Nuclear Regulatory Authority
of the Slovak Republic

REPORT
on Activities of the Nuclear Regulatory Authority of the Slovak Republic and Safety of Nuclear Installations in the Slovak Republic in 1994

Introduction

The report summarizes activities of the Nuclear Regulatory Authority of the Slovak Republic (NRA SR) and briefly presents results of the national expert supervision over nuclear safety of nuclear facilities in the SR in 1994. It follows a detailed report that has been issued only in Slovak.

The national supervision over the nuclear safety, in the second year of the NRA SR existence, has been performed pursuant to the Act No. 28/1984 on the National Supervision over Nuclear Safety of Nuclear Facilities and related regulations and decrees of the former Czechoslovak Atomic Energy Commission. As per the above-quoted act, the national regulator of nuclear safety:

- assesses and inspects construction, operation and decommissioning of nuclear facilities in the SR in terms of following the nuclear safety conditions,
- supervises a nuclear fuel, nuclear material and radioactive waste treatment and security of nuclear facilities,
- ensures fulfilment of the SR obligations under international conventions, multilateral and bilateral treaties, particularly in the area of continuous safety enhancement of the SR nuclear facilities, peaceful utilization and non-misusing the nuclear power respectively, emergency planning including timely notification in case of nuclear accident,
- is responsible for amendment, development and assessment of related legal regulations through which a legal basis is complemented for the performance of the independent national supervision over nuclear safety of nuclear facilities in the SR,
- approves in-take and supervises filing and control of nuclear materials used in other national industries.

In 1994, the NRA SR have performed a national supervision of following organizations:

- SE, a.s. - Jaslovské Bohunice Nuclear Power Plant, o.z.
  - V-1 Nuclear Power Plant (V-1 NPP)
  - V-2 Nuclear Power Plant (V-2 NPP)
  - A-1 Nuclear Power Plant (A-1 NPP)

- SE, a.s. - Mochovce Nuclear Power Plant, o.z.
- SE, a.s. - Radioactive waste repository, Mochovce
- Organizations providing a specialized training of NPP personnel
- Organizations providing specific deliveries and activities for the nuclear power industry (through a responsible organization)
- Organizations having an ownership of nuclear materials
- Organizations providing activities related to import of radioactive sources
- Organizations using radioactive sources.

The national supervision of the hereabove organizations or structures has been performed in co-operation with other regulatory authorities of the Slovak Republic.

Organizational structure of the NRA SR

The NRA SR's organizational structure has been completed in 1994 and personnel responsible for crucial activities has been procured step-by-step.

By the 31-st December 1994, the NRA SR actually employed 65 members of personnel out of the planned number of 65, whereby 80 % of them were university-level educated ones. The organizational structure of the NRA SR, divided according to responsibilities of the authority following from particular legal regulations related to performance of the national supervision over nuclear safety of nuclear installations, has been proved. The NRA SR, based in Bratislava, is divided into two branches:

- Policy Branch
- Inspector Branch (based in Trnava).

Permanent inspection activities at sites of nuclear power plants are ensured by three resident inspectors at Bohunice NPP site, and four site inspectors at Mochovce NPP site.

1. SAFETY OF NUCLEAR POWER PLANTS IN THE SLOVAK REPUBLIC

The national supervision carried out by NRA SR as per the Act No. 28/1984, in 1994, was focused primarily on inspection and assessment of nuclear safety and reliability of nuclear power plant operations, training level of selected NPP personnel and continuous enhancement of nuclear safety of nuclear power installations.

To this end, following has been carried out by the NRA SR at nuclear power plants in 1994:

a) inspections:

- routine ones, focused mostly on operation safety;
- special ones, focused mostly on meeting limits and conditions of a safe operation, quality, and on following operational procedures and implementation of measures from NRA's inspections;
- team ones, focused mostly on unit start-ups following major overhauls, investigation of safety-related events and others requiring participation of inspectors of various skills;

b) documentation assessment at issuance of decisions, following in particular:

- safety documentation;
- summary of marginal states and operational parameters, limits and conditions;
- classified equipment quality assurance programmes;
- plant commissioning programmes;
- results of periodic tests and inspections;
- results of personnel training;
- safety improvement design modifications;

c) analysis of breakdowns

d) verification of selected personnel skills, as well as inspection of training standard in organizations preparing personnel for nuclear power plants,

e) assessment of operation safety indicators,

Inspection results recorded in protocols were assessed and analysed. Consequently, NRA SR took decisions with binding measures that must be implemented by a responsible organization in a stipulated deadline. The NRA SR took 137 decisions in 1994.

Relevant scientific research institutions of the Slovak Republic also participate at assessment of complex issue of NPP safety enhancement, as well as at assessment of complicated operational events. Independent foreign experts are also used under provided technical assistance whose participation is provided mostly by the International Atomic Energy Agency in Vienna (IAEA).

In 1994, there were two nuclear power plants of SE a.s. - Bohunice NPP operational in the Slovak Republic (V-1 NPP and V-2 NPP).

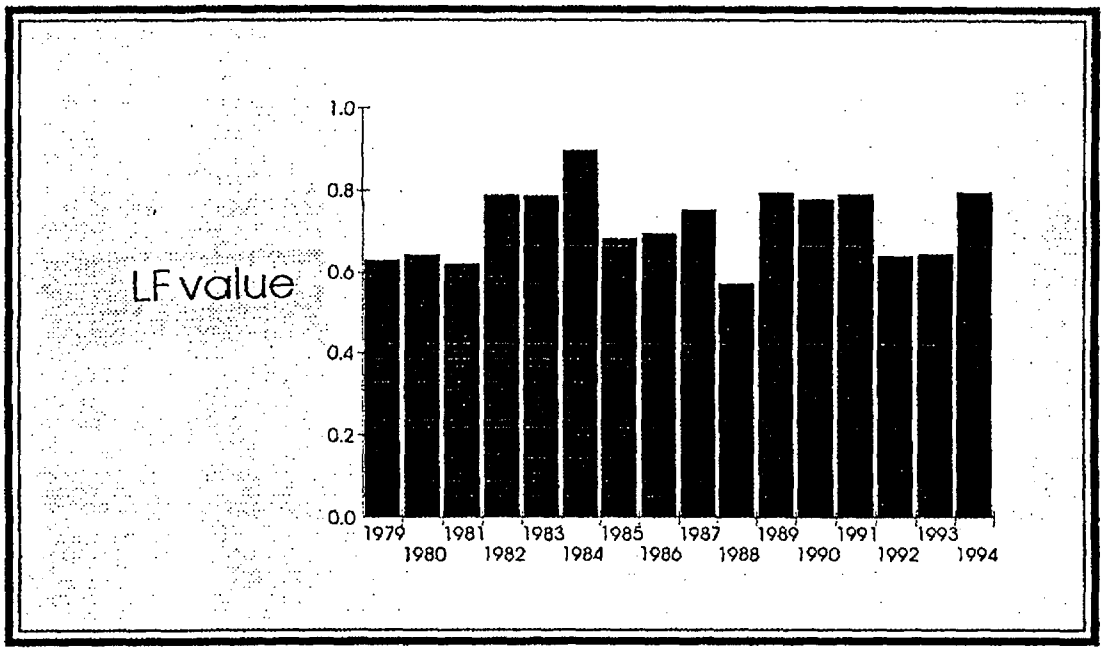
1.1.1. V-1 Nuclear Power Plant

The V-1 NPP with two VVER 440/V-230 type reactors was commissioned in 1978-80, as one of the last with these type of reactors. Safety enhancement of this type of reactors was a subject of international expert community interest in 1994. Comparing to other NPP's of this type, important technical improvements were implemented on the V-1 NPP during construction and operation, so that it is considered one the safest ones of this kind at present. There were series of measures implemented in 1994, too. As much as 1.15 billion Slovak Korunas (SK) were invested in 1991-1994 to upgrade the safety.

The coefficient of installed capacity is one of the criteria used for a nuclear unit operational reliability assessment. Annual coefficients of the unit 1 and 2 capacity use since the operation commissioning are shown at the figure 1 and 2. The value of the coefficient throughout the entire operational period of the V-1 NPP is relatively high - 74.6 %. In 1994, the coefficient of the installed capacity annual use was 78.5 %.

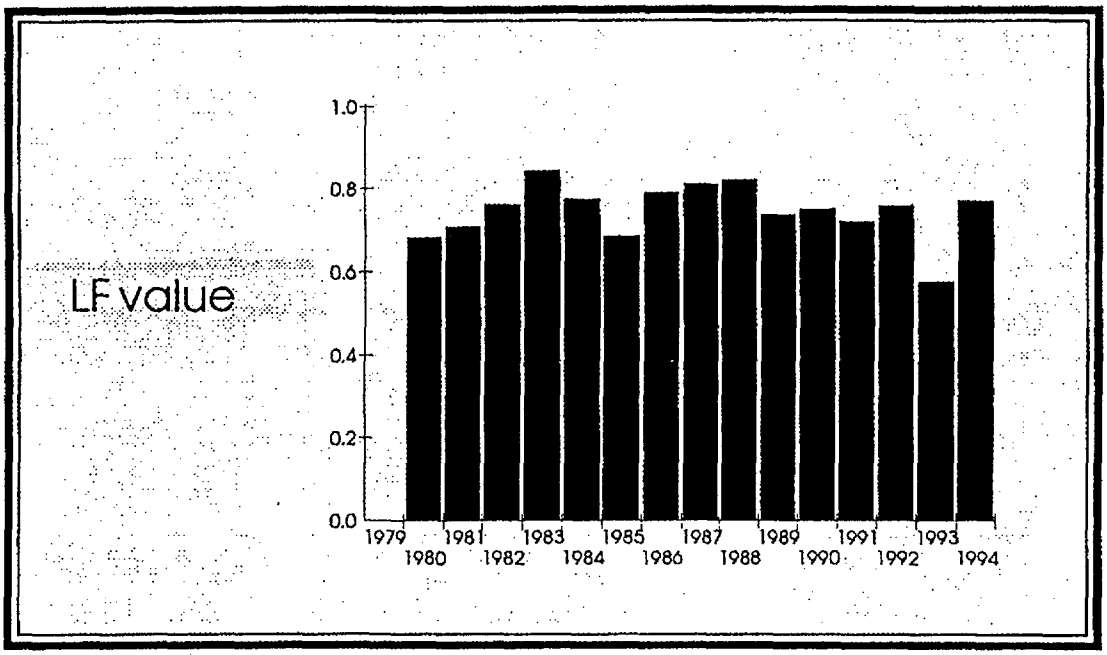
Coefficient of Bohunice NPP unit 1 use

Fig. 1



Coefficient of Bohunice NPP unit 2 use

Fig. 2

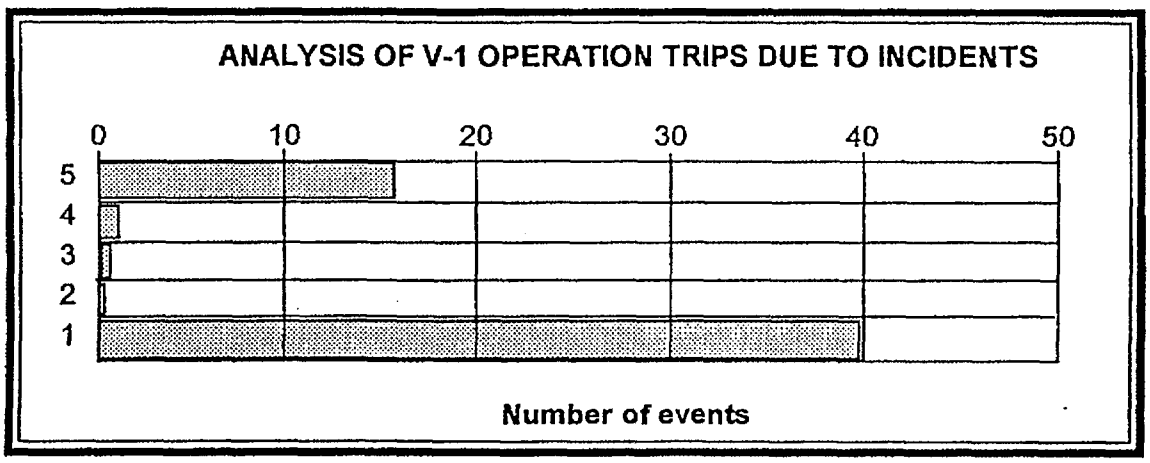


Major operation trips were caused due to following reasons:

	unit 1	unit 2
Maintenance overhauls and reconstruction	446.757 GWh	443.502 GWh
Trips due to breakdowns	32.653 GWh	57.183 GWh
Required back-up	32.931 GWh	263.429 GWh
Other influences	131.225 GWh	19.710 GWh
Dispatching back-up	22.794 GWh	56.634 GWh

Operation trips due to incidents at V-1 NPP are shown at the following figure No.3.

Fig. 3



1) Technical incidents
2) Inaccuracy of operational procedures

3) Human factor influence
4) Design failure
5) Scheduled power reduction

In 1994, a total of 65 operational events occurred that resulted in power generation reduction. This number is roughly by one third lower as compared to 1993 when 96 such events had been recorded. The reasons may be characterized as follows:

a) technical failures (40), out of these:
   - normal wear-out and ageing of material (27),
   - due to hidden defect (2),
   - false action of protections (5),
   - others (6),
b) operational procedure inaccuracy (1),
c) human factor impact (4 + 1 partially),
d) design failure (1),
e) scheduled power reduction by a dispatcher (18), out of those: due to power surplus in the grid (9), scheduled tests of equipment (9) respectively.

If actual failures are considered only (without the scheduled power reduction to make tests and the ones requested by a dispatcher), then the number amounts to 47, that is almost slightly beyond one half as compared to the 90 failures in 1993, hence indicating a significant improvement with a production loss share of 5.4 %.

There were two cases at the V-1 NPP unit 2 of a reactor automatic rapid shut-down. In one of those, a switchboard feeding ventilators of three reactor coolant pumps was short-circuited under a reactor nominal power. Both turbine generators were tripped one by another and the reactor was quickly shut-down during shutting the pumps down. In the other case, a turbine limiter malfunctioned during a test of turbine generator protections under a reactor power of 53 %. Inadequate actions of attendance staff resulted in a reactor quick shut-down. A history of V-1 NPP reactor emergency shut-downs in 1990 through 1994 is illustrated at the figure 4.

Meeting safe operation limits and conditions is one of the most important indicators of a NPP safe operation that are tracked and assessed by the NRA SR. There were 5 permanent and 4 temporary modifications to limits and conditions approved for the V-1 NPP units in the period assessed.

Limits and conditions were violated in two cases at V-1 NPP:

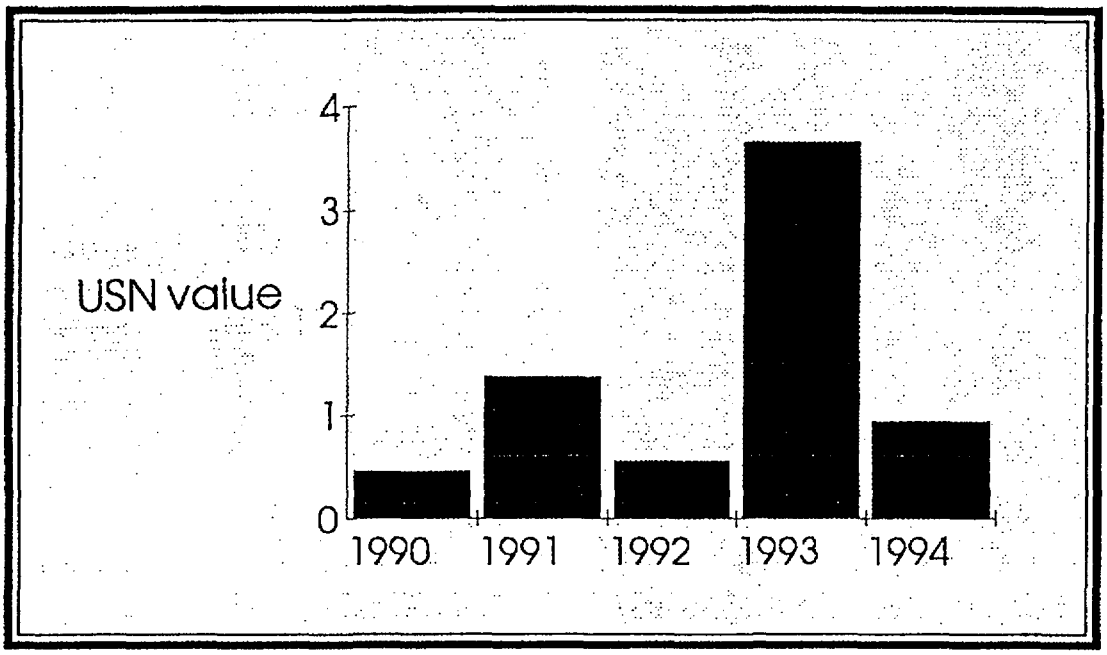
- During the failure transient due to the short-circuited switchboard of the V-1 NPP unit 2, a limit of running the reactor coolant pumps (RCP's) without a ventilator was violated for a short-time. The limit value allows such run for 10 minutes; actually the RCP 24 was working for 14 minutes without a ventilator, RCP 26 for 16 minutes and RCP 25 for 18 minutes. The reactor coolant pump, however, have not been damaged, as confirmed during the unit major overhaul.

- During assembling the reactor after the major overhaul, the attendance personnel mutually exchanged two lead cables supplying control rod drives, hence

causing a non-designed motion of the control rods. The non-designed connection was partially observed at physical start-up experiments and confirmed by repeated experiments at a higher power. For this reason the reactor was shut-down, cables connected properly, reactor re-started up and relevant experiments repeated.

Unplanned emergency shut-downs of V-1 NPP

Fig. 4



The USN undicator value for V-1 NPP is an average one of unit USN values

All the events were subjected to special and team inspections in order to find out primary reasons and determine corrective measures so that exclude repetition of analogous failures. An analysis of a serious failure of 1993 has been completed (starting a turbine up from the external grid) and a responsible organization, SE a.s.- EBO o.z. was fined with 250,000 SK.

The events have also been evaluated according to INES scale (an international scale for individual evaluation of events occurred at NPP's and other nuclear installations ranging between 0 and 7 grade).

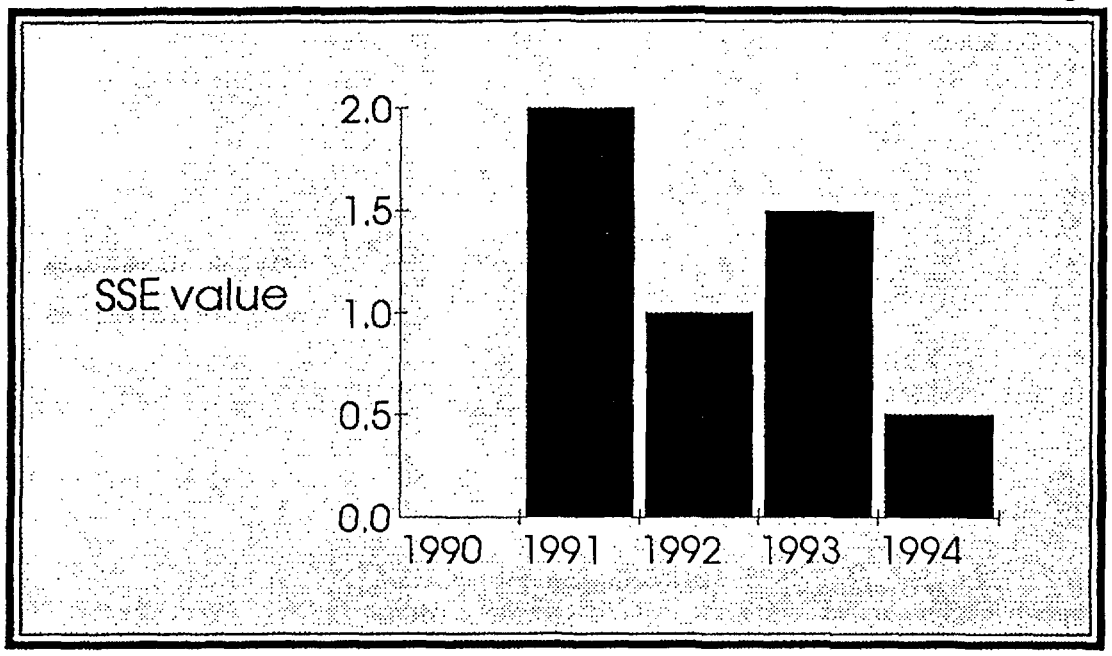
The event were evaluated as follows:

under the scale	45 events
INES 0	19 events
INES 1	1 event

The number of safety-important events in 1990 through 1994, is shown at fig. 5.

Safety related events at V-1 NPP

Fig. 5



The SSE indicator value for V-1 NPP is an average one of unit SSE values. A unit SSE value is the number of safety related event that are ranked the level 1 or higher according to the INES scale.

Inspections have been conducted by nuclear safety inspectors based on an yearly scheme, but also operatively - based on situation at NPP's, even in nights and on holidays. A total of 51 inspection reports and 18 protocols have been developed about the inspection activities. Comprehensive inspections prior to re-starting a unit after a major overhaul and refuelling were the most important ones, requiring extensive expert assessment before a decision is issued on operation in coming cycle.

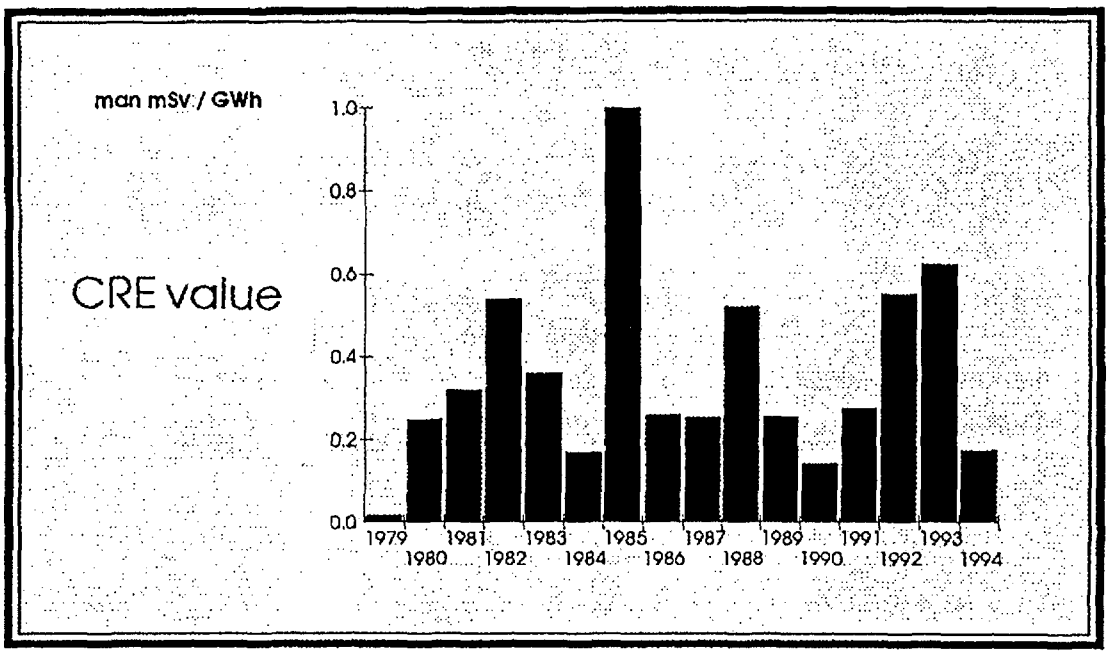
There is very low personnel irradiation load at V-1 NPP. The fig. 6 shows a development of a collective dose per unit of electricity generated (man mSv/GWh).

Following is the production of radioactive wastes (RAW) in 1994:

Active concentrate	250 m^3
Saturated sorbents	5.1 m^3
Solid RAW in casks	39 casks
Large-size RAW	1 m^3
Contaminated wood, etc.	5 m^3
Combustible waste	7594 kg
Active oils	200 l
Active filters	16 pcs = 3.52 m^3

Collective dose of V-1 NPP personnel per unit electricity generated

Fig. 6



A state of RAW storage spaces:

	Space filled-up	Available capacity
Active concentrate	3353 m^3	947 m^3
Saturated sorbents	254 m^3	906 m^3
Solid RAW	810 m^3	80 m^3

The fig. 7 shows volume of radioactive effluents per unit of electricity generated in 1990 through 1994.

Further V-1 NPP safety enhancement

A step-by-step reconstruction planned from 1994 through 1997 is a long-term expedient of V-1 NPP safety enhancement. Early in 1994, the NRA SR completed an analysis and assessment of Slovak and foreign documents and reports related to V-1 NPP safety enhancement through the step-by-step reconstruction.

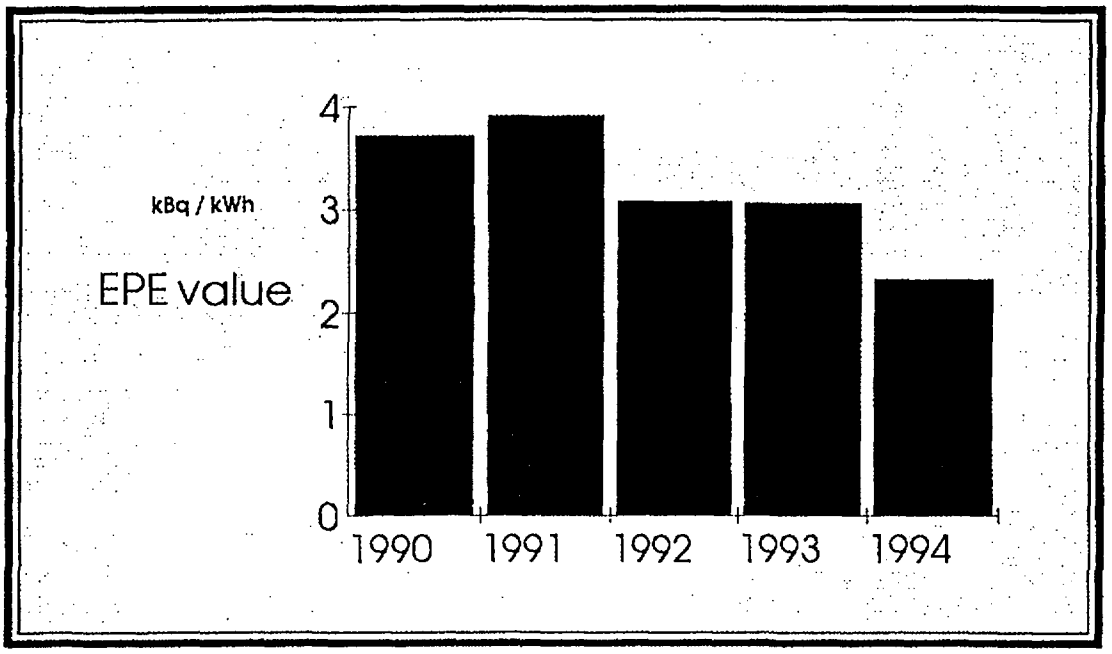
Based on assessment of all documents, as well as its own assessment of a state of the plant and its principal components, the NRA SR issued the Decision No. 1/94 on 24 February 1994. Through this decision, the NRA SR prepared grounds for a land-use permit to be issued for the "Step-by-step reconstruction of V-1 NPP units 1 & 2" and set out its organizational and technical terms of the reconstruction.

The organizational and technical terms comprise requirements on a schedule and programme of the step-by-step reconstruction, scope of technical requirements, use

of probabilistic analyses of safety, approval of design modifications and amendments to the Decision No. 5/91 of the former Czechoslovak Atomic Energy Commission (CSKAE).

Specific activity of radioactive effluents from V-1 NPP

Fig. 7



The technical terms determine measures, including deadlines for fulfilment in following areas:

- maintaining the primary circuit integrity
- reactor core cooling during operation
- reactor core cooling during coolant leakage from the primary circuit
- containment (hermetic zone)
- auxiliary systems (service water, electrical equipment, instrumentation and control, fire protection, seismicity).

The V-1 NPP will attain a safety level acceptable for older NPP's through the implementation of the above requirements.

The NRA SR, through its decision No 110/94, set out terms of V-1 NPP operation in 1994 and coming years, as well as those under which the units may be re-started after each refuelling outage. This will only be possible based on NRA SR's approval, after the terms will have been met, and the approval will be valid only for one fuel cycle, i.e. for approximately one year.

Linked to the implementation of the step-by-step reconstruction of V-1 NPP in 1994, the NRA SR endorsed design modifications and technical designs. This included

modifications in I & C, electric power supply as well as main and auxiliary technological circuits. The total of 47 design modifications have been approved in 1994.

Further improvement of the hermetic areas tightness and proving the proof of LBB (leak before break) principle application rank among the most important works implemented.

	Mass leak-rate from hermetic zone volume per 24 hrs. [in %]		
	prior to reconstruction	1993	1994
unit 1	5039 (1990)	403.96 (June 1993)	255.06
unit 2	7173 (1990)	466.0 (March 1993) 390.2 (December 93)	291.3

Even though the V-1 NPP hermetic zone tightness is still not comparable to modern units, it has been 20 to 25-fold improved in 1990 - 1994.

Complicated computing and experimental works have proved that it is possible to apply the LBB principle in safety assessment in terms of probability of main cooling system pipeline rupture.

It has been proved that there is an extremely low probability of a potential development of crack in the primary piping which is made of austenitic steel, used at the V-1 NPP, which a detectable amount of coolant leaks through till a total rupture. This is a value of the order of 10^{-6} per reactor-year that is considered an improbable event, based on internationally accepted criteria for NPP's.

To ensure further conditions, particularly a sensitive and reliable leak-detection from a formed crack, in-service measures may be taken sufficiently quickly to minimize the probability of piping rupture.

The analyses results have been assessed at a consultancy meeting of experts nominated by IAEA, with participation of the NRA SR and the Operator. To apply the V-1 NPP safety improving principle, the NRA SR charged the operator with implementation of some complementary leak-detection analyses, stricter check of water chemical modes, prevention of water shock, etc., as well as adjustment of operational procedures.

Overall evaluation of V-1 NPP nuclear safety

Based on the assessment, limits and conditions of a safe operation, safety indicators, operation results, including breakdowns and human factor errors, inspection results, scheduled test results, safety enhancement programme implementation and selected personnel examination results, ***the NRA SR assesses the V-1 NPP operation in 1994 as reliable and safe.***

1.1.2. V-2 Nuclear Power Plant

The V-2 Nuclear Power Plant with two VVER 440/V-213 type reactors has a number of improvements comparing to the V-230 design (V-1 NPP). However, operation safety enhancement activities are going on nevertheless.

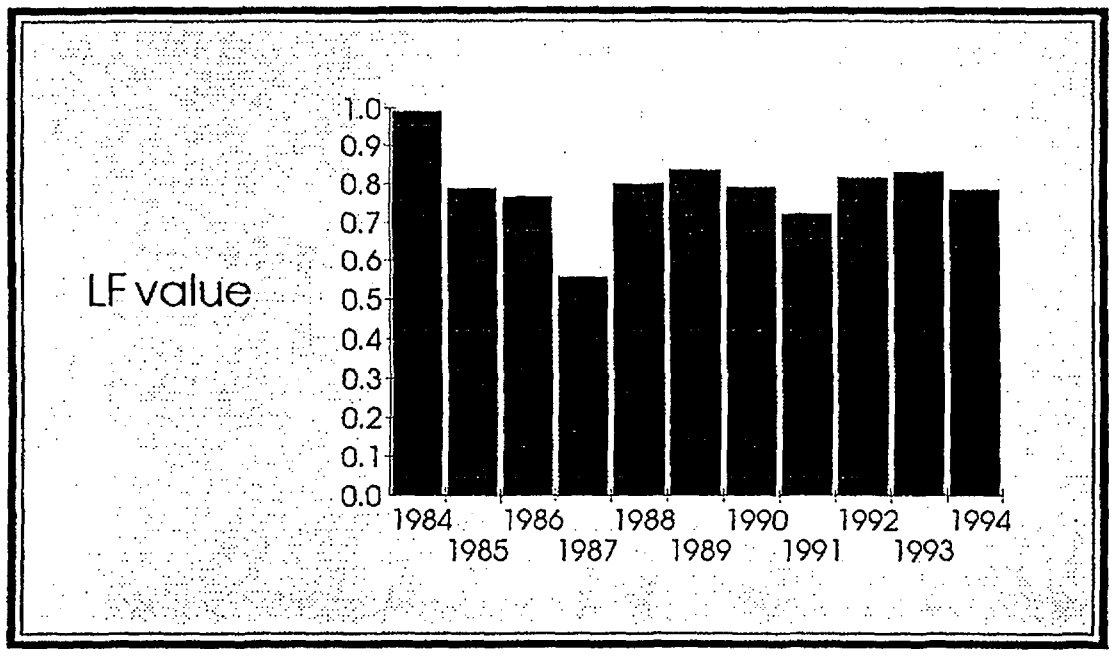
An approval for the operation of the units 3 and 4 of the V-2 NPP has been issued by the former CSKAE for a period of 4 years - till September 1995 for the unit 3 and August 1996 for the unit 4. The unit 3 has been in operation since 1984, the unit 5 since 1985 and the coefficient of installed capacity is shown at the figure 8, 9. The operation of the V-2 NPP in 1994 was reliable, with the coefficient of the installed capacity annual use of 78.3 %.

Major operation trips were caused due to following reasons:

	unit 3	unit 4
Maintenance overhauls and reconstruction	570.869 GWh	603.415 GWh
Trips due to breakdowns	1.757 GWh	9.070 GWh
Required back-up	12.940 GWh	1.557 GWh
Other influences	14.366 GWh	37.581 GWh
Dispatching back-up	186.103 GWh	123.017 GWh

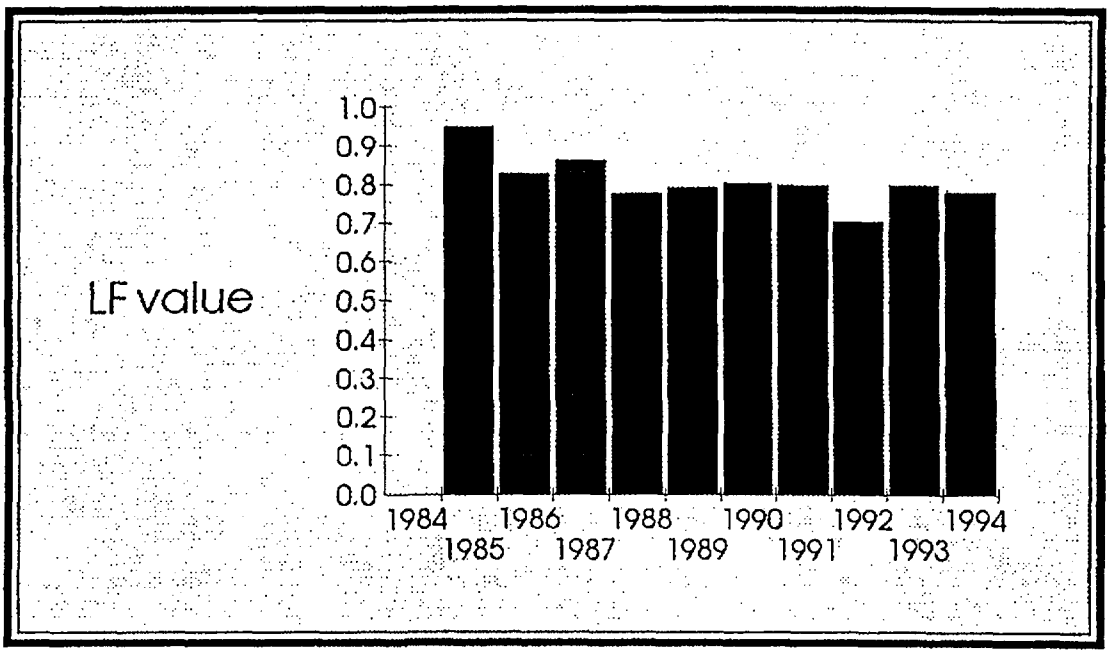
Coefficient of Bohunice NPP unit 3 use

Fig. 8



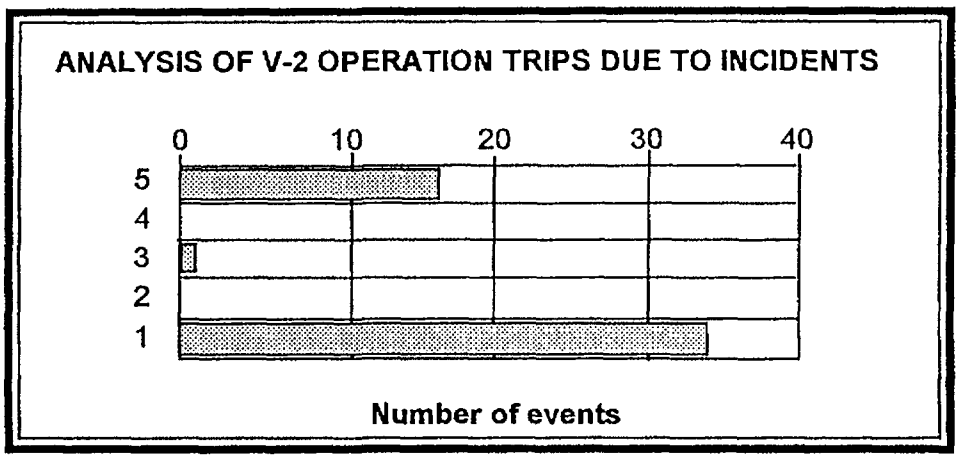
Coefficient of Bohunice NPP unit 4 use

Fig. 9



Operation trips due to breakdowns at V-1 NPP are shown at the following figure No. 10.

Fig. 10



1) Technical incidents
2) Inaccuracy of operational procedures
3) Human factor influence
4) Design failure
5) Scheduled power reduction

Operation results, particularly drop of the annual use of the installed capacity, comparing to the last ten years, are significantly influenced by the large dispatching back-up, commands of the energetic dispatching to reduce power due to power surplus in the Slovak electric power grid.

In 1994, a total of 56 events occurred that resulted in power generation reduction, that is by 10 less that in 1993. The reasons are following:

a) technical failures (35), out of these:
- normal wear-out and ageing of material (15),
- false action of protections (12),
- due to hidden defect (1),
- others and non-identified (7),

b) operational procedure inaccuracy (0+2 partially),

c) human factor impact (1+2 partially - together with b),

d) design failure (0),

e) scheduled power reduction by a dispatcher (18), due to power surplus in the grid (15), scheduled tests of equipment (3) respectively.

There was one case of automatic quick reactor scram (HO-1 - emergency protection No. 1) at each of the V-2 NPP units. The cases were thoroughly analysed by the Operator's commission for incidents, under NRA SR's supervision. Transients resulting in reactor scram were in accordance with the design. The development of the V-2 reactors emergency scrams in 1990 through 1992 is shown at the fig. 11.

At the unit 3 of the V-2 NPP, at 100 % reactor power, all feedwater pumps tripped due to a false signal "Low level in feedwater tank". The trip of the pumps resulted in scram of both turbine generators and reactor. Since this was a repeated failure and previous corrective actions had not been efficient enough, a reconstruction of the protection "feedwater tank level" was undertaken. The protection is tripled at present and sets activated when signals from two sensors are provided.

At the unit 4 of the V-2 NPP, at 100 % reactor power, two turbine generators were tripped due to a false the signal "High level of water in 1 steam generator". Corrective measures were directed to reconstruction of steam generator level regulators.

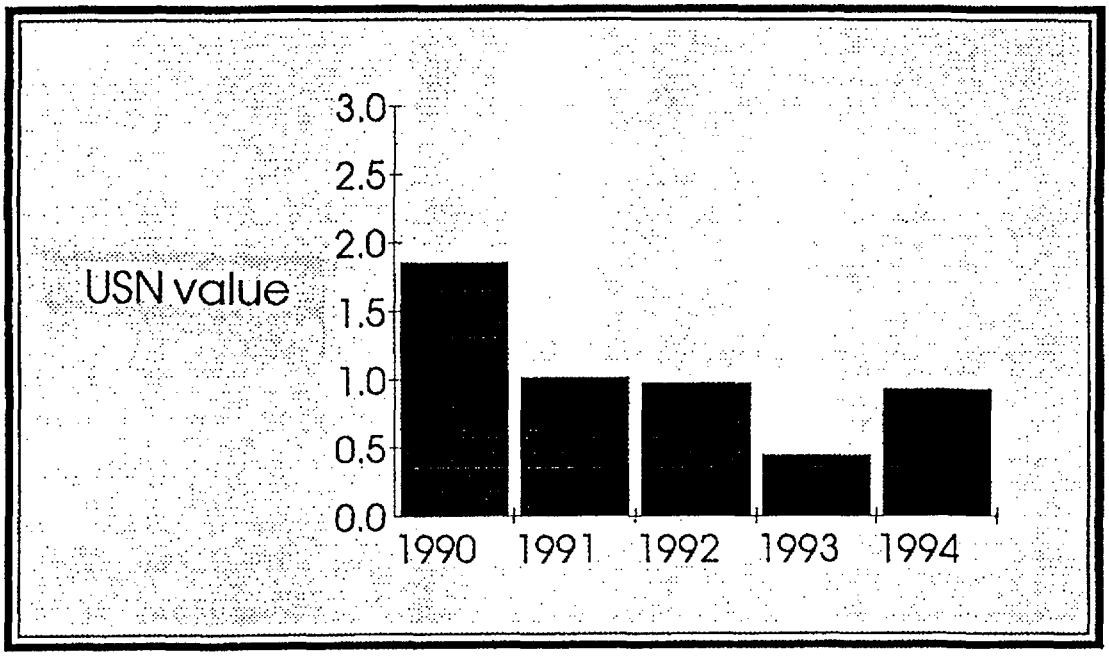
All events have been evaluated according to INES scale.

The events were ranked as follows:

under the scale	38 events
INES 0	17 events
INES 1	1 event

Safety related events at V-2 NPP

Fig. 11

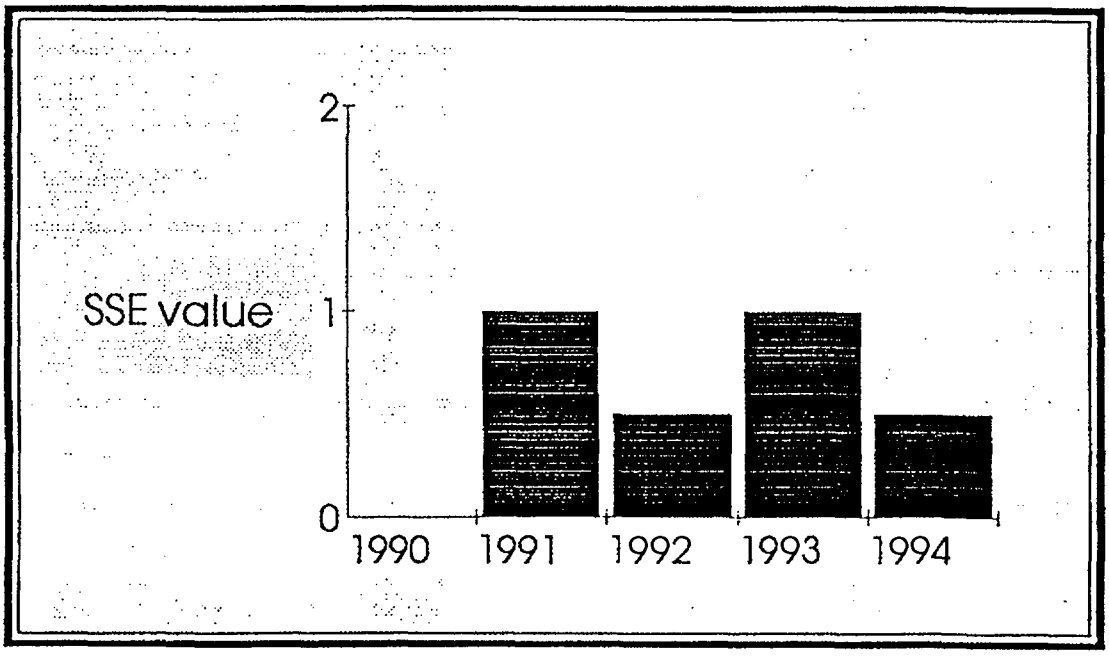


The SSE indicator value for V-2 NPP is an average one of unit SSE values. A unit SSE value is the number of safety related event that are ranked the level 1 or higher according to the INES scale.

The number of safety-important events in 1990 through 1994, is shown at fig.12.

Safety related events at V-2 NPP

Fig. 12



The SSE indicator value for V-2 NPP is an average one of unit SSE values. A unit SSE is the number of safety related event that are ranked the level 1 or higher according to the INES scale.

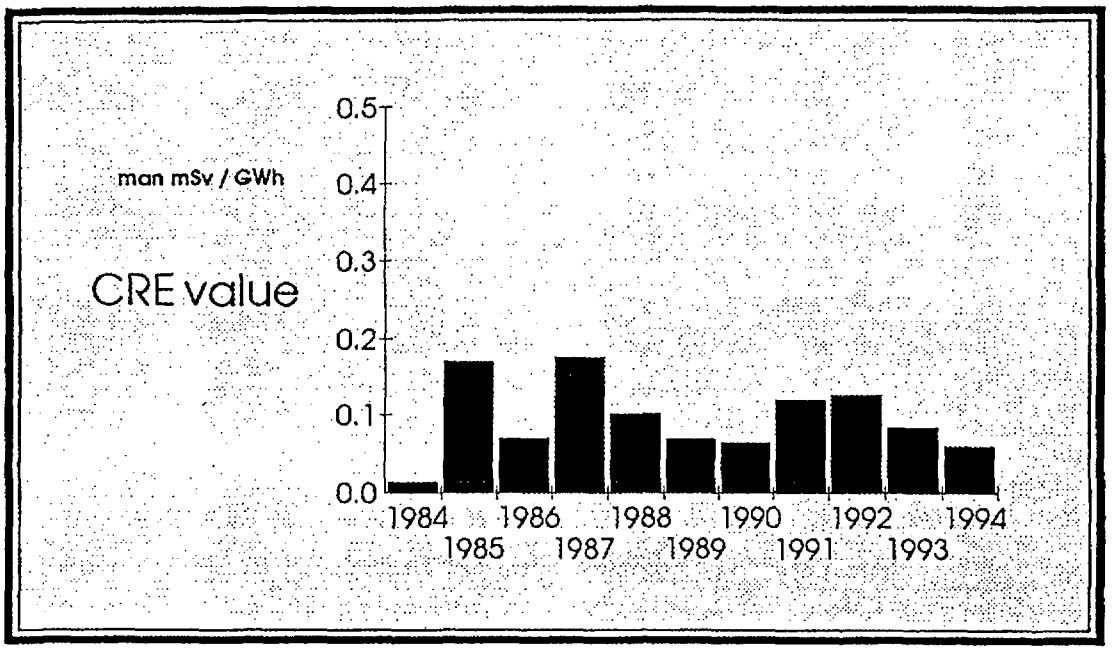
Meeting limits and conditions of a safe operation ranks among the most important indicators a NPP safe operation. None of these was violated in 1994. Based on detailed analyses the NRA SR approved 10 modifications (5 of them are permanent and 5 temporary ones).

The personnel irradiation dose-rate is very low as compared to international practise, that is a consequence of used material of main circuits, high tightness of fuel assemblies and good organization of work.

The fig. 13 shows a development of a collective dose per unit of electricity generated (man mSv/GWh):

Collective dose of V-2 NPP personnel per unit of electricity generated

Fig. 13



Following is the production of radioactive wastes (RAW) in 1994:

Active concentrate	125 m^3
Saturated sorbents	1 m^3
Solid RAW in casks	0
Large-size RAW	0
Contaminated wood, etc.	50 pallets
Combustible waste	8430 kg
Oils	10 l
Air-conditioning filters	0

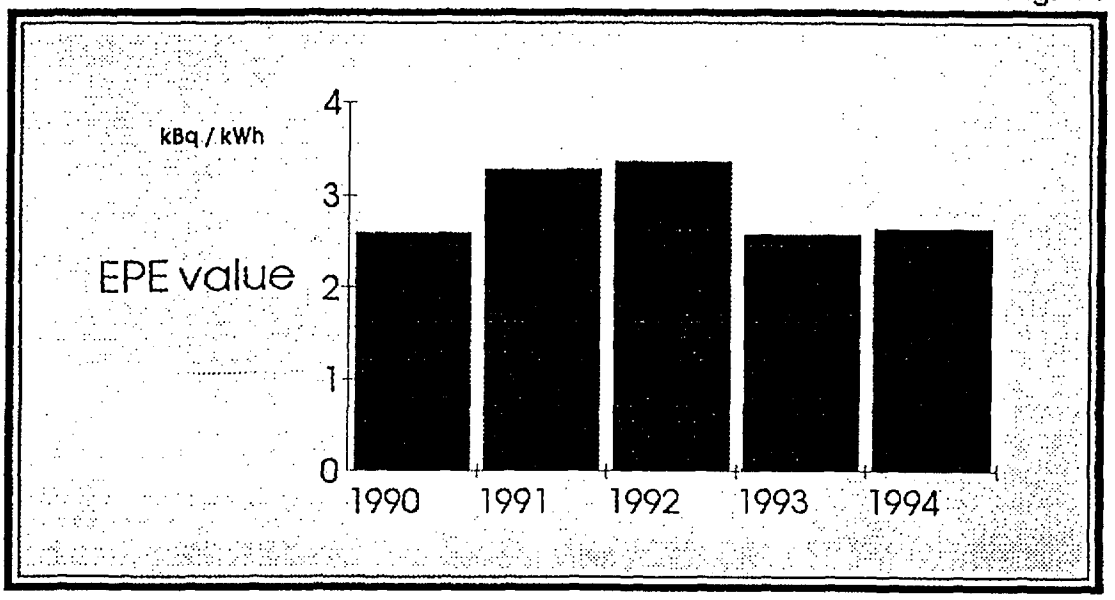
A state of RAW storage spaces:

	Space filled-up	Available capacity
Active concentrate	2905 m^3	3640 m^3
Sorbents	35 m^3	2725 m^3
Solid RAW	270 pallets	2290 pallets

The fig. 14 shows a volume of radioactive effluents per unit of electricity generated in 1990 through 1994.

Specific activity of radioactive effluents from V-2 NPP

Fig. 14



Further V-2 NPP safety enhancement

In order to further improve the V-2 NPP safety, measures are implemented that follow from analyses of failures, operator's operating experience and/or international operating experience. The NRA SR assessed design modifications, technical solutions respectively, of I&C (instrumentation and control) and machinery.

In 1994, during units major overhauls, a considerable number of the approved modifications was implemented; activities related to hermetic spaces tightness improvement were performed as well.

Periodic tightness testing results are recorded in the following table:

	Mass leak-rate from hermetic zone volume per 24 hrs. [in %]				
	1990	1991	1992	1993	1994
unit 3	14.03	16.60	16.50	16.70	15.60
unit 4	16.20	16.23	15.60	15.40	16.07

Since no unambiguous tendency in hermetic zone tightness improvement has not yet been made clear so far, the NRA SR has issued a decision in the end of the year, in which the NRA SR imposed the Operator to submit a programme of the hermetic zone tightness improvement. It is necessary, within this programme, to perform an analysis of untightness formation reasons and their sorting, determine a schedule of untightness removal and success criteria of re-tightening works.

Even though the V-2 NPP belongs to the generation of improved nuclear power plants with the VVER 440 reactor, it is necessary to arrange for a programme of further nuclear safety enhancement not only of the operation itself, but also through resolving of some design deficiencies, comparing to modern safety criteria for new NPP's.

There was an IAEA mission conducted upon the NRA SR's request, to assess the V-2 NPP design safety based on current international practises, that concluded following:

- the V-2 design is advanced comparing to older VVER 440/V-213, and includes such design requirements as the ones applied to other NPP's all over the world constructed in the same time. The requirements contain e.g. three fully independent safety systems, each having capacity enough to mitigate a reactor coolant piping rupture, then a containment with a bubble condenser tower;
- the operator performed a lot of works to improve the original design, aimed at safety enhancement;
- development of a safety report after 10 years of operation is an important contribution to extending the knowledge about the power plant;
- the issue of reactor pressure vessel enbrittlement is significantly more favourable that the one of the older types, due to an improved chemical composition of the pressure vessel material and welds, as well as the manner of nuclear fuel loading;
- a programme the steam generator inspection is very extensive and a high-quality one, and covers all problem points;
- extension of the current systems of inspection and control covers functions which are required for nuclear power plants;
- the programme of electric equipment monitoring is very extensive and of a high quality.

Furthermore, the mission worked out recommendations for further safety enhancement in individual areas, that will be used by the NRA SR together with

conclusions of the safety report after the 10 years of operation to prepare a decision on further safety enhancement of the V-2 NPP.

Overall evaluation of V-2 NPP nuclear safety

Based on an inspection programme assessment, inspection results, limits and conditions of a safe operation, safety indicators, operation results, including breakdowns and human factor errors, periodic test results, implementation of design modifications of the level of introducing quality assurance programmes and selected personnel examination results, ***the NRA SR assesses the V-2 NPP operation in 1994 as very reliable and safe.***

1.1.3. Mochovce Nuclear Power Plant (SE a.s. - EMO o.z.)

In 1994, the power plant continued to be in the stage of temporary stoppage of the construction due to a lack of funding. The nuclear power plant has a valid construction permit issued in 1983 for the units 1 and 2.

The NRA SR's inspections focused on inspection of attended areas, verification of safety system states, review of maintenance, fire protection, safeguarding, personnel training and qualification, simulator preparation, conditions of fuel storing. There were deficiencies found mainly in individual quality assurance programmes.

Special inspections focused on inspection of electric equipment, special drainage system, conservation, status of selected operational procedures, status of I&C system. Following deficiencies were identified by the inspections: not meeting conditions for storage, conservation, incomplete list of operational procedures.

The prime task to get the loan from the EBRD, but also to ensure any other way of Mochovce NPP completion whatsoever, is the implementation of nuclear safety improvements.

By the end of 1993, EdF experts developed the document "Safety Improvement Report (SIR) of Mochovce NPP". The report assesses the current status and suggests measures to enhance safety in 32 areas.

In 1994, the EBRD acting as the prime lender concluded a contract with RISKAUDIT to perform EMO project (units 1 & 2) safety assessment (the RISKAUDIT is a consortium of GRS, Germany, and IPSN, France, which are supporting organizations to nuclear regulatory authorities in particular countries).

In June 1994, the first version, and by December 1994 the final version of the report "Assessment of Mochovce Nuclear Power Plant Safety improvements" comprising following areas: safety analyses, reactor core design, pressure components, fire protection, internal hazards, system analyses, electric system, measurement and control, containment, seismicity, operations, radiation protection, radioactive wastes, nuclear fuel and decommissioning.

The main conclusion of the report is a statement that if the EMO project is completed it will conform to EBRD safety related principles.

In order to get an independent assessment of Mochovce NPP safety, the NRA

SR asked the IAEA to conduct a mission to assess safety issues and the safety enhancement report. The IAEA expert assessed following areas: power control, fuel cooling in operational conditions, fuel cooling at leakage from the primary circuit, containment, measurement and control, electric systems, safety analyses, internal hazards and external hazards.

The final report of the IAEA Mission assesses individual areas and recommends further measures eventually. The IAEA Mission was not so extensive as the RISKAUDIT one, however, in most areas dealt with in both reports, the IAEA's and RISKAUDIT's positions were identical with the ones of NRA SR's.

1.1.4. Bohunice A-1 Nuclear Power Plant (SE a.s. - EBO o.z.)

The power plant has been shut down on 22 February 1977, after an accident, when an overheated blocked fuel assembly began to melt, and consequently radioactivity was released into the primary part of steam generators, and partially into the secondary circuit through untightnesses in the steam generators. The accident was additionally ranked as decree "4" accident according to the INES international scale. During the accident, however, there was no release of radioactivity into the environment, none of the service personnel was injured, nor suffered damage to his/her health by irradiation.

The station has been in the stage of a step-by-step decommissioning for long period. In 1984 through 1990, a total of 439 (all handleable assemblies) out of 572 spent fuel assemblies were transported to the U.S.S.R. The reactor hall was accidentally contaminated during works with unhandleable fuel on 12 May 1991. Consequently, the contamination spread out into the spaces under the reactor hall. Further fuel handling is impossible before the reactor hall decontamination is completed. At present, there are 128 unhandleable fuel assemblies in a long-term storage and 4 ones are ready to be transported.

In parallel with the spent-fuel related activities, technologies were developed and constructed for radioactive waste treatment. There were two bituminization lines built up, an experimental incinerator, chrompik vitrification line, cementation line and dowtherm treatment line. The two last technologies were not proved as successful and are therefore out of operation. The bituminization lines are under licensing process at present; the experimental incinerator has been in operation for 2 years. The vitrification line is now in the stage of active tests preparation. Preparation and construction of Bohunice treatment centre commenced in 1993 that will comprise a cementation line, incinerator, high-pressure press and equipment for a waste final treatment before disposal at a repository. The Bohunice treatment centre operations are planned to be started in 1996.

In 1989 and 1990, cooling towers and some parts of the secondary circuit were decontaminated and decommissioned.

In 1994, the NRA SR's inspection activities at the A-1 NPP were focused on a state of the A-1 NPP equipment and works related to:

a) improvement of storage and fuel handling conditions;

b) improvement of radioactive material storage;

b) improvement of radioactive material treatment.

To this end, inspections were performed of readiness and works progress on the reactor hall decontamination, manner of fuel long-term storage, status of liquid RAW tanks, solid RAW storage, operation of active water treatment station, evaporation station, experimental bituminization line, bituminization and vitrification line and experimental incinerator. Based on these inspections and safety documentation review, the NRA SR issued an approval for operation of some buildings, for active tests respectively.

In 1994, there were 5 failures at the A-1 NPP, one of which was safety-related and ranked as degree "1" according to INES international scale. This was a leak of radioactive water from a hot chamber collector into three attended areas through a ventilation system.

The failure, which a human factor significantly contributed to, was caused by an incorrect setting up a route, insufficiently developed scheme of works and ambiguous command to block systems for repair.

In 1994, no valid "Limits and conditions" were breached. A proposal of adjusted "Limits and conditions" following from A-1 NPP operation change (so-called "A-1 NPP special mode") and containing limits and conditions for RAW treatment and decommissioning as well, has been approved after commenting.

During the works of floor and equipment decontamination of the A-1 nuclear island (water from a special drainage system) and other works, a total of 1462 m^3 of active waters (water from a special drainage system + bituminization line breed steam condensate) were produced in 1994, i.e. 165 pcs of 200 l casks with a solid waste.

Following wastes were treated at treatment lines, the evaporation station respectively, in 1994:

- *evaporation station* - 1412 m^3 of waste water out of the total 1462 m^3, hence forming 10 m^3 of concentrate that is stored in a tank;
- *experimental bituminizing line* - 105 l of dowtherm and 6.5 m^3 of concentrates, forming 15 casks of a bituminous product;
- *experimental incinerator* - 1.2 tons of combustible waste were incinerated not containing the alpha-activity, together with similar waste from V-1 and V-2 units (the total of 17.1 tons), giving rise to 2 m^3 of ashes that is stored in 15 casks.

There are following volumes of radioactive waste stored at A-1 NPP at present:

Type	Volume	Total activity
Chrompik I in KS-2, incl. sludge	12 m^3	2.1 * 10^{13} Bq
Chrompik II in DS casings + sludge	7 m^3	1.3 * 10^{14} Bq
Chrompik III in DS casings + sludge	13 m^3	1.3 * 10^{15} Bq
Dowtherm in DS casings + sludge	45 m^3	1.8 * 10^{12} Bq

Water of long-term storage	530 m^3	1.1 * 10^{14} Bq
Sludge of long-term storage	5 m^3	7.3 * 10^{12} Bq
Concentrate - tank 44/10N 1/4	304 m^3	1.2 * 10^{13} Bq
Oils	62 m^3	9 * 10^{8} Bq
Sludge + residual liquid RAW of the build. 41	275 m^3	8.6 * 10^{13} Bq
Sludge - monte jus HK	0.8 m^3	1 * 10^{14} Bq
Sorbents 44/10 N3	15 m^3	1.5 * 10^{11} Bq
Heavy water	0.85 m^3	1 * 10^{10} Bq
Special RAW (decontamination) 44/20	50-70 m^3	ca 10^{12} Bq
Oily water of the building 44/20	80 m^3	8 * 10^{7} Bq

Solid radioactive waste

Type	Volume	Total activity
Contaminated soil	[a]11,000 m^3	4.7 * 10^{12} Bq
Metallic scrap from primary and secondary circuits	1,711 tons	1.8 * 10^{12} Bq
Solid RAW - HK		1.2 * 10^{11} Bq
Solid RAW, unsorted 44/20	480 m^3	1.2 * 10^{11} Bq
Concrete 44/20, 839	[a]676 m^3	5 * 10^{8} Bq
Ventilation filters	220 pcs	1.2 * 10^{11} Bq
Soft incombustible	713 m^3	2.3 * 10^{8} Bq
Combustible	466 m^3	2.3 * 10^{8} Bq
Ashes + bituminous product	ca 20 m^3	ca 10^{11} Bq

[a] estimate including wastes coming from decommissioned buildings and treatment of soil around the tanks

The Slovak Governmental Decrees No. 266/93 and 877/94 approved a schedule of the A-1 NPP bringing into a radiation-safe status, with a stress on crucial activities in 1994 and development of a complex project of the A-1 NPP bringing into a radiation-safe status. By the end of 1994, the project had been developed in form of technical bases and after submission to the NRA SR and consequent approval, individual parts of it will be processed as partial tasks in form of an executive documentation.

A strategy of attaining the 1-st level of radiation-safe status (so-called "wet status") has been incorporated into the schedule pursuant to NRA SR requirements, with the main goal to enhance safety of risky RAW storing so that storing of liquid RAW be in conformance with valid regulations (Regulation No. 67/1987) and that spent fuel be stored in a storage with at least two reliable barriers preventing release of radioactive materials into environment.

1.2. Nuclear materials and safeguards

The filing and inspection of nuclear materials follow from requirements of the Agreement between the Slovak Republic and IAEA inspectors on guarantees based on the Non-proliferation Treaty.

The NRA SR performed 76 inspections of nuclear material, 22 of which were conducted together with IAEA inspectors. The inspections were carried out at following sites: SE a.s. - EBO o.z. (A-1 NPP, V-1 NPP, V-2 NPP, spent fuel intermediate storage), SE a.s. - EMO o.z. (Mochovce NPP) and at 69 minor users of nuclear material all over Slovakia. A comprehensive inspection was conducted at minor users' in 1994, a total of 6 new licences for intake were issued and licences of 4 organizations for nuclear material intake were cancelled. Physical stock-taking of nuclear materials was carried out without any significant problems.

In 1994, following nuclear materials were transported:

a) *Fresh nuclear fuel:*
   - 2 transits of fuel assemblies from the Russian Federation (RF) to the Czech Republic (CR)
   - 2 transits of fuel from RF to SE a.s. - EBO o.z.

b) *Internal transportation of spent fuel.* There were a total of 390 fuel assemblies transported from all units of the V-1 and V-2 NPP's into the intermediate spent fuel storage.

c) *Uranium concentrate*
   There was one transit of uranium concentrate (UOC) from the CR through the Slovak Republic.

There are 4,836 VVER 440 fuel assemblies placed in the intermediate spent fuel storage, some 1,176 of which belong to Dukovany NPP (EDU), Czech Republic. The intermediate spent fuel storage is filled by 88 %.

When carrying out their national surveillance over safeguards of nuclear power plants, the NRA SR focused on inspecting the effectiveness of current NPP safeguard systems.

Bohunice NPP safeguards, in the period assessed, was provided by technical expedients level of which corresponds to the period of their erection and, in addition, is complemented with protection by the Slovak Army guardian units.

A level of security comparable with safeguard systems used in advanced industrial countries will be attained by completion and starting up of automated complex of NPP safeguards (AKOBOJE).

The operator submitted to the NRA SR a Pre-operational Safety Analysis Report for the 1-st stage of AKOBOJE for approval.

Linked with assessment of completion works on the stage 1 of AKOBOJE security system and assessment of the proposed system efficiency, there was an inspection of safeguarding conducted at Bohunice NPP. The level of the security system has been assessed as sufficient by experts and recommendations on the system have been taken into account in proposing further improvements to the system.

Safeguards of the fresh fuel storage at Bohunice NPP is provided by their own security service using some elements of the AKOBOJE system, that is under construction, and minor construction adjustments around the fresh fuel storage.

In connection with the stage 1 assessment - notably questionable parts of the proposed safeguard system resulting from articulation of surrounding terrain, as well as from a status and readiness training of Mochovce NPP security service, an inspection of

safeguards was carried out at SE a.s. - EMO o.z. Radioactive waste repository security was also inspected within this inspection. NRA SR's inspectors stated that the proposed system of a guardian stand placed on the other end of the repository area without any fence detection is insufficient.

On 6 July 1994, during a demonstration of GREENPEACE movement near to Mochovce NPP site, a group of a number of protesters illegally crossed the site external fencing that is a part of the fresh fuel storage safeguard system. Mochovce NPP security service commander evaluated the penetration as a beginning of a potential attack on the fresh fuel storage, and as one exceeding the security service possibilities and asked for a help from Police Headquarters at Kalná nad Hronom and Levice. Despite the fact that the Mochovce NPP security service proceeded in line with the fresh fuel storage safeguard project, and no attempt was recorded on penetration into the fresh fuel storage, NRA SR's inspectors classified the response of the entire safeguard system as insufficient due to late arrival of the Police unit, and therefore the intervention was inefficient.

Based on the event of July 1994 and as per NRA SR requirements, measures have been taken about intervention of Levice region police forced units in as short time as possible, pursuant to provisions of the Police Force Act. At the same time, an agreement is being prepared between the Ministries of Economy and Interior of the Slovak Republic on activities of police forced units in case of extraordinary events at Mochovce NPP.

1.3. Radioactive waste (RAW)

Radioactive waste creation and treatment, including quantities, is shown in the assessment of NPP's. The NRA SR files the RAW growth, as well as its eventual treatment in nuclear power plants. The ultimate goal of RAW treatment is a disposal in a solidified form hence providing for a minimum impact of the waste upon environment.

A treated low and intermediate-level RAW's will be finally disposed of at Mochovce repository. Mochovce RAW repository Pre-operational Safety Analysis Report was submitted to the NRA SR in November 1993. The report included proposed derived limits and conditions for this nuclear installation. The report was being assessed in 1994, using conclusions of assessment done by an international team of experts within IAEA programme Waste Management Assessment and Technical Review Programme (WATRP).

The final report processed by the end of 1994 comprised a number of recommendations that will require modifications to the safety analyses report in implementation, as well as some additional measures and tests at the repository itself.

The NRA SR's position on the submitted Pre-operational Safety Analysis Report requires to better document all data influencing a long-stability of the repository. Furthermore, the NRA SR requires to re-assess technical data of the repository drainage system in order to provide for its functioning, to change a manner of waste laying into vaults and a manner of filling an interspace up in laying containers so that these could be retrievable. The NRA SR moreover requires a system approach to the safety analyses to be taken, that will result, besides others, in criteria of waste acceptance to the repository.

Entire independence of the repository operator on waste producers is a matter-of-principle requirement, as well as providing for all aspects related to the repository high-quality operation.

1.4. Emergency planning and NRA SR's Control and Crisis Centre

The NRA SR continued in development of activities started in 1993 in the area of emergency planning. The performance of the SR liaison place has improved through updating of international agreements with Austria, Hungary and Germany, as well as through multilateral agreements on information and notification exchange and mutual assistance in case of a nuclear accident either in Slovakia or abroad. Communication about such NRA SR activities are provided, as per agreement concluded, by the Ministry of Interior - section of Civil Defence, through a non-stop service of an operational officer.

In order to fulfil special tasks of the liaison place in case of a nuclear event, system of bringing such group into readiness has improved through a Radiocontact service and PAGER apparatuses. There were 3 trainings of notifying the working group held for the purpose of precluding eventual deficiencies.

Based on RAMG international mission recommendations, a NRA SR's Control and Crisis Centre has started to be built up. A basic concept of the centre activities and proposal for its equipment have been developed. Beyond its role as the liaison place of SR, the Control and Crisis Centre, in case of a nuclear accident, will: assess the situation and its progress; prepare a proposal of measures and recommendations for the SR Governmental Committee for radiation accidents and measures focused on the public protection. The NRA SR succeeded to obtain a technical assistance from the U.S.A. and Great Britain to complete construction and equipment of the Control and Crisis Centre. The Control and Crisis Centre is planned to be commenced late in March 1995.

Unification of nuclear power plant emergency plan structures and terminology has been an essential activity in the area of internal emergency planning. The issue of forces and devices needed to solve a crisis situation has opened. On the basis of conclusions adopted, NPP operators will develop a stock-list of forces and devices needed to solve crisis situations.

1.5. International activities to improve the national surveillance quality

In 1994, the NRA SR arranged for international contacts notably within the frame of:

1) the Slovak Republic membership in the International Atomic Energy Agency (IAEA)
2) co-operation with the OECD countries
3) PHARE programmes
4) intergovernmental co-operation
5) co-operation among regulatory authorities of IAEA member countries.

Co-operation with IAEA based in Vienna has the most important role, in terms of international importance, prestige and extensive range of technical assistance - both indirect (participation at various conferences, seminars, technical committee sessions) and direct (expert assessments, supplies of technology, short-term attachments, scientific

trips, training courses).

The Slovak Republic applied for a position in the Board of Governors at the 38-th General Conference of IAEA held on September 1994. The Slovak Republic was elected at the Conference to be a representative of East-European countries for the period of 1994 to 1996 in the Board of Governors.

There were six national and three regional projects under development focused on personnel qualification upgrading, quality assurance in commissioning and operation of nuclear power plants, enhancement of use and safety of VVER-series power plants, safety assessment of NPP sites, nuclear safety assessment, management of radioactive wastes coming from VVER reactors and probabilistic assessment of their safety.

Five important missions of IAEA expert teams were held to assess: the V-2 NPP design safety; Mochovce NPP safety improvements; enbrittlement and annealing of pressure vessels of VVER 440-type reactors; possibility of LBB (leak before break) principle application on V-1 NPP piping; and Pre-operational safety analysis report of Mochovce radioactive waste repository. Joint works were carried out on scientific contracts in the area of reactor residual life-time, spent fuel long-term storage issue, new decontamination methods for classified equipment of VVER 440 NPP's and in the area of gamma-ray physics, superconductivity and nuclear reactions.

Financial and technical aid to the Slovak Republic was provided within co-operation with OECD, particularly in public informing methods.

PHARE programmes related to industrial energetics are co-ordinated by the Ministry of Economy. The NRA SR is involved in defining the programmes, mostly in the nuclear safety area. The NRA SR developed three proposals of national projects to support the national surveillance over the nuclear safety and two proposals of regional projects, amounting approximately up to ECU 3 million that should be commenced in the first quarter of 1995.

The NRA SR ensures implementation and/or preparation of intergovernmental agreements in the area of peaceful use of nuclear power. This involves particularly neighbouring countries (Hungary, Poland, Czech Republic, Ukraine, Austria) and countries with an advanced nuclear industry (Canada, U.S.A., Germany, France, Russia). Further co-operation is done based on agreements among regulatory authorities. This is notably the case of the U.S.A. where our partner, the Nuclear Regulatory Commission (NRC), provides us with a very significant assistance in preparing the authority staff.

The NRA SR, within a co-ordination mechanism of G-24 countries technical aid (NUSAC), enforced the SR needs according to priorities determined together with industries. This involves areas like personnel preparation, including hardware supplies, and nuclear safety enhancement. This mechanism also provided for defence of political and economic, as well as safety aspects of V-1 NPP further operation.

Within IAEA's information exchange programmes, the NRA SR provides the national co-ordination, acceptance and providing data from/to INES system (international classification of nuclear events) and IRS system (system of collection and evaluation of safety-related events at NPPs), as well as application of experience to the conditions of the Slovak Republic.

1.6. Other activities

Following was carried out in 1994:

- inspections focused on personnel preparation at Bohunice and Mochovce NPPs,
- assessment of technical equipment and professional skills of personnel of organizations authorized to train nuclear installations staff
- inspection of corrective measures implementation adopted based on recommendations of G-24 Co-ordination group mission held in 1993.

The basic theoretical preparation, simulator training and training on a simulation computerized educating system are performed by the Training and educational centre of Nuclear Power Plant Research Institute based in Trnava, and practice and periodic training is held at Bohunice NPP and Mochovce NPP.

Commissioning works on Mochovce NPP simulator have started in the second half of 1994 that is supplied by consortium of Siemens/S3 Technologies with commissioning deadline of September 1995.

The National Testing Commission for verification of special professional abilities of nuclear installation selected personnel, established according to §8, art. 3 of the Act No. 28/1984 on National Surveillance over Nuclear Safety of Nuclear Installations, was called to 9 sessions.

A total of 69 licences for manipulations at nuclear installations have been issued for selected personnel.

Beyond the performance of the national surveillance at nuclear installations of the Slovak Republic, the NRA SR conducted other activities as well, that follow from its authorisation. This involves particularly legislation activities that was, in the past year, focused on creation of an act on peaceful use of nuclear power (Nuclear Act), and generally binding legal regulations for the act execution. The creation of the Nuclear Act is the NRA SR's task based on the Governmental Decree No. 190/94.

A decision-making activities of the NRA SR is focused on managing and authorizing NPP accident analysis programmes, probabilistic safety assessment, finalizing the issue of NPP site seismicity in the Slovak Republic and others.

The NRA SR paid a considerable attention to quality assurance systems at NPPs. Besides others, proposals of partial quality assurance programmes were assessed for operations of Bohunice and Mochovce NPPs. Based on identified facts, the NRA SR charged SE a.s. with a task to arrange for co-ordination of the entire process of quality assurance programmes development at Bohunice and Mochovce NPPs, following a quality assurance programme of Slovenské Elektrárne a.s.

1.7. Conclusion

In 1994, the structure of the NRA SR has been completed and a positive development of Slovak nuclear power plants safety has been achieved. The progress of V-1 and V-2 NPPs safety indicators was also favourable, such as: rate of failures, number of emergency reactor scrams, low irradiation load of personnel and no events that might potentially endanger the environment. Necessary measures have been set out

to further improve, step-by-step, the V-1 NPP operation safety and a manner of its operation. Based on experience gained during a 10-year operation of the V-2 NPP, the operator shall submit proposals and the NRA SR will provide detailed requirements on *further safety enhancement.*

Even though there has been no progress in Mochovce NPP construction, opinions on the scope of safety improvements has crystallized that should provide a proper level of safety in completion.

At the shut-down A-1 NPP, a rational concept of its bringing into a safe status is being created step-by-step, although a number of issues related to storing and transportation of the damaged fuel assemblies will require further difficult works.

International obligations of the Slovak Republic were fully provided in the area of IAEA guarantee system for nuclear materials as well as double-use materials. Works continued on improvement of nuclear installation site safeguard system through implementation of the stage 1 of automated complex of Bohunice NPP safeguard system AKOBOJE. The Pre-operational Safety Analysis Report on the radioactive waster repository has been assessed under participation of international experts and actions were recommended to remove deficiencies made during siting and construction.

A Control and Crisis Centre of the NRA SR has started to be built with a significant aid of foreign countries, the Great Britain in particular. The Centre will evaluate situation independently in case of a nuclear event, and will also contribute to prevention and protection of the public.

The NRA SR's international position has furthermore been strengthened: in the International Atomic Energy Agency, as well as in relation to other international organizations and foreign regulatory authorities. A Slovak deputy has been elected, as representative of the Eastern Europe countries, a member of IAEA Board of Governors for the period of 1994 to 1996. Furthermore, the scope of technical assistance has been extended in assessing the nuclear safety and measures aimed to further improvement, through experts' services, software and hardware supplies.

Based on inspection activities conclusions, the NRA SR assesses the operation of NPPs in the Slovak Republic as safe and reliable.

Following will be the most important issues of the national surveillance over the nuclear safety of nuclear installations performed by the NRA SR in 1995:

- safety enhancement through implementation of a step-by-step reconstruction of V-1 NPP;
- decommissioning of the A-1 NPP;
- licensing of Mochovce radioactive waste repository commissioning.

New issues of 1995 will be linked to completion and safety improvement of Mochovce NPP and proposals of V-2 NPP safety enhancement in connection with conclusions of the safety analysis report after 10 years of operation.