5. Safety of Nuclear Installations in Slovakia

5.1 Site Selection

5.1.1 Legislation Related to Site Selection

Slovakia does not envisage, in the near future, to select any new site for a nuclear installation. The energy sector development concept assumes the completion of the nuclear power plant Mochovce under construction. The selection process for a repository of high radioactive waste (and/or spent fuel) is under preparation, and only a general geological survey has been conducted so far by SE a.s.

With respect to construction of a nuclear installation, the organization proposing a construction has to attach, to the application for the licensing of the site a permission of ÚJD issued based on the review of the inception safety report which also contains site review from the viewpoint of nuclear safety (FMTIR Decree No. 85/1976 Coll., Section 7).

FM TIR Decree No. 83/1976 provides, in its Section 88, for the general basic criteria concerning the site: technical planning, town planning design of the nuclear power installations.

Technical details concerning nuclear power installations are provided for by CSKAE Decree No. 4/1979 on general criteria of nuclear safety in selecting locations for construction of nuclear power installations. The Decree identifies grade 1 exclusion criteria:

- exceeding of limit dose of ionizing radiation,
- territories with seizmicity higher than and including 8^0 MSK,
- territories with slides-connected breaks,
- territories over mines etc.

All the above criteria unambiguously exclude the site from selection for the above mentioned purpose. Territories under grade 2 exclusion criteria may be conditionally considered. They e.g. include:

- carst areas,
- territories with drinking water reservoirs,
- territories with significant altitude profiles etc.

Other criteria such as speed and direction of ground water flows, method of public supplies, distance to State borders etc. only serve for comparison purposes between different sites.

Equipment relevant to nuclear safety in nuclear installations has to be designed so as to enable safe shut-down of the reactor in cases of natural disasters which can realistically be expected (earthquakes, thunderstorms, floods etc.) or due to human activities (aircraft crush, explosion close to the power plant). The design has to account for the most significant historical natural phenomena which have been recorded for the site in question and in its vicinity (CSKAE Decree No. 2/1978, Section 10).

Design documentation of workplaces with radiation sources has to be submitted, in an extent needed for review of all circumstances connected with the protection of the employees, to hygienic service authorities. In approving the construction of plants and installations (also of nuclear installations) which during the planned operation introduce or may, in cases of accidents introduce radioactive substances into the environment, also consequences of such operation or accidents for the population living in the vicinity of such plants must be considered. Authorities which make decisions on such constructions must mandatorily receive background materials showing the extent of the population exposure during the operation or as a result of an accident (Decree of MZ SR No.65/1972, Section 8 (4) and (5).

Act of National Council of the Slovak Republic No. 272/1994 Coll.II., On the Protection of Human Health, provides for the responsibility to specially protect the health against effects of ionizing radiation (Section 9(b)).

Act of National Council of the Slovak Republic No. 127/1994 Coll.II. on Environmental Impacts Assessment , regulates the procedure of a comprehensive expert and public review of constructions of prior to their approval. The objective of the review is mainly to :

- comprehensively identify, describe and assess direct and indirect environmental impacts,
- identify measures to prevent or reduce environmental damage,
- clarify and compare advantages and disadvantages of different solutions with the current status.

5.1.2 Meeting of Criteria at Bohunice and Mochovce Sites

Criteria for the site selection of nuclear installations for the WWER-440/230 units corresponded to the then applicable Soviet standards and approaches, with radiation protection of the public provided for by distance (this also corresponded to the approach in other countries during the 50s). The principle of a three kms wide protection zone with no permanent settlements was applied in selecting the site.

During the time of the site selection, designing and construction of NPP Bohunice, no standards providing for the construction of NPP in a seismic area existed either in Czechoslovakia or in other countries. The Czechoslovak standard „Seismic Loads of Constructions" was used. The standard envisaged earthquakes with a probability of once in 200 years and an intensity of 6.4° MCS at the Jaslovské Bohunice site. No earthquake with an intensity of 8° MCS as recorded in 1906 as the strongest earthquake in the area, with the epicenter at a distance of 17 kms in the area of the Little Carpathian mountains has been considered for the NPP site, mainly because of the profile and the slope of the area.

Re-assessment of sesimic load of the Jaslovské Bohunice site was included into the safety upgrading projects of NPP Bohunice units. The resulting seismic effect was calculated and confirmed, later on, by IAEA missions (see Section 2.1.1) are as follows :

- for SSE (Safe Shut-down) earthquakes (with a probability of 10^{-4} years), intensity 8 of the MSK 64 scale - with maximal horizontal acceleration of 0.25 $m.s^{-2}$ and a maximal vertical acceleration of 0.13 $m.s^{-2}$.

- for design eqarthquake value (with a probability of 10^{-2} years), intensity 7 of the MSK 64 scale, with half of the SSE acceleration values.

The calculations and analyses supported the necessity to upgrade the seismic resistance of category 1 buildings and structures which have to withstand SSE without any damage. This category includes buildings and structures the failure of which may cause damage to components or systems needed for safe shut-down and post-cooling of the reactor or the failure of which may cause radioactivity leaks. The list of such buildings and structures was approved by IAEA.

Background materials for the selection of the MOCHOVCE site were developed in 09/79, in line of the applicable legislation; the selection was performed in 11/79. The general designer prepared and forwarded to the investor on January 31, 1980, a study of a series of buildings; this study exceeded the scope provided for by Decree No. 163/1973 Coll. on Documentation of Buildings. Study of a series of buildings was developed at a time when basic problems concerning the master plan of the power plant by Soviet designers have not yet been resolved - the issues concerning the master plan could not be discussed since the seismicity level of the NPP site was not known. Seismicity issues could be concluded in 07/80 and a more detailed geological survey was started in 09/80.

The survey gave not very favorable results, and this caused that the units were moved elsewhere to meet the requirement concerning the location of category I premises (with respect to seismic resistance) according to the then applicable Soviet standards (VSN 15-78). The site master plan was completed in 03/81. The commission selected the site in 11/79.

So-called zone proceeding started at ONV Levice on September 18, 1980, and a license together with an annex were issued in 06/81 with respect to the NPP Mochovce site from the viewpoint of seizmicity issues. Subsequently, the designer started developing the „Project" according to Decree No. 163/73 Coll. On the Documentation of Buildings, and the preparatory works at the Mochovce site.

The original project of NPP Mochovce was developed based on the knowledge concerning the seismic hazards of the site collected during the preparatory and design period of the NPP Mochovce construction in the 80s, considering earthquake of MSK grade VI for safe shutdown of the reactor, and horizontal acceleration value of PGA = 0.06 g. Legislative development represented by IAEA guide 50-SG-D15 introduced the smallest acceleration value in horizontal direction of 0.1 g for nuclear power plants.

Based on this, seismic re-assessment of „Selected Buildings and Technological Systems" was performed in the framework of the SE-EMO unit 1 safety upgrade program, and improvement of building structures are gradually implemented.

5.1.3 International Agreements

All bilateral agreements made with the neighboring countries and listed in Section 4.7.7. remain in force with respect to design and construction of nuclear installations in the territory of the Slovak Republic. Based on these agreements, Slovakia is obliged to notify the neighboring countries of nuclear installations planned, and of the expected schedules of the operation of nuclear installations.

As far as multilateral agreements are concerned, Slovakia is the signatory to the following international agreements:

5.1.3.1 Convention on Environmental Impact Assessment in a Transboundary Context (Espoo)

The Convention is based on the need for international cooperation in assessing environmental impacts, in particular of trans-boundary nature. It reinforces the necessity of measures taken by states aimed at assessment of environmental effects of various activities within the states, based on their legal regulations, administrative measures and national policies.

The Convention was signed by the CSFR on February 25, 1991. It has so far not been ratified by Slovakia.

The Convention has been implemented into the national legislation through Act of National Council of Slovakia On the Environmental Impact Assessment, No. 127/1994 Coll.II. The Act provides that construction of nuclear power plants is subject of international review from the viewpoint of transboundary environmental effects.

5.1.3.2 Convention of the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basle)

The objective of the Convention is to ensure international cooperation concerning the threat of damage to human health and the environment which may originate from hazardous waste and other waste and their trans-boundary movements. Based on the Convention, states should take measures necessary to bring handling of hazardous waste and their movements across the boundaries of states and including their disposal into accordance with requirements for human health and environmental protection.

The Convention came into effect for the CSFR on May 5, 1992, and Slovakia notified succession to it on May 28, 1993 effective as of January 1, 1993.

5.2 Design Preparation and Construction

5.2.1 Designing and Construction-Relevant Legislation

Project documentation was developed pursuant to the Decree No. 163/73 Coll. On Documentation of Buildings, Decree No. 105/81 On Project Documentation, and Act No. 50/1976 Coll. On Spatial Planning and Rules of Construction (Building Act).

Some quality-related changes in legislation related to preparation of construction occurred after 1978 when CSKAE Decree No. 2/1978 On Securing of Nuclear Safety in Designing, Approving and Implementing of Constructions with Nuclear Power Installations was issued, which set forth basic technical requirements with respect to nuclear safety, aimed at preventing environmental emissions of radioactive substances.

The design of the core and related protection systems must provide for keeping parameters of fuel elements during normal and abnormal operation below their maximum values, in the case of emergency condition the values of fuel element damage will not be exceeded. Limit parameters of fuel elements which serve as a basis for the shut-down of other equipment shall not be exceeded.

Control systems have to be equipped so as to monitor, measure, record and control systems of safety relevance.

Protection systems must be able to automatically start up systems for shut down of the reactor, and the operators must at the same time have the possibility of starting up these systems manually. Protective systems must be redundant and must enable to perform functional tests.

Design principles of the primary circuit must provide for sufficient strength under normal and abnormal operation so as to prevent loss of coolant, and to enable, throughout the operation, periodical or continuous monitoring of the primary circuit status and to allow tests needed to test nuclear safety.

Nuclear power installations must be equipped with a protective envelope which would provide, under conditions of leakage connected with radioactive substances, for a reduction of such losses to keep them below limit values if this function is not provided by other technical means.

Building structures, technological aggregates and safety equipment of have to be designed, manufactured, assembled and tested so as to ensure their reliable function. Manufacturers and suppliers of selected equipment (equipment of safety significance), their materials and components are obliged to specify in the documentation of supplies the results of selected output quality control and tests of material properties of components, equipment, basic materials, welding seams and welded-on pieces, along with material characteristics and composition and findings, and the elimination of deficiencies identified by the controls (CSKAE Decree No. 436/1990, Section 19). If special technological procedures may affect the resulting characteristics of materials and products, further tests (such as keeping of witness samples) have to be ensured in advance.

The Control system must enable monitoring, measuring, recording and controlling of values and of systems of safety significance. Devices and control elements have to be designed and located so as to provide the operating staff continuously with sufficient information on the operation of the nuclear power installation (CSKAE Decree No. 2/1978, Section 14). The operation control room has to enable safe and reliable control and checks of the operation. The human factor is only considered with respect to activities outside of the nuclear power installation.

5.2.2 NI Project Preparation of Nuclear Installation at Mochovce Site

General Directorate of Slovenské energetické podniky developed, in 1973, a capital investment project of the construction of a nuclear power plant with 440 MW units at Mochovce site. The project was based on the study „Site Selection for NPP in the Territory of Slovakia and Its Technical and Economic Assessment, Along with the Assessment of the NPP Location on the Site Surroundings". Owing to the change which occurred during the project development of WWER-1000 units, the subsequent preparatory works at the site were suspended. The site preparation was resumed to implement the construction according to the original goals in 1978.

Pre-project works on the nuclear power plant Mochovce with a total installed capacity of 4x440MW were started based on the position issued by the former Czechoslovak Atomic Energy Commission of March 14, 1979 and based on the subsequent approval by the Federal Ministry of Fuels and Energy.

From the point of view of the further progress, the year 1988 became a milestone: due to unresolved difficulties with the I&C system originally suggested for NPP Mochovce it was decided to start preparations for the awarding of a contract for the delivery of a new I&C system. Selection of the I&C system was completed in 1991, and the system manufactured by company SIEMENS was selected.

The lack of funds resulted in an another suspension of design works in 1991, which also gradually meant delays in NPP Mochovce units construction.

Design and implementation works were resumed in 1996 again, after the signing of contracts and loan agreements, and review works on construction and technologies started in 06/96.

No construction of a nuclear power plant is planned in Slovakia other than at Bohunice and Mochovce.

5.3 Operation

5.3.1 Operator Licensing Procedure

The Atomic Act defines the criteria for authorization of the individual stages of nuclear installations, and thus also including commissioning and operation. Primary responsibility for nuclear safety rests with the operator of the installation. The Act also sets forth the responsibilities of the operator with respect to operation, emergency planning, quality assurance, nuclear safety, liability for damage etc., the fulfillment of which have to be demonstrated to the Regulatory Authority.

CSKAE Decree No. 6/1980 sets forth more detailed criteria to ensure nuclear safety during the start-up and operation of a nuclear installation.

Pursuant to the Atomic Act and ČSKAE Decree No. 61/1980, the operator has to attach to his application for operation license submitted to ÚJD the following safety-related documents:

- limits and conditions of safe operation,
- NI commissioning program and its individual stages,
- quality assurance program,
- internal emergency plan,
- pre-operation safety report,
- physical protection plan,
- system of management of radioactive waste and spent nuclear fuel,
- conceptual plan of decommissioning of the nuclear installation,
- program of operation controls of equipment (components and systems),
- selected operating regulations meeting ÚJD criteria,
- testing programs of equipment and systems of safety significance,
- documents documenting the professional competence of the employees,
- documents on the readiness of the nuclear installation for commissioning,
- insurance-related documents (or other financial security),
- environmental radiation control program for NI surrounding area.

In addition to ÚJD, also other State authorities are involved in the licensing process (also see Section 3.1.3.1):

- Ministry of Health - for the area of radiation protection,
- Ministry of Interior - for the area of fire protection, physical protection and of the population,
- Ministry of Environment - for the area of environmental impacts,
- Safety at Work Authority - for the area of industrial safety,
- Regional State administration bodies-as issuer of licenses for the use of buildings and equipment.

ÚJD issues operation license based on the assessment report on the nuclear installation commissioning stage attached to the operator's application.

During the commissioning of a nuclear installation and during its operation, operator shall be responsible to keep to the reviewed and approved documentation. Any deviation from it is only possible based on preceding approval by ÚJD.

In his activities, the operator also has to follow IAEA safety standards such as regulation SC 50-C-O „Safety of NPP Operation", SC 50-C-QA „Quality Assurance at NPPs„ and the corresponding guidelines.

The safety concept of nuclear power plants is based on so-called „defence in-depth" strategy which is generally used for design and operation of nuclear power plants world-wide. ÚJD, in reviewing NPP safety, assesses the capability of the installation to fulfill safety functions along the line of the design so as to provide for the required level of defence-in-depth protection.

5.3.2 Operation Limits and Conditions

Operation limits and conditions (OLC) were already required by the former ČSKAE as part of the Safety Report. OLC for Bohunice V-1 units were issued prior to the units being put into operation in 1978, and they had been reviewed by a number of research institutes, including VÚJE Trnava. OLC for WWER-440/230 units were reviewed in mid-80s according to the IAEA guideline SG 50-O3 using the format of the company Westinghouse and US NRC instructions for PWR units. Having been approved by the Regulatory Authority, they became effective as of 1988. OLC for Bohunice V-2 units have been developed in accordance with the above mentioned format.

OLC exist for all nuclear installations in Slovakia, in formats and contents following IAEA and US NRC guidelines. The following is specified for each of the limit conditions:

- objective of limit condition,
- text of limit condition,
- validity of limit condition (what unit regime it applies to),
- activities of operating staff in cases when the limit condition is not met,
- control-related requirements: frequency, type and scope of controls and tests of systems and equipment.

OLC for Bohunice V-1 were amended as of October 1, 1995, and split into three separate documents (their formats and contents follow IAEA and US NRC guidelines):

- Limits and Conditions for the Operation of Bohunice V-1 Unit 1,
- Limits and Conditions for the Operation of Bohunice V-1 Unit 2,
- Limits and Conditions for the Interim Spent Fuel Storage.

New OLC for Bohunice V-2 were issued in March 1998 subject of approval by ÚJD; they have been split into two separate documents:

- Limits and Conditions for the Operation of Bohunice V-2 Unit 3,
- Limits and Conditions for the Operation of Bohunice V-2 Unit 4.

The meeting of limits and conditions is continuously monitored by the operating staff and daily by the technical support staff.

Prior to transition of the unit to a lower sequential number, the operating staff is obliged to check the possibility of such transaction based on checklists which are attached to operating documentation. The meeting of all limits and conditions applicable to the relevant operation stage in question has to be checked. The shift supervisor only approves the change when the meeting of all the OLC has been checked.

The responsibility of individual employees and/or operator's divisions with respect to the notification of Regulatory Authorities on „OLC Violation" events is laid down in OLC as well as in the quality assurance guideline „Management of Events at Nuclear Installations" which basically provides for three levels of reporting:

- Shift Supervisor on duty informs on the phone the Regulatory Authority within 8 hours,
- Operator sends to the Regulatory Authority a preliminary report on the event within 72 hours,
- Operator submits OLC violation report along with an analysis discussed within the Breakdown Commission within 30 days.

If an amendment to OLC is needed, an annex to the regulation is drafted with the corresponding reasoning, and the amendment becomes effective upon its approval by the Regulatory Authority.

Operator's nuclear safety Regulatory divisions prepare periodical reports on the nuclear safety status on quarterly and annual basis, and submit them to the utility management. The reports also contain evaluation of the entire OLC area. Number of OLC amendments, non-availability time of safety systems, and OLC violations, if any, are used as parameters.

For NPP Mochovce, OLC were submitted to ÚJD in the framework of the review of the Pre-Operation Safety Report. ÚJD reviewed and approved the draft. OLC are based on IAEA document 50-SG - O3. From formal viewpoint, their structure is identical with those developed for the Bohunice NPP with OLC specific to the NPP Mochove design added.

5.3.3 Maintenance Testing and Control Documentation for Management and Operation

Operation, maintenance and testing of systems and the procedures in case of transient and emergency conditions of nuclear installations are laid down in the management and operating documentation as required by the CSKAE Decree No.6/1980.

Documentation departments are established at the individual nuclear power plants to manage the entire field of documentation. Their main task include:

- maintenance of a uniform documentation system including a standard system of documentation labeling, rules for working with documentation and a uniform system of document filing at archives,
- issuing, distribution and updating of operating documentation according to requirements from the units,
- recording, issuing, distribution and updating of internal regulations according to the requirements of the Quality Assurance Department, and their maintenance in the computer network,
- to issue and distribute Annexes and Amendments to operating regulations as required by the given system,
- development of plans for amending operating documentation for the calendar year and monitoring of its fulfillment,

- to organize the review and approval procedures for newly drafted operating documentation and its amendments and supplements.

Procedures, principles and instructions for the development of operating documentation are detailed in the respective standards and instructions of the system. Every operating document is subject of review and approval procedures at the individual divisions involved, and its final approval is the responsibility of Deputy Director, Operation. Also, the processes of drafting amendments and supplements to the individual documents, follow the same path.

The following basic types of documentation used are described bellow :

- Operating documents,
- Equipment controls and tests documentation,
- Technological and working procedures for maintenance.

5.3.3.1 Operating Documentation

This type of documentation means a set of documents developed to set forth the method of operation organization, management and control, to set forth the method of the service of technology under nominal steady-state and transient conditions, as well as under abnormal and emergency conditions. It also defines procedures for the performance of certain activities directly connected with operation, documentation of equipment quality, position-related responsibilities of the maintenance staff, assurance of fire protection of operating workplaces, and for the documentation on the operation and related facts.

The following types of operating documentation may be distinguished:

- ***Standardizing documentation*** which defines basic organizational and technical requirements for a reliable, economic and safe operation of the nuclear power plant.
- ***Organization and operation-related documentation*** which deals with the organization of the operation and the operation of units itself under nominal and non-nominal conditions. It comprises:

  a) operating regulations. Operating regulations define the method of the maintenance of technological equipment under normal, steady-state and transient conditions as well as upon emergency situations. Moreover, they set conditions and method of start-up and shutdown of the equipment. They are set up according to operation instructions from the manufacturer, design materials, model regulations and directive materials as well as based on experience from operation, experimental results and accounting for specific conditions of the power plant. Every regulation has an operating and a descriptive part. Currently, a project is going on at the Bohunice power plant concerning the development of a new generation of operating regulations. A major change, in addition to formal change of the graphical format, concerns re-writing of the operating part to yield handling charts which in turn are prepared as step - by step procedures. Any activity performed is confirmed by the signature of the responsible employer. The addition of handling charts to the regulations had already been under preparation for NPP Mochovce at the time of the construction and followed the experience of similar regulations developed for NPP ISAR 2 (Germany) and was tested during the start-up of the power plant. Operating regulations have to be checked at least once in three years to confirm their applicability.

b) other operations-related documents. This group includes:
Operation diagrams - they illustrate graphically a certain separate portion of the technology and identify control elements and sensors along with their functions within the control and instrumentation system. The corresponding operation department performs a check of the matching with the actual conditions once in three years, and records the performing of the check.
Schedules for control of protection blocking and switching of equipment. They are being set up based on the requirements on controls of equipment as laid down by OLC and PP.
Function-related duties. They are developed for each shift maintenance function of NPP according to the organization rules. The purpose of this documentation is to define the organizational relationships between the employees, requirements concerning the scope of familiarity with operating documentation, and the main work-related obligations and responsibilities.

c) fire regulations of the workplaces are prepared for workplaces and buildings at high risk of fire. The main purpose of the fire regulations is to define requirements on fire protection from the viewpoint of maximal safety of the workplaces, safety of the employees and nuclear safety of the unit.

5.3.3.2 Equipment Controls and Tests Documentation

Surveillance programs serve the performance of equipment controls and tests. An extensive „Surveillance Program„ system is in place which is described in detail in QA standards „Periodical Tests of Systems and Equipment„. The IAEA safety guide SG 50-O8 was used as a basis for their development. They are intended for equipment for which such instructions have to be drafted (particularly all safety systems).

„Surveillance Program„ is a written program to test a system or equipment. It is used by the staff to follow closely and to record the course of the test, thus significantly reducing the possibility of errors. It is not allowed to skip individual points or to alter the program. Certain programs also require independent checks. The program specifies:

- supervisor of the test,
- program objective and purpose,
- safety measures to be taken during the test,
- initial condition and preparatory works,
- testprocedures form,
- success criteria and test evaluation.

Nuclear safety divisions manage the entire process of standard development of „Surveillance Programs„ of records and test evaluations.

Documentation of controls performed is used to conduct in-service inspections, and serves to

- record important measures, tolerances and settings at repairs which are important for the evaluation and further maintenance planning,
- check and evaluate the required quality of repair works and materials used to evaluate operation readiness.

Control documentation includes the following documents:

- attest slips for materials used,
- list of weldings and x-ray scans with their assessment,
- measurement record,
- setting protocol,
- record on non-destructive controls performed,
- record on visual inspection.

5.3.3.3 Technological and Working Procedures for Maintenance

The QA Guideline „Guidelines for Technological Procedures, Methods and Instructions" , takes care of a clear-cut structure of regulations, and the introduction of quality checkpoints. It describes technological and working procedures, their graphical format, organizational and technical data, content of texts as well as procedures for developing, updating and approving of technological and working procedures.

The technological procedures for selected equipment include „Checklists of Operations Performed" with points set to stop temporarily works to prevent discrepancies from occurring, and to improve conventional and nuclear safety.

Development and implementation of reference procedures represents protection against discrepancies during development of technological procedures, and defines them unequivocally. Reference procedures are the first approved copies serving comparison purposes with copies upon their authorization for routine uses.

Authorized copies of reference procedures are used for the implementation of works.

The mandatory use of references, i.e. of the number of the work order on maintenance documents, provides for a good identification and monitoring of these documents and thus a correct use of them.

As a part of the QA Program, a fix review and development schedule is set up for all maintenance regulations. Monitoring of maintenance actions are part of the planned care for fixed assets within the SOZAR and/or ARGO information systems „Care for Equipment" which also contain annual schedule of repairs broken down into monthly and weekly repair plans.

5.3.4 Technical Support of Operation

Technical support and safety units are parts of operator's organizational divisions the main task of which include:

I. organization of measures for the protection of health of the employees and the public against ionizing radiation in NPP surroundings by applying the ALARA principle upon working with ionizing radiation,
II. organization of internal and external radiation monitoring, personal dosimetric monitoring and exercise of supervision of the compliance with radiation safety rules,
III. development of pre-project documentation through requirements for capital investments in the fields of
    A. safety upgrading, improved reliability and effectivity of operation,
    B. care for design modifications of nuclear installations, management and coordination of residual life cycle evaluation program,

IV. organization of the development of operating regulations for normal and emergency operation, and of other operating documentation and their continuous updating,
V. exercise of supervision of compliance with nuclear safety rules during the operation, and reviews of all design changes in equipment and operational regimes from the aspect of nuclear safety,
VI. organization of analyses of events at nuclear installations, preparation of analyses and overall organization of feedback from own and foreign nuclear installations,
VII. probabilistic safety analysis (PSA) and its application,
VIII. setting up of a program of periodical tests of nuclear safety significant equipment and systems,
IX. keeping records on nuclear materials, calculations of fuel loading and fuel cycle strategy, exercise of supervision of nuclear safety during refueling and physical start-up,
X. organization of, and care for safety emergency analyses,
XI. management of technically oriented projects of international cooperation (PHARE projects etc.),
XII. responsibility for fire protection,
XIII. organization and coordination of liaisons of the divisions with Regulatory Authorities in the field of nuclear and technical safety,
XIV. management and organization of the entire field of emergency planning.

In taking care of the above tasks, the operator cooperates with external supporting organizations such as:

- various research institutes, design and analytical organizations - VÚJE Trnava, a.s., RELKO s.r.o. Bratislava,
- Slovak Institute of Hydrometeorology,
- universities,
- Slovak Academy of Sciences,
- commercial contractors from home and abroad - Siemens, VUEZ Tlmace, a.s., ÚJV Rez a.s.

„Nuclear Safety Commitee" are advisory bodies to the managements of the individual organizational divisions of the operator. Their main task is to evaluate the level of nuclear safety, and to suggest approaches to comprehensive safety issues conceminf nuclear installations.

5.3.5 Analysis of Events at Nuclear Installations

Operators as well as regulatory authorities pay significant attention to prevention and analyses of events at nuclear installations (NIE) because of their significant impact on safe and reliable operation of nuclear installations.

Throughout the operation of nuclear installation, operator continuously investigates, analyzes, reports to the regulatory Authorities and records events at nuclear installations, and takes corresponding measures.

QA guidelines on „Management of Events at Nuclear Installations" have been developed to raise the effectivity of the entire process as well as to express the support of the management to the analysis of reasons of events at nuclear installations and to investigate them in an objective manner. They define procedures and the organization of investigations of NIE causes aimed at taking remedial measures at the individual power plants.

The objective is to

- take care of analysis of safety or economy of operation significant NIE and take, based on such analysis, remedial measures to improve NPP safety and reliability,

- define responsibility for meeting of the reporting obligation of the operator vis-a-vis Regulatory Authorities as soon as any NIE occurs,
- set binding rules, obligations and responsibility for administrative management of all NIE, with the exception of emergency which are managed in accordance with Emergency Plan.

The entire process connected with the investigation, reporting, analysis and archiving of NIE as well as remedial measures is the responsibility of the Feedback Group (SSV) which is a part of Nuclear Safety Divisions at the individual power plants. The training of the Feedback Group staff on the use of HPES methodology (introduced by the US organization INPO) was organized by the company Nuclear Electric from the United Kingdom. Repeated training sessions were organized in the framework of PHARE program and delivered, among others, by the Spanish companies Union Fenosa and Tecnatom.

5.3.5.1 Definition and Classification of Events at Nuclear Installation

An event at nuclear installation(NIE) is a deviation from normal operating conditions as defined in the operating regulation or project documentation, due to the occurrence or continued presence of a single or several partial breakdowns on the equipment or due to inappropriate interventions by the maintenance staff or deficiencies in regulations.

Two categories of NIE are distinguished depending on their actual or potential impacts on nuclear and/or technical safety, and also depending on the human factor contribution. Every NIE category has its own way of management. For NIE which meet the criteria defined by the regulation, a comprehensive analysis must be conducted using one of the methods for the identification of the root cause.

NIE of Category II the reasons for which are known are investigated aimed at taking and implementing of effective remedial measures.

The administrative mechanism of the investigations with respect to both NIE categories is the responsibility of the feedback group.

Category I. includes all safety significant NIE which have negative impact on the safety (nuclear, radiation or technical), NIE with non-design course during nuclear safety significant transient conditions, which have negative impact on the safety NIE with a significant share of the human factor (including sabotage), significant deficiencies identified during controls (tests) as well as serious deficiencies concerning operating regulations.

Also, this group includes breakdowns of the availability of safety systems identified upon reviews in the framework of general overhauls or in-service inspections.

Category II. includes non-safety significant NIE, breakdowns of isolated systems with smaller impact on the technological process, reductions of output for standard repairs of statistical breaks or planned repairs, reduction of output due to safety insignificant statistical breaks of the installation, and identified non-category I operation procedures deficiencies.

The guideline „Management of Events at Nuclear Installations" defines criteria for NIE classification as category I or II.

5.3.5.2 Documentation and Analysis of Events at Nuclear Installation

The guideline includes a flow diagram of the investigation procedure of NIE including notification of Regulatory Authority. For both NIE categories, the shift supervisor completes a standard reporting form, and also attaches comments by the respective staff.

To analyze of Category I NIE is the responsibility of the feedback group who develops it based on positions by professional divisions and on own analyses and/or conclusions arrived at by Working Groups.

For NIE which meet the criteria for the investigation of the root cause, the feedback group conducts, together with the corresponding divisions, a comprehensive analysis using one of the following methodologies (or their combination):

- HPES - "Human Performance Support" developed at INPO, USA. This method includes analysis of tasks, barriers and changes, and provides an overall view of NIE.
- ASSET-" Assessment of Safety-Significant Events" developed by IAEA.

The analysis of Category NIE I is completed by presenting Operating Event Report which is submitted for review by **Breakdown Commissions** which are a collective advisory body to directors of nuclear power plants for NIE management. Breakdown Commissions meet once a month to approve conclusions from analyses and to instruct to implement remedial measures which are mandatory to all employees. NIE reports are sent to the Regulatory Authorities the representative of which has the right to attend the Breakdown Commission sessions.

The implementation of remedial measures is documented by the corresponding responsible division via computer network where it is filed. Breakdown Commissions check the fulfillment progress.

The investigation of Category II NIE is coordinated by the feedback group which works closely together with professional divisions of the operation, maintenance, technical support and safety department.

The entire agenda of NIE investigations and analyses is kept in the computer network; all network users have access to this agenda. Any network user may contribute his/her comments or relevant observations to the statements concerning operation-related events. Only feedback group members involved in the investigation of nuclear installation are however authorized to make changes in the agenda.

Extraordinary Breakdown Commission

Sessions of the Extraordinary Breakdown Commission are convoked by the Deputy Director, Operation, according to the urgency of the situation so as to draft and submit to the Regulatory Authorities, within 72 hours, minutes of the session. The session of the Commission is convoked within 24 hours of the identification of NIE for those NIE with respect to which such procedure is required by the regulation. The task of the Extraordinary Breakdown Commission is to identify direct cause of inappropriate functioning of systems or inaccurate interventions by the maintenance staff, and to define immediate remedial measures. To the extent the cause of the failure has been fully clarified and the correct functioning of safety significant systems is has been restored, and the Deputy

Director, Operation, considers that restarting of the unit is safe, no session of Extraordinary Breakdown Commission needs to be convoked prior to unit start-up. Completed „Surveillance Program" is submitted to the Extraordinary Breakdown Commission session for post-accident review.

Minutes from the Extraordinary Breakdown Commission sessions represent the official preliminary report on the event required by the Regulatory Authorities for safety significant events, in accordance with OLC. Subsequently, the root cause is analyzed, and final analysis is conducted as standard report on category I NIE including remedial measures. It is then reviewed and approved by the Extraordinary Breakdown Commission.

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Independent NIE Review

Reports on category I NIE are also sent to the Research Institute VÚJE Trnava, and a representative of the Institute participates in the Breakdown Commission's sessions where he/she can present his/her positions and suggest measures. In addition, he/she performs independent reviews of safety significant NIE on a quarterly and annual basis, and suggests remedial measures if needed. The report is made available to the operator.

Event Reporting

The operator is responsible to inform State authorities on selected NIE within set deadlines. The information has to contain preliminary assessment evaluation of the respective NIE according to the INES scale. It is prepared by the Shift Supervisor of the shift during which the respective event occurred, if there is any change in the preliminary assessment of the event (e.g. as a consequence of the event development), such change is notified to the Regulatory Authorities by Deputy Director, Technical Support and Safety. The final assessment of the event from operator's viewpoint is the responsibility of the feedback group. The report is approved by Breakdown Commission. A guideline defines the format, contents and time sequence of the report provided to the Regulatory Authorities.

Feedback from Nuclear Installation Events at other NPPs

The operator uses international information systems on operation-related experience in the nuclear power sector (WANO and IAEA) to implement measures on own units based on analyses of breakdowns experienced by operators in other countries, as well as to share his own experience with other operators. The objective of such activities is to prevent similar breakdowns by implementation of preventive measures, as well as avoiding of double safety analyses and non - standard approaches to solutions. QA Guideline „NIE Feedback from NPP Abroad" develops details of processing and utilization of information from other NPP events.

Efficiency Assessment of Implemented Remedial Measures

The main parameter of feedback efficiency from own NIE is the trend of the occurrence of breakdowns showing identical mechanism of failure. Once a year, the feedback group prepares a

summary statistical evaluation of the occurrence of repeated events, and assesses the efficiency of related implemented measures.

The control of the efficiency of remedial measures depends on the type of measures, and is being dealt with in the framework of quality assurance:

- Remedial measures implemented as design changes are evaluated according to the guideline „Documentation on Equipment Changes".
- Amendments to operating regulations, test programs, „Surveillance Programs„ and organization adjustments in the keeping of operating documentation are evaluated after their implementation during operation if enabled by the nature of the change. The evaluation has a standard format, i.e. amendments to operating regulations on a 3-years basis.
- Measures resulting in amendment of regulations for abnormal and emergency operation which cannot be checked for correctness during real operation, are checked by the efficiency of their implemented measures connected with the validation mechanism for these regulations.

Information Flows on NIE within SE

Heads of the respective departments and divisions are obliged to:

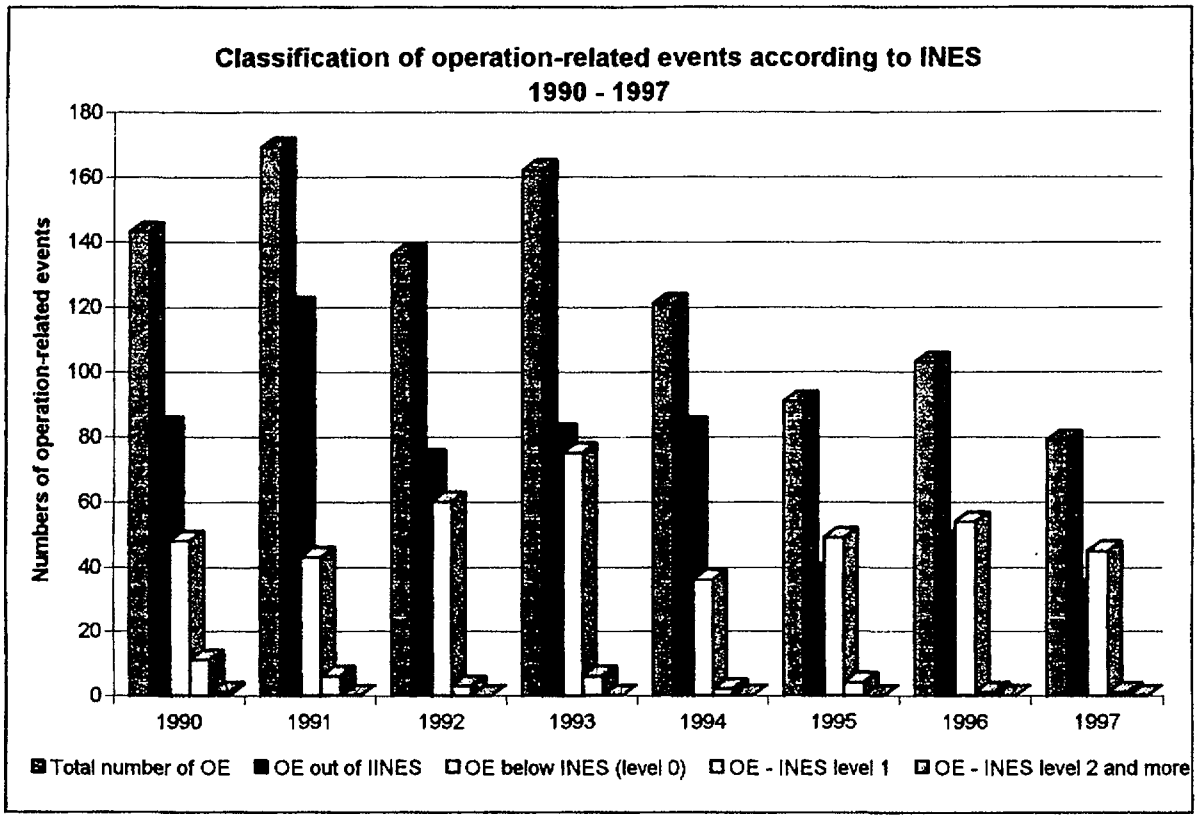
- familiarize themselves with NIE database of the own NPP and to continuously follow it,
- familiarize themselves with all reports on category I NIE operation-related events, and - to the extent of their professional field - also with category II events, and with minutes of the ordinary and extraordinary Breakdown Commissions for each month,
- include applicable knowledge into training programs for employees they supervise. VÚJE Trnava, in cooperation with Human Resources Department and with the employees of the training center, take care for the implementation of NIE-derived knowledge into the initial and repeated training programs (re-training).

Any employee involved is obliged to be familiar with the results of NIE analyses, in particular those he/she was a part of. Any backgrounds or results of analysis which contradict his/her observations or understanding of the event make him/her entitled to ask the head of the Operation Conditions Department to further deal with the respective NIE or to explain the discrepancies.

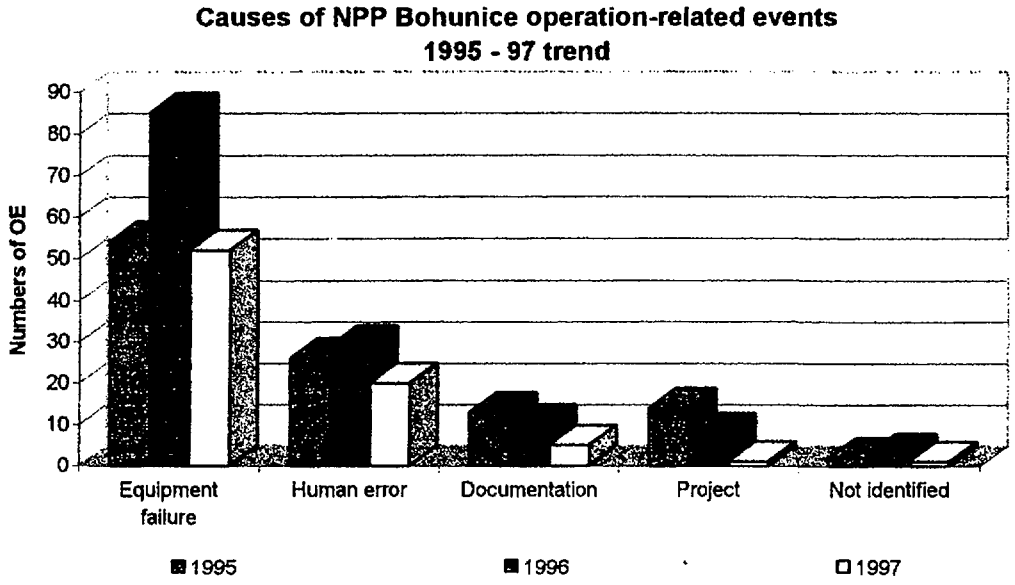
5.3.5.3 Statistical Evaluation of NIE, Development and Trends

Below we present data on the occurrence of NIE in 1997, along with development and trends for the recent period of time.

The Number of NIE in 1997 at **NPP Bohunice units** has been the lowest in the history of the units operation. A single NIE event occurred assessed as class 1 INES. Also of importance is the clearly decreasing trend of NIE since 1993, even the more that extensive gradual reconstruction works are going on at the units during extended general overhauls. The following diagram illustrates the development of breakdown rates and of safety significant NIE at NPP Bohunice within 1990-1997.



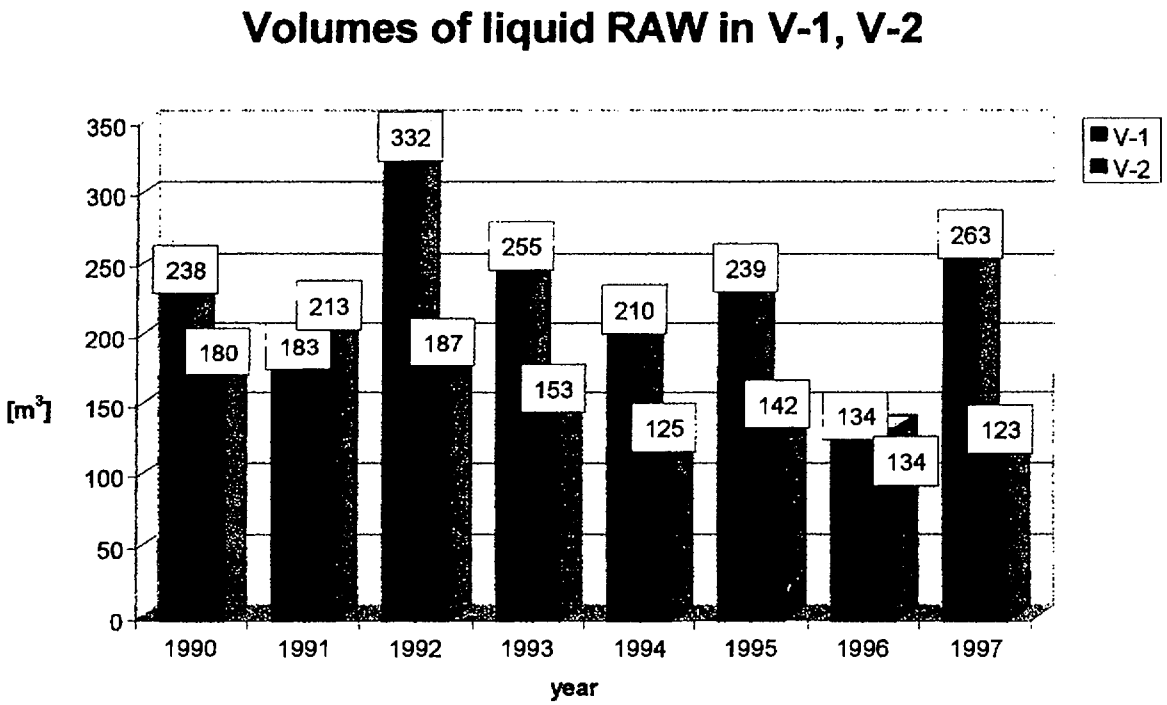
Year	1990	1991	1992	1993	1994	1995	1996	1997
Total NIE	143	169	136	162	121	91	103	79
Out-of-Scale NIE	83	120	73	81	83	38	48	33
Below-Scale INES	48	43	60	75	36	49	54	45
NIE INES 1	11	6	3	6	2	4	1	1
NIE INES 2 +	1	0	0	0	0	0	0	0

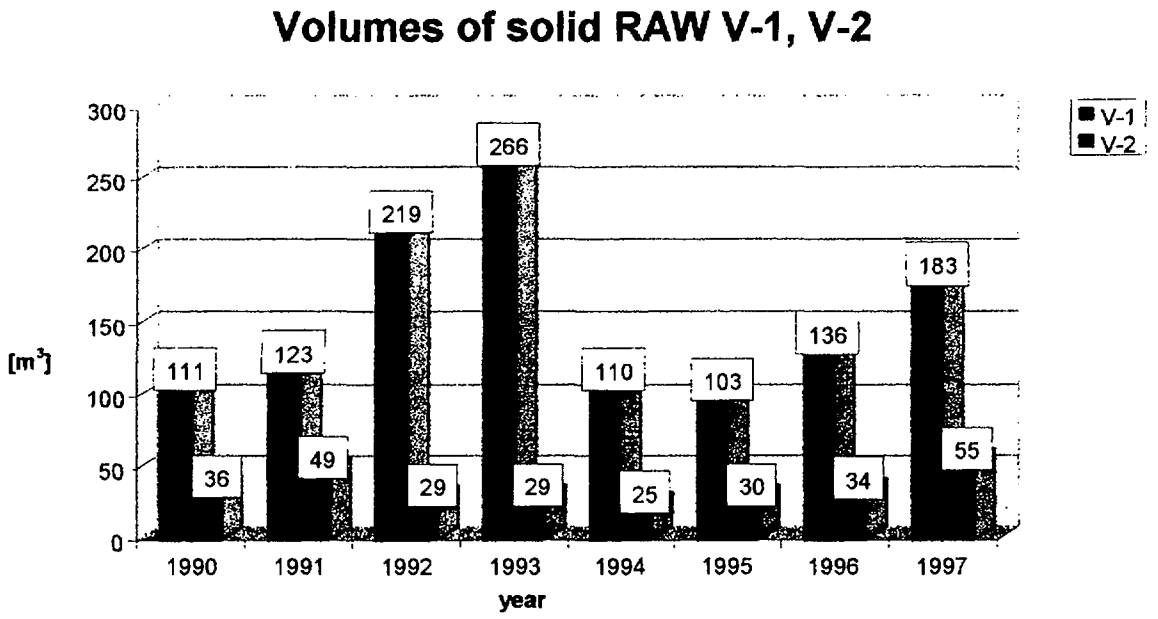


Causes of nuclear installation events at SE EBO 1997, comparison with 1995 and 1996					
Year	Installation	Staff	Documentation	Project	Unknown
1995	54	26	13	14	2
1996	85	29	10	8	3
1997	52	20	5	1	1

5.3.6 Radioactive Waste Production (RAW)

The Production of RAW and their subsequent processing and disposal are at the foreground of ÚJD's interest. An in-depth inspection was conducted by ÚJD in 1997 focusing on keeping of records, storage and subsequent processing and disposal of RAW at SE-EBO. The conclusion of the inspection was that contractors have to be obliged by contracts, and incentives have to be provided to minimize RAW production during the performance of works on the primary circuit. Volumes of liquid and solid RAW generated during the operation of the individual SE-EBO units within 1990 - 1997 are shown in the diagrams below.





It is evident from the above diagrams that the total RAW generation is higher at Bohunice V-1 than at Bohunice V-2 units The increased generation of solid and liquid RAW at Bohunice V-1 units in 1992 and 1993 as well as within 1996 - 1997 was due to the Small Reconstruction and/or to extended general overhauls of units 1 and 2 during Gradual Reconstruction. Extensive adjustments were done at the primary circuit equipment during the outages, connected with increased generation of solid RAW.

5.4 Planned Safety Upgrading Activities at Nuclear Installations

In addition to the ongoing safety upgrading programs for NPP V-1 and EMO units, the most significant long-term program is the „NPP V-2 Units Modernization and Safety Upgrading Program" the objectives of which have been described in Section 2.2.4.

The safety upgrading process has been split into several stages:

Stage 1 - resolution of actual problems; it represents less costly modifications. They can be implemented during „Gradual Reconstruction" of Bohunice V-1. New safety review of Bohunice V-2 units, identification of safety significant problems and priority setting with respect to implementation of measures.

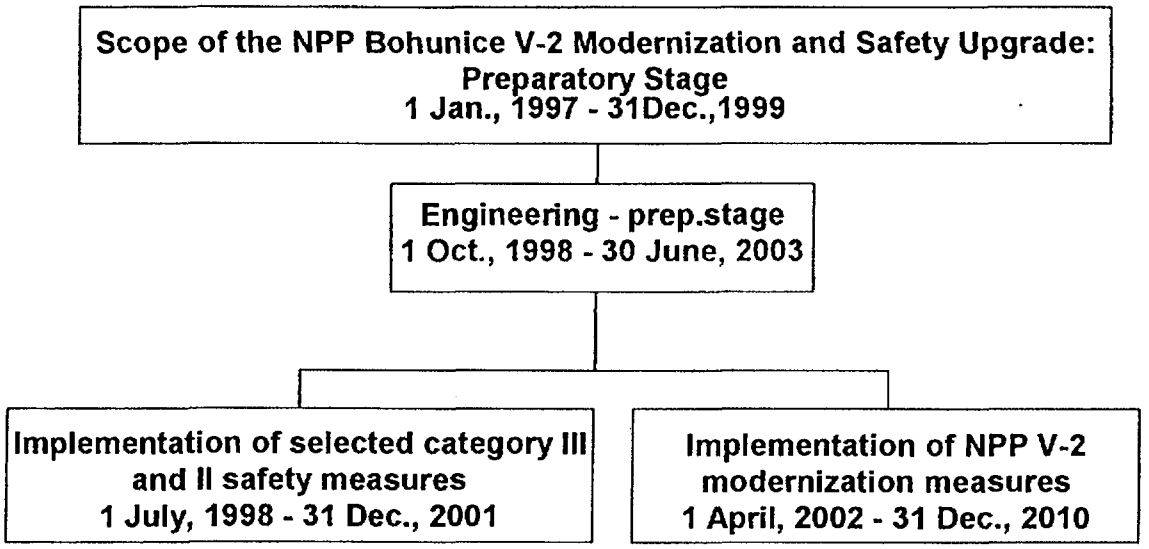
Stage 2 - implementation of safety measures (ÚJD Resolution No. 4/96;) of category 2 and 3 as identified in the IAEA document WWER-EBP03/96. Implementation of measures contained in Final Safety Report (after 10 years of operation) and the development of preliminary and safety documentation for subsequent reconstruction - Inception Project.

Stage 3 - implementation of measures included in the Inception Project and of measures concerning the increased installed capacity

Stage 4 - implementation of measures for life time extension of Bohunice V-2 units to 40 years.

The Bohunice V-2 modernization program includes the results of activities from previous years aimed at identifying important actions resulting in ensuring and upgrading of nuclear safety, reliability and efficiency of operation throughout the designed life cycle. The suggestions for nuclear safety upgrading requirements are based on the recommendations of the Operation Safety Report for NPP V-2 After 10 Years of Operation, ÚJD requirements (Resolution No. 4/96;) on the present trends of NPP safety upgrading as formulated in IAEA document – EBP WWER-03/96, on conclusions of missions to SE-EBO , and on the results of the PSA Study Level 1. The modernization program also takes into account experience of the „V 213 Operators Club". Fig. 5.4.1. illustrates the draft time schedule of the program implementation.

Fig. 5.4.1 Schedule of the NPP V-2 units modernization and safety improvement program



Below are the most significant safety-related issues (category III and II) to be dealt with under the „NPP V-2 Units Modernization and Nuclear Safety Upgrading Program„ :

- Implementation of measures to prevent blocking of emergency system pumps at their suction side.
- Strength calculations for internal equipment of bubbling tower for design basis accident.
- Seismic upgrade of selected primary circuit equipment.
- Installation of independent super-emergency feeding of steam generators.
- Reduction of internal risk due to burst of high-energy pipes - prevention of damage to safety systems.
- Requalification of safety-relevant equipment - demonstration of their functionality under normal and emergency conditions.
- Fire prevention - prevention of breakdowns with common root cause due to fire effects.
- Emergency de-gassing of reactor and steam generators.
- Integrity upgrade of reactor pressure vessel.
- Adjustment of unit and emergency control rooms.

- Improvement of the reliability of control and monitoring elements.

The implementation of the „NPP V-2 Units Modernization and Safety Upgrading Program" will result in an improved nuclear safety level, required by ÚJD and IAEA recommendations applicable to NPP in general, and to WWER 440/V213 in particular, and will improve the reliability and the efficiency of Bohunice V-2 units operation.