the medical sector, 232 in the industry); 401 workplaces were using unsealed sources (in this, 120 in medicine).

Twenty-eight emergency events were reported and examined in 1996. The most serious was the detection of a significant ^{60}Co radionuclide source in a wagon transporting metal scrap (Horní Dvořiště, March 1996). Although no health detriment was identified, radiation protection principles had clearly been violated. The case is under investigation by law enforcement bodies.

Eighteen events involved suspected loss of control over ionizing radiation sources during transport or dismantling or as suspected theft or violent intrusion to workplaces maintaining such sources. The suspicion was confirmed in 11 cases, these, however, were not very significant from the radiation protection point of view.

Ten events were evaluated as unsubstantiated reports, caused by various factors such as wrong measurements of exported metal scrap, measuring instrument malfunction, findings of insignificant radiation sources, and wrong recording.

Professional exposure

Professionally exposed workers, of whom there were over 25 thousand in 1996, were examined in one- or three-month periods by the National Personal Dosimetry Service company, by the dosimetric service of the Dukovany and Temelín nuclear power plants, dosimetric service of the Uranium Industry (DIAMO company), and dosimetric service of the Nuclear Research Institute at Řež. From among the total, records for 21 150 persons were entered into the Central Professional

Exposure Registry, which is being built up by the SÚJB, in 1996; the remaining workers will be entered during the year 1997.

In 1996, the SÚJB examined 18 events where dosimetric service bodies reported that a personnel dosemeter exhibited radiation level exceeding the limit of 20 mSv; in two instances the level was suspected of exceeding the yearly effective dose limit of 50 mSv. In 13 instances, the personal doses had really been exceeded, whereas in the remaining 5 cases (including the two cases of exceeding the 50 mSv limit) the dosemeter had been misused or abused (left near a radiation source, used during medical exposure of the person, contaminated, ...).

In the uranium industry, the SÚJB concentrated on the exposure of workers during uranium ore mining and milling, activities associated with liquidation of underground ore mining, on the preparation of remediation and land reclamation following in-situ leaching, and rehabilitation/land reclamation at uranium mining sites. For 118 uranium industry workers, examinations were performed in relation to suspected occupational disease from irradiation.

Where elevated profesional exposure levels had been identified, it was found that these had not been due to non-compliance with rules governing ionizing radiation source handling or labour regulations (such as failure to perform inspections of equipment and radiation sources or human factor effects); in fact, all resulted from permitted activities, viz. application of demanding diagnostic methods in medicine, where a narrow circle of specialists is involved. Although the use of such methods is warranted, it is true that radiation protection is not always optimized, and the SÚJB inspections will have to address this issue in the future.

Based on a request from the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), exposure of professional personnel was evaluated over the 1990-1996 period, and the following conclusions were arrived at:

- *The average values, distributions and time trends of the individual effective dose (E) are comparable to those in industrially developed countries.*
- *At the Dukovany NPP, the average annual value of E was within 0.5 to 0.8 mSv over the entire period of plant operation (the professional annual limit is 50 mSv).*
- *Individual doses continue to be highest in the uranium industry, where the number of personnel monitored by the dosimetric service has decreased to 1399. Over the period in question, the average annual values of E lay with the range of 10.3 to 12.3 mSv; specifically at the Dolní Rožínka mine, the average value was 13.2 mSv (with a maximum of 47.9 mSv).*
- *The field of medical applications of ionizing radiation sources has experienced an increase in the number of personnel: for instance, the radiodiagnosis branch employed 2 000 more personnel in 1996 than in 1990. No significant changes in the effective doses have taken place, the levels match those observed in the developed countries. The radiodiagnosis branch experienced a certain increase in the average values of E due to substantial innovations in the technology and advent of new demanding medical examination techniques.*
- *In the field of industrial applications of ionizing radiations (beyond the nuclear industry), the number of personnel involved in non-destructive testing has decreased (mainly due to privatization of large companies); on the other hand, a new profession has emerged, viz. ionizing radiation sources repair and maintenance personnel. The trends in the average effective doses exhibit no significant changes and also are at the level found in industrially developed countries.*

Central registries and databases in the radiation protection sector

Creation of the Central Professional Exposure Registry continued in 1996. Furthermore, basis was laid for the Central Medical Exposure Database, which should become an efficient tool in efforts to control and optimize the medical exposure burden.

The IAEA database program continued to be employed in 1996 for maintaining records of sealed ionizing radiation sources.

Within the preparation of the Central Medical Exposure Database, an optimum data collection method was proposed in 1996, enabling the radiation burden of patients to be evaluated. This evaluation is based on the knowledge of frequency of the various types of examination in the medical fields concerned – nuclear medicine, radiodiagnosis, and radiotherapy. In 1996, the SÚJB developed for this purpose frequency studies allowing the required information on the status and development of the number of radiodiagnostic examinations and nuclear medicine examinations to be obtained. Of increasing importance in this respect are the techniques of computed tomography (CT) and mammographic examination in radiodiagnosis, and emission tomographic examination in nuclear medicine.

Radiation protection of workers against natural sources

Organizations that deliberately employ natural sources of ionizing radiation (in fact: ^{222}Rn and its decay products) and which are under constant the SÚJB supervision include (apart from uranium ore mining and milling facilities):

- Jáchymov and Teplice health resorts, and
- speleotherapeutic facilities at Ostrov u Macochy and Mladeč u Kutné Hory.

Sites where natural radiation sources (again only ^{222}Rn and its decay products) constitute a concomitant labour risk factor involve:

- mines where minerals (ores, combustible shale, clays) are extracted – Měděnec, Nové Strašecí and Lubná u Rakovníka sites
- groundwater treatment plants
- caves accessible to visitors

It was found by inspections that radiation protection of workers at the sites concerned is adequate. Mapping of the exposure level at groundwater treatment plants will be completed in 1997.

Public protection against natural radiation sources

The majority of public exposure in buildings in the Czech Republic stems from radon; it is estimated that radon is responsible for ca 15% of the total annual incidence of lung cancer. This exposure component has a very wide span, higher exposure levels being controllable by meeting optimization provisions.

In collaboration with the National Radiation Protection Institute and the District Administration bodies, the SÚJB:

- *continued to identify dwellings exposed to an inadequately high radon risk. Measurements were evaluated in 13 708 buildings in 1996; levels in excess of the intervention value of 200 Bq/m^3 were found in 4736 of them, of which the District Administration bodies were notified in the form of SÚJB Statements;*
- *continued to identify water sources with high levels of radon and/or other natural radionuclides. In 32 cases, requirements for remedial provisions were imposed on the water suppliers as a precondition for water supply to users to be permitted;*
- *continued to identify higher radon risk schools and similar facilities. The District Administration bodies were notified of 60 buildings where exposure was found to exceed the intervention level.*

Radiation protection in the uranium industry

State supervision executed by the SÚJB in the uranium industry concentrated on the following main areas in 1996:

- Uranium mining and milling at the Dolní Rožínka site.
- Mining liquidation work at the Hamr site (TÚU Stráž pod Ralskem subsidiary)
- Preparation of rehabilitation work after finishing chemical leaching at the Stráž pod Ralskem site as stipulated by the Decree of the Czech Government No. 179/1996 (CHT Stráž pod Ralskem subsidiary)
- Mine liquidation, decontamination, and rehabilitation work at sites under uranium deposit administration (SUL Příbram subsidiary).

A total of 1399 persons worked in the controlled zones on uranium industry assignments underground (uranium ore mining at Dolní Rožínka, preparation of mines for abandoning at Stráž pod Ralskem, construction of a cavern gas storage facility at Příbram). In 1996, the SÚJB issued a decision on the introduction of integral personal dosemeters for 632 workers in the Dolní Rožínka mine.

In accordance with the decisions of the State Mining Administration on mine liquidation, the SÚJB issued 61 binding statements concerning the individual projects, defining radiation protection provisions for rehabilitation and for releasing materials from controlled zones at the underground and open extraction sites.

For several years, the Uranium Mine Administration at Příbram has been taking inventory of over 4000 old burdens from the uranium industry with a view to determining their environmental impacts and preparing risk analyses. In 1996, the SÚJB accomplished 18 inspection visits at the old burdens and 22 local examinations to approve remedial provision goals. Based on those activities and on

the review of the risk analyses submitted by the Uranium Mine Administration, the SÚJB issued 12 binding statements in 1996.

Activities at sites which are under the responsibility of the DIAMO company are under complex monitoring of the air, fallout, surface water effluents, and a system of monitoring boreholes. The monitoring programme is approved annually by the state supervision bodies (the SÚJB and the Institute for Expertise and Emergency Management). In July 1996, the SÚJB performed an inspection visit concerned with the monitoring programme and with its current results. No major drawbacks were identified.

In all areas under the responsibility of DIAMO and its legal successors at sites affected by survey and uranium ore mining and milling, the SÚJB carried out 68 planned or sudden inspection visits and on-site examinations within its radiation protection supervision responsibility, and issued 26 decisions in this respect. The main goals of the SÚJB supervision were coordinated with those of bodies of the State Mining Administration, which executes supreme supervision of the sites. Environmental protection bodies at sites affected by the uranium industry issue comprehensive decisions on remedial actions in harmony with the SÚJB statements. In emergency situations, such as water leaks from the flooded mining fields at the Zadní Chodov and Olší-Drahonín sites, the bodies of the various state supervision authorities took actions in concert.

Medical aspects of radiation protection

In 1996, the SÚJB examined 131 cases of suspect occupational disease:

- In the group of uranium mine workers (118), there were 115 cases of lung cancer and 3 cases of other diseases. For 78 lung cancer patients, the causal nexus between the disease and work in mine was probable; the occupational disease statute under the Governmental Decree No. 290/1995, specifying the Occupational Disease List, was awarded to 72 patients.
- In the group of other workers (13), 5 were lung cancer patients, four patients suffered from esophageal cancer, thyroidal cancer, basalioma, and blood picture changes, respectively, and the remaining 4 cases were non-specified complaints. Only for one of them, the casual nexus between work in a risk environment and the disease was found likely and the patient was awarded the occupational disease statute.

The numbers of diseases examined and occupational disease statutes awarded in relation to work in ionizing radiation risk environment are in line with the trends observed over the past decade (a slight decrease is seen in lung cancer incidence). Since a long latent period (15 to 40 years) has to be taken into account for tumours induced by ionizing radiation, the tumours reported in 1996 were due to working exposure in the sixties and fifties.

Fetal doses due to radiodiagnostic examination or nuclear medicine examination of the mother were estimated for 29 cases. In 23 of them, the equivalent dose estimate was below 5.0 mSv, in 6 the estimate was between 6 and 300 mSv. In all cases the genetic center was informed.

In relation to the detection of a Co-60 source in transported metal scrap, as reported earlier, 12 persons where the possibility of a significant exposure existed were subjected to medical examination: for all of them, hematological, biochemical, and basic internal

examination was performed at the Occupational Disease Departments of the Faculty Hospital in Prague and Faculty Hospital in Hradec Králové. Three patients were invited to ophthalmologic, dermatological, sexuological, and cytogenetic (peripheral blood lymphocytes) examinations but not all of the examinations were actually carried out because the patients did not show interest. Unambiguous signs evidencing deterministic radiation effects were found in none of the persons. The Police was informed about the medical examination results.

RADIATION MONITORING NETWORK OF THE CZECH REPUBLIC

The Radiation Monitoring Network (RMN) of the Czech Republic is coordinated by the SÚJB, which acts as its Management in cooperation with the National Radiation Protection Institute. The monitoring results are given in Annual Reports on Radiation Situation in the Czech Republic, which are submitted to the Governmental Emergency Commission on Radiation Accidents and to the public through District Administration bodies, health centers and libraries.

The Radiation Monitoring Network operates in two regimes: the normal regime, aimed at monitoring the actual radiation situation and early detection of radiation accidents, and the emergency regime aimed at evaluating the consequences of such a radiation accident. The normal regime is implemented by permanent bodies engaged in the Network, the emergency regime includes, in addition, emergency bodies. The normal monitoring regime involves several sub-systems, in which selected or all permanent RMN bodies are engaged. The sub-systems are as follows:

- **Early warning network**, which comprises 37 measuring points with automatic transmission of observed data. The measuring points are operated by the Czech Hydrometeorological Institute (27), SÚJB Regional Centers (8), the National Radiation Protection Institute (1), and the Institute for Expertise and Emergency Management in Příbram (1).
- **Territorial network of 234 measuring points** equipped with thermoluminescent dosemeters (TLD). This **TLD-network** is also operated by the above-mentioned organizations: the SÚJB Regional Centers, the National Radiation Protection Institute, and the Institute for Expertise and Emergency Management.
- **Local TLD networks with 78 measuring points in the surroundings of the Dukovany and Temelín nuclear power plants,** operated by the Environmental Radiation Monitoring Laboratories of the two nuclear power plants and the SÚJB Regional Center in Brno.
- **Territorial network of 12 air contamination measuring points** operated by the SÚJB Regional Centers, Environmental Radiation Monitoring Laboratories, and the National Radiation Protection Institute.
- **Network of 11 laboratories** (6 laboratories of the SÚJB Regional Centers, 2 Environmental Radiation Monitoring Laboratories of NPPs, and laboratories of the National Radiation Protection Institute) equipped with gamma-spectrometric and radiochemical analytical instrumentation to quantitate radionuclides in environmental samples (aerosols, fallout, foods, drinking water, animal food, etc.).

Monitoring of post-Chernobyl effects and signal monitoring for radiation accident detection

The monitoring programme is aimed at measuring the radionuclide activity and ionizing radiation dose distribution over the Czech Republic with a view to obtaining long-time trends and detecting deviations from them at an early stage. Attention in centered on artificial radionuclides; those occurring in the environment in measurable quantities and monitored by the RMN include:

- ^{137}Cs, ^{90}Sr, $^{239+240}Pu$, and ^{85}Kr in air,
- ^{137}Cs, ^{90}Sr, and ^{3}H in foods,
- ^{137}Cs in the human body.

Air contamination

As in the previous years, no serious deviations of concentrations of artificial radionuclides in air occurred in 1996. The volume activities of ^{137}Cs due to its transfer from higher atmospheric layers and resuspension of the original fallout from the soil surface were largely in the order of units to tens of $\mu Bq/m^3$ and exhibited a permanently decreasing trend.

A part of airborne activity of ^{137}Cs comes from global fallout, resulting from previous atmospheric nuclear weapon tests. In addition to the artificial radionuclides, the aerosols contain ^{7}Be, which is cosmogenic, and natural radionuclides of the uranium and thorium decay series. By way of example, the time dependence of the volume activities of ^{137}Cs, ^{7}Be and ^{210}Pb in airborne aerosol and of the specific activities in fallout, as has been measured by the Air Contamination Measuring Point of the National Radiation Protection Institute since 1986, is shown in the figure below.

Monitoring of ^{85}Kr was included in the airborne radionuclide monitoring system of the RMN in 1996 as part of efforts aimed at introducing gradually the monitoring of all artificial radionuclides detectable in the environment. Krypton 85 is a fission product and is also present in minor quantities in nuclear power plant effluents. The major sources of this radionuclide, however, are nuclear fuel reprocessing plants; nuclear weapon tests contributed in the past as well. The measurement of ^{85}Kr volume activities is a continuation of work performed previously by the Radiation Dosimetry Institute, Academy of Sciences of the Czech Republic.

Volume activities of airborne aerosol (monthly averages)

(Data by the Air Contamination Measuring Point of the National Radiation Protection Institute in Prague)

Specific activities of radionuclides in fallout on water surface (monthly averages)

(Data by the Air Contamination Measuring Point of the National Radiation Protection Institute in Prague)

Volume activity of ^{85}Kr in air in Prague

Contamination of foods

Radionuclide contamination of foods has been monitored on a long-term basis following the relevant monitoring plan. This plan has been set up for the various commodities with particular respect to the significance of their consumption. Since no event bringing about increase in the amount of radionuclides in the environment occurred in 1996, no increase in food contamination levels was observed either.

The volume activities of ^{137}Cs in some basic foods, i.e. milk, beef, and pork, are in the order of tenths of Bq/l (Bq/kg). The values for ^{137}Cs and ^{90}Sr in drinking water are very low, viz. tenths to units of mBq/l or even below the limit of detection. The tritium content of drinking water has also been nearly constant at units of Bq/l.

Average annual mass/volume activities of ^{137}Cs in pork, beef, and milk

Internal contamination of humans

Monitoring of the internal contamination by ^{137}Cs using the whole-body counter of the National Radiation Protection Institute continued in 1996 in a reference group of 30 persons (15 males, 15 females), largely Prague citizens 22 to 72 years age. In view of the very low ^{137}Cs content in the population, such measurements are now performed once a year only, applying long measuring times to reach the lowest detection limits reasonably attainable. The measurements gave the average ^{137}Cs activity in the body of an individual of 146 Bq. A similar internal contamination value was obtained by measuring the ^{137}Cs volume activity in the urine of a selected group of population.

External exposure

Experience in the several years' operation of the territorial TLD network reassures that any deviation from the normal situation at a given site would be detected. The dose equivalent rate is continually monitored by the Early Warning Network, the average values in 10-minute intervals being recorded. The data are at the natural background level for the sites in question.

Quarterly averages of the photon dose rate equivalent H_x (nSv/h), as determined by the territorial TLD network

	Prague	Central Bohemia	South Bohemia	West Bohemia
	(Prague RC – 14)	(Prague RC – 25)	(Č. Budějov. RC–30)	(Plzeň RC – 25)
I/96	118.8	132.2	154.5	132.0
II/96	105.3	121.5	157.8	119.4
III/96	113.9	119.3	147.2	120.9
IV/96	127.2	145.3	146.6	128.1
	North Bohemia	**East Bohemia**	**South Moravia**	**North Moravia**
	(Ústí n.L. RC – 23)	(Hr. Králové RC– 21)	(Brno RC – 26)	(Ostrava RC – 21)
I/96	134.6	118.8	139.1	107.4
II/96	117.1	125.5	134.4	106.0
III/96	124.4	111.0	140.2	108.0
IV/96	129.3	126.4	149.5	124.2

The responsible Regional Centers (RC) and numbers of monitoring sites are given in parentheses

Monitoring of nuclear power plant effluents and surroundings

The total releases of radionuclides from the Dukovany nuclear power plant into air and surface waters remained low in 1996. No accident leaks occurred, and as given in the utility's quarterly reports „Radiation Situation in the Surroundings of the Dukovany NPP“, the total atmospheric releases were below 1% of the derived annual limits, and the liquid effluents were below 5% for the corrosion and fission products and about 75% for tritium.

The dose rates in the surroundings of the Dukovany NPP are monitored constantly by a teledosimetric system, operated by the plant. A monitoring point of the national Early Warning Network is also located at that site.

The dose equivalent from external exposure in the surroundings of the Dukovany and Temelín nuclear power plants (pre-operational monitoring for the latter) is being monitored by local TLD networks operated by the radiation monitoring laboratories of the plants and, independently, by the SÚJB Regional Centers using thermoluminescent dosemeters. No significant deviation from the common level was detected by either of the monitoring systems.

Periodical sampling and radionuclide activity measurements in the environment are also performed both by the radiation monitoring laboratories and by the SÚJB Regional Centers. As the previous years, there were no differences in the radionuclide contents of the environmental samples from the Dukovany surroundings and from other parts of the Czech Republic.

Radioactivity releases from the Dukovany nuclear power plant

The annual releases are plotted below as fractions of the corresponding annual limits. The values for fission products and tritium refer to liquid discharges, the values for noble gases, iodine, and aerosols refer to gaseous discharges.

EMERGENCY PREPAREDNESS

Crisis Coordination Center

The SÚJB emergency preparedness, which is particularly concerned with the management of situations arising from radiation accidents, concentrated mainly on reviewing emergency plans of nuclear facilities and setting up the Crisis Coordination Center, which is SÚJB's technical and professional basis serving the needs of the Czech Governmental Commission on Radiation Accidents. Preparatory work was done in 1995 and in the 1st half of 1996, and the Crisis Coordination Center was opened officially in July 1996 in the presence of representatives of the engaged Ministries and other Czech organizations as well as representatives of the Embassy of the United Kingdom and the UK Nuclear Installations Inspectorate, which participated in the equipment of the Center with some technical facilities.

Subsequently, the performance of the Center was tested by engaging it in two international nuclear emergency exercises: „EXERCISE 96", organized by Austria, and „INEX 2", organized by the NEA/OECD. The exercises provided opportunity to test and examine the coordination function, communication and information and data transmission between the Center and bodies and organizations involved in the emergency planning system, both at the national and international levels, as well as to test the preparedness of selected components of the Radiation Monitoring Network. In command of the exercise within the SÚJB authority was the Crisis Staff, who had at their disposal technical means of the Crisis Coordination Center and of the National Radiation Protection Institute.

The exercise gave evidence that the SÚJB has the capability for coordinating, within the Czech Republic, activities associated with the assessment of the radiation situation arising from a radiation accident abroad having impacts on this country. The performance of the SÚJB Contact Point was tested in cooperation with the Czech Civil Defence Headquarters in the fulfilment of tasks following from international agreements, both within the country and in relation to other countries. The emergency preparedness exercises proved that the SÚJB has the capability for coordinating effectively activities of the components of the Radiation Monitoring Network, the Early Warning Network, for analyzing information and data obtained, and for preparing proposals of measures to be taken by the Government and State Administration bodies to protect the population and environment. The coordination and communication during joint exercises with the Czech Civil Defence Headquarters, Czech Hydrometeorological Institute, and the Operational Center of the Rescue Fire Department proved to be good as well.

Inspection activities

At the Dukovany site, SÚJB's efforts concentrated on improving the public warning system within the emergency planning zone. The SÚJB reviewed proposals for a new design of the public warning system that would eliminate false signals and make possible selection of territories where the sirens should be activated. In fact, however, unplanned siren activation took place after the new system was implemented; the SÚJB paid major attention to this event and to remedial actions

taken to prevent such events in the future. A number of proposals submitted by the Dukovany plant management in relation to the preparation of review of the internal emergency plan were also assessed.

At the Temelín site, attention was systematically paid to the on-site emergency plan of the NPP as well as to the off-site emergency plans of the administrative districts affected.

At the Nuclear Research Institute at Řež, the SÚJB concentrated on the upgrading of the emergency monitoring and data evaluation system.

OTHER ACTIVITIES OF THE STATE OFFICE FOR NUCLEAR SAFETY

Legislative activities

In 1996, the SÚJB activities in the legislative field were associated with the preparation of the Peaceful Uses of Nuclear Energy and Ionizing Radiations Act („Atomic Act“).

Preparation of the Atomic Act in the form of a Bill was the joint responsibility of the Czech Ministry of Industry and Trade and the SÚJB. In January 1996, the Government submitted the Bill to the Czech Parliament (House of Representatives), and representatives of the SÚJB were present when the bill was discussed by the relevant Parliamentary Committees and prepared statements on many amendments proposed by some Members of Parliament. The third reading of the Bill was postponed due to complications associated with the preparation of general elections. The newly elected House of Representatives passed the bill only on 20 December 1996, and subsequently the bill was passed on to the Senate.

In relation to the Atomic Act, pains were taken to prepare 16 associated regulations, which the SÚJB is authorized to issue under the Atomic Act. However, since the final version of the operating regulations can only be adopted after the Atomic Act has been passed, the delay in the parliamentary procedures will cause delay in the schedule of the regulations as well.

Based on consultation with the IAEA, the SÚJB prepared for the Czech Government a proposal for signing a new Agreement between the Czech Republic and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons. The Government adopted the Agreement, and the latter was signed in Vienna on 18 September 1996 and submitted to the Czech Parliament for approval.

Within the process of Czech Republic's preparation for joining the European Union, the SÚJB was engaged in the harmonization of the Czech and EU legislation in the field of nuclear safety and radiation protection, as well as in filling out the relevant parts of the EU Questionnaire.

International cooperation

The SÚJB activities in the field of international cooperation concentrated mainly on the development of bilateral contacts with the counterpart bodies and coordination of projects of technical cooperation and assistance, which in the field of nuclear safety and radiation protection are organized by the IAEA, EU (PHARE), US AID, and OECD. Cooperation within the Forum (formerly Association) of Regulatory Bodies of Countries Operating VVER Reactors continued in 1996 as well.

Significant events in 1996 included participation in the 40th (anniversary) IAEA general conference and creation of conditions for represetation of the Czech Republic in the Board of Governors. The 40th IAEA general conference, which was held in September 1996, elected the Czech Republic to the Board of Governors for the next two-year term of office. The fact that the Czech Republic is represented in the Board of Governors, the IAEA’s supreme body between the general conferences,

strengthens the position of this country within the IAEA and tightens mutual cooperation.

Bilateral cooperation

Among important activities in the bilateral relations with Germany were two meetings of the Czech-German Technical Expert Team, concerned with the preparation of a technical document on nuclear and radiation safety assurance and on environmental impacts of the Isar II and Temelín nuclear power plants, which both lie near the state borders. Public information documents on the safety of the two plants should be ready for exchange between the Czech Republic and the Federal Republic of Germany in May 1997.

Among bilateral contacts, cooperation between the SÚJB and the US Nuclear Regulatory Commission, particularly in the training of experts in regulatory inspection of nuclear facilities, has been playing a major role. In addition to some minor activities, training of the SÚJB and Nuclear Research Institute Řež personnel took place in 1996 within the preparation for licensing of the Temelín nuclear power plant; moreover, two staff members underwent long-term training in inspection activities. In collaboration with USE DOE experts, a new program of technical cooperation aimed at support of nuclear power plant operators and their technical background was launched. In June 1996, the SÚJB organized a workshop attended by US DOE experts and the beneficiaries, i.e. ČEZ a.s. and the Nuclear Research Institute at Řež, where the finalized projects were discussed and a plan of new activities was prepared.

Extensive informal bilateral contacts in 1996 included cooperation with the Nuclear Regulatory Authority of the Slovak Republic. Nuclear safety of plants with VVER 440/213 reactors in ten years of operation and important proposals for improvement of the original design and further safety enhancement of the Dukovany plant were discussed at a meeting of representatives of the regulatory bodies and NPP operators organized by the Slovak Regulatory Authority in cooperation with the SÚJB and their Hungarian counterpart in January 1996.

The SÚJB and the Nuclear Regulatory Authority of the Slovak Republic prepared a draft cooperation programme for the period till the year 2000, viz. by detailing the issues included in the Agreement between the Governments of the Czech and Slovak Republics on Cooperation in the Field of State Supervision of Nuclear Safety of Nuclear Facilities and Nuclear Materials.

Within cooperation between the SÚJB and the UK Nuclear Installations Inspectorate, a British delegation led by HM Chief Inspector of Nuclear Installations Mr S. A. Harbison visited the Czech Republic in July 1996 on the occasion of opening the SÚJB Crisis Coordination Center. Furthermore, cooperation with the British Department of Trade and Industry is being effected through the research organization of AEA Technology.

Cooperation within international organizations

The SÚJB has maintained professional contacts with the OECD Nuclear Energy Agency (NEA). SÚJB representatives participated in the regular meeting of the NEA/OECD Committee on Nuclear Regulatory Activities (CNRA), joining representatives of regulatory bodies, where the Czech Republic presented itself for the first time as a NEA/OECD Full Member, and in the meeting of the Committee on Radiation Protection and Public Health (CRPPH). The participation of the Czech Republic in the INEX 2 exercise is another example of international cooperation.

The SÚJB is a Founding Member of the Forum of Regulatory Bodies of Countries Operating VVER Type Reactors, established in 1993 in support of nuclear safety and radiation protection improvements by making use of common experience, information exchange, and coordination of nuclear safety assurance efforts. The SÚJB organized the 3rd Forum Meeting in Prague, June 1996. The Meeting was attended, as well as by ordinary members, by representatives of the IAEA, OECD/NEA, and countries supporting activities of the latter (USA and Germany). The Czech Republic's annual presidency of the Forum

thereby culminated. The 3rd Meeting reviewed activities of the Working Groups, discussed suggestions, and founded three new Working Groups for the next term of office, with the following scopes of activity:

1. *Licensing process of dry spent fuel storage facilities, with the task to finalize Table of Content for the SAR and prepare a set of criteria for an assessment of the safety of operational states of DSFSF (this Working Group will be headed by the Czech Republic).*
2. *In-service inspections at nuclear power plants, with the task to modify the EU document „Proposal for common position of European regulators on qualification of non-destructive testing systems for pre- and in-service inspection of lightwater reactor components“ (this Working Group will be headed by Finland).*
3. *Reactor pressure vessel embrittlement, with the task to prepare a report on common understanding of Russian norms and standards (this Working Group will be headed by Finland).*

Coordinated by the SÚJB, the second international training course in „Physical Security of Nuclear Installations and Nuclear Materials“ was held in 1996. This training course was funded to a large part by the US DOE, and lectured by SANDIA National Laboratories staff members. An IAEA Workshop on „The Role of NPP Management in Public Information“ was held at the Dukovany plant in August 1996. The two international exercises organized in the Czech Republic for 60 experts (from roughly 16 countries) were favourably rated by both the IAEA and the US DOE.

International technical assistance programmes

The project preparation stage within the programme of technical assistance between the Czech Republic and the IAEA culminated in mid-1996. Based on discussions with the organizations involved and following its own review, the SÚJB submitted to the IAEA five draft project schemes:

- *Assessment of Corrosion of Zircaloy Cladding in Nuclear Fuel (continuation of the 1995 – 1996 project).*
- *Radioactive Waste Characterization Programme (continuation of the 1995 – 1996 project).*
- *Remediation for Uranium Mill Tailings Impoundments (by using waste material and products of other mining activities).*
- *Quality Assurance Programme in Radiology and Radiotherapy.*
- *A Model Project (see below).*

Unlike the previous years, the SÚJB made use of the opportunity and submitted, in addition to the proposed projects of technical cooperation with the IAEA in the conventional format, a so-called Model Project. Such projects are by definition aimed at problems of special importance, whose addressing will result in a major improvement in the social status and/or economy of the beneficiary country. Both the volume of funding and expert support from the IAEA and the beneficiary country's involvement are appreciable. Following preliminary consultations with the IAEA, the joint nuclear medicine project of the Nuclear Research Institute at Řež and the Bulovka hospital, which is also supported by the Czech Ministry of Health, was selected as the Model Project. Within this project, manufacturing capabilities and a distribution network for cardiological and oncological radiodiagnostic pharmaceuticals should be built up within four years with IAEA's assistance. So far, technical discussions with IAEA experts have been finished and the project has been launched.

During the preparation of the scope of the IAEA technical assistance programme for the 1997 – 1998 period, the SÚJB was also engaged in planning activities concerned with the whole European region. Additional cooperation with the IAEA was through many expert discussions and negotiations, devoted to topics such as:

- *strengthening the non-proliferation regime and safeguards system;*
- *nuclear energy for non-power uses and the International Nuclear Information System.*

In relation to the review of the internal activities of the Office, the SÚJB requested from the IAEA an expert mission. This mission reviewed, in cooperation with the SÚJB experts, SÚJB's internal quality assurance system. Experts from the US, Finland, and UK found the organization of the Office, including documentation, very good, and put forth recommendations for a future optimization of the system.

Technical cooperation with the IAEA in 1996 also had the form of foreign expert missions with the following scopes:

- *Reviewing proposed modifications in the Temelín NPP design with respect to the shortcomings identified by the IAEA for VVER 1000 reactors.*
- *Providing support to SÚJB experts in assessing the role of the human factor within the Temelín NPP design.*
- *Reviewing the design approach to fire protection at the Temelín NPP with respect to nuclear safety.*
- *Reviewing the level of preparedness of the SÚJB Crisis Coordination Center for managing situations arising from radiation accidents.*

The regional PHARE-Nuclear Safety programme, coordinated by the SÚJB, constitutes a significant fraction of foreign technical assistance to the Czech Republic, with respect to both the scope and volume of the assistance provided. This is aimed at three crucial aspects of the nuclear programme: (i) support provided to regulatory bodies – RAMG projects; (ii) support provided to scientific institutions – TSO projects; and (iii) support provided to nuclear power plant operators. Within this scope, the SÚJB was engaged in many activities in 1996, such as discussion of the technical terms of reference of the projects proposed and definition of new projects for the period to come. Important was the participation of experts of the SÚJB, the Dukovany nuclear power plant, and the Machine Design Research Institute (SVÚSS Běchovice) in specification of the so far largest PHARE project, consisting in testing the safety system of the bubbling facility at the VVER 440/213 unit in various accident conditions.

Among additional programmes of technical assistance to the Czech Republic and other Central and East European countries was the „Invitation Programme" by the government of Japan, within which training courses on nuclear power plant maintenance and on seismic aspects of nuclear power plant designs have been organized.

Public information

In March 1996, the SÚJB submitted to the Government of the Czech Republic the SÚJB Annual Report 1995. Based on this Report, the SÚJB prepared Czech and English versions of a public report, which was distributed to the institutions involved. The English version was sent to SÚJB's regulatory counterparts abroad and to the contact points of bilateral agreements concerned with the nuclear safety issue. The public report was also the issue of a dedicated press conference attended by mass media reporters, where the SÚJB Chairman was present.

During the year, the SÚJB continued its discussions with representatives of the „Foundation Against the Nuclear Threat“ and the „South-Bohemian Mothers“ movement, particularly with respect to the proosed Atomic Act and the associated regulations.

The SÚJB informed operatively the Czech Press Agency service and other media on facts within the SÚJB responsibility; specifically, the SÚJB responded to topical issues attracting public attention.

ABBREVIATIONS

EU	European Union
HO	Reactor Protection System
IAEA	International Atomic Energy Agency
INES	International Nuclear Event Scale
ISFSF	Interim spent fuel storage facility
MCP	Main circulation pump
MSH	Main steam header
NEA/OECD	OECD Nuclear Energy Agency
NPP	Nuclear power plant
NPT	Non-Proliferation Treaty
NRI	Nuclear Research Institute at Řež
RPS	Reactor Protection System
SG	Steam generator
SÚJB	State Office for Nuclear Safety of the Czech Republic
TG	Turbogenerator
TLD	Thermoluminescent dosemeter
ÚJP	Nuclear Fuel Institute
US AID	US Agency of International Development
US DOE	US Department of Energy
WEC	Westinghouse Electric Corporation

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STATE OFFICE
FOR NUCLEAR SAFETY
OF THE CZECH REPUBLIC

ANNUAL REPORT 1996

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Operation of Dukovany Unit 1

Operation of Dukovany Unit 2

Operation of Dukovany Unit 3

Operation of Dukovany Unit 4

Average daily output [MWe]

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NUMBERS OF RADIODIAGNOSTIC EXAMINATIONS 1986 – 1995

NUMBERS OF NUCLEAR MEDICINE EXAMINATIONS, 1986 – 1995

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milk
beef
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Activity of fission products

Activity of tritium

Activity of noble gases

Activity of iodine

Activity of aerosols