IAEA-TECDOC-640

Ranking of safety issues for WWER-440 model 230 nuclear power plants

Report of the IAEA Extrabudgetary Programme on the safety of WWER-440 model 230 nuclear power plants

INTERNATIONAL ATOMIC ENERGY AGENCY IAEA

RANKING OF SAFETY ISSUES FOR
WWER-440 MODEL 230 NUCLEAR POWER PLANTS
IAEA, VIENNA, 1992
IAEA-TECDOC-640
ISSN 1011-4289

Printed by the IAEA in Austria
February 1992

PLEASE BE AWARE THAT
ALL OF THE MISSING PAGES IN THIS DOCUMENT
WERE ORIGINALLY BLANK

RANKING OF SAFETY ISSUES FOR WWER-440 MODEL 230 NUCLEAR POWER PLANTS

(IAEA-TECDOC-640)

ADDENDUM

COMMENTS OF THE INTERNATIONAL SAFETY ADVISORY GROUP (INSAG) ON THE FOUR CATEGORIES USED TO RANK SAFETY ISSUES

INSAG considers that the results presented in this report constitute a useful basis to assist operating organizations and regulatory bodies in the three countries involved, Bulgaria, Czechoslovakia and the Russian Federation, in assessing the present safety level of their plants and defining a safety policy. The report identifies around 100 generic safety issues. They are ranked according to their safety significance in four categories of increasing severity. In each country, the operating organization will have to analyze each issue and determine whether it is applicable to its plants, taking into account the actions already launched, this review being under the control of the national regulatory body.

It is clear that the weaknesses or deficiencies identified in Categories III and IV, which are of high safety concern, require some immediate attention in order to improve safety. The risk in this process will depend on the expected time of plant operation before the deficiency is corrected, and on the effectiveness of the interim measures which could be taken immediately.

INSAG considers that the division between Categories III and IV is somewhat artificial, and that the present definition of the criteria may be misinterpreted. Consequently INSAG suggests that, in this TECDOC, as well as in the final summary report of the Programme - First Phase, the definitions be slightly modified, and proposes:

Categories III and IV: Issues are of high safety concern.

- Immediate attention is required, and appropriate action must be initiated.
- Whenever possible, interim measures should be considered and implemented without delay.
- For the most safety significant issues, provisional compensatory measures have to be established now until the problem is resolved satisfactorily within a reasonable period of time.

24 January 1992

FOREWORD

In response to requests from Member States operating Soviet designed WWER-440/230 nuclear power plants (NPPs) for assistance through the IAEA's nuclear safety services, a major international Project was established to evaluate these first generation reactors as a complement to relevant ongoing national, bilateral and multilateral activities. The Project is extrabudgetary and depends on voluntary contributions from Member States.

The objective is to assist countries operating WWER-440/230 NPPs in performing comprehensive safety reviews aimed at identifying design and operational weaknesses. The review should form the technical basis for the safety decisions which must ultimately be taken to improve safety.

The scope of the project includes a review of the conceptual design of WWER-440/230 NPPs, safety review missions to each one of the operating reactors to review design and operational aspects and studies to resolve issues of generic safety concern.

In order to assist the Governments of Bulgaria, Czechoslovakia and the Russian Federation to set priorities for the corrective measures required at their plants, two project review meetings have been convened by the IAEA in Vienna respectively in August 19-23, and October 18 - November 1, 1991. About 1300 specific safety items identified during the safety review missions and in the conceptual design review have been grouped in broader categories representing some 100 issues of safety concern and further ranked according to their safety significance.

The meeting report (WWER RD-037) prepared by a group of international experts and the IAEA staff evaluates the safety significance of the issues and provides the technical basis for short and long term programmes required to improve the safety of WWER-440/230 NPPs.

The Project Steering Committee has also reviewed the report during its December 9-13, 1991 meeting.

EDITORIAL NOTE

CONTENTS

1. INTRODUCTION

In the framework of the IAEA Project on the Safety of WWER-440/230 Nuclear Power Plants, a conceptual design review was conducted in February 1991 by the IAEA for this type of plant. Safety review missions have also been carried out to Bohunice units 1-2 in Czechoslovakia (April 91), to Kozloduy units 1-4 in Bulgaria (June 91), to Novovoronezh units 3-4 (Aug 91) and Kola units 1-2 (Sept 91) in the USSR. This missions addressed areas related both to design and operational safety.

In order to help the Governments of Czechoslovakia, Bulgaria and the USSR to set priorities for the corrective measures required at their plants two project review meetings have been convened by the IAEA in Vienna respectively from August 19-23 and 18 October to November 1, 1991. About 1300 specific safety items identified during the safety review missions and in the conceptual design review have been grouped in broader categories representing some 100 issues of safety concern and further analyzed.

This report was prepared by a group of international experts and the IAEA staff and reviewed by the Project Steering Committee, December 9-13, 1991 in Vienna.

An overview of the safety issues identified is presented indicating their effect on the performance of the basic safety functions.

In addition, individual issues are defined and given a short description of the underlying safety concern, the ranking category (I-IV) and the justification for the ranking. Specific items related to the issue are identified based on their sequential reference in the IAEA data base. Reference to these items is made to facilitate the identification of the issue in the various project reports (see Refs.). It does not represent, necessarily the endorsement of the authors of this report to the specific recommendations. Therefore, conceptual recommendations related to design issues are given as a technical basis for the safety modifications required.

Issues related to seismic safety are not discussed in this report. They are being addressed, however, in related activities of the WWER safety project.

The areas of waste treatment, waste disposal, chemistry and radiation protection were not investigated in detail during the safety review missions.

A comprehensive review of the regulatory bodies in the countries of the plants reviewed was also not carried out.

Issues are treated as generic to all plants and according to their safety significance. It may happen, that at a particular plant the issue has been completely or partially solved or it is of less safety significance due to plant specific conditions. National authorities and plant operators should therefore evaluate the relevance of each issue in order to establish specific work programmes for improving their plant's safety.

It is an essential indication of a good safety culture that each WWER plant develops its own action plan to address the concerns identified in this report. That action plan should then be reviewed by the national regulatory organizations.

The action plans should further evaluate the importance of the safety issues reported here, and they should contain a schedule for technical analysis and implementation of necessary improvements.

It must be recognized that extensive modifications may be required to address some of the nuclear safety concerns identified. Moreover, many of the design issues cannot be resolved in the short-term and may indeed take years to be resolved. On the other hand, operational safety issues can be addressed to a large extent, in the short-term.

Some corrective actions will entail costs and construction time that could only be justifiable if a long term operation of these plants is forecast.

In the interim, there is a clear need for all user countries to establish special operating regimes and compensatory measures to materially increase safety.

A comprehensive backfitting evaluation, including thermohydraulic calculations, stress analysis and reliability analysis, where appropriate, should be performed for proposed changes before their implementation. This evaluation should also consider the possible drawbacks of the changes, in order to ensure that the measures to be taken, actually reduce the risk as intended.

RANKING OF SAFETY ISSUES

Central to the IAEA Project was the evaluation of the safety significance of the deficiencies identified during the conceptual design review and safety review missions. An important goal was the ranking of individual safety issues according to their impact on NPP safety.

The technical knowledge and experience of the international experts who participated in the Project along with generally accepted current safety principles and objectives such as IAEA NUSS Codes and Guides and INSAG 3 formed the basis for the identification of specific deficiencies (i.e. safety <u>items</u>). Next, individual safety items related to the same major safety concern have been grouped in broader categories characterizing safety <u>issues</u>.

To facilitate the interrogation and analysis the safety items have been stored in a computerized data base. The data base contains some 1300 records. Each record includes a reference to a safety mission or meeting were it was raised, a classification according to INSAG Basic Safety Principles, the related issues and ranking.

Due consideration was also given to two aspects specific to WWER-440/230 NPPs. First, these plants were designed according to earlier safety standards which were mainly related to industrial codes, standards and rules. Second, these reactors have some positive features compared to other pressurized water reactors.

Issues both related to design and operation are ranked according to their safety significance in four categories of increasing severity.

Category I:	Issues in Category I reflect a departure from recognized international practices. It may be appropriate to address them as part of actions to resolve higher priority issues.
Category II:	Issues in Category II are of safety concern. Defense in depth is degraded. Action is required to resolve the issue.
Category III:	Issues in Category III are of high safety concern. Defense in depth is insufficient. Immediate corrective action is necessary. Interim measures might also be necessary.
Category IV:	Issues in Category IV are of the highest safety concern. Defence in depth is unacceptable. Immediate action is required to overcome the issue. Compensatory measures have to be established until the safety problems are resolved.

The assignment of a severity category to an issue starts with an evaluation of the potential degradation of defense in depth. Issues affecting accident prevention are given more importance because they affect the first lines of defense. If an unequivocal categorization is not possible, the issue is then analyzed based on its influence on the performance of the safety functions. In this case, the frequency at which the safety function can be demanded is also considered. Four classes of potential plant states are defined, in the order of decreasing likelihood:

- normal operational events
- incidents and accidents within the original Design Basis
- accidents beyond the original Design Basis
- severe accidents involving a major core damage

It should be noted here that the original Design Basis with respect to Loss of Coolant Accidents is a leak equivalent to 32 mm diameter pipe break.

Finally the issue is evaluated based on its potential to cause accidents with unacceptable consequences.

The approach used for ranking of issues related to plant operation is in principle the same. Issues affecting management and organization essential procedures,and training are among those ranked in higher categories.

The methodology described aimed at providing guidance for the experts to rank safety issues in a systematic and consistent way. It has to be recognized, however, that a degree of subjectivity will always be present in the experts' judgement. The IAEA Project also draws from this fact as experts from different countries have participated in this Project reflecting, to a considerable extent, the existing international experience, and practices.

A summary of the safety issues and their respective categories is shown in the table below for each one of the areas of design and operation.

WWER 440/230 NPPs RANKING OF SAFETY ISSUES

Area	Categories			
	I	II	III	IV
Design				
Core		4		
Systems		5	7	3
Components		2	5	5
I & C		4	7	1
Electrical		1	2	2
Ac. Analysis		4	5	
Fire Protection			3	
		(20)	(29)	(11)
Operation				
Management	2	3	6	2
Op. Procedures		2	1	1
Plt. Operations	1	2	3	
Maintenance	1	2	-	1
Training	1	1	3	
E. Planning		2	3	
	(5)	(12)	(16)	(4)
TOTAL	**5**	**32**	**45**	**15**

2. OVERVIEW OF SAFETY ISSUES

The design of WWER 440 model 230 NPPs was developed in the early sixties in compliance with the USSR industrial codes, standards and rules effective at that time. The safety concept of the design assumes a high reliability of essential primary circuit components and of auxiliary systems during plant lifetime and conservative design margins. Therefore no special measures are considered in the plant design to protect against a large failure of the primary cooling circuit. Plant safety also relies to a large extent on organizational measures aimed at the prevention of accidents.

The WWER-440/230 project reviewed mainly the extent to which the basic safety concept was realized and which shortcomings in design and operation could endanger plant safety.

The assessment approach was based on the "defense in depth" concept which provides an overall strategy for safety measures and features of NPPs. Safety issues related to accident prevention have been given more importance than those related to accident mitigation. This approach helps on focusing on the design and operational issues related to accident prevention.

An overview of the safety issues identified is presented in terms of basic safety functions and successive barriers designed to prevent the release of radioactive material to the environment.

The basic safety functions are: controlling the power, cooling the fuel and confining the radioactive material.

The three successive barriers which should always be protected are: the fuel and its cladding, the primary coolant boundary and the confinement structures and equipment.

Protection of the first barrier will be included in the first two basic safety functions. The second barrier will be examined separately and the third barrier will be examined together with the third basic safety function. Consequently, the results of the safety assessment of the WWER-440/230s will be presented according to the following main headings:

- controlling the power in normal as well as in transient or accident conditions,
- cooling the fuel in all conditions, namely during normal operation at power, during shutdown or refuelling, and following a Loss of Coolant Accident (LOCA),
- preserving the primary circuit integrity, and
- confining the radioactive material in case of LOCA,

In addition to that, five areas of design will be presented separately, because they interfere with nearly every system or equipment in a plant and thus influence the performance of the main safety functions. These areas are the following:

- instrumentation and control (including man-machine interface),
- electric power supply,
- fire protection,
- protection against earthquakes and other external hazards,
- accident analysis,

The Safety Review Missions reviewed in detail those operating attributes and practices that impacted directly on the safe operation of the plants taking into account the known design deficiencies. It was concluded that the major concerns could be grouped in the following five operational areas:

- management,
- operating procedures,
- plant operations,
- maintenance,
- training,

Finally the two following areas are discussed.

- emergency planning and,
- regulatory interfaces.

Sub-sections include short description of systems operations and discuss required system modifications or improvements related to both plant design and operation. References are also given to the related safety issues presented in the following sections of this report.

2.1. Controlling the Power

2.1.1. Controlling the Power in Normal Conditions

Although it is shown to a large extent that the present core design of the WWER-440/230 is conservative, a full knowledge of the design margins is not available at the plants. A systematic evaluation of core design margins, on the basis of actual core loading is needed. Such an evaluation would be the basis to establish the limits and conditions for operation in order to ensure that the plant is kept within its design limits. Examples of such limits are: maximum thermal power, maximum burn-up, shutdown margin, maximum peaking factors, sub-criticality at shutdown and in the fuel storage pool, permitted operating range of the control rods and primary circuit integrity limitations for power changes.

Moreover, core characteristics need to be verified and compared to calculational results with modern codes, after each reloading, to ensure that the plant is still within its design basis.

Keeping the core within its design margins during plant operation requires a reliable in-core power and flux monitoring system. The present in-core power monitoring system has a reduced capability. The original in-core flux monitoring system had a poor reliability and has been deactivated.

Safety issues related to this subsection are:

Core 1	In Core Monitoring (II)
Core 2	Core Design Margin Evaluation (II)
Core 3	Fuel Examination (II)
Core 4	Reloading Procedures and Test Programme (II)
I&C 2	Reliability of I&C Equipment (III)
I&C 3	Control and Protection Systems Interaction (II)
I&C 5	I&C Support to Operation and Control Room Design (III)
Accident Analysis 4	Accident During Shutdown or Refuelling (II)
Management 13	Computer Utilization (I)
Operating Procedures 3	Limits and Conditions (III)
Operating Procedures 4	Procedures. Operation (II).

2.1.2. Controlling the Power in Transient and Accident Conditions

Controlling the reactor power in transient or accident conditions requires a comprehensive accident analysis to make sure that the plant is able to cope with power excursion transients such as:

> spurious withdrawal of a control rod at full power, inadvertent boric acid dilution of the primary coolant, inadvertent reopening of an isolated primary circuit loop, (the possibility for unborated water plug moving into the core) and steam line breaks or secondary side transients causing fast cooling at the core inlet.

The initial cause of the above transients can be an equipment failure or an operator's error. This should be defined after a preliminary assessment of the procedures and review of the automatic devices related to these transients.

Interlocking may also be required to prevent power excursions which, according to the analysis, might damage the core.

Safety issues related to this subsection are:

Systems 10	Main Steamline Isolation (IV)
Systems 12	Secondary Circuit Pressure Relief (II)
Components 12	Secondary Circuit In-Service Inspection (II)
I&C 6	Interlocking (II)
Accident Analysis 2	Emergency Protection Signals (III)
Accident Analysis 5	Qualification of Safety Analysis (II)
Accident Analysis 6	Scope of Accident and Transient Analysis (III)
Management 9	Experience Feedback (III)
Operating Procedures 2	Emergency Operating Procedures (IV)
Operating Procedures 4	Procedures. Operation (II)
Training 2	Training of Plant Operators (III).

2.2. Cooling the Fuel

2.2.1. Cooling the Fuel in Plant Operating and Transient Conditions

Two main features of the WWER-440/230 NPPs have to be recalled:

a. In all conditions, with the exception of loss of coolant accidents, the steam generators are the only way to cool the reactor core.

b. In case of total loss of heat sink, the core can be cooled without any damage during a minimum period of six hours, due to the large water inventory of the steam generators. This has been demonstrated during the fire events at Greifswald in 1975 and at Armenia in 1982.

Normally, after the reactor is shutdown, the decay heat is removed first by the main turbine condensers and at least one out of two emergency feedwater pumps (65 t/h at 65 b) As the decay heat decreases, the steam is led to the technological condenser and the condensate is returned to the feedwater system.

When the liquid phase starts, decay heat is removed via the technological condenser and one (out of two) decay heat removal pump (500 t/h at 6.5 b). The technological condenser is cooled by the Service Water System.

Emergency feedwater and decay heat removal pumps are electrically backed up by the diesels. These pumps are cooled by the service water system and installed in the same area of the turbine hall, close to the main feedwater pumps.

At all levels there are interconnections between the two units. (The basic design of the WWER-440/230s is two twinned units of 440 MW each). For instance, the emergency feedwater pumps of one unit can inject water into the steam generators of the other unit. The decay heat removal pumps can take suction from the technological condenser of a unit and inject water into the steam generators of the other unit.

The two 150 m^3 deaerators feeding the emergency feedwater pumps can be refilled by water taken from the main condensers by the main condensate pumps or from the make up system or from the technological condenser.

Due to all these interconnections, no single active failure can totally impair the reactor heat removal function. But potential for common-cause failures is non negligible because of the layout. Diversity is then the most obvious means to reach an acceptable level of safety.

Taking full benefit from the positive safety features of the WWER-440/230s in the core cooling function should be one of the main objectives in order to reach an acceptable level of safety. This can be accomplished by making sure that the steam generator water inventory is preserved and being able to face the main common cause failures which could prevent decay heat removal via the steam generators.

Control of the Steam Generator Water Inventory

Depletion of steam generator water is a major safety concern. A study to determine the spectrum of events that can cause significant loss of the steam generators secondary side water inventory. Preventive measures, like an early reactor trip, should then be implemented. Among these measures, the most obvious one is reactor scram on low level in the steam generator.

Safety issues related to this subsection are:

Systems 3	Decay Heat Removal. Ensuring Adequate SG Inventory (IV)
Accident Analysis 2	Emergency Protection Signals (III)
Management 9	Experience Feedback (III)
Operating Procedures 2	Emergency Operating Procedures (IV)
Operating Procedures 4	Procedures. Operation (II)
Training 2	Training of Plant Operators (III)

Failure of Decay Heat Removal Function in the Machine Hall

A common-cause, like a big fire in the machine hall, could destroy or prevent from functioning all the equipment which are located close together in the machine hall (common to both units).

Considering the operating experience of the WWERs, the probability of such an event is non-negligible.

An alternate means for supplying feedwater located outside the machine hall is required, for direct feeding into the steam generators.

In the design of this new feedwater system, the following should be taken into account: A pipe connection should allow for injection of water from an external source (fire brigade trucks for instance) before the tanks of the system are depleted; The pump discharge line should be connected as close as possible to the steam generator and, if possible, at a different location from the main and emergency feedwater pump line; It should be demonstrated that the system and its building are seismically qualified and designed. In addition, this system could also be able to cool the diesels and their vital auxiliaries (see next section);

Safety issues related to this subsection are:

Systems 3	Decay Heat Removal. Ensuring adequate SG Inventory (IV)
Systems 4	Decay Heat Removal. Heat removal path (II)
I&C 11	Control Room. Habitability/Remote Shutdown Panel (III)
Accident Analysis 6	Scope of Accident And Transient Analysis (III)
Accident Analysis 9	Evaluation of Modifications (III)
Fire Protection 1	Fire Protection Analysis (III)
Fire Protection 2	Fire Protection Equipment (III)
Fire Protection 3	Fire Protection. Inspection (III)
Operating Procedures 2	Emergency Operating Procedures (IV)

Failure of Decay Heat Removal Function at the Ultimate Heat Sink

The service water pumps common to both units are installed close together in the same building. In case of a common cause rendering all the pumps inoperative at the same time, the decay heat removal systems would be unavailable. The diesels, which are cooled by service water, would also be unavailable.

In this case, the only source of electric power left would be the external auxiliary source. However, there is a non negligible probability of loosing the external sources when the plant is shutdown, depending on the relative power of the plant with respect to the local network.

A common cause, for instance an earthquake, could also affect the source of water where the service water take suction and the external electric source.

The new feedwater system described above would back up the existing systems of decay heat removal in all these cases.

But the integrity and availability of the existing service water system components should be better ensured by added inspection and physical barriers to protect the system from most of the common cause failures.

Safety issues related to this subsection are:

Systems 5	Decay Heat Removal. Service Water System (III)
Plant Operation 2	Procedures. Surveillance (III)
Maintenance 3	Equipment Material Conditions (IV).

Failure of Decay Heat Removal Function Due to the Loss of the Electric Cables

Due to the layout of the electric power and control cables of a WWER-440/230, a common cause, like a fire in a cable gallery, could result in a total unavailability of the electric sources or of the service water system which is common to both units. This type of event happened twice: in Greifswald (1975) and in Armenia (1982).

After the big Armenian fire, a solution to cope with such an event was designed and implemented in Armenia. The same type of solution was also implemented in Kola and Bohunice.

It consists of a network of power cables with a distinct and independent layout from all other cables. One pump of each system important to safety can be connected in about one hour to this network by means of a connecting board and a set of already prepared cables available in the same room. The network of independent cables connects the local boards to a building separate from all other buildings, which in turn can be connected to any external or internal available electric source.

Of course, such a modification is complementary to all other preventive measures which should be taken against fire (see chapter on fire protection).

Safety issues related to this subsection are:

Electrical 1	Electrical Redundancy, Separation and Independence (IV)
Fire Protection 1	Fire Protection Analysis (III)
Fire Protection 3	Fire protection. Inspection (III)
Operating Procedures 2	Emergency Operating Procedures (IV)
Plant Operations 2	Procedures. Surveillance (III)
Training 2	Training of Plant Operators (III).

Failure of Decay Heat Removal Function Due to the Loss of the Control Room

The main control room being close to the machine hall, there is a potential for adverse environmental conditions due to steam, a turbine missile or a fire. Although feeding the steam generators might be possible from the other unit, a minimum of instrumentation and control would be necessary to do so.

Modifications to the control room should be made to increase its habitability in accident conditions and to protect it from external hazards.

In addition, a remote shutdown panel should be installed sufficiently far away from the control room so as not to be affected by the same extreme environmental conditions at the same time. This panel would allow the operator to keep the plant in safe shutdown conditions which means essentially to assure the decay heat removal from the core.

Safety issues related to this subsection are:

Systems 14	Ventilation/Cooling Capability (III)
I&C 5	I&C Support to Operation and Control Room Design (III)
I&C 11	Control Room Habitability/Remote Shutdown Panel (III)
Fire Protection 1	Fire Protection Analysis (III)
Fire Protection 2	Fire Protection Equipment (III)
Operating Procedures 2	Emergency Operating Procedures (IV)
Training 2	Training of Plant Operators (III).

2.2.2. Cooling the Fuel Under Loss of Coolant Conditions

WWER-440/230s are designed to cope with primary circuit breaks up to 32 mm equivalent diameter (Design Basis Accident). Therefore, two types of events have to be considered according to the size of the break. In addition to that, the boundaries of the primary circuit have to be well-defined.

Primary Circuit Break Less than or Equal to 32 mm Equivalent Diameter

When a leak appears in the primary circuit, which cannot be compensated by the make up system (3 or 4 volumetric pumps of 6 m^3/h each) the pressurizer level and then the primary pressure will decrease. The reactor will be shut down and the safety injection system will be started automatically on a low pressurizer level combined with a low primary pressure.

There are six safety injection pumps (high pressure) in two groups of three, each group being connected to a distinct 6 KV busbar. When the system is called upon, two pumps of each group are started, but only one pump is enough to cope with the Design Basis Accident (DBA). In case of simultaneous loss of offsite power, one pump in each group is backed up by a diesel.

After a certain time, water in the safety injection storage tank is mainly recirculated water which has spilled from the break into the hermetic compartment and has been collected in the compartment sump which in turn communicates with the tank.

This water has to be cooled down by the containment spray system heat exchangers. The containment spray system is started automatically on a high pressure in the hermetic compartment.

There are three containment spray pumps, but two are necessary to cope with the DBA. Each one of these two pumps is supplied by a distinct diesel.

Studies are needed to assess the capabilities and the limitations of the safety injection and containment systems. The studies should include:

* an accident analysis to check the adequacy of these two systems to cope with a DBA, not only in the short term, but also in the long term core cooling recirculation phase. The efficiency of the two current designs options (cold or hot leg injection), according to the location of the break, should be evaluated.

* an analysis to assess the probability of a common cause failure of the core cooling function simultaneously with a DBA/LOCA.

* a qualitative fault tree analysis taking into account all vital auxiliaries. The objective of the study would be to identify all single failures which would result in loss or severe degradation of the core cooling function.

Depending on the results of the above studies, the necessary modifications should be made.

In addition to these studies, it should be examined whether the primary loop main isolation valves can be used to isolate a break in the primary circuit main pipes. Following the study, detailed emergency procedures should then be written.

Safety issues related to this subsection are:

Systems 8	ECCS - Redundancy and Physical Separation of Redundant Parts (IV)
I&C 4	I&C Redundancy, Separation and Independence (IV)
I&C 5	I&C Support to Operation and Control Room Design (III)

I&C 7	I&C and Electrical Equipment Qualification (III)
I&C 12	Instrumentation Setpoint Margins (II)
Electrical 2	Reliability of Electrical Equipment (III)
Electrical 3	Diesel Generator Loading (IV)
Accident Analysis 1	Confinement Analysis (III)
Accident Analysis 2	Emergency Protection Signals (III)
Accident Analysis 6	Scope of Accident and Transient Analysis (III)
Accident Analysis 7	Loss of Coolant Accidents (III)
Accident Analysis 8	Radiological Consequences (II)
Accident Analysis 9	Evaluation of Modifications (III)
Management 10	Quality Assurance (III)
Operating Procedures 2	Emergency Operating Procedures (IV)
Operating Procedures 3	Limits and Conditions (III)
Plant Operations 2	Procedures. Surveillance (III)
Plant Operations 3	Work Control (III)
Maintenance 2	Procedures. Maintenance (II)
Maintenance 3	Equipment Material Conditions (IV)
Training 2	Training of Plant Operators (III).

Primary Circuit Break Larger than 32 mm

Accident analyses should be extended to evaluate the limit size of a primary circuit break that the current safety injection and containment spray systems could face without adjunction of a low head high flow safety injection system (available at Kozloduy units 3 and 4) or of accumulators.

The minimum amount of equipment necessary to face the accident should be determined in these studies.

It would then be possible to determine the modifications which would be required on the existing systems (in addition to those defined above) to extend their capability beyond the DBA up to a well-defined size of break. To face primary pipe breaks beyond this value and up to the largest size (500 mm double-ended break) would require major improvements to be defined by further accident analyses.

Safety issues related to this subsection are:

Systems 7	ECCS - Full LOCA Spectrum Capability and Long Term Cooling (III)
I&C 1	Accident Monitoring Instrumentation (II)
I&C 5	I&C Support to Operation and Control Room Design (III)
I&C 7	I&C and Electrical Equipment Qualification (III)
I&C 12	Instrumentation Setpoint Margins (II)
Accident Analysis 1	Confinement Analysis (III)
Accident Analysis 2	Emergency Protection Signals (III)
Accident Analysis 6	Scope of Accident and Transient Analysis (III)
Accident Analysis 7	Loss of Coolant Accidents (III)

Accident Analysis 8	Radiological Consequences (II)
Accident Analysis 9	Evaluation of Modifications (III)
Operating Procedures 2	Emergency Operating Procedures (IV)
Training 2	Training of Plant Operators (III)
Emergency planning 5	Post Accident Sampling (II).

Interfacing Systems LOCA and Confinement Bypass

It is of high significance to safety to define the boundaries of the primary circuit on which it has to be assumed that a leakage or a break may happen.

According to the single failure criterion, the primary circuit extends to the second isolation valve on all pipes connected to the main loops of the primary circuit.

It should be checked that, with this definition, no part of the primary circuit stays outside of the hermetic compartment. If this is not the case, it means that a DBA/LOCA could happen outside the hermetic compartment and then the plant could not cope with such an accident. Therefore, installation of new isolation devices may be required.

Safety issues related to this subsection are:

Systems 1	Confinement - Leaktightness (III)
Systems 13	Reliable Isolation (II)
Accident Analysis 1	Confinement Analysis (III)
Accident Analysis 6	Scope of Accident and Transient Analysis (III)
Accident Analysis 8	Radiological Consequences (II)
Accident Analysis 9	Evaluation of Modifications (III)
Operating Procedures 2	Emergency Operating Procedures (IV)
Plant Operations 2	Procedures. Surveillance (III)
Plant Operations 3	Work Control (III).

Common Cause Failures due to Pipe Whip

Primary pipes and pipes connected to the primary circuit up to the first isolation valve are high energy pipes. One of these pipes may have a complete rupture within the hermetic compartment and then damage other pipes due to pipe whip phenomenon. Among the other pipes, are safety injection pipes or containment spray pipes.

Thus, the initial break would increase the severity of the consequences of the LOCA by impairing partially or totally the safety injection system or the containment spray system.

To prevent such a common cause series of failures, a pipe whip analysis in the hermetic compartment should be performed and preventive measures taken as required by the study.

Safety issues related to this subsection are:

Systems 8	ECCS - Redundancy and Physical Separation of Redundant Parts (IV)
Systems 15	Dynamic Loads Due to Piping Failures (II)
Components 10	Primary Circuit Stress Analysis (III)

2.2.3. Cooling the Fuel Under Shutdown or Refuelling Conditions

During reactor refuelling or in the spent fuel pool, no single failure or single operator's error should result in an accident like a reactivity transient due to spurious boron dilution or cold water injection or an overheating accident due to drainage of the spent fuel pool.

In case a single failure or operator's error can result in such an accident, an accident analysis would be necessary to evaluate the consequences and take the appropriate measures either to prevent or to limit the consequences of the accident.

Safety issues related to this subsection are:

Systems 4	Decay Heat Removal. Heat Removal Path (II)
Systems 5	Decay Heat Removal. Service Water System (III)
I&C 5	I&C Support to Operation and Control Room Design (III)
Accident Analysis 4	Accident During Shutdown or Refueling (II)
Management 5	Organization (III)
Operating Procedures 3	Limits and Conditions (III)
Operating Procedures 4	Procedures. Operation (II)
Plant Operations 3	Work Control (III)
Maintenance 1	Maintenance Programmme (II).

2.3. Preserving the Primary Circuit Integrity

This is one of the main safety objectives in the area of prevention. Therefore, most of the issues related to this topic were ranked high. Some of these relate to component integrity, others to systems, but they should be addressed in parallel with the same high level of urgency.

2.3.1. Maintaining Component Integrity

Reactor Pressure Vessel

The irradiation by high energy neutrons has caused reactor vessel wall embrittlement especially in the circular weld at the elevation of the reactor core. This causes an increase of the ductile to brittle transition temperature from less than O°C in a new vessel to more than 150°C in some plants. The primary circuit must not be pressurized at temperatures below the transition temperature to prevent brittle fracture. A potential method for reducing the transition temperature is vessel annealing. But the effectiveness of this process has not been yet sufficiently validated and more information is needed about the embrittlement phenomenon and the way its progress can be predicted.

It has been proven, though, that the rate of embrittlement can be significantly slowed down by reducing the fast neutron flux, positioning, for instance,dummy elements into the outermost core positions.

In-service inspection should be improved using the most adequate detection methods with updated acceptance criteria.

Re-evaluation of stress analyses using more refined methods than the initial one is also needed to account for DBA and beyond DBA accidents.

Another issue related to the reactor vessel is that the vessel rests on an annular tank, filled with water. It should be demonstrated that this tank will keep its integrity during the plant lifetime or in case of earthquake.

Safety issues related to this subsection are:

Components 1	Embrittlement. Baseline Information and Analysis (IV)
Components 2	Embrittlement. Validation of Annealing (IV)
Components 3	Embrittlement. Flux Reduction (IV)
Components 5	Vessel ISI. Inspection Techniques and Acceptance Criteria (III)
Components 6	Vessel ISI. Corrosion Monitoring (II)
Components 7	Vessel Stress Analysis (III)
Components 11	Vessel Support Integrity (III)
Operating Procedures 3	Limits and Conditions (III).

Primary Circuit

A major safety concern is the fact that WWER-440/230s do not account for large diameter (more than 32 mm equivalent diameter) break LOCA. Therefore, it is of high importance to safety to demonstrate that it is possible to detect those defects in the primary circuit which can evolve into a break.

This requires an analysis of the applicability of the "Leak Before Break" (LBB) concept and the implementation of the corresponding modifications. In addition, the LBB concept relies upon extended stress analysis calculations and the implementation of improved in-service inspection techniques.

Safety issues related to this subsection are:

Components 8	Leak Before Break Applicability (IV)
Components 9	Primary Circuit In-Service Inspection (III)
Components 10	Primary Circuit Stress Analysis (III)
Management 10	Quality Assurance (III)
Operating Procedures 3	Limits and Conditions (III)
Plant Operations 2	Procedures. Surveillance (III)
Plant Operations 6	Chemistry (I)

2.3.2. Primary Circuit Overpressure Protection

Protection of primary circuit against overpressure is insured by the pressurizer safety valves. These valves are generally pilot operated valves. But they are not qualified for water or water/steam mixtures. This means that the primary circuit is not well protected during periods when the pressurizer is full of water and the primary circuit is still closed.

The sizing of these valves should also be evaluated considering various transients and feed and bleed capability. Moreover, some of these valves do not fulfill seismic requirements and the layout is such that potential common cause failures of the impulse lines cannot be disregarded.

To reduce the frequency of opening of the pressurizer safety valves, protection signals should be implemented as found necessary.

Safety issues related to this subsection are:

Systems 9	ECCS - Primary Break Isolation Options (II)
Systems 11	Primary Circuit Pressure Relief (III)
Accident Analysis 2	Emergency Protection Signals (III)
Operating Procedures 2	Emergency Operating Procedures (IV)
Plant Operations 1	Surveillance Programme (II)
Plant Operations 2	Procedures. Surveillance (III)
Training 2	Training of Plant Operators (III).

2.3.3. Primary Circuit Cold Overpressure Protection

Since pressure limits are temperature dependent, primary circuit cold overpressure may happen in case of a sharp increase of pressure at a given temperature or a sharp decrease in temperature at a given pressure.

The first case is covered above. The second case may have different causes and may also result in recriticality. An incident of this type (spurious opening of the bypass to the turbine) occurred in Bohunice unit 2 in 1984. It was analyzed in the Report of the October 1990 ASSET Mission to Bohunice.

A general review of the potential for overcooling transients should be performed. This investigation should not be restricted to a main steam line break. It should be completed by accident analysis to evaluate, for each transient, the significance of the thermal shock on the reactor pressure vessel and to test various design solutions. When this task will have been accomplished, it will be possible to define the necessary modifications to perform, or procedures to establish, with their relative priorities, in order to reach an adequate protection against a primary circuit cold pressurization.

Safety issues related to this subsection are:

Systems 9	ECCS - Primary Break Isolation Options (II)
Systems 10	Main Steamline Isolation (IV)
Components 4	Embrittlement. Prevention of Low Temperature Pressurization (IV)

Components 12	Secondary Circuit In-Service Inspection (II)
Accident Analysis 6	Scope of Accident and Transient Analysis (III)
Operating Procedures 3	Limits and Conditions (III)
Operating Procedures 4	Procedures. Operation (II)
Plant Operations 2	Procedures. Surveillance (III).

2.4. Confining the Radioactive Material in Case of LOCA

As in the previous chapter concerning the cooling of the core in case of LOCA, two types of events have to be considered, according to the size of the break.

2.4.1. Primary Circuit Break Less than or Equal to 32 mm Equivalent Diameter

Although the containment flaps and the containment spray system have been designed to protect the integrity of the hermetic compartment, their actual performance has never been fully checked and taken into account in an accident analysis, particularly in view of the high leak rate of the hermetic compartment.

Even if the first priority is to make sure that the core will be efficiently cooled down, which would limit the risk of radioactive release, it is also necessary to evaluate the overall efficiency of the confinement in an accident analysis considering the following parameters:

* the actual leak rate of the hermeticcompartment;

* the performance of the flaps with various realistic assumptions (normal behavior, non opening, one flap stuck open, etc.);

* the actual characteristics of the containment spray system as measured by tests (performed or to be performed) such as: time necessary for the spray to start following a DBA/LOCA, efficiency of the sprinklers according to the flow provided by the pumps, temperature of the water coming from the reactor and the containment sump via the safety injection tank, etc.;

* the single failure criterion which, in an acceptable design, should not reduce the performance of the systems below the minimum required;

* realistic assumptions concerning the primary coolant contamination.

These accident analyses might conclude that modifications are necessary concerning the systems or to improve the leaktightness of the confinement. As long as these analyses, as well as the complementary tests as needed, are not performed, no major modifications should be undertaken.

Safety issues related to this subsection are:

Systems 1	Confinement - Leaktightness (III)
Systems 5	Decay Heat Removal. Service Water System (III)
Systems 8	ECCS - Redundancy and Physical Separation of Redundant Parts (IV)

Systems 15	Dynamic Loads Due to Piping Failures (II)
Accident Analysis 1	Confinement Analysis (III)
Accident Analysis 8	Radiological Consequences (II)
Operating Procedures 2	Emergency Operating Procedures (IV)
Maintenance 3	Equipment Material Conditions (IV)
Training 2	Training of Plant Operators (III)

2.4.2. Primary Circuit Break Larger than 32 mm

According to preliminary analyses performed by the U.S. Department of Energy (DOE/NE-0086), structural failure of the confinement may not occur even with a large break LOCA unless an hydrogen explosion occurs. The main problem is then to prevent hydrogen accumulation within the confinement.

The high leak rate of the confinement would probably not be enough to prevent hydrogen accumulation in the upper parts of the confinement like the pressurizer compartment. Solutions to these problems have still to be found. Among them, forced filtered venting is to be investigated as it would solve the problem of hydrogen accumulation and reduce considerably the impact of the confinement high leak rate. Use of hydrogen igniters should also be considered.

Safety issues related to this subsection are:

System 2	Confinement - Severe Accident Conditions (III)
Systems 5	Decay Heat Removal. Service Water System (III)
Systems 8	ECCS - Redundancy and Physical Separation of Redundant Parts (IV)
Systems 15	Dynamic Loads due to Piping Failures (II)
Accident Analysis 1	Confinement Analysis (III)
Accident Analysis 5	Qualification of safety analysis (II)
Accident Analysis 6	Scope of accident and transient analysis (III)
Accident Analysis 8	Radiological consequences (II)
Operating Procedures 2	Emergency Operating Procedures (IV)
Training 2	Training of plant operators (III)
Emergency Planning 1	Emergency Response Programme (III)
Emergency Planning 2	Emergency Response Procedures (III)
Emergency Planning 3	Emergency Response Facilities (III)
Emergency Planning 4	Emergency Response. Training (II)
Emergency Planning 5	Post Accident Sampling (II).

2.5. Areas Affecting Performance of all Safety Functions

2.5.1. Instrumentation and Control

Instrumentation and Control are directly associated with the performance of safety functions and its reliability should be consistent with the related mechanical or electrical systems reliability.

Moreover, I&C is generally more sensitive to ageing, interconnection problems and all types of environmental conditions: temperature, humidity, radiations, fire, external pressure, pipe whip, missiles, etc...

I&C is also at the interface between operator and the plant, and, as such, has a predominant significance to safety. For the same reason, I&C is tightly connected to the operating procedures and both should be assessed at the same time.

I&C vital auxiliary systems need to be as reliable as the I&C equipment they serve. This means that safety assessment studies to be performed on I&C should also include the I&C vital auxiliaries.

I&C in Safety Functions

Complementary to the previous review of the main safety functions, an assessment of the corresponding I&C systems and equipment and the associated operating procedures (including tests and maintenance) should be performed.

It is required first to establish a list of the I&C systems and equipment on which the safety functions depend upon. This list should included information related to:

- vital auxiliary systems on which I&C depends: electric power supply, ventilation, etc.,
- tests usually performed, in what plant conditions and with what frequency,
- age of the equipment,
- observed reliability (good, medium or bad), and
- potential extreme environmental and seismic conditions in which the equipment will have to perform their function.

Based on the above collected information and the schematics of each I&C system, a comprehensive investigation should be performed to verify:

- whether the single failure criterion can be successfully applied to each safety function considering the numerous interconnections between redundant channels or with non-safety-related equipment,

- the need for automatic interlocks deemed necessary to prevent operator errors,

- whether tests covering all components of the I&C systems are possible and actually in use during plant operation with an acceptable frequency considering the observed reliability of the system.

- whether components supposed to operate in harsh environmental conditions are qualified to do so. If not, a programme of replacement by qualified components has to be set up.

- whether any potential common-cause event, due to internal hazards, can cause simultaneous failure of redundant I&C equipment thus failing a safety function.

- define what should be done at the level of I&C to improve the performance of each safety function (e.g. accident monitoring instrumentation ...).

Finally, a detailed programme for upgrading systems and equipment is required where the investigations have identified shortcomings.

Safety issues related to this subsection are:

Systems 14	Ventilation/Cooling Capability (III)
I&C 2	Reliability of I&C Equipment (III)
I&C 3	Control and Protection Systems Interaction (II)
I&C 4	I&C Redundancy, Separation and Independence (IV)
I&C 6	Interlocking (II)
I&C 7	I&C and Electrical Equipment Qualification (III)
I&C 8	I&C and Electrical Equipment Classification (III)
I&C 10	Testability of I&C Equipment (III)
Operating Procedures 1	Procedures. Programme (II)
Operating Procedures 2	Emergency Operating Procedures (IV)
Operating Procedures 4	Procedures. Operation (II)
Plant Operations 1	Surveillance Programme (II)
Plant Operations 2	Procedures. Surveillance (III).

I&C in the Control Room

In the control room, it was observed several times during Safety Review Missions that excessive demands are placed on operators, especially in the case of transient conditions, due to an insufficient degree of information, centralization and automation. Therefore, a control room design review, based on the accomplishment of main safety functions, need to be performed to determine what modifications and (or) what additional devices (e.g. computerized safety parameter display system) would help the operator significantly in case of emergency.

The potential drawbacks of such modifications have to be carefully evaluated before any implementation, especially in this area of man-machine interface.

Safety issues related to this subsection are:

I&C 5	I&C Support to Operation and Control Room Design (III)
I&C 11	Control Room Habitability/Remote Shutdown Panel (III)
Management 6	Modification Control (III).

Comments on Specific Safety Review Recommendations on I&C

Some of the specific recommendations made on I&C are discussed below.

Implementation of Additional Scram Signals.

Highest consideration should be given to the following:

* scram on low steam generator level, which is a most important one because it will contribute to maintaining steam generator water inventory (see section 2.1.1. above),

* scram on high pressurizer level, as a means to reduce the frequency of pressurizer safety valves opening (see section 3.2.).

Safety issues related to this subsection are:

Accident Analysis 2	Emergency Protection Signals (III)
Management 6	Modification Control (III)
Operating Procedures 3	Limits and Conditions (III).

Accident Monitoring Instrumentation and Sampling for Severe Accident Management

Accident monitoring instrumentation as well as the capability of taking samples to assess post accident core and radiological conditions needs to be defined as a result of the accident analysis performed.

Safety issues related to this subsection are:

I&C 1	Accident Monitoring Instrumentation (II)
Emergency Planning 1	Emergency Response Programme (III)
Emergency Planning 2	Emergency Response Procedures (III)
Emergency Planning 5	Post Accident Sampling (II).

Instrumentation Setpoint Margins

The safety related instrumentation channel uncertainties (accuracy, drift, calibration) needs to be determined and combined to fix the margins to be used to establish the plant setpoints from the values used in safety analyses.

Safety issue related to this subsection is:

I&C 12 Instrumentation Setpoint Margins (II)

I&C Signal Priority

Operation of the emergency systems should not be inhibited by equipment protection signals or manual actions, at least during a minimum amount of time after the initial I&C signal. This should be checked during the studies of section 5.1. But the most urgent cases are already known and concern the diesels, the safety injection pumps and the confinement spray pumps.

Safety issue related to this subsection is:

I&C 9 I&C Signal Priority (III)

Remote Shutdown Panel

There are insufficient provisions to maintain control room habitability (see chapter 2.1.5.). In case of a main control room inhabitability or unavailability, a remote shutdown panel should exist to allow the operator put and keep the plant in safe shutdown conditions. This panel should be installed in a location where it would not be affected by the conditions in the main control room.

Safety issues related to this subsection are:

I&C 11	Control Room Habitability/Remote Shutdown Panel (III)
Operating Procedures 2	Emergency Operating Procedures (IV).

2.5.2. Electric Power Supply

Electric power supply (EPS) is needed for every active electro-mechanical equipment. Thus, EPS systems take part in every safety function and should have the same level of reliability as the mechanical equipment they feed.

Moreover, an EPS failure can be a common cause of failure for one or several main safety functions.

The most significant weak points in the EPS systems of the WWER-440/230's are inadequate redundancy and insufficient functional and layout independence between redundant equipment.

EPS will be examined, looking first at electrical systems supplying AC power (6 kV and 400 V) to safety related equipment. These systems consist of the diesels and the associated AC power distribution system.

Then the batteries and related 220 V DC power distribution systems feeding safety related equipment will be considered.

The cases of Reversible Motor Generators reliability and of the cable segregation will be presented separately.

AC Power Supply and the Safety Functions

Safety related functions are performed by electro-mechanical equipment which should be redundant, in order to fulfil the single failure criterion, and adequately segregated to prevent common cause failures. The corresponding AC power supply systems should then comply with the same design criteria so as not to impair the operability of the safety functions.

In a WWER-440/230, 6 kV and 400 V AC safety-related distribution systems are organized in 2 trains with distribution boards installed in separate rooms.

There are, however, interconnections between the distribution boards of the two trains at all levels. Therefore, comprehensive investigation should be performed to determine whether it is possible to implement a strict train segregation concept and to eliminate as many interconnecting cables as possible.

At the same time, the means to improve separation in the layout between the two trains should be investigated and strict procedures should be implemented to keep doors and ducts between rooms of the two trains closed. Potential consequences on the required cooling and ventilation systems capacity need to be considered.

In case of loss of off-site power, the main source of AC power supply is the diesel. Three diesel generators are installed in each unit, two of them are directly connected to the two redundant 6 kV busbars, the third one is on standby and can be connected to any of the two busbars.

There are two programmes of diesel loading corresponding respectively to the loss of external power and the loss of primary coolant accident with loss of external power.

Each diesel can take a total load of 1600 KW, which is sufficient for one diesel to take the full load corresponding to the second situation within the limits of a DBA accident (32 mm leak). However, the 3 containment spray pumps are connected two to one of the 6 KV busbars and one to the other redundant 6 KV busbars. In case of a DBA/LOCA 2 out of 3 containment spray pumps are required. Therefore if the diesel which feeds the busbars where the 2 containment spray pumps are connected should fail the third (swing) diesel has to be started. The load sequencing logic of the diesels is complex and may be a source of common cause failures. For instance, the failure of a time relay could cause failure of both trains of diesel generators simultaneously. To avoid such potential common modes and reach a strict independence between the two trains the containment spray may be organized in two trains (4 pumps instead of 3). Moreover, to solve the problem of beyond DBA/LOCA, when 2 safety injection pumps are necessary would require adding a fourth diesel or replacing the diesels by more powerful ones would be required.

Of course, the diesel vital auxiliaries (e.g. I&C, oil supply, cooling water, batteries....) would have to be organized in two trains as well. This might be difficult in the area of diesel cooling water which is provided by the service water system. To prevent a total loss of cooling water combined with a loss of electric power, cooling of the diesels by a separate source should be considered. This source could be the alternate water source defined in chapter 2.1.2.

Safety issues related to this subsection are:

Systems 14	Ventilation/Cooling Capability (III)
I&C 5	I&C Support to Operation and Control Room Design (III)
I&C 7	I&C and Electrical Equipment Qualification (III)
I&C 8	I&C and Electrical Equipment Classification (III)
Electrical 1	Electrical Redundancy, Separation and Independence (IV)
Electrical 2	Reliability of Electrical Equipment (III)
Electrical 3	Diesel Generator Loading (IV)
Electrical 5	Connection to Offsite Power Supplies (II)
Plant Operations 2	Procedures. Surveillance (III).

DC Power Supply and the Safety Function

220 V DC supply is necessary to provide control and actuation force to all equipment and, in particular, to the 6 kV equipment, including the two diesel busbars. Therefore, 220 V DC supply systems are vital for the accomplishment of all safety functions.

In WWER-440/230 NPPs there is only one 220 V battery per unit to provide energy to vital loads. A third one is common to both units. The design covers the loss of one battery by several sectionalized DC busbars and manually switchable interconnections between the three DC busbars. Such a procedure is time consuming, complicated and a potential source of common cause failures and operator errors. This design does not fulfill the single failure criterion.

In addition, there is no means of monitoring the battery circuits and galvanic interruptions within the battery circuitry will not be recognized, as long as DC power is delivered via the reversible motor generator sets. Immediate loss of vital DC power after a loss of AC supply would be the consequence. Batteries being the ultimate energy source, a modification of the current design is most important and would have a significant impact on safety. Batteries of each unit should be organized in two independent trains. An extension of the discharge time (currently 30 minutes) should be taken into consideration. Battery circuit monitors should be installed.

As a consequence of the battery design, there is only one single board within each unit supplying vital power to safety loads and providing actuation force and control voltage to the 6 kV busbars.

Therefore, one single failure (e.g. short circuit, fire,) at the level of this single DC distribution board could render all safety systems of one unit inoperable. Moreover, no information is available in the control room about the status of the switches at the level of the DC distribution boards.

To solve these problems the DC distribution system of each unit should be organized in two independent trains, at the same time as the batteries and the chargers.

Safety issues related to this subsection are:

I&C 5	I&C support to Operation and Control Room Design (III)
Electrical 4	Battery Discharge Time (III)
Plant Operations 2	Procedures. Surveillance (III)

Emergency AC/DC Power Supply by Reversible Motor Generators (RMG)

In normal operation, an RMG operates as a battery charger. In case of loss of power on the vital AC busbars, power flow direction reverses and the vital busbars are now supplied from the RMG operating in the inverter mode and this discharges the battery. There is one RMG in each unit plus two or three RMGs common to both units and connected to the third battery.

In most of the plants, RMGs have shown a poor reliability and have required frequent repairs. They should be replaced by separate static battery chargers and inverters. This will increase functional redundancy, simplify the functional structure of the equipment and result in a much better reliability.

Safety issue related to this subsection is:

Electrical 2	Reliability of Electrical Equipment (III)

Cable Segregation

There is no strict separation between the cable routes of redundant trains or between the cable routes of the two twinned units. There are several areas where redundant cable paths cross each other (junction areas). In these junction areas, redundant cables from the same unit or even from different units may be arranged in common trays on a certain distance. Similar junctions exist within the I&C systems or between I&C and power cables.

Although a strict separation between redundant cables would be impossible within the existing buildings, local improvements are possible: all junction areas should be identified and improvements of local separation and fire protection in these areas should be defined and implemented.

Due to the limitation of such improvements, an independent approach, like an independent cable network could be considered.

Safety issues related to this subsection are:

Electrical 1	Electrical Redundancy, Separation and Independence (IV)
Fire Protection 1	Fire Protection Analysis (III)
Fire Protection 2	Fire Protection Equipment (III)
Fire Protection 3	Fire Protection. Inspection (III)

2.5.3. Fire Protection

Poor design (concerning fire) of the station buildings and of the layout of systems, with the addition of poor housekeeping habits, creates a significant risk of fire with a potential for common mode failure of whole safety functions in the WWER-440/230 NPPs.

In the area of fire prevention, flammable material used for the roofs, floor covers, wall painting and cable coating should be replaced by non-flammable material. As an interim measure, sections of roofs or floors or walls covered with flammable material should be divided by means of non-flammable strips.

More generally, an inventory of all flammable material of the plant should be performed and adequate measures (detection, automatic extinction, etc.) taken to limit the risk of fire.

With respect to fire detection only areas such as transformers, cable corridors and diesels are covered. Other places with high fire risks or with high safety consequences in case of fire, such as the turbine oil tanks, the safety injection pump room, the reactor hall, the service water pump building or even the main control room are generally not equipped with fire detection systems.

In all the areas where a fire would have severe consequences for safety due to common mode failure of one or several safety-related functions, automatic fire detection and extinguishing systems are required. Redundant equipment should also be located in different fire areas.

In addition, the appropriate location or necessary installation of all kinds of barriers should be determined considering:

sealings with a non-flammable material of all penetrations through walls,

fire barriers to divide areas of high fire risk or high fire consequences for safety and

fire doors capable of withstanding a fire for a sufficient time and preventing the passage of smoke.

An adequate surveillance and maintenance of existing fire equipment is a prerequisite to make sure that this equipment is in good operating condition and correctly used at all times. Fire protection awareness has to be developed by training, and should be considered part of safety culture.

As fire protection is closely linked to specific plant layout and site conditions, the above recommendations are only a basis for a more detailed fire risk evaluation which has to be conducted in each plant with the objective of defining precise plant specific recommendations in order to reduce significantly the fire risk impact on safety of the WWER-440/230 NPPs.

Safety issues related to this subsection are:

Systems 8	ECCS - Redundancy and Physical Separation of Redundant Parts (IV)
I&C 4	I&C Redundancy, Separation and Independence (IV)
I&C 11	Control Room Habitability/Remote Shutdown Panel (III)
Electrical 1	Electrical Redundancy, Separation and Independence (IV)
Fire Protection 1	Fire Protection Analysis (III)
Fire Protection 2	Fire Protection Equipment (III)
Fire Protection 3	Fire Protection. Inspection (III)
Management 4	Housekeeping (II).

2.5.4. Accident Analysis

The most important accident analyses are defined above in the review of the main safety functions. But a systematic approach to accident analysis is necessary to ensure that all relevant accidents or transients have been evaluated and that the analyses consider appropriate boundary conditions, application of the single failure criterion, assumptions concerning operator action and common mode failures. Accidents not considered so far, including accidents beyond the DBA should be included in the analyses.

A comprehensive list of accidents to be analyzed needs to be established.

All analyses should be carried out to final stable conditions. For accidents involving release of radioactivity to the environment, a complete calculation of source terms and radiological consequences to the public should also be performed.

Some realistic best estimate (rather than conservative analyses) should also be realized to form a basis for development of operating procedures and operator training.

The computer codes used in the analyses should have been validated by measurements or checking with another modern computer code already validated.

The results of all accident analyses should be incorporated in a safety analysis report.

Safety issues related to this subsection are:

Accident Analysis 3	Severe Accident Analysis (II)
Accident Analysis 4	Accident During Shutdown or Refuelling (II)
Accident Analysis 5	Qualification of Safety Analysis (II)
Accident Analysis 6	Scope of Accident and Transient Analysis (III)
Accident Analysis 8	Radiological Consequences (II)
Operating Procedures 2	Emergency Operating Procedures (IV)
Training 1	Training Programme (III)
Emergency Planning 1	Emergency Response Programme (III)
Emergency Planning 2	Emergency Response Procedures (III)
Emergency Planning 3	Emergency Response Facilities (III)
Emergency Planning 4	Emergency Response Training (II).

2.6. Operation and Management of the Plant

The design deficiencies of the WWER-440/230 plants have already been discussed. The Eastern European operators of the four plants visited have been isolated from the rest of the nuclear safety community until recently. As a result, there are significant differences between the operating practices of WWER users and international practices.

The missions concluded that immediate attention is needed by the plants to improve their approach to operations, to improve the standards of maintenance and to instill a higher safety awareness in their staff. In a number of instances, key elements needed to establish a firm safety culture were missing. While many of the design issues will take many months or years to fully solve and implement, most of the operations issues can be addressed immediately at the plant level.

2.6.1. Management

The safe and efficient operation of a nuclear power plant requires that the organizational structure and responsibilities be clearly defined; that management set the example for and expect high performance standards; that objectives and goals be established, monitored, and corrective actions taken; and that management be closely involved in the day to day operation of the plant. The plant management must demonstrate leadership and be committed to the establishment of a safety culture in which nuclear safety issues receive the attention warranted by their significance.

The Safety Review Missions found that plant organizational structures were bureaucratic and cumbersome, and that restructuring was required. Many of the essential elements necessary to establish a safety culture were absent. In particular, management generally set low standards, accepted poor performance and failed to enforce published standards and rules. In most of the organizations, the responsibilities for plant performance were fragmented and not clear, the lines of communication were long and the organizations were not functionally structured. None of the plants reviewed had established quality assurance programmes.

Management issues covered in this section are:

Management 1	Management Involvement (IV)
Management 2	Management Development (III)
Management 3	Safety Culture (IV)
Management 4	Housekeeping (II)
Management 5	Organization (III)
Management 6	Modification Control (III)
Management 7	Document Management (I)
Management 8	Configuration Management (III)
Management 9	Experience Feedback (III)
Management 10	Quality Assurance (III)
Management 11	Radiation Protection Practices (II)
Management 12	Industrial Safety Practices (II)
Management 13	Computer Utilization (I).

2.6.2. Operating Procedures

Comprehensive operating procedures should be provided for the operators. Operating procedures must be clear, concise, verified for their accuracy and validity, and contain sufficient detail to enable trained operators to perform their activities accurately, thus avoiding human error. The use of and compliance with procedures needs to be enforced.

At all the plants visited, procedures were found to be inadequate. For many operating activities, and in particular for emergency or abnormal operations, there were either no procedures available or they were of such poor quality that they could not be relied upon for their accuracy. The use of procedures when available was not enforced.

The need to develop or to improve the plant technical specifications was identified at most plants. In many cases, plant limits and conditions had not been identified for some important conditions; and acceptance criteria had not been specified for all periodic tests.

Issues relating to operating procedures covered in this section are:

Accident Analysis 6	Scope of Accident and Transient Analysis (III)
Operating Procedures 1	Procedures Programme (II)
Operating Procedures 2	Emergency Operating Procedures (IV)
Operating Procedures 3	Limits and Conditions (III)
Operating Procedures 4	Operating Procedures (II).

2.6.3. Plant Operations

Plant operational activities have a direct impact on the behavior and performance of the reactor and its associated systems. The operating policies, procedures, and practices need to be well defined and strictly adhered to.

The Safety Review Missions concluded that although the plants reviewed had high capacity factors, there was insufficient control of operational details by the control room staff; and there was a need to develop a safety culture in the operation of the units. In most cases the control rooms were inadequately staffed with qualified reactor operators to safely operate and manage the plant in transient and accident conditions. In view of the inadequate instrumentation and human factor considerations in the control rooms, the control room and shift staffing problems deserve high priority attention.A number of plant practices were inadequate and did not promote safe operations, such as: many surveillance procedures for safety systems had not been developed; surveillance testing data was not routinely recorded and evaluated; and testacceptance criteria was either not specified or was inadequate. Many needed improvements were also identified in the areas of system isolation tagging, equipment labelling and the overall work control process.

Plant operations issues covered in this section are:

Plant Operations 1	Surveillance Programme (II)
Plant Operations 2	Surveillance Procedures (III)
Plant Operations 3	Work Control (III)
Plant Operations 4	Organization of Shifts (III)
Plant Operations 5	Labels and Operator Aids (II)
Plant Operations 6	Chemistry (I).

2.6.4. Plant Maintenance

Proper maintenance of plant equipment is essential for the safe, reliable and efficient performance of a nuclear power plant. It was found during the reviews that the maintenance organizations were overly complex resulting in the absence of clear lines of responsibility and authority. The material conditions of equipment and systems at all of the plants reviewed were in need of significant improvement. In some cases, the poor material conditions of the equipment could have resulted in essential safety systems failing to operate as designed. Maintenance standards were poorly defined, a factor which contributed to the poor material conditions. In particular, the maintenance standards and the material condition of balance of plant (BOP) equipment were in need of significant improvement. This was of great concern in that some systems important to safety, such as the Service Water System, have been treated as BOP systems and maintained with almost no quality control. Due to the old design of the plants, procurement of spare parts was problematic and existing spare parts were inadequately stored.

Plant maintenance issues covered in this section are:

Maintenance 1	Maintenance Programme (II)
Maintenance 2	Procedures. Maintenance (II)
Maintenance 3	Equipment Material Conditions (IV)
Maintenance 4	Warehouse (I).

2.6.5. Training

Adequate training of plant personnel is essential for safe nuclear power plant operation. All plant personnel should receive appropriate training and only suitably qualified personnel should be allowed to operate and maintain the plant. Qualifications should be maintained and upgraded by continuing training programmes. At all of the plants reviewed, the training programmes were not systematically structured and training standards were poorly defined. Simulator facilities were not available to all plants and when they were they were found to be inadequate. Refresher or continuing training programmes needed to be strengthened.

Adequate full scope simulator facilities need to be developed. The current approach to training operators does not provide assurance that they can adequately respond to and manage the wide range of possible accidents. In most cases, insufficient training, in lieu of having a simulator, has been provided to the operators to develop and maintain their control room skills for managing accidents.

Training issues covered in this section are:

Training 1	Training Programme (III)
Training 2	Training of Plant Operators (III)
Training 3	Training Facilities (II)
Training 4	Training MaterialS (II)
Training 5	Training Records (I).

2.7. Emergency Planning

In order to effectively cope with a nuclear related accident and to mitigate its impact on both plant personnel and the general public, both the nuclear power plant and the local government authorities need to have on-site and off-site emergency response plans in place. In order to be prepared for such emergency situations there should be adequate resources and facilities and, in addition, personnel should receive adequate training. The emergency plans should be tested by drills, exercises, and public information activities.

Although on-site and off-site emergency plans were available at all plants, the level of detail and quality varied widely. Concern was expressed that the emergency facilities and equipment available to cope with an accident were inadequate. The emergency plans in most cases were based on the most severe accident scenarios, which places considerable constraints on both the on-site and off-site plans. Emergency plans needed to address less severe accident situations, which would require a more limited scope response. Criteria to classify levels of alerts or emergencies needed to be developed so that a graded approach could be taken to radiation and plant accidents. Plant accidents not associated with the reactor also needed to be considered.

Finally, it was found at most plants that the conduct of drills and exercises was inadequate to ensure that both on- and off-site personnel could properly respond to and manage an emergency situation.

Emergency planning issues covered in this section are:

Emergency Planning 1	Emergency Response Programme (III)
Emergency Planning 2	Emergency Response Procedures (III)
Emergency Planning 3	Emergency Response Facilities (III)
Emergency Planning 4	Emergency Response. Training (III)
Emergency Planning 5	Post Accident Sampling (II).

2.8. Regulatory Interfaces

The Safety Review Missions did not perform detailed reviews of the regulatory bodies in the countries of the plants reviewed. However, it became apparent when reviewing the regulatory interfaces that the regulatory process needed to be strengthened. To improve nuclear plant safety in the long term, the regulatory bodies must be able to establish adequate safety requirements and enforce them. It was found that the regulatory bodies had poor inspection standards and were ineffective in identifying safety concerns. The regulatory bodies need to have sufficient independence and authority to act in the best interests of nuclear safety.

3. DESIGN ISSUES

ISSUE NUMBER: Core 1

ISSUE TITLE: In-Core Monitoring

RANK OF ISSUE: II

ISSUE CLARIFICATION:

At present the power distribution is monitored only by a reduced number of thermocouples at core outlet. The original in-core flux monitoring system Volna (wire activation) has demonstrated poor reliability and has been deactivated at the plants. The main objective of that system during and after commissioning was to validate the core codes.

RELATED ITEMS:

24, 25, 26, 27, 121, 307, 308, 594, 588, 587, 665, 728, 1022, 1040, 1041

JUSTIFICATION OF RANKING:

Safety of WWER-440/230 is based among other features on the high core margins. The verification and confirmation of power distribution is essential to maintain these margins. During the last decade a lot of modifications in the core have been done (e.g. new fuel assemblies, dummy assemblies at the core periphery) changing the core margins in an unknown manner. The core codes currently used need new validation. Controlling power depends on the core margins available.

CONCEPTUAL RECOMMENDATIONS:

Improve thermocouple availability. Install a system composed of in-core flux detectors and associated hard and software capable of providing to operator prompt information on core-wide neutron flux and/or power distribution. Cross calibration of signals from thermocouples, in-core flux detectors and ex-core flux detectors should be established.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	IN-CORE MONITORING	24	IN CORE FLUX MEASUREMENT Due to fuel jackets measurements were based on thermocouple indication. Since jackets have been modified, such measurements are not accurate anymore and axial flux measurement is necessary. Such system existed in the original design. This requirement is more important if new fuel design is used.	D+O	CORE	2.1	DESREV	1.5.4
II	IN-CORE MONITORING	25	FAILED THERMOCOUPLES The reactor can be operated with up to 25% failed thermocouples, if certain symetry conditions are respected. This limit seems high in the absence of a second system for neutron flux measurement.	D+O	CORE	2.1	DESREV	1.5.5.2
II	IN-CORE MONITORING	26	POWER MAPPING Verify how the operators manage the display of power mapping and what are the procedures in case of deviations.	D+O	CORE	2.1	DESREV	1.5.6.1
II	IN-CORE MONITORING	27	SELF POWER DETECTORS - KOLA In Kola, it will be interesting to analyse the Self Power Detector measurements and compare them with thermocouple measurements.	D	CORE	2.1	DESREV	1.5.6.2
II	IN-CORE MONITORING	121	3-D POWER DISTRIBUTION Taking into account operation requirements, the use of more extensive in core instrumentation with capability for 3-D power distribution monitoring would be advisable.	D+O	CORE	2.1	DESREV	4.4.4.A
II	IN-CORE MONITORING	307	FAILED THERMOCOUPLES LIMIT The limit of maximum number of failed thermocouples should be lowered to 25% (as in V-2).	D	CORE	2.1	BOHUNICE	7.6.(1)
II	IN-CORE MONITORING	308	3-D POWER DISTRIBUTION An improved system for on-line calculation of core power distribution should be installed.	D	CORE	2.1	BOHUNICE	7.6.(2)
II	IN-CORE MONITORING	587	3-D POWER DISTRIBUTION A in core flux measurement system should be developed and installed.	D	CORE	2.1	KOZLODUY	7.4.(1)
II	IN-CORE MONITORING	588	ON LINE FLUX MONITORING An on-line system, combining thermocouples and in core detectors and computer simulation should be developed and installed.	D	CORE	2.1	KOZLODUY	7.4.(2)
II	IN-CORE MONITORING	594	IN CORE FLUX MEASUREMENTS An in-core flux measurement system such as the Hindukush should be installed.	D	CORE	2.1	KOZLODUY	7.8.(2)
II	IN-CORE MONITORING	665	IN CORE FLUX MAPPING Replace neutron flux measuring system (Volna) by a more reliable system with continuous indication.	D	CORE	2.1	KOZLODUY	10.3.(2)
II	IN-CORE MONITORING	728	IN-CORE SYSTEM An in-core system that allows axial power profile monitoring and radial distribution should be implemented.	D	CORE	2.1	NOVOVORONE	7.8.(1)
II	IN-CORE MONITORING	1022	AXIAL POWER SHAPE FACTOR Axial power shape information from fixed in-core detector should be used to justify peaking factors during transient Xe conditions.	D	CORE	2.1	KOLA	7.1.(4)
II	IN-CORE MONITORING	1040	IN-CORE CROSS CALIBRATION Cross calibration of signals from thermocouples, fixed in-core detectors and ex-core detectors should be performed.	D	CORE	2.1	KOLA	7.8.(2)
II	IN-CORE MONITORING	1041	IN-CORE DATA UTILIZATION Data from in-core detectors should be utilized for more detailed peaking factor surveillance under Xe transient conditions.	D	CORE	2.1	KOLA	7.8.(3)

ISSUE NUMBER: Core 2

ISSUE TITLE: Core Design Margin Evaluation

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Fuel management and design criteria for fuel burnup were changed in comparison with original design. Different definitions of DNB and different DNB correlations are in use. The spectrum of core design bases transients is not completed to allow a comprehensive knowledge on the core design margin.

RELATED ITEMS:

3, 4, 8, 10, 580, 581, 582, 717, 719, 721, 722, 1026, 1032, 1039

JUSTIFICATION OF RANKING:

Although it is believed that the present core design is conservative, the full knowledge of design margins is necessary, according to international practices. The limits and conditions established for normal operations base mainly on the evaluation of the core design margin. This information should be available at the plant.

CONCEPTUAL RECOMMENDATIONS:

Systematic evaluation of core design margins should be performed using advanced calculational tools on the basis of actual core loadings and burnup targets. This includes a set of core design basis transients that cover all events with the potential of violating design limits.

This issue becomes more important if maximum burnup limits are increased, requiring a detailed analysis of its implication.

CAT	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	CORE DESIGN MARGIN EVALUATION	3	PEAKING FACTORS Fuel management was modified for some reactors to include shield assemblies. In these cases, the peaking factors have to be reviewed in order to be sure that design limits are respected.	D	CORE	1.8	DESREV	1.1.5.2.A
II	CORE DESIGN MARGIN EVALUATION	4	HIGHER BURNUP The design criterion for fuel burnup is no more valid. Nowadays higher values are attained, up to 43 MWd/kg in average. This is realised only in Kola plant, and a special licensing procedure has been undergone. A new fuel management policy will be necessary.	D+O	CORE	1.8	DESREV	1.1.5.4.
II	CORE DESIGN MARGIN EVALUATION	8	CORE DESIGN MARGIN Systematic evaluation of core design margins needs more investigation. This may lead to broadening of DBA spectrum on the basis of operational experience Also international developments should be taken into account.	D	CORE	1.4	DESREV	1.1.7.1.
II	CORE DESIGN MARGIN EVALUATION	10	CRITICAL HEAT FLUX RATIO Tha Critical Heat Flux Ratio of 1.0 needs more discussion.	D	CORE	2.2	DESREV	1.1.8.6
II	CORE DESIGN MARGIN EVALUATION	580	CORE DESIGN BASIS The core design basis and general design criteria should be obtained from Soviet designers.	D	CORE	1.4	KOZLODUY	7.1.(1)
II	CORE DESIGN MARGIN EVALUATION	581	CORE TRANSIENTS A set of design basis transients should be identified with assistance of Soviet designers.	D	CORE	1.4	KOZLODUY	7.1.(2)
II	CORE DESIGN MARGIN EVALUATION	582	DESIGN LIMITS VERIFICATION Perform sufficient analysis of design basis events to ensure that design limits are satisfied.	D	CORE	1.4	KOZLODUY	7.1.(3)
II	CORE DESIGN MARGIN EVALUATION	717	FUEL ROD DESIGN MODELS Report on models should be available including: densification, clad stress and strain, thermal expansion, fission gas release, crud deposition, clad oxidation, zirconium hydride formation, fuel rod growth, clad flattering, power history, transients, power limits under such events.	D	CORE	1.8	NOVOVORONE	7.2.(1)
II	CORE DESIGN MARGIN EVALUATION	719	XENON DISTRIBUTION Assess the impact of the worst xenon distribution on control rod withdrawal and on boron dilution events	D	CORE	1.11	NOVOVORONE	7.4.(1)
II	CORE DESIGN MARGIN EVALUATION	721	HOT ROD CALCULATIONS Weigh the rod powers obtained in PERMAK calculations with the power generated in the related axial region.	D	CORE	1.11	NOVOVORONE	7.4.(2)
II	CORE DESIGN MARGIN EVALUATION	722	Xe AND Sm CALCULATIONS The sharp variations in Xenon and Samarium concentrations during the early days of the fuel cycle should be considered in the calculations.	D	CORE	1.11	NOVOVORONE	7.6.(1)
II	CORE DESIGN MARGIN EVALUATION	1026	PELLET CLAD INTERACTION Pellet / clad interaction under transient conditions should be better evaluated and limits should be defined.	D	CORE	1.8	KOLA	7.2.(1)
II	CORE DESIGN MARGIN EVALUATION	1032	UNCERTAINTIES IN DNBR Uncertainties in DNBR due to flow distribution uncertainties, based on parameters such as number of plugged tubes, should be considered.	D	CORE	1.8	KOLA	7.5.(1)
II	CORE DESIGN MARGIN EVALUATION	1039	MEASUREMENT UNCERTAINTIES Thermocouple measurement uncertainty of 1% should be evaluated on a statistical basis.	D	CORE	1.8	KOLA	7.8.(1)

ISSUE NUMBER: Core 3

ISSUE TITLE: Fuel Examination

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Although fuel performance has been good, the few fuel failure cases have not been fully investigated due to lack of appropriate facilities or arrangements with suppliers.
Only sipping tests are carried out during refuelling, but rejection criteria is not according to international practices.

RELATED ITEMS:

12, 13, 279, 304, 585, 724

JUSTIFICATION OF RANKING:

Feedback of operating experience requires a complete investigation of failed fuels in order to identify the root causes and to take appropriate corrective action.

CONCEPTUAL RECOMMENDATIONS:
Reduce rejection criteria for sipping tests in accordance with international practices.
Perform a thorough examination of failed fuels, on site or through arrangement with outside laboratories, in order to identify root causes of failures and take appropriate action by modifying the design, the manufacturing process improving quality assurance or the operating conditions.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	FUEL EXAMINATION	12	BURNUP MEASUREMENTS There is a lack of documentation on burnup measurements carried out on WWER fuels (in order to validate the codes, specially at higher burnup).	D	CORE	1.8	DESREV	1.2.8.3.
II	FUEL EXAMINATION	13	FUEL FAILURE STATISTICS It is suggested to analyze the statistics on fuel failure and on primary water activity at each plant visited.	D+O	CORE	1.8	DESREV	1.3.6.1.
II	FUEL EXAMINATION	279	FUEL FAILURES Improve fuel design to be debris resistant and make audits in fuel design and fabrication.	O	CORE	1.8	BOHUNICE	5.5.(1)
II	FUEL EXAMINATION	304	POST FAILURE FUEL EXAMINATION Consideration should be given to perform post failure fuel examination in hot-cells in order to identify causes.	D	CORE	1.8	BOHUNICE	7.2.(1)
II	FUEL EXAMINATION	585	FUEL EXAMINATION All irradiated fuel should undergo wet sipping at the time of reload.	D	CORE	1.8	KOZLODUY	7.2.(1)
II	FUEL EXAMINATION	724	SIPPING TEST Reduce the Iodine activity test rejection limits according to international practices.	D	CORE	1.8	NOVOVORONE	7.7.(2)

ISSUE NUMBER: Core 4

ISSUE TITLE: Reloading Procedures and Test Programme

RANK OF ISSUE: II

ISSUE CLARIFICATION:
Existing reload procedures are not sufficiently formalized.
No systematic approach exists to perform a comparison of experimental and calculational results of core characteristics after core reload.

RELATED ITEMS:

11, 19, 20, 32, 33, 300, 306, 723, 725, 726, 727, 1019, 1027, 1028, 1031, 1033, 1035, 1038

JUSTIFICATION OF RANKING:

Prediction and verification of core design characteristics is important to ensure appropriate fuel performance, and to ensure that the plant is within its design basis.

CONCEPTUAL RECOMMENDATIONS:

Establish a more systematic approach to reloading calculation, reloading procedures and test programme to verify core characteristics and ensure high fuel performance.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	RELOADING PROCEDURES AND TEST PROGRAMME	11	RELOAD CALCULATIONS AND TESTS Calculations and measurements to be performed for each new load should be investigated. In this way, the predictions and the caracteristics of the new load are verified.	D+O	CORE	1.8	DESREV 1.2.6.1.
II	RELOADING PROCEDURES AND TEST PROGRAMME	19	ROD DROP MEASUREMENTS Rod drop measurements should be analyzed in detail during the plant specific review.	D	CORE	2.2	DESREV 1.4.5.3.
II	RELOADING PROCEDURES AND TEST PROGRAMME	20	MEASUREMENTS AT RE-STARTUP We suggest to perform more measurements at the begining of every cycle, e.g. reactivity coefficients and axial neutron flux distribution This will be still more useful in case of higher performance of the fuel.	D+O	CORE	1.8	DESREV 1.4.5.3.A
II	RELOADING PROCEDURES AND TEST PROGRAMME	32	STARTUP CORE EXPERIMENTS Experimental results obtained during startup and their comparison with theoretical predictions should be verified.	D+O	CORE	1.8	DESREV 1.7.6.2.
II	RELOADING PROCEDURES AND TEST PROGRAMME	33	AVOIDING LOADING ERRORS The procedures used to avoid loading errors during refueling should be analysed.	D+O	CORE	1.8	DESREV 1.7.6.3
II	RELOADING PROCEDURES AND TEST PROGRAMME	300	FUEL PERFORATION BY PASS Analyse deviations between calculated and measured power distribution for cores with perforated and old assemblies to estimate flow by-pass.	D	CORE	2.1	BOHUNICE 7.1.(1)
II	RELOADING PROCEDURES AND TEST PROGRAMME	306	ROD WORTH MEASUREMENTS Compare reactivity measurements based in point kinetics from at least two different ionization chamber locations.	D	CORE	2 2	BOHUNICE 7.4.(1)
II	RELOADING PROCEDURES AND TEST PROGRAMME	723	RELOADING CORE CRITICALITY A third in-core detector should be installed during refuelling to better control the core criticality.	D	CORE	2.2	NOVOVORONE 7.7.(1)
II	RELOADING PROCEDURES AND TEST PROGRAMME	725	FRESH FUEL EXAMINATION Fresh fuel assemblies should be inspected to be sure that no remaining debris are left.	D	CORE	1.8	NOVOVORONE 7.7 (3)
II	RELOADING PROCEDURES AND TEST PROGRAMME	726	SYMMETRY OF CORE LOADING An acceptance criterion should exist for the measurements thorough review of the design calculation should be done if the criterion is violated.	D	CORE	2 2	NOVOVORONE 7.7.(4)
II	RELOADING PROCEDURES AND TEST PROGRAMME	727	ROD WORTH MEASUREMENTS Measure the worth of every control rod group.	D	CORE	2.2	NOVOVORONE 7.7.(5)
II	RELOADING PROCEDURES AND TEST PROGRAMME	1019	RELOAD REQUIREMENTS UPDATE The designer of the reload, rather than the technitian should be responsible for updating technical requirement document.	D	CORE	1.19	KOLA 7.1.(1)
II	RELOADING PROCEDURES AND TEST PROGRAMME	1027	FUEL CROSS SHUFFLING Fuel assemblies should be shuffled across sectors to reduce probability of sector power tilts	D	CORE	1.8	KOLA 7.3.(1)
II	RELOADING PROCEDURES AND TEST PROGRAMME	1028	CALCULATION PROCEDURES Planned reload calculation procedures should be completed and implemented.	D	CORE	1.19	KOLA 7.3.(2)
II	RELOADING PROCEDURES AND TEST PROGRAMME	1031	ROD WORTH INTERCOMPARISON Comparison of rod worths based on reactivity meter and boron end-point method with calculated boron worth should be made.	D	CORE	1.8	KOLA 7.4.(1)
II	RELOADING PROCEDURES AND TEST PROGRAMME	1033	FRESH FUEL RANDOMIZATION Fresh fuel should be randomized in loading placement. Burned fuel should be loaded in sectors other than were they were last cycle.	D	CORE	1.8	KOLA 7.7.(1)
II	RELOADING PROCEDURES AND TEST PROGRAMME	1035	NUMBERING OF FUEL ASSEMBLIES Numbers on assemblies should consist of the number of the cycle on which they were fed and a serial number.	D	CORE	1 8	KOLA 7.7.(3)
II	RELOADING PROCEDURES AND TEST PROGRAMME	1038	FUEL TRANSPORTATION Accelerometers should be placed in fresh fuel containers and an acceptance criterion should be defined.	D	CORE	1.8	KOLA 7.7.(6)

ISSUE NUMBER: Systems 1

ISSUE TITLE: Confinement - Leaktightness

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Under original DBA conditions the confinement would exhibit a high volumetric leak rate due to limited leak tightness characteristics.

RELATED ITEMS:

65, 68, 335, 336, 337, 338, 658, 762, 798, 1076, 1114

JUSTIFICATION OF RANKING:

Current analysis has shown that a very high leakrate for the confinement exists such that given a design basis accident, moderate releases of radioactivity to the atmosphere would occur resulting in greatly increased public concern. Given the potentially severe consequences of a DBA and the minimal control of leakrate, this issue of significant concern.

CONCEPTUAL RECOMMENDATIONS:

Overall effectiveness of confinement should be significantly improved. However, because confinement was not designed to completely control leak rate, it may not be practical to reduce the rate such that radioactivity is entirely contained.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	CONFINEMENT - LEAKTIGHTNESS	65	HERMETIC COMPARTMENT FLAPS The weight operated valves (flaps) protecting the hermetic compartment against overpressure are not redundant. The same is also true for other isolation valves of the ventilation system.	D	SYSTEMS	3.7	DESREV	2.9.1.2
III	CONFINEMENT LEAKTIGHTNESS	68	HERMETIC COMPARTMENT LEAK It is recommended to implement measures to minimize the leak rate of the hermetic compartment and to establish test procedures for the compartment as a whole and for closing elements and penetrations.	D+O	SYSTEMS	3.7	DESREV	2.9.9
III	CONFINEMENT - LEAKTIGHTNESS	335	CONFINEMENT TEST When confinment leak is reduced, increase test pressure. Maintain test pressure for some time to assure stabilization.	D	COMPONENTS	3.7	BOHUNICE	9.7.(1)
III	CONFINEMENT - LEAKTIGHTNESS	336	CONFINEMENT DOOR CONTROL Establish administrative to avoid both internal and external confinment doors to be open at same time. Install alarm to detect this condition.	D	COMPONENTS	3.7	BOHUNICE	9.7.(2)
III	CONFINEMENT - LEAKTIGHTNESS	337	CONFINEMENT TIGHTNESS Improve confinment tightness by modifications in electrical penetrations, mechanical penetrations, door seals, cover plate checks. Perform local leak tests.	D	COMPONENTS	3.7	BOHUNICE	9.7.(3)
III	CONFINEMENT - LEAKTIGHTNESS	338	CONFINEMENT AIR CONDITIONED Install 2 fast closing valves, one inside other outside confinment in the air conditioned penetrations.	D	COMPONENTS	3.7	BOHUNICE	9.7.(4)
III	CONFINEMENT - LEAKTIGHTNESS	658	CONFINMENT TIGHTNESS Efforts to identify major confinment leak paths should be intensified and more efficient sealing arrangements for penetrations should be investigated.	D	COMPONENTS	3.7	KOZLODUY	9.9.(1)
III	CONFINEMENT - LEAKTIGHTNESS	762	PENETRATIONS The hermetic compartment penetration must be enhanced by a double isolation.	D	SYSTEMS	3.7	NOVOVORONE	8.9.(1)
III	CONFINEMENT - LEAKTIGHTNESS	798	HERMETIC ZONE INTEGRITY Limit switches should be provided on all access doors and wired to the main control room annunciator.	D	I&C	2.3	NOVOVORONE	10.7.(1)
III	CONFINEMENT - LEAKTIGHTNESS	1076	VENTILATION ISOLATION Double isolation of ventilation penetrations to steam generator compartment should be installed.	D	SYSTEMS	3.7	KOLA	8.8.(1)
III	CONFINEMENT - LEAKTIGHTNESS	1114	CONFINMENT LEAKTIGHTNESS Decisions and actions to improve confinment lektightness should be taken without delay. Tightness requirements should be determined. Leak rate should be measured.	D	COMPONENTS	3.7	KOLA	9.8.(1)

ISSUE NUMBER: Systems 2

ISSUE TITLE: Confinement - Severe Accident Conditions

RANK OF ISSUE: III

ISSUE CLARIFICATION:

The ability of the confinement to handle the conditions resulting from a severe core accident is in serious question. Significant H2 would be generated under a severe core accident and would be released to the relatively small confinement volume. While the confinement has a very high leak rate, it is judged to be insufficient to prevent the accumulation of explosive concentrations of H2 in the building. A major H2 explosion could cause the failure of the confinement structure, increasing accident severity and the release of radioactivity to the environment. Even if the confinement structure would maintain its integrity, the high confinement leak rate would result in significant radioactive release to the environment under severe accident conditions.

RELATED ITEMS:

626, 630, 764, 765, 1077

JUSTIFICATION OF RANKING:

A severe core accident generating significant radioactivity and H2 is of concern because of the shortcomings in prevention exhibited by the WWER 440/230. Significant radioactivity release due to high inherent leak rate and failure of confinement due to H2 explosion are expected given such an accident. Purpose of containment, to prevent large releases following severe accidents is not met. Achievement of upgrades to meet this purpose for a reasonable spectrum of events would greatly reduce risk.

CONCEPTUAL RECOMMENDATIONS:

Solutions for hydrogen control should be investigated, such as H_2 ignitors, as well as the potential of filtered venting to reduce the radioactive leaks.

Implement practical means of controlling radioactive releases following severe accidents such as forced filtered venting and use of H_2 ignitors. Following actions should be addressed:

* Determine ability of structure to withstand large blowdown forces.
* Evaluate and upgrade as necessary and practical relief valves.
* Determine potential for ignitors to significantly reduce H_2 explosion problem.
* Reduce leak rate to practical levels which can be maintained following blow down.
* Based on results of above analyses, determine practicality of installing severe accident filter with forced ventilation of the containment to maintain slight vacuum after initial blowdown.
* Determine overall practicality, cost effectiveness for specific plant, implement as warranted.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	CONFINEMENT - SEVERE ACCIDENT CONDITIONS	626	FILTERED VENTING OF CONFINMENT We support the plans for addition of a filtered venting system in the confinment to cope with all primary break spectrum.	D	SYSTEMS	3.7	KOZLODUY 8.5.(5)
III	CONFINEMENT - SEVERE ACCIDENT CONDITIONS	630	HYDROGENE CONTROL A study of potential H production should be performed. Recirculators or recombiners should be added if required.	D	SYSTEMS	3.7	KOZLODUY 8.5.(9)
III	CONFINEMENT - SEVERE ACCIDENT CONDITIONS	764	REINFORCING CONFINEMENT Install a device on the discharge from the hermetic compartment to decrease radioactive releases from into the atmosphere.	D	SYSTEMS	4.2	NOVOVORONE 8.9.(3)
III	CONFINEMENT - SEVERE ACCIDENT CONDITIONS	765	HYDROGEN CONTROL Quantify the hydrogen produced in post accidental situations and add hydrogen recombiners.	D	SYSTEMS	4.2	NOVOVORONE 8.9.(4)
III	CONFINEMENT - SEVERE ACCIDENT CONDITIONS	1077	STEAM GENERATOR COMPARTMENT Filtered venting system should be implemented to limit radioactive releases from steam generator compartment in case of accidents beyond design basis.	D	SYSTEMS	3.7	KOLA 8.8.(2)

ISSUE NUMBER: Systems 3

ISSUE TITLE: Decay heat removal. Ensuring adequate SG inventory

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

Some transients might cause significant loss of coolant from the SG's before the reactor is shutdown. Supply of new feedwater to the SG is endangered because the current systems for doing this are all located in the turbine building, and could be lost due to a common cause such as major fire. Potential single failures in the feedwater and auxiliary feedwater system have been identified which could completely prevent supply of water to the SG's.

RELATED ITEMS:

46-48, 53, 72, 314, 315, 613-615, 751-753, 755, 861, 862, 1062, 1065, 1066

JUSTIFICATION OF RANKING:

Decay heat removal is essential to prevent severe core damage. Currently the only proven method for decay heat removal is to use SG's, and adequate SG inventory is needed for this. The likelihood of losing SG inventory is high without corrective measures, as shown by the operating experience. The consequences of lost inventory could be very severe to the plant and to the general public living in its neighborhood.

CONCEPTUAL RECOMMENDATIONS:

1. Ensure early reactor trip in all transients that cause loss of coolant from the SG's.

2. Provide additional reliable means for supplying feedwater to the steam generators. Those means should not rely on any equipment located in turbine building. They should also have their own dedicated power supply, component cooling, and feedwater source.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	DECAY HEAT REMOVAL - SG INVENTORY	46	AUXILIARY FEEDWATER CAPACITY Due to the total water capacity available (1500m3), the system has supply capability for not less than 20 hours. It should be checked in each plant the way the different sources of water are used by the auxiliary feedwater pumps	D	SYSTEMS	4.6	DESREV 2.4.1.2
IV	DECAY HEAT REMOVAL - SG INVENTORY	47	AUX FEED BACKFITTING Due to potential damage by fire to aux-feed system, like the ones that ocurred in Greifwald (1975) and Armenia (1982), it is important to check if modifications implemented in Armenia and Kola have been also been done in other plants.	D+O	SYSTEMS	1.6	DESREV 2.4.6.A
IV	DECAY HEAT REMOVAL - SG INVENTORY	48	AUX FEED LAYOUT AND OPERATION A review of the layout and operating procedures of the auxiliary feedwater system should be performed in oreder to evaluate its sensitivity to common mode failure.	D+O	SYSTEMS	1.6	DESREV 2.4.7.
IV	DECAY HEAT REMOVAL - SG INVENTORY	53	WATER SOURCES FOR HEAT REMOVAL Should the various sources of water for alternative decay heat removal be lost, some emergency action would be required to provide further water supply. Operating procedures should be available to initiate emergency make-up. Such make-up would not be of normal quality and the effect of this water in system performance should be assessed.	D+O	SYSTEMS	4.6	DESREV 2.6.5.B
IV	DECAY HEAT REMOVAL SG INVENTORY	72	STEAM GENERATOR LOW LEVEL TRIP Steam generators are used in normal operation as well as for residual heat removal, being the exclusive link to the ultimate heat sink. Therefore it is recommended to reconsider implementation of reactor trip generated by low level in the steam generator.	D	SYSTEMS	2.3	DESREV 2.12.4
IV	DECAY HEAT REMOVAL - SG INVENTORY	314	SCRAM ON LOW SG LEVEL Install a steam generator low level scram signal.	D	SYSTEMS	2.3	BOHUNICE 8.2.(4)
IV	DECAY HEAT REMOVAL - SG INVENTORY	315	SUPER EMERGENCY FEEDWATER Complete planned modifications in super emergency feedwater system (external source, discharge line, double line).	D	SYSTEMS	3.6	BOHUNICE 8.3.(1)
IV	DECAY HEAT REMOVAL SG INVENTORY	613	EMERGENCY FEEDWATER CONNECTION Direct connection between emergency feedwater tank and pumps should be provided at units 1/2 similar to units 3/4.	D	SYSTEMS	3.6	KOZLODUY 8.3.(2)
IV	DECAY HEAT REMOVAL - SG INVENTORY	614	INTERCONNECTION BETWEEN TRAINS Interconnection between trains is recommended as a preliminary backfitting, before an overall backfitting of feedwater system is performed.	D	SYSTEMS	3.6	KOZLODUY 8.3.(3)
IV	DECAY HEAT REMOVAL - SG INVENTORY	615	SUPER EMERGENCY FEEDWATER We strongly support the inclusion of a separate emergency feedwater system.	D	SYSTEMS	3.6	KOZLODUY 8.3.(4)
IV	DECAY HEAT REMOVAL - SG INVENTORY	751	AFWS RELIABILITY Isolation valves located on the single and common pipeline betwen the deaerator and the AFWS pump discharge should be maintained open during normal operation.	D	SYSTEMS	3.6	NOVOVORONE 8.7.(1)
IV	DECAY HEAT REMOVAL - SG INVENTORY	752	AFWS BACKFITTING Install the suplementory auxiliary feedwater system now under development	D	SYSTEMS	1.6	NOVOVORONE 8.7.(2)
IV	DECAY HEAT REMOVAL - SG INVENTORY	753	AFWS PUMP AUTOMATIC The AFWS pump automatic device should be converted into alarms in the main control room.	D	SYSTEMS	2.3	NOVOVORONE 8.7.(3)
IV	DECAY HEAT REMOVAL - SG INVENTORY	755	AFWS LAYOUT Due to common mode potencialities implement a new steam generator auxiliary feedwater system outside the turbine hall.	D	SYSTEMS	1.6	NOVOVORONE 8.8.(1)
IV	DECAY HEAT REMOVAL SG INVENTORY	861	AUX FEED COMMON HEADER BREAK Segregation of the common header should be considered. In the meantime, the qualification of the isolation devices should be assessed.	D	ACCIDENT	3.6	NOVOVORONE 12.4.(3)
IV	DECAY HEAT REMOVAL - SG INVENTORY	862	STEAM LINE BREAK Segregation of the common header should be considered. Qualification of the isolation devices of the emergency feedwater system should be assessed.	D	ACCIDENT	3.6	NOVOVORONE 12.4.(4)
IV	DECAY HEAT REMOVAL - SG INVENTORY	1062	AFWS SINGLE FAILURE CRITERIA Modify the design of Auxiliary Feedwater System to cope with single failure criteria.	D	SYSTEMS	3.6	KOLA 8.5.(1)
IV	DECAY HEAT REMOVAL - SG INVENTORY	1065	AUX FEED STARTUP SIGNAL Review the choice of signals to start the auxiliary feedwater system. At present Loss of External Power plus Low SG level.	D	I&C	3 6	KOLA 8.5.(4)
IV	DECAY HEAT REMOVAL - SG INVENTORY	1066	AUX FEED COMMON CAUSE FAILURE A new, independent, geographically separated auxiliary feedwater system should be installed.	D	SYSTEMS	3.6	KOLA 8.6.(1)

ISSUE NUMBER: Systems 4

ISSUE TITLE: Decay heat removal. Heat removal path

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Cooling down of the plant and ensuring long-term heat removal in shutdown condition requires a reliable heat removal path from the SG's to the ultimate heat sink. In the hot shutdown conditions and in the first phase of cooling towards cold shutdown, the correct function of the steam system valves is needed. During the second cooling phase and the cold shutdown, the heat removal path consists of technical condenser, low pressure pumps, piping and valves which form a closed loop. All equipment needed for normal heat removal are located close to each other in the turbine building and the redundant equipment could be lost due to a common external cause. The heat removal path could also be lost due to a single failure.

RELATED ITEMS:

50, 51, 757, 758

JUSTIFICATION OF RANKING:

Without heat removal path the plant safety can be provided only for a limited time. The time depends on the state of the steam system valves and the amount of feedwater available.

CONCEPTUAL RECOMMENDATIONS:

1. Install additional equipment as needed to make the heat removal path single failure proof.

2. Separate redundant equipment by physical barriers or increased distance between them.

3. Protect the steam system valves from external hazards.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	DECAY HEAT REMOVAL - HEAT REMOVAL PATH	50	TECHNOLOGICAL CONDENSER Steam generator are used to remove decay heat down to cold shutdown conditions, using technical condenser. Both technical condenser pummps are located in the same cell in turbine building. No segregation or protection is provided. Operational experience records that failure of both pumps has occurred.	D	SYSTEMS	1.6	DESREV 2.6.1
II	DECAY HEAT REMOVAL - HEAT REMOVAL PATH	51	DECAY HEAT REMOVAL Normal shutdown procedures has 2 diverse means of heat removal initially. Thereafter, it is dependent upon the technical condenser. The lack of segregation betwee the two trains of technical condenser equipment requires careful consideration of the consequences and the frequency of system failure.	D	SYSTEMS	1.6	DESREV 2.6.5
II	DECAY HEAT REMOVAL - HEAT REMOVAL PATH	757	REACTOR SHUTDOWN COOLING Loss of the reactor shutdown cooling system induced by a common mode failure needs to be addressed by installating a new system outside the turbine hall.	D	SYSTEMS	1.6	NOVOVORONE 8.8.(3)
II	DECAY HEAT REMOVAL - HEAT REMOVAL PATH	758	COMMON CAUSE FAILURE Install the steam relief valves, the safety valves, and the steam isolation valves and their auxiliaries outside the turbine hall, or protect them against common cause failure induced by fire or pipe whip.	D	SYSTEMS	1.6	NOVOVORONE 8.8.(4)

ISSUE NUMBER: Systems 5

ISSUE TITLE: Decay Heat Removal. Service Water System

RANK OF ISSUE: III

ISSUE CLARIFICATION:
The service water system is essential as an ultimate heat sink. It provides cooling for vital safety systems such as diesel generators and removes the decay heat under LOCA conditions. Even a short loss of the service water system would result in abnormal plant conditions where the sequence of events would be unpredictable and which would be difficult to control by the operator. The complexity of the consequences would be increased by the fact that the system serves two plant units.

The vital equipment of the system are located close to each other and could all be lost due to a common external cause. Also a number of potential single failures has been identified that would result in loss of the system. A major leak in the service water system might cause flooding of other safety relevant systems.

A specific concern with the service water system is lack of intermediate cooling system between the service water system and the systems or components to be cooled. An internal leak in the heat exchanger would cause either entry of untreated water into the systems with special water chemistry requirements or a leak of radioactive coolant to the environment.

Inadequate possibilities exist for monitoring the state of the service water system piping and other components.

RELATED ITEMS:
62, 69-71, 622-624, 745, 746, 761, 766, 1072, 1073, 1075

JUSTIFICATION OF RANKING:

The decay heat removal can be provided only for a very short time without service water system. There are severe shortcomings that influence the reliability of the system.

CONCEPTUAL RECOMMENDATIONS:
1. Install additional equipment as needed to make the service water system single failure proof.
2. Separate redundant equipment by physical barriers or by increased distance between them.
3. Implement inspections as needed to monitor the physical condition of the service water system piping, especially in locations where the likelihood of a large leak is highest.
4. Address the concerns related to the lack of intermediate cooling circuit.
5. Provide separate single failure proof cooling for the diesel generators.

CAT	ISSUE	ITEM n	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	DECAY HEAT REMOVAL -SERVICE WATER SYSTEM	62	SPRAY SYSTEM HEAT EXCHANGERS As the spray system heat exchangers are cooled by service water, there is only one barrier left between primary coolant and the outside in case of primary pipe break.	D	SYSTEMS	3.6	DESREV 2.8.5
III	DECAY HEAT REMOVAL -SERVICE WATER SYSTEM	69	LOSS OF SERVICE WATER Due to multiple dependencies including two units and due to lack of diversity for cooling, a total loss of service water seems to lead to severe consequences which should be investigated.	D	SYSTEMS	1 6	DESREV 2.10 5
III	DECAY HEAT REMOVAL -SERVICE WATER SYSTEM	70	BLACKOUT DUE TO SERVICE WATER Of particular concern is the situation identified in Greifswald where a station blackout was caused by loss of service water.	D	SYSTEMS	1.6	DESREV 2.10.6
III	DECAY HEAT REMOVAL -SERVICE WATER SYSTEM	71	SEGREGATION OF SERVICE WATER All pumps of the service water are located in the same cell. Common mode failures have to be investigated.	D	SYSTEMS	1.6	DESREV 2.10.5.2
III	DECAY HEAT REMOVAL -SERVICE WATER SYSTEM	622	ESSENTIAL SERVICE WATER Provide two separate pumping houses, one for normal operation and other for essential service water.	D	SYSTEMS	3.6	KOZLODUY 8.5.(1)
III	DECAY HEAT REMOVAL -SERVICE WATER SYSTEM	623	SEPARATE COOLING FUNCTIONS Separate the cooling functions for safety and non-safety systems.	D	SYSTEMS	3 6	KOZLODUY 8.5.(2)
III	DECAY HEAT REMOVAL -SERVICE WATER SYSTEM	624	ESSENTIAL COMPONENT COOLING Install a separate cooling system for safety related components	D	SYSTEMS	3.6	KOZLODUY 8.5.(3)
III	DECAY HEAT REMOVAL SERVICE WATER SYSTEM	745	SPRAY SYSTEM HEAT EXCHANGERS Heat exchanger should be equipped with a radioactivity measurement on the service water system side.	D	SYSTEMS	3.6	NOVOVORONE 8.5.(2)
III	DECAY HEAT REMOVAL SERVICE WATER SYSTEM	746	SPRAY SYSTEM HEAT EXCHANGERS Design should be improved to prevent clogging of the connected pipes and to avoid fouling of the heat exchanger tubes create an intermediate cooling system filled with demineralized water.	D	SYSTEMS	3.6	NOVOVORONE 8.5.(3)
III	DECAY HEAT REMOVAL SERVICE WATER SYSTEM	761	SERVICE WATER SEGREGATION Service water pump station should be divided into two independent trains with physical barrier.	D	SYSTEMS	1.6	NOVOVORONE 8.8.(7)
III	DECAY HEAT REMOVAL -SERVICE WATER SYSTEM	766	INTERMEDIATE COOLING SYSTEM Create a closed intermediate cooling system for the safety component cooling	D	SYSTEMS	3.6	NOVOVORONE 8.10.(1)
III	DECAY HEAT REMOVAL SERVICE WATER SYSTEM	1072	SERVICE WATER SEPARATION Physical separation of the emergency service water system should be implemented.	D	SYSTEMS	1.6	KOLA 8.6.(7)
III	DECAY HEAT REMOVAL -SERVICE WATER SYSTEM	1073	SERVICE WATER SINGLE FAILURE Modifify service water system to cope with single failure criteria.	D	SYSTEMS	1.6	KOLA 8.7.(1)
III	DECAY HEAT REMOVAL SERVICE WATER SYSTEM	1075	SERVICE WATER HEAT EXCHANGER Analyse the consequence of rupture in service water heat exchanger and define measures to be taken to avoid releases.	D	SYSTEMS	1.7	KOLA 8.7.(3)

ISSUE NUMBER: System 6

ISSUE TITLE: Decay Heat Removal. Component Reliability

RANK OF ISSUE: III

ISSUE CLARIFICATION:

The failure probability of active components needed for decay heat removal purposes shall be small to ensure adequate reliability. The existing systematic recording and evaluation of failure data has shown that the reliability of the original WWER-440 components is not adequate. For this reason it has been necessary to replace key components such as auxiliary feedwater pumps with a new type.

RELATED ITEMS:

659, 660

JUSTIFICATION OF RANKING:

Adequate safety function reliability can not be achieved without components that meet minimum reliability targets.

CONCEPTUAL RECOMMENDATIONS:

Assess the component failure records and change the components as found necessary. At the same time, acquire spare components of the current type to ensure fast repairs.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	DECAY HEAT REMOVAL-COMPONENT RELIABILITY	659	REMNANT LIFE ESTIMATION The programme to estimate remnant life should be carried out to its second phase.	D	COMPONENTS	1.4	KOZLODUY 9.10.(1)
III	DECAY HEAT REMOVAL-COMPONENT RELIABILITY	660	SECONDARY COMPONENTS LIFE Projec to evaluate structure condition of secondary side equipment should be completed in its second phase.	D	COMPONENTS	1.4	KOZLODUY 9.10.(2)

ISSUE NUMBER: Systems 7

ISSUE TITLE: ECCS - Full LOCA spectrum capability and long term cooling.

RANK OF ISSUE: III

ISSUE CLARIFICATION:

The ECCS systems are not able to provide an adequate safety function for short and long term cooling for the full spectrum of LOCA's.

RELATED ITEMS:

384, 628, 689, 856

JUSTIFICATION OF RANKING:

There are no accumulators or low pressure injection system, to adequately to deal with medium and large primary circuit breaks. The impact of medium and large break LOCA would be extremely serious when combined with the confinement integrity and leak rate concerns.

In the absence of low pressure injection system, the functional capability of the ECCS for long-term cooling and recirculation is also significantly diminished.

CONCEPTUAL RECOMMENDATIONS:

Feasibility of installing Low Pressure Injection (LPI) and/or accumulators should be determined.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	ECCS - FULL LOCA SPECTRUM CAPABILITY	384	STARTUP OF SPRAY PUMPS Check the possibility of earlier connection of the spray pumps to the Diesel to achieve lower confinment peak pressure and reduce activity release.	D	ACCIDENT	3.6	BOHUNICE	11.9.(2)
III	ECCS - FULL LOCA SPECTRUM CAPABILITY	628	SPRAY CAPABILITY Review spray system design capability and performance after new accident analysis for all LOCA spectrum.	D	SYSTEMS	3.7	KOZLODUY	8.5.(7)
III	ECCS - FULL LOCA SPECTRUM CAPABILITY	689	HYDRO ACCUMULATORS High pressure hydro accumulators should be installed.	D	ACCIDENT	3.6	KOZLODUY	11.2.(1)
III	ECCS - FULL LOCA SPECTRUM CAPABILITY	856	ACCUMULATORS FOR LARGER LOCA The concerns (high energy tanks in the reactor building, coincident top and bottom core flooding) should be addressed before making a decision on the design of the accumulators.	D	ACCIDENT	1.11	NOVOVORONE	12.3.(11)

ISSUE NUMBER: Systems 8

ISSUE TITLE: ECCS - Redundancy and Physical Separation of Redundant Parts

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

The current ECCS is lacking adequate redundancy and might be lost as a consequence of a single failure. Common mode/common cause failure of ECCS function is a general concern because of lack of equipment separation.

Several other shortcomings have been identified that influence reliability of existing high pressure injection system and spray system: equipment qualification for accident environment functional capability for long term cooling and recirculation spray effectiveness, EC tank integrity, potential for foreign material blockage of pumps needed for ECCS recirculation, and function bypass through break in hot legs. Furthermore, borated water heatup during early LOCA scenarios, sump pump capacity problems with extensive spills and resulting flooding of vital parts of the injection and spray system could cause total loss of their safety function. The flooding could also originate from tank or pipe rupture as well as from fire fighting.
Material and quality issues as well as long runs of small piping also raise concerns about the likelihood of LOCA.

RELATED ITEMS:

54, 55, 58-61, 63, 64, 75-77, 379, 401, 507, 619, 627, 739, 743, 744, 747, 759, 1053, 1054, 1056, 1057, 1068, 1070, 1168, 1178

JUSTIFICATION OF RANKING:

Concerns about redundancy and separation of ECCS components are significant and can result in system failure under accident conditions.

CONCEPTUAL RECOMMENDATIONS:

A failure modes and effects analysis (or similar analysis) should be conducted to identify the major areas where improvements should be made.

A physical separation concept should be developed, segregation of the high pressure injection and spray systems should be considered. Long term cooling strategy should be analyzed and developed.

CAT	ISSUE	ITEM n	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	ECCS - REDUNDANCY AND SEPARATION	54	SAFETY INJECTION POINTS Some stations have modified the emergency injection points The 12 cold leg points are no longer used and injection is in 2 hot legs Injection on hot leg must be demonstrated to be effective.	D	SYSTEMS	3 6	DESREV 2.7.5 1.
IV	ECCS REDUNDANCY AND SEPARATION	55	HOT LEG INJECTION REDUNDANCY In plants were safety injection is in 2 hot legs, the reduction of injection poits must be assessed. Of concern is a break in a leg so that all injection from one train is lost to the break, coupled with a single failure in the other train.	D	SYSTEMS	3.6	DESREV 2.7.5.1.A
IV	ECCS REDUNDANCY AND SEPARATION	58	PUMPS SEGREGATION The lack of segregation between the spray, safety injection and borated water pumps requires some consideration. It is recommended that site visits assess the potential for hazards such as fires, flood, pipe whip, etc Of particular concern are the location of the borated water storage tank and the absence of fire suppression system	D	SYSTEMS	1.6	DESREV 2.7.5.4
IV	ECCS - REDUNDANCY AND SEPARATION	59	PUMPS QUALIFICATION The environmental qualification of spray and safety injection pumps has to be confirmed.	D	SYSTEMS	3.3	DESREV 2.7.5.5
IV	ECCS - REDUNDANCY AND SEPARATION	60	REPLACEMENT OF INJECTION PUMPS Injection pumps type E.P.-50 are being replaced by TS-N-65-130. This should be checked on the sites.	D	SYSTEMS	3.6	DESREV 2.7.5.6
IV	ECCS - REDUNDANCY AND SEPARATION	61	RECIRCULATION FOLLOWING A LOCA Qualification of high pressure safety injection pumps for long term recirculation following a LOCA should be checked.	D	SYSTEMS	3.6	DESREV 2.7.5.7
IV	ECCS - REDUNDANCY AND SEPARATION	63	SPRAY PUMP COMMON MODE FAILURE As the spray pumps and the safety injection pumps are all in the same room, under the borated water storage tank, the risk of flooding all the pumps and other potencial common mode failures should be investigated.	D	SYSTEMS	1.6	DESREV 2.8.6
IV	ECCS - REDUNDANCY AND SEPARATION	64	FILTERING DEVICES The capacity of filtering devices to prevent damage to spray and injection pumps should be evaluated.	D	SYSTEMS	3.6	DESREV 2.8.9
IV	ECCS - REDUNDANCY AND SEPARATION	75	LOSS OF REDUNDANT SYSTEMS Due to the poor degree of system redundancy, diversity and segregation, it is recommended to systematically evaluate the consequences of total loss of redundant systems. It is also recommended to define the existing possibilities to cope with such accidents.	D	SYSTEMS	1.6	DESREV III.2.2.4
IV	ECCS - REDUNDANCY AND SEPARATION	76	LONG TERM COOLING It is recommended to investigate the functional capability of the emergency cooling system for long term cooling.	D	SYSTEMS	3.6	DESREV III.2.2.5
IV	ECCS REDUNDANCY AND SEPARATION	77	SYSTEM/COMPONENT QUALIFICATION System and component qualification, including environmental conditions during normal and adverse plant conditions should be investigated	D	SYSTEMS	3.3	DESREV III.2.2.6
IV	ECCS - REDUNDANCY AND SEPARATION	379	SAFETY INJECTION HEADER Install valves in each injection line or a partion in the safety injection header to limit break size in case of header rupture.	D	ACCIDENT	1.6	BOHUNICE 11.6.(4)
IV	ECCS - REDUNDANCY AND SEPARATION	401	FLOODING OF SI PUMP ROOM Potential flooding of Safety Injection pump room should be investigated. From fire emergency point of view a adequate sump pump should be installed.	O	FIRE	1.6	BOHUNICE 12.4.(5)
IV	ECCS - REDUNDANCY AND SEPARATION	507	TESTING OF SPRAY SYSTEM Modification should be introduced to ensure that spray system componets can be teste adequately, without deactivating the system completely.	O	OPS	3.4	KOZLODUY 3.7.(8)
IV	ECCS - REDUNDANCY AND SEPARATION	619	EMERGENCY COOLING WATER TANK Perform a analyses of emergency cooling water tank in the early stages of a DBA. Reinforce the tank or add sump isolation if necessary.	D	SYSTEMS	3.6	KOZLODUY 8.4.(2)
IV	ECCS - REDUNDANCY AND SEPARATION	627	CONFINMENT SPRAY We support the proposal to segregate different trains of confinment spray	D	SYSTEMS	3.7	KOZLODUY 8.5.(6)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
			system and separate the system from others.					
IV	ECCS - REDUNDANCY AND SEPARATION	739	HOT LEG INJECTION REDUNDANCY The numbers of injection lines into the hot primary legs should be increase to meet the single failure criterion.	D	SYSTEMS	3.6	NOVOVORONE	8.3.(1)
IV	ECCS - REDUNDANCY AND SEPARATION	743	BORON TANK & PUMPS AFTER LOCA The water temperature in the boron tank and at safety inyection pumps should be compatible with their design limits.	D	SYSTEMS	3.6	NOVOVORONE	8.4.(3)
IV	ECCS - REDUNDANCY AND SEPARATION	744	SPRAY SYSTEM Improve its design in order to meet single failure criteria and to increase its reliability.	D	SYSTEMS	3.7	NOVOVORONE	8.5.(1)
IV	ECCS - REDUNDANCY AND SEPARATION	747	TESTING OF SPRAY SYSTEM Study if the cooling line on the borated water tank can be permanently maintained open and serve as a zero flow line for the spray pumps.	D	SYSTEMS	3.4	NOVOVORONE	8.5.(4)
IV	ECCS - REDUNDANCY AND SEPARATION	759	COMMON CAUSE FAILURE Common cause failure risk in the boron room requires protection to avoid the loss of the two trains of the spray system and safety injection system.	D	SYSTEMS	1.6	NOVOVORONE	8.8.(5)
IV	ECCS - REDUNDANCY AND SEPARATION	1053	NEW SAFETY INJECTION PUMPS New safety injection pumps with 63m3/hour flow rate and design temperature 100 C , should be installed.	D	SYSTEMS	3.6	KOLA	8.3.(1)
IV	ECCS - REDUNDANCY AND SEPARATION	1054	ECCS SINGLE FAILURE CRITERIA Safety injection system should be modified to meet single failure criteria (at least the active one).	D	SYSTEMS	1.6	KOLA	8.3.(2)
IV	ECCS - REDUNDANCY AND SEPARATION	1056	SAFETY INJECTION INTERLOCK Provide interlock to avoid more than two safety injection pump switches being put in the "off" position.	D	SYSTEMS	3.6	KOLA	8.3.(4)
IV	ECCS - REDUNDANCY AND SEPARATION	1057	SPRAY SINGLE FAILURE CRITERIA The spray system should be modified with respect to singla failure criteria.	D	SYSTEMS	3.6	KOLA	8.3.(5)
IV	ECCS - REDUNDANCY AND SEPARATION	1068	BORON ROOM PHYSICAL SEPARATION Physical separation should be implemented in the boron room.	D	SYSTEMS	3.6	KOLA	8.6.(3)
IV	ECCS - REDUNDANCY AND SEPARATION	1070	ECCS SUPPORT SYSTEMS Redundant ventilation system should be installed tocool safety injection and spray pumps. Cooling of safety injection pump oil should be handled by a redundant system.	D	SYSTEMS	3.6	KOLA	8.6.(5)
IV	ECCS - REDUNDANCY AND SEPARATION	1168	SINGLE FAILURE CRITERIA Single failure criteria and conservative assumptions should be systematically applied.	D	ACCIDENT	1.11	KOLA	12.1.(4)
IV	ECCS - REDUNDANCY AND SEPARATION	1178	ECCS SINGLE FAILURE The single failure criterion should be systematically used in the redesign of the Emergency Core Cooling System.	D	ACCIDENT	1.11	KOLA	12.5.(3)

ISSUES NUMBER: Systems 9

ISSUE TITLE: ECCS - Primary Break Isolation Options

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Use of primary circuit isolation valves to isolate primary system leaks has been proposed as an emergency procedure option. Such isolation involves a significant risk of pressurized thermal shock, if the primary circuit temperature has decreased below the normal operating temperature before isolation. A wrong diagnosis of the break location, followed by closure of wrong valves may also cause a complicated accident sequence.

RELATED ITEMS:

39

JUSTIFICATION OF RANKING:

Use of primary isolation valves might be a viable method of controlling the effects of a LOCA given the current design deficiencies and failure mode potential. On the other hand, it involves significant risks if not done properly.

CONCEPTUAL RECOMMENDATIONS:

In case the primary circuit isolation valve operation is considered as a procedure option during a LOCA, supporting analysis should be conducted to evaluate primary system pressure transients and system pressure control.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	ECCS - PRIMARY BREAK ISOLATION OPTIONS	39	PRIMARY LOOP ISOLATION STUDY The effect of closing the isolation valves after an spectrum of leaks (including design basis leak) should be investigated. This should include operating procedures and operator response.	D	SYSTEMS	1.11	DESREV	2.1.7.

ISSUE NUMBER: Systems 10

ISSUE TITLE: Main Steamline Isolation

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

A main steamline break would result in rapid overcooling of the primary and loss of secondary water which could cause a severe thermal shock to the primary system and in particular the reactor pressure vessel. Due to the RPV embrittlement problems, the vessel temperature could drop below the NDT limit.

RELATED ITEMS:

49, 311-313, 361, 381, 609-611, 697, 737, 1049, 1191

JUSTIFICATION OF RANKING:

The RPV embrittlement problems that have been identified make this a potentially severe accident that could result in brittle fracture of the RPV.

CONCEPTUAL RECOMMENDATIONS:

Install fast closing automatic isolation valves to limit the thermal shock to the Reactor Pressure Vessel to an acceptable level, following a main steam line break. The number, location and performance of the valves must be evaluated taking into account, as a minimum:

- the results of the accident analyses,
- the single failure criterion,
- the possibility of installing flow restrictors at the steam generator outlet nozzles,
- isolation valve placement may reduce available decay heat removal paths.

CAT.	ISSUE	ITEM n.	TIITLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	MAIN STEAM LINE ISOLATION	49	MAIN STEAM ISOLATION VALVES The Soviet decision to backfit MSIVs with considerable care, because the positioning may leave the SG safety valves as the only means of decay heat removal (i.e. MSIVs could eliminate the usage of the regulating relief valve and the normal path of decay heat removal through main condenser or technological condenser.	D	SYSTEMS	3.6	DESREV 2.5.2
IV	MAIN STEAM LINE ISOLATION	311	AUTO STEAM ISOLATION VALVES Complete installation of automatic system for actuation of fast acting steam isolation valves (presently manually actuated).	D	SYSTEMS	3.6	BOHUNICE 8.2.(1)
IV	MAIN STEAM LINE ISOLATION	312	DOUBLE STEAM ISOLATION Double the fast acting steam isolation valve on the main steam collector to take into account single failure.	D	SYSTEMS	3 6	BOHUNICE 8.2 (2)
IV	MAIN STEAM LINE ISOLATION	313	STEAM GENERATOR ISOLATION Avoid installing fast acting isolation valves on each steam generator because they are not necessary and may cause other incidents	D	SYSTEMS	3 6	BOHUNICE 8 2 (3)
IV	MAIN STEAM LINE ISOLATION	361	STEAM LINE ISOLATION The existing instrumentation for localization of steam line break should be complemented with a logic circuit for automatic leak isolation	D	I&C	3.6	BOHUNICE 10 5.(3)
IV	MAIN STEAM LINE ISOLATION	381	STEAM HEADER ISOLATION Install another fast closing isolation valve in the main steam header, between the two maintenance valves.	D	ACCIDENT	3.6	BOHUNICE 11.7.(1)
IV	MAIN STEAM LINE ISOLATION	609	SG FLOW RESTRICT We support the proposal to install flow restrictors at the 5 steam generator outlet nozzles	D	SYSTEMS	3.6	KOZLODUY 8.2.(2)
IV	MAIN STEAM LINE ISOLATION	610	FAST ACTING ISOLATION VALVES We strongly support the proposal to include fast acting main steam isolation valves.	D	SYSTEMS	3 6	KOZLODUY 8.2.(3)
IV	MAIN STEAM LINE ISOLATION	611	POSITION OF STEAM DUMP VALVES We strongly support the proposal to move steam dump valve behind the fast acting main steam isolation valves.	D	SYSTEMS	3.6	KOZLODUY 8.2.(4)
IV	MAIN STEAM LINE ISOLATION	697	STEAM GENERATOR ISOLATION Possibilities to isolate main steam with valves in steam collector or one in each steam line should be analysed to select the most appropriate one	D	ACCIDENT	3.6	KOZLODUY 11.3 (1)
IV	MAIN STEAM LINE ISOLATION	737	WATER HAMMER Spurиuos closure of a fast acting main steam isolation valve in the cold shutdown situation should not cause damage on the corresponding line due to water hammer.	D	SYSTEMS	1.9	NOVOVORONE 8.2.(1)
IV	MAIN STEAM LINE ISOLATION	1049	MAIN STEAM LINE ISOLATION Replace the six steam isolation valves by six fast acting isolation valves.	D	SYSTEMS	3.6	KOLA 8.2.(1)
IV	MAIN STEAM LINE ISOLATION	1191	STEAM LINE ISOLATION Fast acting steam isolation valves should be installed in each steam line according to schedule.	D	ACCIDENT	3.6	KOLA 12.7.(1)

ISSUE NUMBER: Systems 11

ISSUE TITLE: Primary Circuit Pressure Relief

RANK OF ISSUE: III

ISSUE CLARIFICATION:

In the original WWER 440/230 design, safety relief valves are provided on the pressurizer. These valves are not qualified to relieve water and their operational reliability is not proven to be adequate under various operating conditions.

RELATED ITEMS:

41, 42, 310, 604, 605, 606, 607, 734-736, 794, 1043

JUSTIFICATION OF RANKING:

Reactor coolant system integrity strongly depends on the reliable operation of primary relief valves. Unreliability of the relief valves and associated components under various operating conditions could result in damage to the primary circuit or the RPV and this presents a severe safety hazard.

CONCEPTUAL RECOMMENDATIONS:

Determine and verify the functional requirements and the reliability targets for the pressurizer relief valves, considering both opening and closing of the valves. Install new valves meeting all requirements.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	PRIMARY CIRCUIT PRESSURE RELIEF	41	LACK OF BLOCK VALVES The frequency of LOCA will be affected by the absence of block valves in the pressurizer relief lines.	D	SYSTEMS	1.10	DESREV	2.2.5.1.
III	PRIMARY CIRCUIT PRESSURE RELIEF	42	PRESSURIZER RELIEF VALVES The proposed replacement of pressurizer spring relief valves by PORVs (pilot operated relief valves) has advantages with respect to bleed and feed, but further studiy issuggested to confirm that the overall functional requirements are met with adequate reliability.	D	SYSTEMS	1.10	DESREV	2.2.5.3
III	PRIMARY CIRCUIT PRESSURE RELIEF	310	NEW PRESSURIZER SAFETY VALVES Complete replacement of pressurizer safety valves by new anti-seismic model.	D	SYSTEMS	1.10	BOHUNICE	8.1.(2)
III	PRIMARY CIRCUIT PRESSURE RELIEF	604	PRESSURIZER RELIF TANK It is strongly recommended to change the pressurizer relief tank to one with higher capacity.	D	SYSTEMS	1.10	KOZLODUY	8.1.(9)
III	PRIMARY CIRCUIT PRESSURE RELIEF	605	PRESSURIZER RELIEF CONNECTION Until pressurizer relief tank is replaced, implement a relief tank connection to the emergency water tank.	D	SYSTEMS	1.10	KOZLODUY	8.1.(10)
III	PRIMARY CIRCUIT PRESSURE RELIEF	606	FEED AND BLEED OPERATION Feed and bleed opeartion mode should be analyzed in datail, considering backfittings in emergency core cooling and confinment.	D	SYSTEMS	4.4	KOZLODUY	8.1.(11)
III	PRIMARY CIRCUIT PRESSURE RELIEF	607	FEED AND BLEED RELIABILITY A reliability analysis of the new feed and bleed system should be performed.	D	SYSTEMS	4.4	KOZLODUY	8.1.(12)
III	PRIMARY CIRCUIT PRESSURE RELIEF	734	PRESSURIZER VALVE ISOLATION Pressurizer valves should be isolated in such a way that their function for protection against overpressure be maintained.	D	SYSTEMS	1.10	NOVOVORONE	8.1.(5)
III	PRIMARY CIRCUIT PRESSURE RELIEF	735	VALVE QUALIFICATION The pressurizer valves should be qualified for water discharge.	D	SYSTEMS	1.10	NOVOVORONE	8.1.(6)
III	PRIMARY CIRCUIT PRESSURE RELIEF	736	PRESSURIZER VALVE DISCHARGE The installation of two separate discharge lines should be studied and implemented.	D	SYSTEMS	1.10	NOVOVORONE	8.1.(7)
III	PRIMARY CIRCUIT PRESSURE RELIEF	794	PRESSURIZER SAFETY VALVE Opening pressure, with and without power to the control circuit, should be determined and checked against the required values for all plant operating modes.	D	I&C	1.21	NOVOVORONE	10.2.(3)
III	PRIMARY CIRCUIT PRESSURE RELIEF	1043	PRESSURIZER SAFETY VALVES Replace four pressurizer safety valves with 2 PORVs.	D	SYSTEMS	1.10	KOLA	8.1.(1)

ISSUE NUMBER: Systems 12

ISSUE TITLE: Secondary Circuit Pressure Relief

RANK: II

ISSUE CLARIFICATION:

In the original WWER 440/230 design 2 safety relief valves are provided for each steam generator on the secondary side. These valves are not qualified to relieve water and their operability is not proven to be reliable. Removal of secondary system pressure relief is also possible by isolation of the steam header with the MSIV.

RELATED ITEMS:

602, 603, 738, 1050, 1051

JUSTIFICATION OF RANKING:

Reactor coolant and secondary system integrity strongly depend on the reliable operation of secondary circuit safety valves. Isolation of downstream safety valves by shutting MSIV does not meet single failure criteria, and poses a safety hazard.

CONCEPTUAL RECOMMENDATIONS:

Determine and verify the functional requirements and the reliability targets for the SG safety valves, considering both opening and closing of the valves. Install new valves meeting all requirements. To meet single failure criteria, installation of a redundant safety discharge circuit located up stream of the MSIV should be addressed.

CAT.	ISSUE	ITEM n.	TIITLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	SECONDARY CIRCUIT PRESSURE RELIEF	602	STEAM RELIEF VALVES Complete planned change of steam generator relief valves.	D	SYSTEMS	3.6	KOZLODUY	8.1.(7)
II	SECONDARY CIRCUIT PRESSURE RELIEF	603	SEGREGATION OF REDUNDANT LINES Segregation of redundant pressurizer relief valve lines should be realized.	D	SYSTEMS	1.9	KOZLODUY	8.1.(8)
II	SECONDARY CIRCUIT PRESSURE RELIEF	738	ATMOSPHERIC DISCHARGE CIRCUIT Install a redundant atmospheric discharge circuit, located upstream of the main steamline isolation valve to satisfy the single failure criterion.	D	SYSTEMS	3.6	NOVOVORONE	8.2.(2)
II	SECONDARY CIRCUIT PRESSURE RELIEF	1050	STEAM RELIEF VALVES Analyse the replacement of the two steam generator PORVs by two others having greater flow.	D	SYSTEMS	3.6	KOLA	8.2.(2)
II	SECONDARY CIRCUIT PRESSURE RELIEF	1051	QUALIFICATION OF SG PORVS Steam generator PORVs should be qualified for water relief conditions.	D	SYSTEMS	3.6	KOLA	8.2.(3)

ISSUE NUMBER: System 13

ISSUE TITLE: Reliable Isolation

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Single isolation valves in pipes connected to primary side provide the primary circuit boundary. Failure of pipes or components connected to the primary circuit may lead to a loss of primary coolant inside the confinement or other NPP rooms. Single isolation valves are used also to isolate some other piping interconnections and branches important to safety.

RELATED ITEMS:

57, 616, 620

JUSTIFICATION OF RANKING:

The single failure criterion and protection against common mode failure are not fulfilled by the current primary circuit piping isolation design.

CONCEPTUAL RECOMMENDATIONS:

Assess the reliability of isolation of the lines connected to the primary circuit and other systems important to safety. Achieve full compliance with single failure criterion adding the required isolation devices keeping in mind to preclude common mode failure implications.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	RELIABLE ISOLATION	57	CHECK VALVE TIGHTNESS Part of injection system pipe contains primary water. A check valve provides the primary circuit boundary. The absence of of a leak tightness automatic test eaquipment around the check valve is a weakness.	D	SYSTEMS	1.10	DESREV 2.7.5.3
II	RELIABLE ISOLATION	616	DOUBLE ISOLATION Two isolation valves should be included in all interconnecting lines in the feedwater system.	D	SYSTEMS	3.1	KOZLODUY 8.3.(5)
II	RELIABLE ISOLATION	620	SINGLE FAILURE CRITERIA A detailed analysis should be performed in order to define lines connected to primary where additional check or isolation valves are needed to fulfill single failure criteria.	D	SYSTEMS	3.1	KOZLODUY 8.4.(3)

ISSUE NUMBER: Systems 14

ISSUE TITLE: Ventilation/Cooling Capability

RANK OF ISSUE: III

ISSUE CLARIFICATION:

I&C, cable and electrical power supply equipment design temperature limits should not be exceeded. Safe operation can be ensured only if equipment temperatures can be kept within the permissible range. This applies to the full operational history and all conditions when functionality is required. Equipment temperature rise can be caused by elevated environmental temperatures as well as by waste heat generated by the equipment itself.

RELATED ITEMS:

281, 625, 763, 790, 817, 831

JUSTIFICATION OF RANKING:

Practical experience as well as PSA-studies conducted for nuclear power plants have shown the importance of ensuring normal environmental conditions for the control equipment.

CONCEPTUAL RECOMMENDATIONS:

Evaluate the cooling power needed to keep the temperatures of the equipment below the specified limits. Improve the ventilation systems to ensure required cooling. Provide adequate redundancy for coping with single failures in the ventilation systems.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	VENTILATION / COOLING CAPABILITY	281	COMPUTER AIR CONDITIONING An independent air conditioning system should be installed for the process computer room.	O	TS	2.3	BOHUNICE 5.7.(2)
III	VENTILATION / COOLING CAPABILITY	625	AIR CONDITIONING Install a new air contitioning or fan coil units at battery, I&C and emergency water tank room. It should be connected to DG power.	D	SYSTEMS	3.7	KOZLODUY 8.5.(4)
III	VENTILATION / COOLING CAPABILITY	763	BORON ROOM DURING LOCA Installing a close ventilation system insuring the boron room cooling during LOCA.	D	SYSTEMS	3.7	NOVOVORONE 8.9.(2)
III	VENTILATION / COOLING CAPABILITY	790	SUZ ENVIRONMENT Reduce the normal temperature in the area of the new nuclear flux system.	D	I&C	3.3	NOVOVORONE 10.1.(13)
III	VENTILATION / COOLING CAPABILITY	817	ELECTRICAL DISTRIBUTION BOARDS Improve the performance of the ventilation system in the switchgear rooms.	D	ELECTRICAL	3.3	NOVOVORONE 11.1.(5)
III	VENTILATION / COOLING CAPABILITY	831	CABLE Install a ventilation system to reduce the temperature.	D	ELECTRICAL	3.3	NOVOVORONE 11.5.(2)

ISSUE NUMBER: Systems 15

ISSUE TITLE: Dynamic Loads due to Piping Failures

RANK OF ISSUE: II

ISSUE CLARIFICATION:

A sudden rupture of a high energy pipe would cause dynamic loads on the equipment and structures located near the break. Besides the direct influence by blowdown flow, loads could be connected with whipping pipes if such whips are not excluded by proper design. Dynamic loads would also occur inside the failed system as a consequence of the decompression wave. The dynamic loads are a serious threat to the integrity of impacted structures and components.

RELATED ITEMS:

855, 1067

JUSTIFICATION OF RANKING:

Dynamic loads are not explicitly addressed in the design by installing restraints against pipe whips nor by separating the vital equipment from the high energy piping systems. No information has been provided on strength analysis of reactor vessel internals in case of a large break LOCA. On the other hand, the building layout would limit the consequence of a primary circuit pipe rupture.

CONCEPTUAL RECOMMENDATIONS:

Assess the need for pipe whip restraints around the high energy piping. Assess the need to remove vital equipment away from such pipes. Analyze the strength of reactor vessel internals in connection with breaks.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	DYNAMIC LOADS DUE TO PIPING FAILURES	855	INTEGRITY AFTER LOCA The structural integrity of the reactor vessel internals during the new design basis LOCA should be assessed.	D	ACCIDENT	1.11	NOVOVORONE 12.3.(10)
II	DYNAMIC LOADS DUE TO PIPING FAILURES	1067	SECONDARY PIPE WHIP PROTECTION Protection agains pipe whip should be installed on steam and feedwater lines at 14.7 m level.	D	SYSTEMS	3.6	KOLA 8.6.(2)

ISSUE NUMBER: Components

ISSUE TITLE: Embrittlement. Introduction

BACKGROUND INFORMATION:

The irradiation by high-energy neutrons has caused reactor vessel wall embrittlement that has progressed much faster than predicted during the vessel design. The fastest embrittlement takes place in the circular weld at the elevation of the reactor core.

The transition temperature where the weld metal fracture properties change from ductile to brittle is in a new vessel typically less than O°C, but now at some plants it may be higher than 150°C. The transition temperature can not be told accurately because it depends on many parameters:

- integrated exposure to high energy neutrons
- contents of impurities such as phosphorus and copper in the vessel metal
- the model used to correlate the shift of transition temperature with the neutron fluence.

The primary circuit must not be pressurized in temperatures below the transition temperature. Besides the cold shutdown conditions, one has to consider the risk of brittle fracture in connection with the pressurized thermal shocks. Such a brittle fracture may occur if all the following conditions are met:

- the vessel wall temperature decreases to a value which is close to the transition temperature,
- there is elevated pressure in the primary circuit, and
- there is an initial crack larger than a critical crack size in the vessel wall.

A potential method for decreasing the transition temperature close to its original value is vessel annealing.

ISSUE NUMBER: Components 1

ISSUE TITLE: Embrittlement. Baseline information and analysis.

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

The real rate of embrittlement and the current values of brittle to ductile transition temperatures of individual WWER pressure vessels are not accurately known. The uncertainty could be reduced by getting more information about the chemical composition of the vessel base metal and the welds. It would also be important to know accurately the integrated neutron flux and to have a proven model for predicting the progress of embrittlement. For pressurized thermal shock analysis, it would be necessary to have an estimate of the minimum crack size that could go unnoticed in inspections and should therefore be postulated as an initial crack. The analysis methods utilized do not always correspond to widely adopted ones.

RELATED ITEMS:

7, 15, 80, 81, 320, 635, 638, 643, 1079

JUSTIFICATION OF RANKING:

Due to some lack in knowledge about vessel material and methodology employed, the vessel assessment and risk estimation is insufficient.

CONCEPTUAL RECOMMENDATIONS:

1. Use all available means to find out chemical composition of the actual weld metal in the beltline region of each RPV.

2. Establish cooperation among all WWER users to find out the actual transition temperatures by testing samples taken from decommissioned RPV's (Armenia, Greifswald). Exchange information about all test results from irradiated samples. Develop an improved embrittlement correlation from the test results.

3. Exchange information on the calculated fast neutron flux values at the reactor vessel wall to have a better understanding about the accuracy of the calculations.

4. Apply the best available NDT technologies to detect the potential cracks from the vessel wall.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
IV	EMBRITTLEMENT - BASELINE INFORMATION	7	UNCERTAINTY IN NEUTRON FLUENCE The uncertainty of the fast neutron fluence and the relationship between it and the radiation induced embrittlement needs further information.	D	CORE	1.10	DESREV	1.1.8.4
IV	EMBRITTLEMENT - BASELINE INFORMATION	15	EFFECT OF HIGHER BURNUP IN RPV The effect the increased burnup on the fast fluence in the vessel has not been discussed.	D	CORE	1.10	DESREV	1.3.8.1
IV	EMBRITTLEMENT - BASELINE INFORMATION	80	REACTOR VESSEL BASELINE DATA Generally, reactor vessel baseline data could be characterized as imcomplete. There is a need to treat the whole body of available data collectively, including plant specific data. Plant specific approach should not be underestimated. As an example, information should be obtained for two-layer cladding on edges of vessel nozzles.	D	COMPONENTS	1.15	DESREV	3.1.2
IV	EMBRITTLEMENT - BASELINE INFORMATION	81	PLANT SPECIFIC VESSEL DATA Base line information, including design specifications, manufacturer's data and commissioning test data, should be reviewed at sites.	D	COMPONENTS	1.15	DESREV	III.3.1.2.
IV	EMBRITTLEMENT - BASELINE INFORMATION	320	CRITICAL TEMPERATURE CURVES After test samples campaign, re-evaluate theoretical calculations and revise critical temperature curves.	D	COMPONENTS	1.10	BOHUNICE	9.1.(3)
IV	EMBRITTLEMENT - BASELINE INFORMATION	635	SAMPLES OF RPV MATERIAL Atemps should be made to obtain test cupons sufficient to provide direct toughness measurements.	D	COMPONENTS	1.10	KOZLODUY	9.1.(4)
IV	EMBRITTLEMENT - BASELINE INFORMATION	638	RPV MANUFACTURING INSPECTION Manufacturing inspection records should be obtained from manufacturers for units 1,2 and 4.	D	COMPONENTS	1.10	KOZLODUY	9.2.(1)
IV	EMBRITTLEMENT - BASELINE INFORMATION	643	EMBRITTLEMENT PROCESS A better understanding of the embrittlement process and how to moderate its effects should be developed.	D	COMPONENTS	1.10	KOZLODUY	9.3.(2)
IV	EMBRITTLEMENT - BASELINE INFORMATION	1079	VESSEL MATERIAL INFORMATION Collect vessel material information available at the manufacturer.	D	COMPONENTS	1.10	KOLA	9.1.(1)

ISSUE NUMBER: Components 2

ISSUE TITLE: Embrittlement. Validation of annealing.

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

Annealing has been applied to recover the material properties of the RPV's. The effectiveness of this process has not yet been sufficiently validated. It is also an open question how fast is the reembrittlement process in the annealed vessel. The potential risks related to annealing are not adequately investigated.

RELATED ITEMS:

83, 322, 324, 325, 642, 644, 1089, 1090

JUSTIFICATION OF RANKING:

Annealing of pressure vessels is being used as an argument to continue the operation of WWER 440/230's despite the safety concerns related to a potential pressurized thermal shock. Supporting evidence is essential for assessment of the actual RPV state after annealing.

CONCEPTUAL RECOMMENDATIONS:

1. Establish cooperation among all WWER uses, to find out the effectiveness of the annealing. The main topic should be testing of samples from pressure vessels which have undergone annealing. Especially large samples from different parts of decommissioned RPV's should be tested.

2. Perform a full scope RPV inspection before and after annealing to see whether annealing process has adverse side effects such as crack formation or growth of the existing small cracks, etc.

3. Develop and implement appropriate means for monitoring the progress of re-embrittlement after annealing.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	EMBRITTLEMENT - VALIDATION OF ANNEALING	83	VESSEL ANNEALING The effectiveness of reactor vessel annealing in restoring initial material properties and material re-embrittlement should be verified by hardness measurements and impact tests.	D	COMPONENTS	1.10	DESREV III.3.1.2.
IV	EMBRITTLEMENT - VALIDATION OF ANNEALING	322	RPV ANNEALING INSPECTION Perform ISI ultrasonic inspection of unit 2 core region weld before and after annealing.	D	COMPONENTS	1.10	BOHUNICE 9.2.(2)
IV	EMBRITTLEMENT - VALIDATION OF ANNEALING	324	SAMPLING RPV MATERIALS Take samples of both unit RPVs for chemical analysis and hardness tests. For unit 2 take samples before and after annealing.	D	COMPONENTS	1.10	BOHUNICE 9.2.(4)
IV	EMBRITTLEMENT - VALIDATION OF ANNEALING	325	ANNEALING PROCEDURE Discuss with vessel manufacturer test results and theoretical calculations and the selected annealing proedure.	D	COMPONENTS	1.10	BOHUNICE 9.3.(1)
IV	EMBRITTLEMENT - VALIDATION OF ANNEALING	642	UNIT 2 ANNEALING The annealing of Unit 2 vessel should be carried out in 1991.	D	COMPONENTS	1.10	KOZLODUY 9.3.(1)
IV	EMBRITTLEMENT - VALIDATION OF ANNEALING	644	POST ANNEALING INSPECTION Whenever repetion of an inspection is required, a different inspector should be employed.	D	COMPONENTS	1.10	KOZLODUY 9.3.(3)
IV	EMBRITTLEMENT - VALIDATION OF ANNEALING	1089	TESTING SAMPLES OF RPV Cut out templates of base material in core zone and welds 4 of Kola 1 and 2 and perform impact tests and other investigations needed.	D	COMPONENTS	1.10	KOLA 9.3.(1)
IV	EMBRITTLEMENT - VALIDATION OF ANNEALING	1090	BEFORE AND AFTER TESTING Non destructive examination should be performed before and after annealing.	D	COMPONENTS	1.10	KOLA 9.3.(2)

ISSUE NUMBER: Components 3

ISSUE TITLE: Embrittlement. Flux reduction.

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

The rate of embrittlement can be significantly slowed down by reducing the fast neutron flux. The experience at some WWER plants has proven that this is a viable approach. The measures taken at some plants include installing dummy elements into the outermost core positions and establishing a low leakage loading scheme where the new fuel is in the middle of the core and the fuel bundles with highest burn-up are on the edge.

RELATED ITEMS:

79, 1025

JUSTIFICATION OF RANKING:

In view of the inadequate knowledge on actual embrittlement of RPV's, every effort should be taken to limit the progress of the embrittlement process.

CONCEPTUAL RECOMMENDATIONS:

Use appropriate flux reduction measures to slow down the embrittlement of the reactor vessel wall.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
IV	EMBRITTLEMENT - FLUX REDUCTION	79	REDUCTION OF FLUENCE TO VESSEL Corrective measures have been taken to reduce high neutron flux at the vessel wall in some plants.	D	COMPONENTS	1.10	DESREV	III.3.1.18
IV	EMBRITTLEMENT - FLUX REDUCTION	1025	LOW LEAKAGE CORE Low leakage loading patterns should be evaluated, in conjunction with dummy assemblies, for vessel fluence reduction.	D	CORE	1.10	KOLA	7.1.(7)

ISSUE NUMBER: Components 4

ISSUE TITLE: Embrittlement. Prevention of low temperature pressurization.

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

It is important to eliminate transients where the temperature drops rapidly to the transition temperature and the primary circuit is subsequently repressurized. Such possibility exists especially in connection with loss-of-coolant accidents which are terminated by isolating the leak. In cold shutdown conditions it is necessary to prevent accidental system pressurization.

RELATED ITEMS:

43, 636, 749

JUSTIFICATION OF RANKING:

The embrittlement of WWER 440/230 pressure vessels has progressed to a point where primary circuit pressurization in temperatures below the normal operating range might cause a fast rupture of the RPV, thus resulting in a severe accident.

CONCEPTUAL RECOMMENDATIONS:

1. Automatic protection should be provided to prevent low temperature overpressurization from (LTOP) of the primary circuit. All conceivable sequences leading to primary circuit temperature drop, (such as an inadvertent opening of the by-pass to condenser) or to pressurization (such as an inadvertent start of a make-up pump) should be covered by this protection.

2. All feasible design modifications, such as limiting the magnitude of potential steam leaks and warming up of the emergency coolant, should be made to decrease the cooling rate during postulated accidents.

3. Design features and appropriate guidance to the operators should be provided to prevent primary circuit repressurization during accidents which may cause significant cooling of the primary circuit.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
IV	*EMBRITTLEMENT - COLD PRESSURIZATION*	*43*	*COLD OVER PRESSURE PROTECTION*	*D+O*	*SYSTEMS*	*1.10*	*DESREV*	*2.2.5.2.*
			Despite manually available cold over pressure protection at cold shutdown, there is no evidence of adequate provisions for all operating conditions. Automatic protection is typical in other plants. Some further study to justify the WWER approach is required.					
IV	EMBRITTLEMENT - COLD PRESSURIZATION	636	COLD PRESSURIZATION	D	COMPONENTS	1.10	KOZLODUY	9.1.(5)
			An interlock should be introduced to prevent cold pressurization. Until this is available, an alarm system should be installed.					
IV	EMBRITTLEMENT - COLD PRESSURIZATION	749	RPV PROTECTION	D	SYSTEMS	1.10	NOVOVORONE	8.6.(2)
			Protect RPV against cold shutdown overpressure with the help of the safety devices.					

ISSUE NUMBER: Components 5

ISSUE TITLE: Vessel ISI. Inspection Techniques and Acceptance Criteria

RANK OF ISSUE: III

ISSUE CLARIFICATION:

The pre-service inspections of the pressure vessels were done using ultrasonic methods with rather limited capabilities. The current ISI methods are much more efficient in detecting cracks but the old acceptance criteria by the manufacturer are still being used. In addition, the present scope of ISI may not be adequate to detect all cracks which might be threatening the vessel integrity.

RELATED ITEMS:

84-87, 321, 323, 639, 1081-1088

JUSTIFICATION OF RANKING:

Vessel integrity being of utmost importance for defence in depth it is not only necessary to improve the ISI methods and scope but also to update the acceptance criteria in relation to present knowledge.

CONCEPTUAL RECOMMENDATIONS:

Assess the available ISI results and methods. Develop and employ ISI methodology which is compatible with the requirements for vessel integrity assessment.
Develop acceptance criteria for vessel in-service inspection adopted to state-of-the-art equipment and methods. Additional strength analysis with conservative defect size estimations should be performed for the defects found covering the whole operation life of the RPV.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	VESSEL ISI - INSPECTION TECHNIQUES	84	VESSEL IN SERVICE INSPECTION In Service Inspection (ISI) has limitations due to impossibility to inspect the inner cylindric wall of the reactor vessel from the outer susface, in some plants.	D	COMPONENTS	3.4	DESREV III.3.1.1C
III	VESSEL ISI - INSPECTION TECHNIQUES	85	NON DESTRUCTIVE EXAMINATIONS Some of the Non Destructive Examination (NDE) equipment may have significant limitations.	D+O	COMPONENTS	3.4	DESREV III.3.1.1D
III	VESSEL ISI - INSPECTION TECHNIQUES	86	SCOPE OF IN SERVICE INSPECTION The scope of In Service Inspection (ISI), the capability of Non Destructive Examination (NDE) techniques, the obtained data and their evaluation should be assessed.	D+O	COMPONENTS	3.4	DESREV III.3.1.2.
III	VESSEL ISI - INSPECTION TECHNIQUES	87	MODERN VESSEL EXAMINATION Modern Non Destructive Examination (NDE) techniques capavle of detecting vessel degradation at an early stage should be used in all reactor vessels. Methods used to evaluate detected deffects should include new techniques used in other countries (e.g. crack arrest approach).	D+O	COMPONENTS	3.4	DESREV III.3.1.2.
III	VESSEL ISI - INSPECTION TECHNIQUES	321	RPV ISI ACCEPTANCE CRITERIA Develope a specific In Service Inspection acceptance criteria adapted to the inspection equipment istead of using manufacturers' one.	D	COMPONENTS	1.10	BOHUNICE 9.2.(1)
III	VESSEL ISI - INSPECTION TECHNIQUES	323	CONTROL ROD PENETRATION ISI Inspect a part of control rod mechanism penetration by ultrasonic method as part of ISI.	D	COMPONENTS	1.10	BOHUNICE 9.2.(3)
III	VESSEL ISI - INSPECTION TECHNIQUES	639	ULTRASONIC MANIPULATOR The delivery of a proven ultrasonic manipulator should be expedited.	D	COMPONENTS	1.10	KOZLODUY 9.2.(2)
III	VESSEL ISI - INSPECTION TECHNIQUES	1081	STRENGTH ANALYSIS OF DEFFECTS Additional strength analysis,with conservative deffect hights, should be performed for deffects found, covering the life of the vessel.	D	COMPONENTS	1.10	KOLA 9.1.(3)
III	VESSEL ISI - INSPECTION TECHNIQUES	1082	VESSEL INSPECTION Ensure good sealing of joints and surfaces in the flange. Inspect hole area of the nozzles to check for leaks into the gap.	D	COMPONENTS	3.4	KOLA 9.2.(1)
III	VESSEL ISI - INSPECTION TECHNIQUES	1083	INSPECTION SYSTEM CALIBRATION Sensitivity setting using reference blocks should be used to check the whole inspection system.	D	COMPONENTS	3.4	KOLA 9.2.(2)
III	VESSEL ISI - INSPECTION TECHNIQUES	1084	RECORDING LEVEL Use much lower recording level than PK 1514-72 standard requires.	D	COMPONENTS	3.4	KOLA 9.2.(3)
III	VESSEL ISI - INSPECTION TECHNIQUES	1085	NEAR SURFACE AREA INSPECTION Inspect the near surface areas using longitudinal wave probes.	D	COMPONENTS	3.4	KOLA 9.2.(4)
III	VESSEL ISI - INSPECTION TECHNIQUES	1086	SCANNING OF DEFFECTS Add and validate special inspection technique for scanning outer surface deffects of welds 3, 4 and 5 having no access from the outside.	D	COMPONENTS	3.4	KOLA 9.2.(5)
III	VESSEL ISI - INSPECTION TECHNIQUES	1087	DEFFECT DIMENSIONING Continue developing different techniques and procedures for dimensioning of surface and sub-surface deffect heights.	D	COMPONENTS	3.4	KOLA 9.2.(6)
III	VESSEL ISI - INSPECTION TECHNIQUES	1088	ISI EQUIPMENT Use of a cetral mast manipulator with a sophisticated data aquisition system should be considered for future ISI inspections.	D	COMPONENTS	3.4	KOLA 9.2.(7)

ISSUE NUMBER: Components 6

ISSUE TITLE: Vessel ISI. Corrosion Monitoring

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Six of the 10 reactor pressure vessel are unclad and have suffered corrosion.
Unclad vessels surface is being inspected visually every 4 years for corrosion by an inspector within a lead shielding container; chart showing the position of corrosion pits is produced. The results are necessarily subjective. The inspector is exposed to a high radiation field which may decrease his motivation for careful work.

RELATED ITEMS:

641

JUSTIFICATION OF RANKING:

Without precise evaluation and follow-up of corrosion pits on the vessel internal surface defence in depth provided by the vessel is degraded.

CONCEPTUAL RECOMMENDATIONS:

Less subjective ISI techniques should be developed and applied.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	VESSEL ISI - CORROSION MONITORING	641	CORROSION MEASUREMENTS More objective corrosion measurement techniques should be used, such as video cameras.	D	COMPONENTS	1.10	KOZLODUY 9.2.(4)

ISSUE NUMBER: Components 7

ISSUE TITLE: Vessel Stress Analysis

RANK OF ISSUE: III

ISSUE CLARIFICATION:

In the design calculation only traditional formulas and basic operational regimes were used. Re-evaluation of stress analyses is needed to account for normal transients and beyond DBA accidents derived transients (PTS) using more refined methods and approaches.

RELATED ITEMS:

82, 318, 632-634, 637, 640, 768, 770, 1080

JUSTIFICATION OF RANKING:

Sufficient defence in depth provided by the RPV must be demonstrated by modern stress analysis methods.

CONCEPTUAL RECOMMENDATIONS:

Stress calculations for normal and transient conditions with modern methods (finite elements) should be made in particular for the regions with complex geometries including a fatigue analysis.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	VESSEL STRESS ANALYSIS	82	VESSEL OPERATING HISTORY Vessel operating history data, including process conditions and pressure temperature transient data, should be reviewed.	D	COMPONENTS	1.15	DESREV III.3.1.2.
III	VESSEL STRESS ANALYSIS	318	VESSEL STRESS ANALYSIS Prepare a document justifying extrapolation of stress analysis results from WWER-440/213 to /230 and reevaluating effects of new accident analysis and seismic analysis.	D	COMPONENTS	1.10	BOHUNICE 9.1.(1)
III	VESSEL STRESS ANALYSIS	632	VESSEL STRESS ANALYSIS Some modern stress analysis should be performed on selected region.	D	COMPONENTS	1.10	KOZLODUY 9.1.(1)
III	VESSEL STRESS ANALYSIS	633	TRANSIENT CONDITIONS The transient conditions derived from accident analysis should be used in the vessel stress analyis.	D	COMPONENTS	1.10	KOZLODUY 9.1.(2)
III	VESSEL STRESS ANALYSIS	634	OPERATING CYCLES Operating cycles which are currently monitored should be compered with design cycle to estimate remaining lifetime.	D	COMPONENTS	1.10	KOZLODUY 9.1.(3)
III	VESSEL STRESS ANALYSIS	637	RPV DESIGN CALCULATIONS Design calculations of vessel aseismic features should be obtained from the designers.	D	COMPONENTS	1.10	KOZLODUY 9.1.(6)
III	VESSEL STRESS ANALYSIS	640	FRACTURE MECHANICS Expertise in fracture mechanics calculations should be developed.	D	COMPONENTS	1.10	KOZLODUY 9.2.(3)
III	VESSEL STRESS ANALYSIS	768	STRESS REDUCTION IN FLANGE An improved concept of sealing should be developed to reduce the stresses in the grooves of the flange.	D	COMPONENTS	1.10	NOVOVORONE 9.1.(1)
III	VESSEL STRESS ANALYSIS	770	MODERN STRESS CALCULATION Stress calculations for normal and transient conditions with modern methods (finite elements) should be made in particular for the regions with complex geometries including a fatigue analysis.	D	COMPONENTS	1.10	NOVOVORONE 9.2.(1)
III	VESSEL STRESS ANALYSIS	1080	VESSEL STRESS ANALYSIS Stress calculations should be performed fro flange zone, head penetrations and nozzles with modern calculation methods.	D	COMPONENTS	1.10	KOLA 9.1.(2)

ISSUE NUMBER: Components 8

ISSUE TITLE: Leak Before Break Applicability

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

The plant design does not account for large diameter break LOCA. The leak before break methodology, if it can be successfully applied, provides early warning before major break in primary piping could develop.

RELATED ITEMS:

89, 90, 328-330, 332, 652, 653, 730, 774, 775, 1045, 1046, 1100-1106, 1108

JUSTIFICATION OF RANKING:

Considering the limited scope of DBA and its consequences, a very low probability of primary piping break is required.

CONCEPTUAL RECOMMENDATIONS:

Complete a comprehensive leak before break applicability analysis and perform required hardware installation and/or modifications. See also Components 6 "Primary Circuit Stress Analysis" and "Components 5 Primary Circuit in-service inspection, which will give input on stress and specific inspection. Immediate consideration should be given to the development of complementary operating procedure to monitor continuously the hermetic compartment air radioactivity and frequently check the leakage of the primary circuit until LBB application has been demonstrated and detection has been installed.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	LEAK BEFORE BREAK APPLICABILITY	89	LEAK BEFORE BREAK APPLICATION For the primary circuit, the implementation of the Leak Before Break (LBB) concept is of great importance. To introduce the concept, a general and plant specific evaluations are necessary. This include. compilation of material data, definition of loads, calculation of maximum deffect size, evaluation of ISI methods, possibility of leak detection and localization, exclusion of singular deffects The analysis should focus on dissimilar welds, castings and welds with reduced testability.	D	COMPONENTS	1.10	DESREV III.2.2.2.
IV	LEAK BEFORE BREAK APPLICABILITY	90	LEAK DETECTION More sophisticated leak detection facilities which will allow small leaks to be detected and localized will be installed in the future. Plans should be reviewed during missions.	D	COMPONENTS	1.10	DESREV 3.6.2
IV	LEAK BEFORE BREAK APPLICABILITY	328	LEAK BEFORE BREAK EXPERIMENTS Test results should involve the comparison of non- exposed and exposed material.	D	COMPONENTS	1.10	BOHUNICE 9.4.(3)
IV	LEAK BEFORE BREAK APPLICABILITY	329	LEAK DETECTION Leak before break programme should be complemented with a leak detection system in both units.	D	COMPONENTS	1.10	BOHUNICE 9.4.(4)
IV	LEAK BEFORE BREAK APPLICABILITY	330	ACCOUSTIC EMMISSION DIAGNOSTIC Install accoustic emission diagnostic system in both units as planned.	D	COMPONENTS	1.10	BOHUNICE 9.4.(5)
IV	LEAK BEFORE BREAK APPLICABILITY	332	LEAK DETECTION ALARM Install a leak detection system alarm in the control room.	D	COMPONENTS	1.10	BOHUNICE 9.4.(7)
IV	LEAK BEFORE BREAK APPLICABILITY	652	LEAK BEFORE BREAK CONCEPT Completion of leak before break study and installation of diagnostic equipment is of ultmost importance.	D	COMPONENTS	1.10	KOZLODUY 9.6 (1)
IV	LEAK BEFORE BREAK APPLICABILITY	653	EXPERIENCE FROM OTHER PLANTS Obtain experience on leak before break applicability from other plants, specially Bohunice.	D	COMPONENTS	1.10	KOZLODUY 9.6.(2)
IV	LEAK BEFORE BREAK APPLICABILITY	730	LEAK IDENTIFICATION Complemantary operating procedure to monitor continuously the hermetic compartment air radioactivity and frequently check the leakage of the primary circuit should be used until LBB detection system is implemented.	D	SYSTEMS	1.10	NOVOVORONE 8.1.(1)
IV	LEAK BEFORE BREAK APPLICABILITY	774	LBB PREREQUISITES Lower bound toughness of the materials should be determined Weldments are examined by repeated NDE. Safety margin for normal and transient conditions shall be quantified Calculation codes as well as the NDE methods have to be validated.	D	COMPONENTS	1.10	NOVOVORONE 9.4.(1)
IV	LEAK BEFORE BREAK APPLICABILITY	775	LARGE SCALE TESTS Study the failure behavior of the relevant materials in large scale tests.	D	COMPONENTS	1.10	NOVOVORONE 9.4.(2)
IV	LEAK BEFORE BREAK APPLICABILITY	1045	LEAK BEFORE BREAK Implement the leak before break concept to the main circuit.	D	SYSTEMS	1.10	KOLA 8.1 (3)
IV	LEAK BEFORE BREAK APPLICABILITY	1046	LEAK DETECTION Additional measurements and monitoring of the primary system should be done in order to detect any leakage.	D	SYSTEMS	1.10	KOLA 8.1.(4)
IV	LEAK BEFORE BREAK APPLICABILITY	1100	LEAK BEFORE BREAK REQUIREMENTS Typical deffects have to be estimated. Data has to be collected and evaluated. Inspection programme and techniques have to be compatible with this deffects.	D	COMPONENTS	1.10	KOLA 9.6.(1)
IV	LEAK BEFORE BREAK APPLICABILITY	1101	LEAK BEFORE BREAK ANALYSIS Estimation of highly stressed parts of components and pipes is needed. Estimation of critical deffect size and crack propagation is needed. Real strain and temperature changes should be measured.	D	COMPONENTS	1.10	KOLA 9.6.(2)
IV	LEAK BEFORE BREAK APPLICABILITY	1102	LEAK BEFORE BREAK TESTS The results of full scale tests should be compared with calculations. Instructions for inspections should be developed.	D	COMPONENTS	1.10	KOLA 9.6.(3)
IV	LEAK BEFORE BREAK APPLICABILITY	1103	INSPECTION OF OPEN VALVES Inspect pipes whenever valves or pumps are opened. Develope inspection equipment for inner surface and volumetric inspection.	D	COMPONENTS	1.10	KOLA 9.6.(4)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	LEAK BEFORE BREAK APPLICABILITY	1104	DISSIMILAR WELD RESEARCH The already planned research programme for full scale dissimilar vessel weld investigation should be implemented.	D	COMPONENTS 1.10	KOLA	9.6.(5)
IV	LEAK BEFORE BREAK APPLICABILITY	1105	PRIMARY INSPECTION PROGRAMME The annual ispection programme for primary system weld should be kept extensive until all weld have been inspected once with present (or better) technique.	D	COMPONENTS 1.10	KOLA	9.6.(6)
IV	LEAK BEFORE BREAK APPLICABILITY	1106	PIPING SUPPORT CONSIDERATIONS Failure of pipe support should be include in LBB calculations. Systematic inspection of supports should be included in ISI programme. Support attachment to concrete and base plate should be inspected.	D	COMPONENTS 1.10	KOLA	9.6.(7)
IV	LEAK BEFORE BREAK APPLICABILITY	1108	VIDEO SURVEILLANCE OF LEAKS Video cameras should be installed to make a continuous overview of leakages inside the confinment.	D	COMPONENTS 1.10	KOLA	9.6.(9)

ISSUE NUMBER: Components 9

ISSUE TITLE: Primary circuit in-service inspection

RANK OF ISSUE: III

ISSUE CLARIFICATION:

In the absence of accurate design margin, the major factor determining safety is comprehensive and balanced inspection of primary circuit components.

RELATED ITEMS:

93, 96-98, 333, 334, 650, 651, 773, 776, 777, 982, 1095-1099, 1110-1113, 1298, 1299

JUSTIFICATION OF RANKING:

Primary circuit in-service inspection results are of importance to demonstrate the defence in depth ability of the circuit. The present level of inspection is insufficient.

CONCEPTUAL RECOMMENDATIONS:

Improve in-service inspection scope, techniques, methods, and programmes for primary piping and components. The improvement should include where relevant the piping preparation for inspection (Weld surfaces......). The annual inspection programmes in the next few years should be extensive enough for all critical points to be inspected as soon as possible.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	93	SCOPE OF PRIMARY CIRCUIT ISI In Service Inspection (ISI) of the primary circuit should cover 100% volume and inside examination of all welds.	D+O	COMPONENTS	1.10	DESREV	III.3.2.2.
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	96	STEAM GENERATOR TUBES Steam generator tubes show a good performance. Only 27 deffected tubes found in Kola. However the applied ISI has been limited in scope and capability.	D	COMPONENTS	1.10	DESREV	III.3.3.1.
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	97	MODERN TUBE EXAMINATION Modern Non Destructive Examination (NDE) methods (e.g. Eddy current) should be used in order to detect tube degradation at an early stage.	D+O	COMPONENTS	1.10	DESREV	III.3.3.2.
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	98	TUBE PLUGGING CRITERIA The tube plugging criteria should be evaluated on a plant specific basis. Besides wall thickness, maximum perissible lengh of a longitudinal deffect should be taken into consideration.	D	COMPONENTS	1.10	DESREV	III.3.3.2
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	333	STEAM GENERATOR INSPECTION Increase eddi current test equipment in order to inspect 40% of tubes of 2 SG per refuelling and develope plugging criteria adapted to the inspection equipment.	D	COMPONENTS	1.10	BOHUNICE	9.6.(1)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	334	SCOPE OF SG INSPECTION In each ISI a percentage of tubes not previously inspected should be included. Plan next inspections based of previous results.	D	COMPONENTS	1.10	BOHUNICE	9.6.(2)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	650	PRESSURIZER INSPECTION Inspect the pressurizer shell from the outside with Ultrasound at the thermal shield level to detect cracking at the inside surface.	D	COMPONENTS	1.10	KOZLODUY	9.5.(1)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	651	PRIMARY INSPECTION RESULTS Computerization of primary inspection results should be expedited.	D	COMPONENTS	1.10	KOZLODUY	9.5.(2)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	773	VOLUMETRIC NDE Longitudinal welds in the elbows of the main coolant piping and welds in the regions with complex geometries should be examined by volumetric NDE methods.	D	COMPONENTS	1.25	NOVOVORONE	9.3.(1)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	776	SG COLLECTOR WELD TESTING For the collector welds a volumetric test method (e.g. X-ray testing) should be applied.	D	COMPONENTS	1.10	NOVOVORONE	9.5.(1)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	777	SG TUBE FAILURES A test method should be applied to quantify the defects of the tubes.	D	COMPONENTS	1.10	NOVOVORONE	9.5.(2)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	982	SG TUBES Eddy current techniques should be employed for inspection of the tubes in heat exchangers.	O	MAINT	1.25	NOVOVORONE	4.7.(1)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	1095	PRIMARY WELDS INSPECTION Investigate possibility of inner surface inspection for longitudinal elbow welds, main gate valves and main pumps. Investigate also possibility of volumetric methods.	D	COMPONENTS	1.10	KOLA	9.5.(1)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	1096	COMPONENT PARTS INSPECTION Investigate, deveope and validate UT and ECT techniques for inspection of tread holes of pumps, and studs and nuts of gate valve and main pumps.	D	COMPONENTS	1.10	KOLA	9.5.(2)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	1097	PREPARATION FOR INSPECTION Machine or grind reinforcements from those welds having limitation in Ultrasonic Test of the root area.	D	COMPONENTS	1.10	KOLA	9.5.(3)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	1098	NOZZLES ORIFICES INSPECTION Inspect nozzle base material with UT in pipes of diameter less than 100 mm having orifices of 32 mm.	D	COMPONENTS	1.10	KOLA	9.5.(4)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	1099	INSPECTION OF AUSTENITIC STEEL Continue developing UT technique for austenitic stainless steel weld.Establish contact and co-operation with foreign inspection and probe design companies.	D	COMPONENTS	1.10	KOLA	9.5.(5)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	1110	STEAM GENERATOR INSPECTION Volumetric inspection should be applied to steam generator collector welds and dissimilar welds.	D	COMPONENTS	1.10	KOLA	9.7.(2)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	1111	STEAM GENERATOR EDDY CURRENT Start eddy current test of SG tubes as soon as possible. Develope a tube plugging criterion.	D	COMPONENTS	1.10	KOLA	9.7.(3)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	1112	COLLECTOR CLADDING INSPECTION Perform scanning of under clad cracks and for deffects in clad volume for SG collector.	D	COMPONENTS	1.10	KOLA	9.7.(4)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	1113	COLLECTOR PARTS INSPECTION Develope eddy current testing for tread holes and bolts of SG collector to find small cracks.	D	COMPONENTS	1.10	KOLA	9.7.(5)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	1298	STEAM GENERATOR EDDY CURRENT All effort should be made to start eddy current testing of the steam generator during next outage.	O	MAINT	1.10	KOLA	4.7.(1)
III	PRIMARY CIRCUIT IN-SERVICE INSPECTION	1299	PRIMARY HYDRAULIC TESTING The frequency of primary circuit hydraulic test should be reduced. Problem has to be discussed with safety authorities.	O	MAINT	1.10	KOLA	4.7.(2)

ISSUE NUMBER: Components 10

ISSUE TITLE: Primary Circuit Stress Analysis

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Detailed primary circuit analysis is essential in evaluating the safety impact of operational conditions and deviations from normal conditions. Results, obtained using modern refined techniques are needed for integrity assessment.

RELATED ITEMS:

91, 92, 327, 331, 645-647, 649, 654, 655, 771, 772, 1091-1094, 1109

JUSTIFICATION OF RANKING:

Primary circuit stress analysis is of importance to demonstrate the defence in depth ability of the circuit.

CONCEPTUAL RECOMMENDATIONS:

Perform detailed stress analysis of primary circuit components with respect to their integrity using modern stress analysis techniques, particularly with respect to stress analysis techniques, particularly with respect to stress concentration, metallurgical discontinuities, temperature cycling, earthquakes, and water hammer.

Stress analysis should be supported by measurements in locations where cyclic loads can be expected.

CAT. ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III PRIMARY CIRCUIT STRESS ANALYSIS	91	SURGE LINE TEMPERATURE For the surge line, it is recommended to perform temperature measurements on points of special interest (e.g. to monitor thermocycles due to possible temperature stratification).	D	COMPONENTS	1.10	DESREV III.3.2.2.
III PRIMARY CIRCUIT STRESS ANALYSIS	92	PRESSURIZER SPRAY The pressurizer should be reviewed regarding possible thermal schock events in the area of the pressurizer spray.	D	COMPONENTS	1.10	DESREV III.3.2.2.
III PRIMARY CIRCUIT STRESS ANALYSIS	326	PRIMARY SYSTEM STRESS ANALYSIS Re-evaluate stress analysis results including the effect of the new accident analysis considered.	D	COMPONENTS	1.10	BOHUNICE 9.4.(1)
III PRIMARY CIRCUIT STRESS ANALYSIS	327	THERMAL DISPLACEMENT Monitor with strain gauges the new support of control rod drive mechanism and steam generators during startup after installation of aditional seismic supports.	D	COMPONENTS	1.10	BOHUNICE 9.4.(2)
III PRIMARY CIRCUIT STRESS ANALYSIS	331	FATIGUE MONITORING SYSTEM Computerize the data (T-t) registered by the fatigue monitoring system and post process the data to estimate fatigue damage.	D	COMPONENTS	1.10	BOHUNICE 9.4.(6)
III PRIMARY CIRCUIT STRESS ANALYSIS	645	PRIMARY STRESS ANALYSIS Capability to perform pipework stress analysis should be developed.	D	COMPONENTS	1.10	KOZLODUY 9.4.(1)
III PRIMARY CIRCUIT STRESS ANALYSIS	646	COMPONENTS STRESS ANALYSIS Capability to perform stress analysis of components such as pumps and isolation valves should be developed.	D	COMPONENTS	1.10	KOZLODUY 9.4.(2)
III PRIMARY CIRCUIT STRESS ANALYSIS	647	MONITORING SURGE LINE Metal temperature at the top and bottom of surge lines should be monitored to assess stratification.	D	COMPONENTS	1.10	KOZLODUY 9.4.(3)
III PRIMARY CIRCUIT STRESS ANALYSIS	649	PRIMARY SEISMIC DESIGN Experience gained from contact with USSR should be used to develope practical seismic design capability.	D	COMPONENTS	1.10	KOZLODUY 9.4.(5)
III PRIMARY CIRCUIT STRESS ANALYSIS	654	SG STRESS ANALYSIS Apply modern stress analysis techniques to complex details of the steam generators, such as the collector shell junction.	D	COMPONENTS	1.10	KOZLODUY 9.7.(1)
III PRIMARY CIRCUIT STRESS ANALYSIS	655	SG METAL TEMPERATURE Instrument areas of steam generator to obtain metal temperature distribution.	D	COMPONENTS	1.10	KOZLODUY 9.7.(2)
III PRIMARY CIRCUIT STRESS ANALYSIS	771	PRIMARY STRESS ANALYSIS Stress calculations with modern methods for normal and transient conditions should include an analysis of earthquake and water hammer.	D	COMPONENTS	1.10	NOVOVORONE 9.2.(2)
III PRIMARY CIRCUIT STRESS ANALYSIS	772	TEMPERATURE LOADING Unsteady cyclic temperature loading should be identified and appropiate stress analysis accompained by meassurements should be carried out.	D	COMPONENTS	1.10	NOVOVORONE 9.2.(3)
III PRIMARY CIRCUIT STRESS ANALYSIS	1091	PRIMARY PIPING STRESS ANALYSIS New stress calculation with modern methods should be performed for primary piping D100-D500 taking into account accident conditions. Analysis of earthquake and water hamer should also be performed.	D	COMPONENTS	1.10	KOLA 9.4.(1)
III PRIMARY CIRCUIT STRESS ANALYSIS	1092	TEMPERATURE CYCLING Areas with temperature cycling should be identified. Blending of coolant with water at different temerature (specially ECCS) should be investigated. Apropriate analysis should be performed with modern calculation methods.	D	COMPONENTS	1.10	KOLA 9.4.(2)
III PRIMARY CIRCUIT STRESS ANALYSIS	1093	GATE VALVE ANALYSIS Stregh calculations of the sealing surface cladding of gate valves should be performed with modern methods.	D	COMPONENTS	1.10	KOLA 9.4.(3)
III PRIMARY CIRCUIT STRESS ANALYSIS	1094	PRESSURIZER STRESS ANALYSIS Strength calculations for the stress concentration and temperature cycling areas of pressurizer should be performed with modern methods.	D	COMPONENTS	1.10	KOLA 9.4.(4)
III PRIMARY CIRCUIT STRESS ANALYSIS	1109	THERMAL CYCLING Calculate the ability of the steam generator collector cladding to withstand the long term thermel cycling.	D	COMPONENTS	1.10	KOLA 9.7.(1)

ISSUE NUMBER: Components 11

ISSUE TITLE: Vessel Support Integrity

RANK OF ISSUE: III

ISSUE CLARIFICATION:

The reactor vessel rests on annular tank, filled with water. Comprehensive seismic analysis and ageing degradation assessment have not been performed to demonstrate its integrity.

RELATED ITEMS:

88, 319

JUSTIFICATION OF RANKING:

Ageing degradation and seismic loading could affect vessel support integrity with likely impact on vessel and primary circuit integrity.

CONCEPTUAL RECOMMENDATIONS:

Complete detailed support structure assessment with respect to seismic loads and ageing degradation.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	VESSEL SUPPORT INTEGRITY	88	INSPECTION OF VESSEL SUPPORT The reactor vessel support structure (annular vessel filled with water which serves also as biological shield) should be inspected. Possible ageing degradation should be assessed.	D+O	COMPONENTS	3.3	DESREV	III.3.1.2.
III	VESSEL SUPPORT INTEGRITY	319	VESSEL SUPPORT SEIMIC DESIGN Complete seismic analysis by including anchorage bolts in the concrete and the biological shield structure. Also mass of water should be considered.	D	COMPONENTS	3.3	BOHUNICE	9.1.(2)

ISSUE NUMBER: Components 12

ISSUE TITLE: Secondary Circuit In-Service Inspection

RANK OF ISSUE: II

ISSUE CLARIFICATION:

In-service inspection of secondary piping is of vital importance to maintain its integrity due to ageing degradation and loading encountered in secondary circuit.

RELATED ITEMS:

100, 309, 608, 657, 1047, 1107

JUSTIFICATION OF RANKING:

Large break in secondary circuit could have negative impact on primary circuit integrity (overcooling, etc.).

CONCEPTUAL RECOMMENDATIONS:

Develop and apply ISI methodology and techniques to assure secondary circuit integrity.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	SECONDARY CIRCUIT IN-SERVICE INSPECTION	100	MAIN STEAM LINES For the main steam lines up to the isolation valves, allowable deffect sizez are 30% higher than for primary piping. The main problem is errosion damage in high velocity regionssuch as ellbows. Ultrasonic thickness measurement gives good results and is recommended for future use.	D	COMPONENTS	1.9	DESREV	3.7.2.6.
II	SECONDARY CIRCUIT IN-SERVICE INSPECTION	309	LEAK DETECTION EXTENSION Once leak detection system has been proven, extend system to main steam lines up to fast isolation valves.	D	SYSTEMS	1.10	BOHUNICE	8.1.(1)
II	SECONDARY CIRCUIT IN-SERVICE INSPECTION	608	STEAM LINE LEAK DETECTION Implement a steam line leak detection system similar to the proposed for the primary system.	D	SYSTEMS	1.9	KOZLODUY	8.2.(1)
II	SECONDARY CIRCUIT IN-SERVICE INSPECTION	657	SG INSPECTION SCOPE Thickness measurement of steam outlet manifold should be introduced.	D	COMPONENTS	1.10	KOZLODUY	9.8.(2)
II	SECONDARY CIRCUIT IN-SERVICE INSPECTION	1047	STEAM LINE LEAKAGE DETECTION Installation ofleak detection system in the main steam line is encouraged.	D	SYSTEMS	1.9	KOLA	8.1.(5)
II	SECONDARY CIRCUIT IN-SERVICE INSPECTION	1107	THICKNESS MEASUREMENT ASME Code case N480 instructions for thickness measurements (or the Soviet equivalent) should be taken into account when inspecting and reporting erosion of ferritic steel pipelines.	D	COMPONENTS	1.10	KOLA	9.6.(8)

ISSUE NUMBER: Instrumentation and Control (I&C) 1

ISSUE TITLE: Accident Monitoring Instrumentation

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Adequate instrumentation (in terms of range, qualification and redundancy) to inform the operator whether the barriers to the release of radioactive materials are being challenged is not currently provided to support severe accident management.

RELATED ITEMS:

28, 109, 125, 346, 601, 673, 957, 1272

JUSTIFICATION OF RANKING:

Accident monitoring instrumentation is claimed for beyond DBA.
It is used to inform the operator of the status of safety related parameters linked to the defense in depth concept (e.g. primary pressure/integrity RCS, containment pressure/integrity containment, radiation level inside and outside containment/integrity RCS and containment) and to allow him to mitigate accidents consequences. This instrumentation is needed to support the use of emergency procedures reducing the probability for wrong actions to be taken. In addition, current plant instrumentation is not qualified for harsh environment (see I&C 7).

CONCEPTUAL RECOMMENDATIONS:

Identify the required post accident monitoring instrumentation.

Identify the shortcomings of the existing instrumentation.

Provide the needed instrumentation.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	ACCIDENT MONITORING INSTRUMENTATION	28	BEYOND DBA MONITORING Accident monitoring for the core does not exist for beyond Design Basis Accident, e.g. level indication, Hydrogen in primary water.	D	I&C	4.6	DESREV	III.1.1.8
II	ACCIDENT MONITORING INSTRUMENTATION	109	SAFETY PARAMETER DISPLAY The installation of a computerized safety parameter display system would be of help to the operators for transient and accident management.	D	I&C	2.3	DESREV	III.4.2.6
II	ACCIDENT MONITORING INSTRUMENTATION	125	POST ACCIDENT MONITORING Check that the range of radiation monitoring corresponds to the maximum possible post accident level. The system shall be provided with on line recording.	D	I&C	1.7	DESREV	III.4.2.11
II	ACCIDENT MONITORING INSTRUMENTATION	346	ACCIDENT MONITORING Severe accident monitoring instruments should be installed, with indication in control room and in other habitable room.	D	I&C	4.6	BOHUNICE	10.1.(8)
II	ACCIDENT MONITORING INSTRUMENTATION	601	STEAM RADIATION MONITORING Install radiation monitors at the steam generator outlet lines.	D	I&C	2.3	KOZLODUY	8.1.(6)
II	ACCIDENT MONITORING INSTRUMENTATION	673	ADDITIONAL PROCESS COMPUTER An additional computer should be installed to ensure redundancy and to provide significant help to operator incase of emergency.	D	I&C	2.3	KOZLODUY	10.6.(1)
II	ACCIDENT MONITORING INSTRUMENTATION	957	SAFETY PARAMETER INDICATORS The instrumentation displaying essential safety parameters should be relocated into a single group and positioned at a prominent place on the reactor control panel.	O	OPS	4.6	NOVOVORONE	3.7.(1)
II	ACCIDENT MONITORING INSTRUMENTATION	1272	SAFETY PARAMETER DISPLAY Instrumentation displaying safety parameters should be relocated in a single prominent group. Until modification is performed, intruments should be highlighted by colour coding.	O	OPS	3.3	KOLA	3.7.(3)

ISSUE NUMBER: I&C 2

ISSUE TITLE: Reliability of I&C equipment

RANK OF ISSUE: III

ISSUE CLARIFICATION:

I&C equipment still used is very old fashioned (e.g. electrochemical switches, relays) and its reliability is questionable. The causes include deterioration with age, difficulty of maintenance and testing and the need for frequent attention.

RELATED ITEMS:

104, 122, 342, 343, 345, 664, 1118, 1150

JUSTIFICATION OF RANKING:

I & C equipment plays a major role in preventing and mitigating abnormal and emergency situations. The provision of reliable and accurate instrumentation is of high safety concern. No investigation of failure records was carried out by the safety review missions.

CONCEPTUAL RECOMMENDATIONS:

Assess I&C component failure records as a basis for a detailed programme for upgrading by safety related instrumentation.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	RELIABILITY OF I&C EQUIPMENT	104	OLD INSTRUMENTATION Instrumentation and control (I&C) equipment still used is very old fashioned (electromechanical switches, relays, and very few old analog instruments).	D	I&C	1.4	DESREV	III.4.1.7
III	RELIABILITY OF I&C EQUIPMENT	122	CORE TEMPERATURE MEASUREMENT The functioning and accuracy of outlet temperature measurements in the case of switchover to analog indication in addition to computer data logging should be checked and tested.	D+O	I&C	2.1	DESREV	4.4.4.B
III	RELIABILITY OF I&C EQUIPMENT	342	STANDARDIZED TRANSMITTERS Transmiters located near sensors of RPS using standardized output signals should be installed.	D	I&C	1.4	BOHUNICE	10.1.(4)
III	RELIABILITY OF I&C EQUIPMENT	343	STEAM GENERATOR LEVEL Quality of steam generator level measurement should be improved.	D	I&C	1.4	BOHUNICE	10.1.(5)
III	RELIABILITY OF I&C EQUIPMENT	345	SECONDARY DEVICES In case of a large reconstruction secondary devices and relay logic should be replaced by electronic equipment.	D	I&C	1.4	BOHUNICE	10.1.(7)
III	RELIABILITY OF I&C EQUIPMENT	664	THERMOCOUPLE CONNECTORS Redesign core thermocouple connectors to improve their availability.	D	I&C	2.1	KOZLODUY	10.3.(1)
III	RELIABILITY OF I&C EQUIPMENT	1118	STANDARDIZED TRANSMITTERS Transmitters of differencial transformer and electromechanical type should be replaced by transmitters with standardized outputs of 4-20 mA or 0-20 mA.	D	I&C	1.4	KOLA	10.1.(4)
III	RELIABILITY OF I&C EQUIPMENT	1150	CONTROL ROOM RECONSTRUCTION In case of a large reconstruction, the equipment in the main control room should be replaced completely with modern equipment.	D	I&C	2.4	KOLA	10.5.(4)

ISSUE NUMBER: I&C 3

ISSUE TITLE: Control and protection systems interaction

RANK OF ISSUE: **II**

ISSUE CLARIFICATION:

Full isolation or separation between control and protection functions of instrumentation is not provided. A fault in the non safety related instrumentation may induce the failure of safety related equipment.

RELATED ITEMS:

101, 352, 668, 782, 1120

JUSTIFICATION OF RANKING:

Control systems faults that can lead to degradation of protection function are of safety concern.

CONCEPTUAL RECOMMENDATIONS:

Identify all cases where control and protection use common equipment.

Evaluate the individual consequence

Take corrective action as required

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	CONTROL / PROTECTION SYSTEMS INTERACTION	101	SEPARATION CONTROL-PROTECTION At the time of the design, due to the absence of formal definition of safety/non-safety related systems, there was no distinct separetion between control and protection functions.	D	I&C	3.1	DESREV	III.4.1.5
II	CONTROL / PROTECTION SYSTEMS INTERACTION	352	COMMON USE OF FLUX DETECTORS Common use of neutron flux detectors for control and protection should be avoided, or it should be shown that failure cannot cause malfuction and failure of RPS simultaneously.	D	I&C	2.1	BOHUNICE	10.4.(3)
II	CONTROL / PROTECTION SYSTEMS INTERACTION	668	COMMON USE OF FLUX DETECTORS The common use of neutron flux detectors for power control and protection should be avoided, or it should be shown that failure cannot cause malfunction and failure of RPS simultaneously.	D	I&C	1.6	KOZLODUY	10.4.(3)
II	CONTROL / PROTECTION SYSTEMS INTERACTION	782	DIVERSITY OF REACTOR TRIP The circuit for de-energizing the rod control system should be separated from those which remove power from the control rods electromagnets, and placed in a physical separate location.	D	I&C	3.5	NOVOVORONE	10.1.(4)
II	CONTROL / PROTECTION SYSTEMS INTERACTION	1120	COMMON USE OF FLUX DETECTORS Use of common flux detectors for power control and reactor protection should provide for electrical isolation of the signal.	D	I&C	1.6	KOLA	10.2.(1)

ISSUE NUMBER: I&C 4

ISSUE TITLE: I&C redundancy, separation and independence.

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

There are numerous instances where redundancy, physical and electrical separation and independence of safety related instrumentation channels are not adequately provided.

RELATED ITEMS:

102, 106, 340, 359, 362, 365, 670, 671, 783, 784, 785, 786, 787, 842, 1119, 1124, 1126, 1134, 1140

JUSTIFICATION OF RANKING:
Single failure (e.g. single relay for containment spray actuation) or common cause events (e.g. fire) could lead to total failure of safety functions.

CONCEPTUAL RECOMMENDATIONS:

Either provide separation, and independence of the existing safety related instrumentation or provide an additional separate independent set of instrumentation system

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	102	SINGLE FAILURE CRITERIA Absence of systematic independence and physical separation do not permit to fully meet single failure criterion nor protection against common mode failure.	D	I&C	3.1	DESREV	III.4.1.2
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	106	SEARCH FOR COMMON MODE FAILURE A systematic search for possible common points and common mode failures in I&C needs to be performed on the plant specific drawings and layout.	D	I&C	3.1	DESREV	III.4.2.4
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	340	I&C REDUNDANCY AND SEPARATION Separation and independence of redundant I&C should be improved within rooms and cable ways. Where this is not possible, fire protection should be improved.	D	I&C	1.6	BOHUNICE	10.1.(2)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	359	ESF ACTUATION LOGIC REDUNDANCY Modify Engineering Safety Features actuation logic to avoid that a single failure cause failure of more than one train. Provide redundancy from sensor to actuator.	D	I&C	3.1	BOHUNICE	10.5.(1)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	362	STEAM RELIEF CONTROL Steam isolation and BRU-A relief valve control circuits should be made redundant, to prevent failure to operate due to single failure.	D	I&C	3.6	BOHUNICE	10.5.(4)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	365	SIGNAL PROCESSING EQUIPMENT In case of a large reconstruction, the signal processing equipment should be moved to 3 separate electronic rooms.	D	I&C	1.6	BOHUNICE	10.6.(3)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	670	I&C REDUNDANCY AND SEPARATION Transmitters of redundant detectors should be installed in separate rooms.	D	I&C	1.6	KOZLODUY	10.5.(2)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	671	CONFINMENT SPRAY LOGIC Redesign confinment spray actuation logic for redundancy from snsors to actuators.	D	I&C	1.6	KOZLODUY	10.5.(3)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	783	WIRING SEPARATION Safety system wiring should be separated in accordance with relevant modern standards.	D	I&C	3.5	NOVOVORONE	10.1.(5)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	784	MITIGATING MEASURES If adequate separation can not be obtained, mitigating measures should be developed and implemented.	D	I&C	3.5	NOVOVORONE	10.1.(6)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	785	BACKUP PROTECTION SYSTEM Develop and install a simplified backup protection system whose sensors, wiring, and logic units are totally separated from the existing systems.	D	I&C	3.5	NOVOVORONE	10.1.(7)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	786	PRESSURE LEVEL REDUNDANCY The pressurizer level channels should be increased to at least a two-way redundancy.	D	I&C	3.5	NOVOVORONE	10.1.(8)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	787	SENSOR RELOCATION One of the two sensor should be relocated to one of the other instrument compartments.	D	I&C	3.5	NOVOVORONE	10.1.(9)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	842	SINGLE FAILURE CRITERION Analyse whether the reactor protection system design is single failure-proof.	D	ACCIDENT	3.5	NOVOVORONE	12.2.(3)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	1119	I&C REDUNDANCY AND SEPARATION Separation and independence of redundant channels and actuation logic should be improved as much as possible.	D	I&C	1.6	KOLA	10.1.(5)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	1124	SEPARATION OF PROTECTION Separation of portions of the protection functions should be achieved as much as possible. This include wiring, racks, cable trays, panels and relay cabinets.	D	I&C	1.6	KOLA	10.2.(5)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	1126	SAFETY INJECTION ACTUATION Safety injection pumps actuation logic should be modified in such way that a single failure cannot cause failure of more than 2 pumps.	D	I&C	3.1	KOLA	10.4.(1)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	1134	SPRAY ACTUATION Independence and separation of spray actuation channels should be attained in such way that a single failure cannot cause failure of more than one pump.	D	I&C	3.1	KOLA	10.4.(9)
IV	I&C REDUNDANCY, SEPARATION, INDEPENDENCE	1140	AFWS ACTUATION The Auxiliary Feedwater System actuation system should be redesigned as a redundant double train system.	D	I&C	3.1	KOLA	10.4.(15)

ISSUE NUMBER: I&C 5

ISSUE TITLE: I&C support to operation and control room design.

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Excessive demands placed on operators due to insufficient degree of information, centralization and automation for normal, abnormal and emergency situations.

RELATED ITEMS AND PRIORITIES:
103, 113, 126, 127, 129, 131, 157, 182, 246, 256-265
353, 363, 364, 366, 367, 473, 599, 648, 733, 792, 802, 803, 804,
938, 947, 948, 949, 950, 951, 952, 956, 1048, 1052, 1061, 1128, 1130, 1135, 1136, 1137, 1138, 1141, 1146, 1147, 1148, 1149, 1152, 1267, 1269, 1277

JUSTIFICATION OF RANKING:

Operators errors are likely to occur but a single error will probably not lead to more frequent challenging of the protection system. In emergency conditions, operator errors may lead to more severe consequences.

CONCEPTUAL RECOMMENDATION:

A control room design review is strongly recommended (NUREG 0700) as a joint effort by designers and operators.

This issue is linked to operator training in the proper use of information and follow up of procedures. A program for upgrading the operator information system needs to be established.

CAT.	ISSUE	ITEM n	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	103	DEGREE OF AUTOMATION There is an insufficient degree of automation and centralization. The computer is mainly for data aquisition	D	I&C	1 5	DESREV	III 4 1 6
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	113	INHIBITING PROTECTION FUNCTION Investigate what are the possibilities of inhibition of protection functions and what are the means in the plant to control such actions (alarms, administrative procedures,etc).	D+O	I&C	3 5	DESREV	III 4 3 2
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	126	CONTROL ROOM TASKS Check the task particion between the main control room and the local auxiliary rooms, specially during accident procedures Comunication between various locations should be checked.	D+O	I&C	2.4	DESREV	III.4.3.1
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	127	CONTROLS AND DISPLAYS GROUPING A review of grouping of controls and displays by task to be performed on all modes of operation should be done The grouping by importance and frequency of use should also be evaluated	D+O	I&C	2 3	DESREV	4 6 5
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	129	CONTROL ROOM DESIGN REVIEW A full control room design review, following criteria given after TMI accident is recommended.	D	I&C	2 4	DESREV	4 6 6
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	131	AUTOMATIC REACTOR CONTROL Investigate the manual actions that operators have to take to switch from manual to automatic reactor control (procedures, location of actuators, etc).	D+O	I&C	1 5	DESREV	III.4.3 3
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	157	MIMIC OF ELECTRIC DISTRIBUTION A mimic diagram should be provided in the control room clearly showing the current status of all electrical distribution	D	I&C	2.3	DESREV	5 9 1
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	182	SG TUBE RUPTURE INDICATION Verify that indications of radioactivity in the steam line and condenser air ejectors are readly available to the operators. Verify that Steam Generator (SG) level indication and feedwater flow indication are readly available to operators.	D+O	ACCIDENT	1 11	DESREV	6 6 6 A
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	246	SAFETY PARAMETER DISPLAY A safety parameter display system (SPDS) should be developed.	O	OPS	3 3	BOHUNICE	3 4 (3)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	256	CONTROL ROOM DESIGN A human factor design review of the control room should be conducted	O	OPS	2.4	BOHUNICE	3.6 (1)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	257	UPGRADE PROCESS COMPUTER The process computer should be upgraded to include parameter trending, alarm, and graphics.	O	I&C	3 3	BOHUNICE	3.6.(2)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	258	SG LEVEL INDICATION New SG level indicators with vertical scale should be installed in desk 7 and 10.	O	OPS	2 3	BOHUNICE	3 6 (3)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	259	SHUTDOWN LEVEL INDICATION Reactor water level indication should be installed for use during shutdown and refueling.	O	OPS	2.3	BOHUNICE	3.6.(4)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	260	LOW GRID FREQUENCY ALARM An alarm on low frequency in the grid should be installed.	O	OPS	2 3	BOHUNICE	3 6.(5)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	261	ADDITIONAL INDICATORS Individuals indicators should be added such as. level in male-up tank, flow in both ECCS collectors, flow in euxiliary and emergency feed water collectors, flow of sprinkler pumps.	O	OPS	2.3	BOHUNICE	3.6.(6)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	262	STANDARD INSTRUMENTATION Consideration should be given to standardizing control room intrumentation.	O	OPS	2.3	BOHUNICE	3.6.(7)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	263	RELIABILITY OF INSTRUMENTS Analyse the reliability of instrumentation under LOCA situation and indicate in control room which ones can be used.	O	OPS	2 3	BOHUNICE	3.6.(8)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	264	ELIMINATION OF ALARMS Consider eliminating useless alarms from standby pumps by preventing low pressure alarm after pump is not running.	O	OPS	2.3	BOHUNICE	3.6.(9)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	265	CONTROL ROOM COMMUNICATION Communication system between control room, shift supervisor office and field	O	OPS	1 19	BOHUNICE	3.6 (10)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
			operators should be upgraded.				
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	353	NEUTRON FLUX INDICATION Improve neutron flux position and measured value indication. At least the signals from channels in operations should be indicated simultaneously.	D	I&C	2.1	BOHUNICE 10.4.(4)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	363	INFORMATION TO OPERATORS The control room should be fitted with additional with additional equipment for operator information, including video displays.	D	I&C	2.3	BOHUNICE 10.6.(1)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	364	RENOVATION OF CONTROL ROOM In case of a large reconstruction, the equipment of the control room should be completely replaced by modern equipment.	D	I&C	2.4	BOHUNICE 10.6.(2)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	366	ADDITIONAL PROCESS COMPUTER An additional computer should be installed to ensure redundancy and to allow installationof video display and protocol printers.	D	I&C	2.3	BOHUNICE 10.6.(4)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	367	UPGRADING OF PLANT COMPUTER In case of a large reconstruction the entire plant computer should be replaced by a more powerful and fully redundant computer.	D	I&C	2.3	BOHUNICE 10.6.(5)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	473	DISPLAY OF LIMITING CONDITIONS Develope an operator aid to visually display existing limiting condition for operation.	O	OPS	2.3	KOZLODUY 3.3.(6)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	599	MAIN VALVE INDICATIONS Operator information about position of main isolation valves should be optimized.	D	SYSTEM	2.3	KOZLODUY 8.1.(4)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	648	PRIMARY CIRCUIT MONITORING Monitoring of loose parts and rotating equipment in the primary should be introduced.	D	I&C	1.10	KOZLODUY 9.4.(4)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	733	SG RUPTURE INDICATION Add a direct monitoring system of radioactivity level of the SG main steam line which will alert the control room.	D	SYSTEMS	1.19	NOVOVORONE 8.1.(4)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	792	ROD POSITION INDICATION Modify the continuous system to count and display the number of the complete revolutions from the bottom of the core to reduce the probability of misplaced rods.	D	I&C	2.3	NOVOVORONE 10.2.(1)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	802	READABILITY OF DISPLAYS Reduce the reflections by controlling room lighting and by reducing light entering from the windows.	D	I&C	1.19	NOVOVORONE 10.7.(5)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	803	LABELS AND LETTERING Replace the labels and alarm window lettering, new labels should have larger letters.	D	I&C	1.19	NOVOVORONE 10.7.(6)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	804	HERMATIC CLOSURE EQUIPMENT Other forms of surveillance for equipment within the hermetic enclosure, should be considered.	D	I&C	1.25	NOVOVORONE 10.7.(7)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	938	CONTROL ROOM OPERATIONS Redesign the operators desks, storage cupboards and aids to provide for the introduction of the third person.	O	OPS	1.19	NOVOVORONE 3.4.(1)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	947	COMPUTER DISPLAYS CONTROL ROOM Install the computer display system in the unit 4.	O	OPS	1.19	NOVOVORONE 3.6.(1)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	948	USE OF NEW EQUIPMENT A policy and instruction should be implemented to control the use of the screen display units during the development period and for subsequent period of operational use.	O	OPS	1.17	NOVOVORONE 3.6.(2)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	949	PANEL DEMARCATION The control panels should be provided with the visible demarcation of systems, major plant items and/or functions.	O	OPS	2.3	NOVOVORONE 3.6.(3)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	950	INSTRUMENTATION Where a new design of instrument is to be fitted the existing features of symmetry should be maintained.	O	OPS	1.19	NOVOVORONE 3.6.(4)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	951	ALARM SYSTEM The alarm system should be enhanced to improve and harmonize the visual and audible distinction betwen the relative priorities of alarm actions.	O	OPS	1.19	NOVOVORONE 3.6.(5)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	952	SWITCH COVERS Improve the design of covers of switches on the unit control desk to ensure that they are adequately retained.	O	OPS	1.19	NOVOVORONE 3.6.(6)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	956	INDICATIONS Provide and maintain adequate indications at all control positions.	O	OPS	1.19	NOVOVORONE 3.6.(10)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1048	ON-LINE BORON-METER On-line Boron-meter should be installed in each block.	D	SYSTEMS	2 3	KOLA 8 1.(6)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1052	SG LEVEL CONTROL To avoid overfilling of the steam generator, an automatic device should be considered.	D	SYSTEMS	1.5	KOLA 8.2.(4)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1061	COOLDOWN FROM CONTROL ROOM In the frame of reconstruction measures, the possibility of conducting cool down of the plant from control room shoud be assessed.	D	SYSTEMS	1.5	KOLA 8.4.(3)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1128	MANUAL INITIATION OF INJECTION Manual initiation of each independent safety injection train from the control room should be installed.	D	I&C	3.1	KOLA 10.4 (3)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1130	MODE SWITCHES ALARM A bloched position on the safety injection mode switch should be alarmed in the priority annunciator in the control room.	D	I&C	2.1	KOLA 10.4.(5)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1135	MANUAL INITIATION OF SPRAY Manual initiation of each redundant spray system train from the control room should be provided.	D	I&C	3.1	KOLA 10.4.(10)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1136	SPRAY MODE SWITCHES Redesign of spray actuation system should avoid mode switches. If block position is needed it should alarm in priority annunciator in the control room.	D	I&C	2.1	KOLA 10.4.(11)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1137	SPRAY VALVE CONTROL Key lock switches should be provided for each spray injection valve.	D	I&C	2.1	KOLA 10.4.(12)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1138	SPRAY PRESSURE INDICATION Spray pressure indication of the two additional channels should be implemented.	D	I&C	2.1	KOLA 10.4 (13)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1141	MANUAL INITIATION OF AFWS The new design of Auxiliary Feedwater System actuation should include manual initiation from the control room.	D	I&C	3.1	KOLA 10.4.(16)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1146	STEAM GENERATOR LEVEL CONTROL Steam Generator level control auto/manual stations should be provided for each steam generator level control.	D	I&C	2.3	KOLA 10.4.(21)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1147	SAFETY PARAMETER PANEL A safety panel displaying safety parameters and the status of safety systems should be installed in the control room.	D	I&C	2.3	KOLA 10.5.(1)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1148	AUDIBLE ALARM DURATION The audible alarm signal should be permanent until operator acknowledge.	D	I&C	2.3	KOLA 10.5.(2)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1149	CONTROL PANEL LABELING Consideration should be given to replacing all the labeling including alarm annunciator window lettering.	D	I&C	2.3	KOLA 10.5.(3)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1152	PROCESS COMPUTER UPGRADING The data aquisition system of the installed computer should be increased to perform alarm function, post trip review and event recording.	D	I&C	2.3	KOLA 10.5.(6)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1267	CONTROL ROOM UPGRADE The control room should be upgraded. More information to operator should be provided.	O	OPS	2.4	KOLA 3.6.(1)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1269	OPEN INSTRUMENT PANELS Back of open intrumentation panels should be protected from inadvertent approach.	O	OPS	2.4	KOLA 3.6.(3)
III	I&C SUPPORT TO OPERATION / CONTROL ROOM	1277	ON LINE BORON MEASUREMENT On line boron measuring equipment should be installed with indication in the control room.	O	OPS	2.3	KOLA 3.8.(5)

ISSUE NUMBER: I&C 6

ISSUE TITLE: Interlocking

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Insufficient automatic interlocking to prevent unacceptable operating conditions or transients.

RELATED ITEMS:

38, 40, 45, 139, 159, 160, 347, 350, 351, 597, 598, 662, 666, 667, 731, 748, 796, 797, 815, 1058, 1063, 1121, 1122, 1131, 1142

JUSTIFICATION OF RANKING:

Absence of sufficient automatic interlocks places excessive pressure on the operator which may lead to human errors.

CONCEPTUAL RECOMMENDATIONS:

Implement corrective action according to the specific single items given above.

For some items a temporary solution may be found in administrative procedures.

Identify possible additional problems related to interlocking.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	INTERLOCKING	38	INADVERTENT LOOP ISOLATION Investigate the methods used to prevent inadvertent closure of primary loop isolation valves	D+O	I&C	1.10	DESREV	2.1.6.A
II	INTERLOCKING	40	CLOSING ALL ISOLATION VALVES There should be some kind of safeguard to prevent inadvertent closure of all primary loop isolation valves.	D	I&C	1.10	DESREV	2.1.9
II	INTERLOCKING	45	OPERATING REGIMES AND PUMPS A problem area related to potential switching errors of main coolant with regard to permissible reactor power has been identified in Greifswald. Consideration of appropriate interlocks is recommended. It is recommended to implement measures to prevent this kind of erroneous switching.	D+O	I&C	1.9	DESREV	2.3.9.
II	INTERLOCKING	139	INTERCONNECTION BETWEEN TRAINS Interconnection between trains and units shall have adequate interlocks and shall be displayed in control room to minimize operator errors.	D+O	ELECTRICAL	1.6	DESREV	5.1.6.3
II	INTERLOCKING	159	POWER LIMITS AND PUMPS Limitation of reactor power given the configuration of electric power supply to reactor coolant pumps should be reconsidered. An interlock solution might be easier if the number of interconnections is reduced.	D	I&C	1.9	DESREV	5.12 5.3
II	INTERLOCKING	160	POWER LIMITS AND PUMPS CONTROL Assess the reliability of equipment and administrative control to keep power limits according to reactor coolant pumps configuration, including: switch over to auxiliary generator supply, logic for scram or power reduction, procedures.	D	I&C	1.9	DESREV	5.12.5.3.A
II	INTERLOCKING	347	REACTOR POWER LIMITS A system should be installed which prevents inadmissible reactor power situations depending on the primary pumps configuration.	D	I&C	3.5	BOHUNICE	10 2 (1)
II	INTERLOCKING	350	STARTUP INTERLOCK Interlock should be installed to prevent startup without proper positioning of ex core flux detectors.	D	I&C	2.1	BOHUNICE	10.4 (1)
II	INTERLOCKING	351	FLUX MEASURING RANGES Automatic switching of neutron flux measuring ranges should be installed.	D	I&C	2.1	BOHUNICE	10.4.(2)
II	INTERLOCKING	597	PUMP INTERLOCKS Interlocks should be installed to prevent starting of more than one main coolant pump at a time.	D	I&C	2.3	KOZLODUY	8.1 (2)
II	INTERLOCKING	598	MAIN VALVE INTERLOCKS Interlocks should be installed to prevent operator to close/open more than one main isolation valve at a time.	D	I&C	2.3	KOZLODUY	8.1 (3)
II	INTERLOCKING	662	REACTOR POWER LIMITS Interlocks or an automatic system should be installed for the adjustment of reactor power in relation to availability of main coolant pumps.	D	I&C	2.3	KOZLODUY	10.2.(1)
II	INTERLOCKING	666	STARTUP INTERLOCK Interlock should be installed to prevent plant startup without proper positioning of neutron flux detectors.	D	I&C	2.1	KOZLODUY	10.4.(1)
II	INTERLOCKING	667	FLUX MEASURING RANGES Automatic switching of neutron measuring ranges should be installed.	D	I&C	2.1	KOZLODUY	10 4.(2)
II	INTERLOCKING	731	SPURIOUS LOOP ISOLATION Implement an administrative procedure that requires disconnection of some of the contactors of the isolation valves.	D	SYSTEMS	1.10	NOVOVORONE	8 1 (2)
II	INTERLOCKING	748	ECCS ACTIVATION Determine whether the signal of the ECCS activation on the pressurizer very low level could be interlocked only at the cold shutdown state.	D	SYSTEMS	3.6	NOVOVORONE	8.6.(1)
II	INTERLOCKING	796	SAFETY INJECTION INTERLOCK Interlocks on pump suction and lubrication oil pressure should be deleted and replaced with an alarm on the main control board.	D	I&C	3.1	NOVOVORONE	10.5.(1)
II	INTERLOCKING	797	SAFETY INJECTION PUMPS The valves in the cooling water circuit should be normally open to prevent the pumps from starting when required	D	I&C	3.1	NOVOVORONE	10.5.(2)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	INTERLOCKING	815	RCP POWER SUPPLY Minimize the number of possible power supply configurations and reduce the opportunity of operator errors by removing the two sectional circuit breakers from the 6 KV supply bus bars during normal operation of the power plant.	D	ELECTRICAL	4.3	NOVOVORONE	11.1.(3)
II	INTERLOCKING	1058	SPRAY PUMPS INTERLOCK Provide an interlock to avoid two spray pump switches being put in the "off" position.	D	SYSTEMS	3.6	KOLA	8.3.(6)
II	INTERLOCKING	1063	AUX FEED PUMPS INTERLOCK Provide interlock to avoid two auxiliary feedwater pump switches being put in "off" position.	D	SYSTEMS	3.6	KOLA	8.5.(2)
II	INTERLOCKING	1121	STARTUP INTERLOCK Interlocks should be installed to prevent plant startup and power operation without proper positioning of flux detectors.	D	I&C	2.1	KOLA	10.2.(2)
II	INTERLOCKING	1122	FLUX MEASURING RANGES Automatic range switching should be considered for flux measuring ranges.	D	I&C	2.1	KOLA	10.2.(3)
II	INTERLOCKING	1131	SAFETY INJECTION VALVE CONTROL Key lock switches for safety injection valves should be provided.	D	I&C	2.1	KOLA	10.4.(6)
II	INTERLOCKING	1142	AFWS ACTUATION INTERLOCKS The new design of Auxiliary Feedwater System actuation should ensure that initiation signal actuates all active elements (pumps and valves) without undue interlocks.	D	I&C	3.1	KOLA	10.4.(17)

ISSUE NUMBER: I&C 7

ISSUE TITLE: I&C and Electrical Equipment Qualification

RANK OF ISSUE: III

ISSUE CLARIFICATION:

At the time the design was made, the environmental and seismic qualification of instrumentation and electrical equipment was not addressed, and there was no backfitting program developed in that field up to now.

RELATED ITEMS:

107, 344, 789, 791, 795, 834, 1116, 1117, 1159

JUSTIFICATION OF RANKING:

The total absence of seismic and environmental qualification of I&C and electrical equipment could lead to total loss of safety functions.

A HELB (High Energy Line Break) leading to harsh environmental conditions may be conservatively assumed as a likely event for which the consequences may be high.

CONCEPTUAL RECOMMENDATIONS:

Identify the safety related I & C and electrical equipment for the postulated faults (HELB, earthquake, etc.). Establish a qualification programme for this equipment.
A generic programme may be established for all VVER 440/230 considering the occurrences which have taken place (earthquakes).

Replace instrumentation which cannot be qualified.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	I&C / ELECTRICAL EQUIPMENT QUALIFICATION	107	ENVIRONMENTAL QUALIFICATION Safety related Instrumentation and Control (I&C) should preserve their functions under accident condition adverse environment.	D	I&C	3.3	DESREV III.4.2.3
III	I&C / ELECTRICAL EQUIPMENT QUALIFICATION	344	ENVIRONMENTAL QUALIFICATION Instruments which has to withstand harsh environment should be qualified for post accident conditions or be replaced by qulified equipment.	D	I&C	3.3	BOHUNICE 10.1.(6)
III	I&C / ELECTRICAL EQUIPMENT QUALIFICATION	789	ENVIRONMENTAL QUALIFICATION Expected environmental conditions for all safety-related equipment should be determined for all plant normal and accident mode including loss of coolant accident.	D	I&C	3.3	NOVOVORONE 10.1.(12)
III	I&C / ELECTRICAL EQUIPMENT QUALIFICATION	791	SEISMIC DESIGN BASIS The equipment require to function after a seismic event should be identified and qualified.	D	I&C	3.3	NOVOVORONE 10.1.(14)
III	I&C / ELECTRICAL EQUIPMENT QUALIFICATION	795	NEW FLUX SYSTEM New nuclear flux system should be tested to function correctly at 45 C, the correct upper limit of the SUZ room.	D	I&C	3.3	NOVOVORONE 10.4.(1)
III	I&C / ELECTRICAL EQUIPMENT QUALIFICATION	834	EL.ENVIRONMENTAL QUALIFICATION Performance of an analysis concerning ambient conditions inside and outside the hermetic zone in case of LOCA is highly recommended.	D	ELECTRICAL	3.3	NOVOVORONE 11.7.(1)
III	I&C / ELECTRICAL EQUIPMENT QUALIFICATION	1116	ENVIRONEMENTAL QUALIFICATION Expected environmental conditions should be determined. Equipment specification should be checked. Changes or replacement should be made.	D	I&C	3.3	KOLA 10.1.(2)
III	I&C / ELECTRICAL EQUIPMENT QUALIFICATION	1117	SEISMIC QUALIFICATION A seismic design basis should be developed. Instrumentation required after seismic event should be identified and seismically qualified	D	I&C	3.3	KOLA 10.1.(3)
III	I&C / ELECTRICAL EQUIPMENT QUALIFICATION	1159	BATTERY SEISMIC QUALIFICATION Seismic qualification of existing batteries should be checked. Replacement should be carried out if necessary.	D	ELECTRICAL	1.6	KOLA 11.5.(1)

ISSUE NUMBER: I&C 8

ISSUE TITLE: I&C and Electrical Equipment Classification

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Safety classification is the basis for applying the corresponding design criteria such as single failure, qualification, common cause failure, testability and maintenance.

RELATED ITEMS:

105, 110, 339, 661, 779, 780, 781, 1115,

JUSTIFICATION OF RANKING:

I&C and electrical equipment cannot be demonstrated to be in accordance with its safety role. It needs to be resolved as a means to implement other related issues.

CONCEPTUAL RECOMMENDATIONS:

Establish a plan for equipment classification and the related criteria to be applied.

CAT.	ISSUE	ITEM n.	TIITLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	I&C /ELECTRICAL EQUIPMENT CLASSIFICATION	105	IMPROVE SEPARATION OF I&C Explore the possibility to assure maximum separation and independence between safety and non-safety related instrumentation and control (I&C).	D	I&C	3.1	DESREV	III.4.2.1
III	I&C /ELECTRICAL EQUIPMENT CLASSIFICATION	110	SEPARATION OF I&C POWER SUPPLY Separation between safety and non-safety I&C power supplies and between different redundant protection channels should be provided.	D	I&C	3.1	DESREV	III.4.2.10
III	I&C /ELECTRICAL EQUIPMENT CLASSIFICATION	339	I&C FUNCTION CLASSIFICATION All I&C functions should be classified according to their importance to safety. Use classification as a basis to decide about measures necessary to improve equipment.	D	I&C	3.3	BOHUNICE	10.1.(1)
III	I&C /ELECTRICAL EQUIPMENT CLASSIFICATION	661	I&C FUNCTION CLASSIFICATION All I&C equipment should be classified according to their importance to safety.	D	I&C	3.1	KOZLODUY	10.1.(1)
III	I&C /ELECTRICAL EQUIPMENT CLASSIFICATION	779	DESIGN BASES Identify the required documents and request copies from the proper authorities.	D	I&C	1.5	NOVOVORONE	10.1.(1)
III	I&C /ELECTRICAL EQUIPMENT CLASSIFICATION	780	DESIGN REQUIREMENTS Systematic study of the existing system and equipment specification documents should be made to identify all design requirements.	D	I&C	1.5	NOVOVORONE	10.1.(2)
III	I&C /ELECTRICAL EQUIPMENT CLASSIFICATION	781	APPLICABLE CODES AND STANDARDS Study the relevant codes and standards to identify those which apply to the Novovoronezh NPP, incorporate them into the design basis and make the necesary modifications to ensure compliance.	D	I&C	1.5	NOVOVORONE	10.1.(3)
III	I&C /ELECTRICAL EQUIPMENT CLASSIFICATION	1115	I&C FUNCTION CLASSIFICATION I&C systems should be classified according to their importance to safety. This should form a basis for establishing measures for improvements.	D	I&C	3.3	KOLA	10.1.(1)

ISSUE NUMBER: I&C 9

ISSUE TITLE: I&C Signal priority.

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Operation of some of the safety systems can be inhibited by equipment protection signals or manual actions.

RELATED ITEMS:

56, 341, 360, 669, 672, 678, 679, 742, 822
1055, 1127, 1129, 1132, 1145

JUSTIFICATION OF RANKING:

The potential for safety functions to be inhibited is a high safety concern.

CONCEPTUAL RECOMMENDATIONS:

Identify safety functions which can be inhibited.

Establish and evaluate the potential consequences.

Implement corrective actions as needed.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	I&C SIGNAL PRIORITY	56	SAFETY INJECTION INTERRUPTION It is possible to stop emergency injection from the control room without any engineered delay. This present a potential for human error.	D+O	I&C	3.6	DESREV	2.7.5.2
III	I&C SIGNAL PRIORITY	341	SIGNAL PRIORITY RPS and ESF signals should have priority over equipment protective devices. Otherwise the protective circuit should be built with redundant logic (e.g. 2 out of 3).	D	I&C	3.1	BOHUNICE	10.1.(3)
III	I&C SIGNAL PRIORITY	360	SAFETY INJECTION ISOLATION Safety injection system should be modified so that automatic actuation get priority over manual isolation.	D	I&C	3.1	BOHUNICE	10.5.(2)
III	I&C SIGNAL PRIORITY	669	SAFETY INJECTION ISOLATION Safety injection logic should be redesigned so that automatic actuation gets priority over manual isolation.	D	I&C	3.1	KOZLODUY	10.5.(1)
III	I&C SIGNAL PRIORITY	672	SPRAY ISOLATION Redesign confinment spray actuation logic so that automatic actation gets priority over operator isolation.	D	I&C	3.1	KOZLODUY	10.5.(4)
III	I&C SIGNAL PRIORITY	678	DG SIGNAL PRIORITY In Unit 1/2 an interlock should be installed to prevent switch off of Diesel Generators by operator as long as automatic actuation conditions exist.	D	I&C	3.1	KOZLODUY	10.7.(4)
III	I&C SIGNAL PRIORITY	679	DG ACTUATION AND PROTECTION An interlock should be installed to give priority of Diesel Generator actuation signals over protective devices.	D	I&C	3.1	KOZLODUY	10.7.(5)
III	I&C SIGNAL PRIORITY	742	ECCS DEACTIVATION AFTER LOCA Deactivation of the ECCS after LOCA should be prevented for a time to be determined from the accident analysis.	D	SYSTEMS	3.6	NOVOVORONE	8.4.(2)
III	I&C SIGNAL PRIORITY	822	DG LOAD SEQUENCER LOGIC Redesign the diesel logic that the automatic diesel start signal has definite priority over manual operator action from the main control room.	D	ELECTRICAL	3.1	NOVOVORONE	11.2.(3)
III	I&C SIGNAL PRIORITY	1055	SAFETY INJECTION ISOLATION To avoid inadvertent deactivation of safety injection system without delay, time interlock feature should be installed.	D	SYSTEMS	3.1	KOLA	8.3.(3)
III	I&C SIGNAL PRIORITY	1127	OIL PRESSURE INTERLOCK Interlock of safety injection pumps on oil pressure should be deleted and replaced by alarm in the control room.	D	I&C	3.1	KOLA	10.4.(2)
III	I&C SIGNAL PRIORITY	1129	MODE SWITCHES CONTROL Safety injection mode switches should be provided with key locks which should be kept under administrative control.	D	I&C	2.1	KOLA	10.4.(4)
III	I&C SIGNAL PRIORITY	1132	SIGNAL FOR VALVE ACTUATION Safety injection valves should be open by safety injection signal (not by line pressure signal).	D	I&C	3.1	KOLA	10.4.(7)
III	I&C SIGNAL PRIORITY	1145	AFWS ACTUATION RESSETING Manual resetting of Auxiliary Feedwater System actuation should only be possible after actuation conditions have disappeared.	D	I&C	3.1	KOLA	10.4.(20)

ISSUE NUMBER: I&C 10

ISSUE TITLE: Testability of I&C Equipment

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Design of most safety related systems does not allow testing activities during normal operation.

RELATED ITEMS:

112, 349, 356, 357, 358, 506, 1123, 1133, 1139, 1143, 1144

JUSTIFICATION OF RANKING:

The reliability of the instrumentation and control systems and equipment will deteriorate due to undetected faults and the absence of periodic testing.

CONCEPTUAL RECOMMENDATIONS:

Establish the list of safety related systems to be tested and the test intervals.

Take corrective measures to allow testing of these systems during power operation.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	TESTABILITY OF I&C EQUIPMENT	112	TESTING PROTECTION FUNCTIONS Testing the complete protection functions (from sensor to final actuation) are provided. Missions should check how this is performed, which tests are performed during normal operation and which during refuelling.	D+O	I&C	1.25	DESREV 4.1.6
III	TESTABILITY OF I&C EQUIPMENT	349	IN CORE MONITORS CALIBRATION The replacement of in core flux monitoring system should be done in such way to allow calibration of on line measurement with periodic measurements by activated wires.	D	I&C	2.1	BOHUNICE 10.3.(1)
III	TESTABILITY OF I&C EQUIPMENT	356	REDUNDANT CHANNEL COMPARATORS Comparators for the redundant measuring channels of RPS should be installed	D	I&C	3.5	BOHUNICE 10.4.(7)
III	TESTABILITY OF I&C EQUIPMENT	357	TESTABILITY OF RPS Testability of the Reactor Protection System should be accomplished by improvements of the system structure	D	I&C	3 4	BOHUNICE 10.4.(8)
III	TESTABILITY OF I&C EQUIPMENT	358	SELF TESTING OF RPS If a large reconstruction is undertaken, Reactor Protection System should be redesigned for self testing capability.	D	I&C	3.5	BOHUNICE 10.4.(9)
III	TESTABILITY OF I&C EQUIPMENT	506	TESTING REACTOR PROTECTION Reactor protection system should be tested at every 3 months. This requires modification of equipment in Unit 1/2.	O	I&C	3.4	KOZLODUY 3.7.(7)
III	TESTABILITY OF I&C EQUIPMENT	1123	TESTABILITY OF RPS Modifications to enable complete testing of Reactor Protection System during opeartion should be implemented.	D	I&C	3.4	KOLA 10.2.(4)
III	TESTABILITY OF I&C EQUIPMENT	1133	TESTING OF ACTUATION LOGIC Testing of safety injection signal and logic from sensor to actuator with the reactor in operation should be implemented.	D	I&C	3.5	KOLA 10.4.(8)
III	TESTABILITY OF I&C EQUIPMENT	1139	TESTING OF SPRAY LOGIC Testing of sray actuation logic signal from sensor to actuator with the reactor inoperation should be provided.	D	I&C	3.5	KOLA 10.4.(14)
III	TESTABILITY OF I&C EQUIPMENT	1143	SPRAY COMPONENTS TESTING Spray pumps and valves should be provided with manual switches for individual testing, but this should not inhibit system actuation.	D	I&C	3.5	KOLA 10.4.(18)
III	TESTABILITY OF I&C EQUIPMENT	1144	TESTING OF AFWS LOGIC Testability of the Auxiliary Feedwater System actuation from sensor to actuatorwith the reactor in operation should be incorporated in the new design.	D	I&C	3.5	KOLA 10.4 (19)

ISSUE NUMBER: I&C 11

ISSUE TITLE: Control Room Habitability/Remote Shutdown Panel

RANK OF ISSUE: III

ISSUE CLARIFICATION:

There is insufficient provision to maintain control room habitability. In case of main control room inhabitability or unavailability, there is no other centralized location from where a safe shutdown can be performed.

RELATED ITEMS:

108, 317, 400, 497, 498, 621, 674, 805, 807, 808, 811, 958, 959, 1014, 1078
1151, 1271

JUSTIFICATION OF RANKING:

Inhabitability or unavailability of the main control room should be considered likely and the consequences of high safety concern if no alternative solution exists.

CONCEPTUAL RECOMMENDATIONS:

Additional measures should be provided to maintain, as far as possible, control room habitability and function in the event of fire, contamination and other similar threats. Identify functional requirements and design basis for the remote shutdown panel and implement. Interim procedures should be prepared to allow the safe plant shutdown from outside the control room.

Additionally, measures (such as self contained breathing apparatus, door improvement, etc.) should be taken immediately to protect Main Control Room personnel in accident conditions until permanent habitability improvements can be made.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	108	REMOTE SHUTDOWN PANNEL Plants should have a remote shutdown pannel.	D	I&C	2.4	DESREV	III.4.2.7
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	317	REMOTE SHUTDOWN PANEL Install an remote shutdown pannel physically separated from the control room.	D	SYSTEMS	2.4	BOHUNICE	8.4.(1)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	400	HABITABILITY OF CONTROL ROOM Habitability assessment of control room, including fire, radiation and contamination should be performed.	O	FIRE	4.6	BOHUNICE	12.4.(4)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	497	CONTROL ROOM VENTILATION Ventilation system of the control room (and shutdown panel of Units 3/4) should be modified to ensure habitability under accident conditions or hazardous atmosphere.	O	OPS	2.4	KOZLODUY	3.6.(1)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	498	BREATHING APPARATUS Self contained breathing apparatus should be readly available in the control room.	O	OPS	5.2	KOZLODUY	3.6.(2)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	621	REMOTE SHUTDOWN PANEL Install a remote shutdown pannel in units 1/2 and relocate pannel of units 3/4.	D	I&C	2.4	KOZLODUY	8.4.(4)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	674	REMOTE SHUTDOWN PANEL An emergency shutdown panel should be installed, geographically separates from control room.	D	I&C	2.4	KOZLODUY	10.6.(2)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	805	REMOTE SHUTDOWN PANEL A comprehensive strategy and plan for achieving safe shutdown from outside the main control room should be developed.	D	I&C	2.4	NOVOVORONE	10.7.(8)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	807	TRIP LOGIC ENDANGERING Place an interposing relay in the logic cabinet to isolate the trip line from the external wiring to protect the internal circuits.	D	I&C	2.4	NOVOVORONE	10.7.(10)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	808	TRIP LOGIC ENDANGERING Relocate the contact of an interposing relay as close to betwen the 220 V bus as possible to further reduce the possibility of bypassing the TH logic due to failures.	D	I&C	2.4	NOVOVORONE	10.7.(11)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	811	AIRBONE MISSILE PROTECTION The windows should be replaced by a wall capable of resisting a design basis airbone missile.	D	I&C	2.4	NOVOVORONE	10.7.(14)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	958	VENTILATION The ventilation system should be modified to maintain habitability for the time period necessary to make the reactor safe under accident conditions.	O	OPS	4.6	NOVOVORONE	3.7.(2)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	959	BREATHING APPARATUS The number of breathing air sets should be increased to a minimun of four.	O	OPS	4.6	NOVOVORONE	3.7.(3)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	1014	SEVERE ACCIDENT CONDITIONS The habitability of the unit control rooms, the radiological control room and the station dispatcher room under the severe accident conditions should be determined.	O	EP	5.4	NOVOVORONE	6.4.(4)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	1078	CONTROL ROOM VENTILATION Filters should be installed in the closed circuit which would cool the control room in case of activity release.	D	SYSTEMS	2.4	KOLA	8.8.(3)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	1151	REMOTE SHUTDOWN CAPABILITY Remote shutdown capability should be completely independent from power supply and instruments in the control room. Transfer switches should be located in the remote shutdown panel.	D	I&C	2.4	KOLA	10.5.(5)
III	CONTROL ROOM HABITABILITY/SHUTDOWN PANEL	1271	BREATHING APARATUS Increaes number of breathing aparatus in control room to 4. Additional air bottles should be provided.	O	OPS	5.2	KOLA	3.7.(2)

ISSUE NUMBER: I&C 12

ISSUE TITLE: Instrumentation setpoint margins

RANK OF ISSUE: II

ISSUE CLARIFICATION:

The uncertainties (accuracies, drift, calibration) of instrumentation channels setpoints of reactor protection and engineered safety features actuation systems have to be determined. The safety margins to account for uncertainties have to be consistent with the values used in safety analysis.

RELATED ITEMS (AND PRIORITIES):

1125

JUSTIFICATION OF RANKING:

This evaluation is the only mean to ensure that safety limits are not violated.

CONCEPTUAL RECOMMENDATIONS:

Determine the list of uncertainties affecting the instrumentation channels of reactor protection and engineered safety systems, actuation systems and their values (in percent of range).

Combine the uncertainties to fix the total channel inaccuracy.
Evaluate if the plant setpoints were conservatively set and take corrective measures if needed.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	INSTRUMENTATION SETPOINT MARGINS	1125	SET POINT ACCURACY Calculations utilizing data from actual instrumentation accuracy and drift characteristic should be done to check if safety limits are still maintained.	D	I&C	1.21	KOLA 10.2.(6)

ISSUE NUMBER: Electrical 1

ISSUE TITLE: Electrical redundancy, separation and independence.

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

There are numerous instances where redundancy, physical and electrical separation and independence of electrical supplies are not adequately provided.

RELATED ITEMS:
132, 134, 135, 137, 146, 147, 148, 149, 154, 155, 156, 369, 675, 677, 788, 819, 820, 824, 827, 828, 830, 1155, 1160

JUSTIFICATION OF RANKING:

Single failure (e.g. 220 V DC switchboard) or common cause event (e.g. fire...) could lead to total failure of a safety function.

CONCEPTUAL RECOMMENDATIONS:

Either provide separation and independence of the safety-related electrical power supplies or provide an additional separate set of power supplies.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	132	POWER SUPPLY TO I&C Interconnection of electric power supply to Instrumentation and Control (I&C) seems to give ways to ensure good reliability and availability and ways to recover from incident situations. But this may also lead to common mode failure.	D	I&C	4 6	DESREV 4.9.4
IV	EL REDUNDANCY, SEPARATION, INDEPENDENCE	134	POWER SUPPLY FAILURES Electric power systems show a substantial common mode failure potential in case of events such as human errors, fires (including cable fires), failure of service water, due to complex interconnections, partial separationt,etc.	D	ELECTRICAL	1 6	DESREV III.5.1.4
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	135	REDUCE INTERCONNECTIONS It is recommended to attempt to reduce the number of automatic or quick manual interconnections.	D	ELECTRICAL	1.6	DESREV III.5.2.4
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	137	CABLE SEGREGATION During missions a number of cable routs should be reviewed in detailed, including plan of routes and visual inspection (following cable routes).	D	ELECTRICAL	1.13	DESREV 5.1.6.1
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	146	COOLING WATER FOR DIESELS Cooling water for Diesels is provided by a common service water system for twin units. It is possible that a single failure within service water can affect more than one Diesel.	D	ELECTRICAL	1 6	DESREV 5.5.5.1
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	147	LOAD SEQUENCER REDUNDANCY Investigate whetre the load sequencer is redundant for the two Diesel buses with respect to local arrangement and auxiliary power supply.	D	ELECTRICAL	1.6	DESREV 5.5.6.1
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	148	OIL TRANSFER PUMP There is only one pump to transfer oil from reservoirs to individual Diesel tanks. Check if this pump can be electrically connected to different Diesel distributions.	D	ELECTRICAL	4.3	DESREV 5.5.5.4
IV	EL REDUNDANCY, SEPARATION, INDEPENDENCE	149	DIESEL STARTUP LOGIC Diesels startup logic should be evaluated. Investigate wheter the logic is redundant and how the standby Diesel is started.	D	ELECTRICAL	4.3	DESREV 5 5.6.4
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	154	IMPROVEMENTS IN BATTERIES It should be considered the installation of 2 separate batteries for each unit, to separate them physically and electrically as far as possible and to increase the discharge time. Installation of a battery circuit monitor would further increase reliability of battery operation.	D	ELECTRICAL	4.3	DESREV 5.6.9.1
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	155	SWITCHGEAR CONTROL REDUNDANCY All 6 kV switchgear may be connected to a single unit battery, instead to independent redundant controls. This should be checked in individual plants.	D	ELECTRICAL	1.5	DESREV 5.7.1
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	156	DIRECT CURRENT DISTRIBUTION The deign of Direct Current (DC) distribution should be modified to reduce the complexity by avoiding interconnections between units.	D	ELECTRICAL	1.6	DESREV 5.8.1
IV	EL REDUNDANCY, SEPARATION, INDEPENDENCE	369	INTERNAL POWER DISTRIBUTION Internal power distribution network should be simplified by minimizing interconnections between two units	D	ELECTRICAL	1.6	BOHUNICE 10.7.(2)
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	675	MOTOR GENERATOR SETS As a first step, improve separation of motor gemerator sets in unit 1/2. As a second step, install static inverters in all units.	D	ELECTRICAL	1.5	KOZLODUY 10.7.(1)
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	677	CABLE PROTECTION Electrical cables of Unit 1/2 should be also separated and covered with fire retardant material.	D	ELECTRICAL	1.6	KOZLODUY 10.7.(3)
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	788	DIESEL LOAD SEQUENCES LOGIC The cross-train connections should be removed	D	I&C	1.6	NOVOVORONE 10.1.(11)
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	819	DISTRIBUTION SEGREGATION Implement a strict train segregation concept, so that failures under all worst case scenarios will be restricted to one train.	D	ELECTRICAL	1.6	NOVOVORONE 11.1.(7)
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	820	SERVICE WATER SUPPLY Not all diesel generators of both units should become inoperative during a fire or flooding or after a service water break.	D	ELECTRICAL	4.3	NOVOVORONE 11.2.(1)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	824	DG GAS OIL SUPPLY Install two pumps and devote them directly to the respective DG.	D	ELECTRICAL	4.3	NOVOVORONE 11.2.(5)
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	827	DC DISTRIBUTION BOARD Install modern DC swithgear within two separate and physically independent rooms and arrange this system together with batteries and chargers in a two train configuration for each unit.	D	ELECTRICAL	1.6	NOVOVORONE 11.3.(3)
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	828	REVERSIBLE MOTOR GENERATORS Separate the redundant RMGs from each other including separate cable routes. Relocate RMGs from the turbine hall.	D	ELECTRICAL	1.6	NOVOVORONE 11.4.(1)
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	830	CABLE SEGREGATION Identify all junction areas with the aim to further improve local separation and fire protection.	D	ELECTRICAL	1.6	NOVOVORONE 11.5.(1)
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	1155	DIESEL GENERATOR SEPARATION Redundant Diesel Generator sets should be physically separated.	D	ELECTRICAL	1.5	KOLA 11.4.(1)
IV	EL. REDUNDANCY, SEPARATION, INDEPENDENCE	1160	BATTERIES REDUNDANCY A system of two DC batteries per Block should be analysed as a possible improvement.	D	ELECTRICAL	4.3	KOLA 11.5.(2)

ISSUE NUMBER: Electrical 2

ISSUE TITLE: Reliability of Electrical Equipment.

RANK OF ISSUE: III

ISSUE CLARIFICATION:

The reliability and performance of electrical equipment in general does not meet current standards. The causes include deterioration with age, difficulty of maintenance and testing, and the need for frequent attention.

RELATED ITEMS:

136, 140, 161, 158, 370, 533, 814, 829, 999, 1156, 1157, 1158, 1161, 1163, 1164

JUSTIFICATION OF RANKING:

Electrical equipment plays a major role in preventing and mitigating abnormal and emergency situations. The provision of reliable electrical equipment is of high safety concern.

CONCEPTUAL RECOMMENDATIONS:

Set up a programme for upgrading electrical equipment and implementing it according to international standards.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	RELIABILITY OF ELECTRICAL EQUIPMENT	136	OLD DESIGN ELECTRIC EQUIPMENT Certain electric equipment reflects the historical limitations, e.g. Diesel-Generators and Reversible Motor-Generators. This, together with natural ageing may justify replacing such equipment with modern version, thereby enabling simpler solution with less interconnections.	D	ELECTRICAL	3.3	DESREV 5.0.6.1.A
III	RELIABILITY OF ELECTRICAL EQUIPMENT	140	VOLTAGE AND FREQUENCY CONTROL Permissible voltage and frequency deviations should be reviewed. Check if specific figures for consumers are consistent with limits. Check calculations and review test results.	D	ELECTRICAL	1.5	DESREV 5.2.6
III	RELIABILITY OF ELECTRICAL EQUIPMENT	158	REVERSIBLE MOTOR GENERATORS Reversible motor generator sets have a very complex method of operation. Considerations should be given to simplifying the design by providing separate battery chargers and inverters.	D	ELECTRICAL	1.5	DESREV 5.11.1
III	RELIABILITY OF ELECTRICAL EQUIPMENT	161	ELECTRICAL COMPONENTS AGEING Critical electrical components should be checked with respect to their conditions and the remaining lifetime in view of a possible replacement which will give a chance for improvements.	D	ELECTRICAL	3.3	DESREV 5.16.6
III	RELIABILITY OF ELECTRICAL EQUIPMENT	370	MOTOR GENERATOR SETS Reversible motor generator sets should be replaced by rectifiers and battery chargers.	D	ELECTRICAL	1.5	BOHUNICE 10.7.(3)
III	RELIABILITY OF ELECTRICAL EQUIPMENT	533	SHORT CIRCUIT IN 6kV BREAKERS The cause of short circuits occurring in 6kV circuit breakers should be investigated and corrected.	O	ELECTRICAL	1.6	KOZLODUY 5.1.(3)
III	RELIABILITY OF ELECTRICAL EQUIPMENT	814	VOLTAGE DEVIATIONS Calculation on the voltage situation at motor terminals should be compared with the design figures under the assumption of the possible worst case conditions.	D	ELECTRICAL	4.3	NOVOVORONE 11.1.(2)
III	RELIABILITY OF ELECTRICAL EQUIPMENT	829	MOTOR GENERATOR SETS A separation of the two functions battery charger and inverter is suggested leading to a simpler functional structure.	D	ELECTRICAL	1.5	NOVOVORONE 11.4.(2)
III	RELIABILITY OF ELECTRICAL EQUIPMENT	999	ELCTRICAL JUNCTION BOXES Electricity junction boxes located near the fire fighting water nozzles should have water proof seals installed.	O	FIRE	1.6	NOVOVORONE 5.3.(11)
III	RELIABILITY OF ELECTRICAL EQUIPMENT	1156	DIESEL SEIMIC QUALIFICATION Seismic qualification of Diesel Generators and auxiliary equipment should be evaluated.	D	ELECTRICAL	1.5	KOLA 11.4.(2)
III	RELIABILITY OF ELECTRICAL EQUIPMENT	1157	DIESEL GENERATOR OIL PUMPS Consideration should be given to replacing the Diesel Genarator starting oil pumps in order to achieve a shorter starting period.	D	ELECTRICAL	1.6	KOLA 11.4.(3)
III	RELIABILITY OF ELECTRICAL EQUIPMENT	1158	DIESEL EXCITATION SYSTEM The advantages of using a static type Diesel generator excitation system with a faster response should be analysed. Use of a brushless exciter should be also considered.	D	ELECTRICAL	1.6	KOLA 11.4.(4)
III	RELIABILITY OF ELECTRICAL EQUIPMENT	1161	DC DISTRIBUTION PANELS Replace the existing DC distribution panels with panels of the closed type.	D	ELECTRICAL	3.3	KOLA 11.5.(3)
III	RELIABILITY OF ELECTRICAL EQUIPMENT	1163	MOTOR GENERATOR BEARINGS Improvement of the quality of the bearings of the reversible motor generator sets or their replacements shoud be considered.	D	ELECTRICAL	3.3	KOLA 11.5.(5)
III	RELIABILITY OF ELECTRICAL EQUIPMENT	1164	MOTOR GENERATOR REPLACEMENT Replacement of Reversible Motor Generator sets by static rectifiers and inverters should be analysed.	D	ELECTRICAL	3.3	KOLA 11.5.(6)

ISSUE NUMBER: Electrical 3

ISSUE TITLE: Diesel Generator Loading

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

The system of load sequencing is vulnerable to single failure causing loss of all diesels. In addition, for beyond DBA/LOCA, the rating of each diesel is not sufficient to supply the total load of one unit.

RELATED ITEMS :

144, 150, 151, 152, 823

JUSTIFICATION OF RANKING:

The failure of the diesels to supply the demanded load when required is a major safety concern.

CONCEPTUAL RECOMMENDATIONS:

Upgrade the design of the diesel load sequencer taking into account the single failure criterion.

Provide new diesels to ensure two independent trains per unit, considering LOCA breaks beyond 32mm.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	DIESEL GENERATOR LOADING	144	DIESEL GENERATOR RATING Relative low rating of 1600 kw is a concern. For LOCA conditions two Diesels are necessary to provide necessary power.	D	ELECTRICAL	1.5	DESREV 5.0.5.4
IV	DIESEL GENERATOR LOADING	150	DIESEL LOAD ASSIGNMENT The adequacy of plant specific assignment of essential loads to Diesels should be checked in view to enhance independence and separation as far as possible.	D	ELECTRICAL	1.6	DESREV 5.13.6
IV	DIESEL GENERATOR LOADING	151	DIESEL LOAD CALCULATIONS Design calculations should be provided to demonstrate that the Diesel Generators have sufficient capacity to perform their duties. The calculations should be supported by test results.	D	ELECTRICAL	1.5	DESREV 5.14.4
IV	DIESEL GENERATOR LOADING	152	POWER TO SERVICE WATER PUMPS Three out of 5 service water pumps are required to operate in an emergency. It should be checked that, either two pumps do not run, or that the Diesel generator is not overloaded.	D	ELECTRICAL	4.3	DESREV 5.15.1
IV	DIESEL GENERATOR LOADING	823	DG LOAD BALANCE Recalculate the load balance under worst case conditions and clarify whether overloading cannot occur if only one DG is serving the respective 6 KV bus due to the assumption that the third is not available.	D	ELECTRICAL	4.3	NOVOVORONE 11.2.(4)

ISSUE NUMBER: Electrical 4

ISSUE TITLE: Battery discharge time and Surveillance

RANK OF ISSUE: III

ISSUE CLARIFICATION:

The discharge time of the batteries is too short (i.e. 30 minutes) and there is no monitoring system to detect galvanic interruption in due time.

RELATED ITEMS:

133, 153, 825, 826

JUSTIFICATION OF RANKING:

The failure if the batteries to supply DC powers when required is of high safety concern.

CONCEPTUAL RECOMMENDATIONS:

Increase the capacity of batteries to a discharge time of 1 to 2 hours and install a monitoring system to detect galvanic interruptions.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	BATTERY DISCHARGE TIME	133	BATTERIES Check the capacity and status surveillance of the batteries and the interconnected use for supply of two units.	D	ELECTRICAL 4.6	DESREV	III.4.3.7
III	BATTERY DISCHARGE TIME	153	BATTERIES DISCHARGE TIME The battery capacity is designated for 30 min discharge time. Nowadays, extended discharge time (2 to 3 hours) are used in other countris to permit accident management measures and to consider station blackout requirements.	D	ELECTRICAL 4.3	DESREV	5.6.4
III	BATTERY DISCHARGE TIME	825	BATTERY DISCHARGE AND CAPACITY Install two physically and electrically isolated batteries to each unit and increase the designed battery discharge time and capacity.	D	ELECTRICAL 4.3	NOVOVORONE	11.3.(1)
III	BATTERY DISCHARGE TIME	826	GALVANIC INTERRUPTION Install a battery circuit monitor to detect galvanic interruptions in due time.	D	ELECTRICAL 4.3	NOVOVORONE	11.3.(2)

ISSUE NUMBER: Electrical 5

ISSUE TITLE: Connection to offsite Power Supplies

RANK OF ISSUE: II

ISSUE CLARIFICATION:

The need for manual action to restore off-site supplies following a reactor trip places unnecessary demands on the diesel generators.

RELATED ITEMS (AND PRIORITIES):

141, 142, 368, 676, 813

JUSTIFICATION OF RANKING:

Loss of off-site power is conservatively assumed to be an expected event. This places frequent demands on the diesel generators.

CONCEPTUAL RECOMMENDATIONS:

Two independent off-site supplies should be available. The first should be available immediately and the standby supply without any unreasonable delay.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	CONNECTION TO OFF-SITE POWER SUPPLIES	141	EXTERNAL POWER SOURCES Confirm that 6kV emergency power bus can be supplied from 2 external sources during all modes of operation. No single accident should be capable of removing all off-site supplies.	D	ELECTRICAL 4.3	DESREV	5.3.6
II	CONNECTION TO OFF-SITE POWER SUPPLIES	142	ADDITIONAL POWER SOURCE Addition of an independent power source, such as the connection to a strong grid (or a separate connection to a hydro or gas turbine) should be considered.	D	ELECTRICAL 4.3	DESREV	III.5.2.1
II	CONNECTION TO OFF-SITE POWER SUPPLIES	368	EXTERNAL POWER SUPPLY Increase availability of external power supplies by installing main generator switches.	D	ELECTRICAL 4.3	BOHUNICE	10.7.(1)
II	CONNECTION TO OFF-SITE POWER SUPPLIES	676	EXTERNAL POWER SUPPLY Main generator circuit breakers should be installed, to keep the main grid as a source even when main generator trips.	D	ELECTRICAL 4.3	KOZLODUY	10.7.(2)
II	CONNECTION TO OFF-SITE POWER SUPPLIES	813	GRID CONNECTION Install an automatic power transfer relay so that the failed supply from one start up transformer can be automatically transferred to the second one.	D	ELECTRICAL 4.3	NOVOVORONE	11.1.(1)

ISSUE NUMBER: Accident Analysis 1

ISSUE TITLE: Confinement Analysis

RANK OF ISSUE: III

ISSUE CLARIFICATION:

The concern is that for breaks larger than the design basis, the confinement system may be overpressurized, causing structural failure, possibly resulting in core damage, and increasing release of radioactivity to the atmosphere. In addition, since a negative confinement pressure might result after sprays are initiated, the ability of the structure to withstand negative pressure is of concern. Not enough analyses have been performed with this respect.

RELATED ITEMS (AND PRIORITIES):

67, 383, 386, 629, 704, 705, 706, 707, 778, 869

JUSTIFICATION OF RANKING:

Actions are necessary to improve confinement performance as well as the performance of confinement systems. Analyses done to date (DOE/NE-0086) indicates structural failure may not occur, even for large break LOCAs. Ability of the overpressure protection flaps to function properly under high pressure/flow rate conditions is not known and is a mater of concern.

CONCEPTUAL RECOMMENDATIONS:

Perform structural analyses to assess confinement integrity, including accident conditions beyond the original design basis. Adequate accident analysis have to be performed in order to obtain these input conditions. Additional analyses are necessary to design additional confinement systems (venting, bubbler condenser, etc).

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	CONFINEMENT ANALYSIS	67	FLAP CHARACTERISTICS The number, types and characteristics of the flaps installed in the hermetic compartments for overpressure protection should be checked on sites.	D	SYSTEMS	3.7	DESREV 2.9.6.B
III	CONFINEMENT ANALYSIS	383	CONFINMENT SUB-ATMOSPHERIC At the same time that confinment tightness is increased installation of devices to prevent sub-atmospheric conditions (vacuum breakers) following spray action may have to be installed.	D	ACCIDENT	1.11	BOHUNICE 11.9.(1)
III	CONFINEMENT ANALYSIS	386	CONFINMENT ANALYSIS Further confinment analysis should be conducted using more sophisticated codes and usin best estimate input data.	D	ACCIDENT	1.11	BOHUNICE 11.9.(4)
III	CONFINEMENT ANALYSIS	629	CONFINMENT ANALYSIS Confinment sub-compartment analysis should be performed and special measures (blowoff panels, openings) provided if necessary.	D	SYSTEMS	3.7	KOZLODUY 8.5.(8)
III	CONFINEMENT ANALYSIS	704	CONFINMENT ANALYSIS Various analysis should be performed to find out what would be the maximum break size the present confinment can cope with.	D	ACCIDENT	1.11	KOZLODUY 11.5.(1)
III	CONFINEMENT ANALYSIS	705	CONFINMENT IMPROVEMENTS Measures should be taken to improve performance of confinment systems (spray, bubbler, venting, etc.).	D	ACCIDENT	1.11	KOZLODUY 11.5.(2)
III	CONFINEMENT ANALYSIS	706	CONFINMENT SUB-ATMOSPHERIC Possibility of sb-atmospheric pressure in the compartments after LOCA should be studied and the consequences evaluated.	D	ACCIDENT	1.11	KOZLODUY 11.5.(3)
III	CONFINEMENT ANALYSIS	707	CONFINMENT LOADS Static and dynamic loads to the confinment structures and to the emergency water tank during LOCA should be analysed.	D	ACCIDENT	1.11	KOZLODUY 11.5.(4)
III	CONFINEMENT ANALYSIS	778	CONFINEMENT ANALYSIS Investigation and analysis of the confinement behavior under accident conditions (LOCAs) should be performed.	D	COMPONENTS	1.11	NOVOVORONE 9.6.(1)
III	CONFINEMENT ANALYSIS	869	EQUIPMENT QUALIFICATION Analyses should be performed with computer codes having internationally accepted condensation models, to determine pressure, temperature and humidity transients after LOCA and SLB to be used for equipment qualification purposes.	D	ACCIDENT	3.3	NOVOVORONE 12.7.(1)

ISSUE NUMBER: Accident Analysis 2

ISSUE TITLE: Emergency protection signals

RANK OF ISSUE: III

ISSUE CLARIFICATION:

There is a concern that reactor scram is not achieved or achieved very late during some transients.

RELATED ITEMS (AND PRIORITIES):
115, 169, 170, 188, 348, 354, 355, 371, 377, 378, 385, 387, 663, 841, 870, 1181, 1195

JUSTIFICATION OF RANKING:

1) The reactor scram on low SG level assists in maintaining the large water inventory in case of some feedwater line ruptures and loss of feedwater events
2) The reactor scram under high containment pressure might not be achieved due safety injection and confinement spray actuation.
3) Reactor trip on high pressure can avoid the opening of pressurizer safety valves.
4) Reactor trip on high pressurizer level can avoid discharge of liquid water through relief valves.
5) Reactor trip on low DNBR is partly covered actually by TC monitoring.

CONCEPTUAL RECOMMENDATIONS:

The implementation of additional scram signals is recommended. The ranking into categories depends on the new trip signal.

	Reactor trip signals	Categories
1.-	low SG level	IV
2.-	actuation of safety injection and spray system	III
3.-	high pressurizer pressure	III
4.-	high pressurizer level	III
5.-	low DNBR	II

Safety System Activation Signals:

6.-	low PRZR pressure	III
7.-	low pressurizer level	III

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	EMERGENCY PROTECTION SIGNALS	115	COVERAGE OF PROTECTION SIGNALS Safety and system analysis should investigate if protection signals indicated for each level cover all plant conditions for which protection is required.	D	I&C	2.3	DESREV	4.2.5
III	EMERGENCY PROTECTION SIGNALS	169	ADDITIONAL SCRAM SIGNALS It is suggested that consideration be given to tripping the reactor on two additional signals: low steam generator level (to preserve the large water inventory) and high primary pressure (to avoid opening of pressurizer safety valve).	D	ACCIDENT	2.3	DESREV	III.6.2.6
III	EMERGENCY PROTECTION SIGNALS	170	SCRAM ON SAFETY SYSTEM TRIP There is a concern that reactor scram is not achieved due to safety actuation (safety injection and confinment spray are initiated at lower pressure than reactor scram). Combining reactor scram with safety system actuation signals would avoid this situation.	D	ACCIDENT	2.3	DESREV	III.6.2.6A
III	EMERGENCY PROTECTION SIGNALS	188	SCRAM ON LOW SG LEVEL The implementation of a reactor scram signal on low Steam Generator (SG) level would assist in maintaining the large water inventory. This would extend the time available to restore feedwater.	D	ACCIDENT	2.3	DESREV	6.7.5.4
III	EMERGENCY PROTECTION SIGNALS	348	PRESSURIZER LEVEL LIMITATION A reliable system for automatic pressurizer water level limitation in normal operation should be installed.	D	I&C	2.1	BOHUNICE	10.2.(2)
III	EMERGENCY PROTECTION SIGNALS	354	ADDITIONAL REACTOR TRIPS Consider implementing additional reactor trip on: high primary pressure, pressurizer high level, low sg level, low Departure from Nucleate Boiling Ratio.	D	ACCIDENT	2.3	BOHUNICE	10.4.(5)
III	EMERGENCY PROTECTION SIGNALS	355	TRIP ON COMPARTMENT PRESSURE Reactor trip on high pressure in SG and RCP compartments should be activated without additional conditions.	D	I&C	2.3	BOHUNICE	10.4.(6)
III	EMERGENCY PROTECTION SIGNALS	371	MINIMUM TENSION FOR DG START The minimum tension on the 6kV bus to trigger Diesel Generators startup should be increased to 80% of nominal voltage.	D	ELECTRICAL	1.5	BOHUNICE	10.7.(4)
III	EMERGENCY PROTECTION SIGNALS	377	SAFETY INJECTION ACTUATION Install additional signals for safety injection actuation on low pressurizer level or low pressurizer pressure.	D	ACCIDENT	3.1	BOHUNICE	11.6.(2)
III	EMERGENCY PROTECTION SIGNALS	378	HIGH TEMPERATURE SIGNAL Consider disconnecting high temperature scram(AZ-2) signal or modifying sensor position,since in the calculations this scram set point was never reached.	D	ACCIDENT	2.3	BOHUNICE	11.6.(3)
III	EMERGENCY PROTECTION SIGNALS	385	HIGH COMPARTMENT PRESSURE TRIP The trip set point for reactor scram on high pressure in the RCP and SG room should be the same as the spray actuation set point.	D	ACCIDENT	2.3	BOHUNICE	11.9.(3)
III	EMERGENCY PROTECTION SIGNALS	387	STEAM GENERATOR LOW LEVEL TRIP A new AZ-1 reactor scram signal on low steam generator level should be installed.	D	ACCIDENT	2.3	BOHUNICE	11.10.(1)
III	EMERGENCY PROTECTION SIGNALS	663	PRESSURIZER LEVEL LIMITATION An automatic protection should be installed to prevent overfilling of the pressurizer.	D	ACCIDENT	2.3	KOZLODUY	10.2.(2)
III	EMERGENCY PROTECTION SIGNALS	841	ADDITIONAL REACTOR TRIP Consideration should be given to tripping the reactor on a high pressurizer pressure signal.	D	ACCIDENT	2.3	NOVOVORONE	12.2.(2)
III	EMERGENCY PROTECTION SIGNALS	870	HIGH COMPARTMENT PRESSURE TRIP Consideration should be given to combining the reactor trip with the signals which actuate containment spray.	D	ACCIDENT	2.3	NOVOVORONE	12.7.(2)
III	EMERGENCY PROTECTION SIGNALS	1181	HIGH CONFINMENT PRESSURE SCRAM Scram on high confinment pressure should be derived from the same signal which actuates spray system, at 1.2 bar pressure.	D	ACCIDENT	2.3	KOLA	12.5.(6)
III	EMERGENCY PROTECTION SIGNALS	1195	SCRAM ON SECONDARY PARAMETERS A reactor scram signal based on secondary side parameters, e.g. low SG level or trip of feedwater pumps should be installed.	D	ACCIDENT	2.3	KOLA	12.7.(5)

ISSUE NUMBER: Accident Analysis 3

ISSUE TITLE: Severe accident analysis

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Few severe accident scenarios have been studied. This is no satisfactory basis for the preparation of a appropriate procedures.

RELATED ITEMS (AND PRIORITIES):

288, 708

JUSTIFICATION OF RANKING:

The results of an analysis of the plant response of the plant to potential severe accidents involving extensive core damage have to be used in preparing guidance on an accident management strategy and emergency preparedness.

CONCEPTUAL RECOMMENDATIONS:

The complete list of potential severe accidents must be developed. In accordance to created list appropriate accident analysis must be conducted and guidance on accident management should be prepared.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	SEVERE ACCIDENT ANALYSIS	288	ACCIDENT MANAGEMENT MEASURES Results of accident analysis should be used to plan accident management measures and to estimate source term.	O	EP	4.4	BOHUNICE 6.3.(2)
II	SEVERE ACCIDENT ANALYSIS	708	SEVERE ACCIDENTS More scenarios of severe accident should be studied as a basis for accident management.	D	ACCIDENT	4.4	KOZLODUY 11.6.(1)

ISSUE NUMBER: Accident Analysis 4

ISSUE TITLE: Accident during shutdown or refuelling

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Accidents occurring during refuelling and shutdown may represent a substantial contribution to overall plant risk. No sufficient analyses have been performed to investigate the potential accidents during refuelling and handling the fuel in spent fuel storage

RELATED ITEMS (AND PRIORITIES):

14, 52, 74, 175, 595, 617, 714, 750, 1036, 1037, 1060

JUSTIFICATION OF RANKING:

Adequate analyses are necessary to verify the subcriticality of the reactor during refuelling and of the fuel storage pool and to determine technical measures to prevent accidents at these conditions.

CONCEPTUAL RECOMMENDATIONS:

Appropriate analyses should be performed. Procedures and technical measures are necessary to avoid boron dilution, drainage of storage pool and loss of decay heat removal capability during shutdown operation. Increase of storage pool capacity may be needed in some plants.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	ACCIDENT DURING SHUTDOWN OR REFUELLING	14	FUEL HANDLING INCIDENTS The record of fuel handling incidents should be discussed in each plant in order to state if there is a relation with the assembly design.	D+O	CORE	1.8	DESREV	1.3.6.3.
II	ACCIDENT DURING SHUTDOWN OR REFUELLING	52	LOSS OF DECAY HEAT REMOVAL The Soviets have suggested that loss of decay heat removal can be mitigated by: a) use of high pressure injection; b) interconection between units; c) refuelling pond water and its associated heat removal means. Further assessment of the effectiveness and reliability of these methods is warranted.	D+O	SYSTEMS	4.6	DESREV	2.6.5.A
II	ACCIDENT DURING SHUTDOWN OR REFUELLING	74	ACCIDENTS AT SHUTDOWN In view of recent PSA results, which indicate that accidents occurring during plant shutdown represents a considerable contribution to overall plant risk, it is recommended to assess the existing possibilities to cope with such accidents.	D	SYSTEMS	1.11	DESREV	III.2.2.3
II	ACCIDENT DURING SHUTDOWN OR REFUELLING	175	PREVENTING BORON DILUTION The existence of both technical and administrative measures to prevent clean water supply into the reactor during refuelling should be verified (e.g. removal of make-up pump breakers).	D+O	ACCIDENT	1.11	DESREV	6.3.6
II	ACCIDENT DURING SHUTDOWN OR REFUELLING	595	STORAGE POOL SUBCRITICALITY Calculations should be done to verify the subcriticality of the fuel storage pool, especially under off-normal conditions.	D	CORE	2.2	KOZLODUY	7.9.(1)
II	ACCIDENT DURING SHUTDOWN OR REFUELLING	617	SPENT FUEL POOL Add a check valve on the inlet pipe of spend fuel pool cooling system to prevent pool drainage.	D	SYSTEMS	1.11	KOZLODUY	8.3.(6)
II	ACCIDENT DURING SHUTDOWN OR REFUELLING	714	FUEL HANDLING ACCIDENTS Accidents during fuel handling or concerning spent fuel storage should be analysed.	D	ACCIDENT	1.11	KOZLODUY	11.7.(5)
II	ACCIDENT DURING SHUTDOWN OR REFUELLING	750	LOSS OF OPEN REACTOR COOLING Estimate core melt probability caused by the loss of reactor cooling when the primary circuit is open and its water inventory is limited.	D	SYSTEMS	1.11	NOVOVORONE	8.6.(3)
II	ACCIDENT DURING SHUTDOWN OR REFUELLING	1036	RERACKING OF STORAGE POOL The planned reracking of the fuel storage pool with boron steel should be implemented.	D	CORE	2.2	KOLA	7.7.(4)
II	ACCIDENT DURING SHUTDOWN OR REFUELLING	1037	STORAGE POOL CALCULATIONS Standard deviation of calculated reactivity should be obtained from Obninsk to evaluate uncertainties.	D	CORE	2.2	KOLA	7.7.(5)
II	ACCIDENT DURING SHUTDOWN OR REFUELLING	1060	LOCA DURING SHUTDOWN Develope a procedure to cope with LOCA occurring during shutdown.	D	SYSTEMS	3.9	KOLA	8.4.(2)

ISSUE NUMBER: Accident Analysis 5

ISSUE TITLE: Qualification of safety analysis

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Computer codes used for accident/transient analysis at the time of design or by supporting institutes have some severe limitations. There was also a lack of adequate computer facilities, trained personnel and lack of experimental data for appropriate code validation. Validated state-of-the-art computer codes are necessary for realistic description of transients and accidents.

RELATED ITEMS:

16, 17, 29, 31, 35, 36, 165, 178, 179, 305, 375, 382, 586, 589, 590, 591, 682-688, 698, 702, 710, 718, 844, 1029, 1030, 1173, 1175, 1185

JUSTIFICATION OF RANKING:

If an accident analysis according to international practices is to be prepared to each unit, appropriate advanced computer codes, computer facilities and trained personnel would be required.

CONCEPTUAL RECOMMENDATIONS:

Obtain adequate advanced computer codes, improve computer facilities and provide trained personnel in order to prepare the necessary safety analysis. Some of earlier analysis should be confirmed with advanced computer codes.

Advanced 3D neutronic /thermal-hydraulic computer codes should be used for core transient analysis. Participation in code verification and validation programmes is also recommended. Independent verification of design calculations is necessary and feedback from reviews of calculations should be provided to the plants.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	QUALIFICATION OF SAFETY ANALYSIS	16	INFORMATION ON PIN 04 CODE There is a lack of information on the PIN 04 code, e.g. the thermal conductivity of UO2, as a functionof burnup.	D	CORE	1 4	DESREV	1.3.8.2.
II	QUALIFICATION OF SAFETY ANALYSIS	17	CODES FOR PIN TRANSIENTS Codes for pin transient calculations exist, but no information was obtained	D	CORE	1.4	DESREV	1.3.8.3.
II	QUALIFICATION OF SAFETY ANALYSIS	29	THREE-DIMENSIONAL KINETICS For rod ejection accident, it is necessary to perform three dimensional kinetics calculations.	D	CORE	1.11	DESREV	1.6.7
II	QUALIFICATION OF SAFETY ANALYSIS	31	FUEL MANAGEMENT CALCULATIONS It should be checked by which methods fuel management calculations are performed in each plant.	D	CORE	1.8	DESREV	1.7.6.1
II	QUALIFICATION OF SAFETY ANALYSIS	35	THERMO HYDRAULICCORRELATION The review of correlations for accident conditions has not been discussed during the Design Review Meeting, and should be done durin the Safety Review Mission.	D	CORE	1.11	DESREV	III.1.1.5
II	QUALIFICATION OF SAFETY ANALYSIS	36	CORE DYNAMIC BEHAVIOUR The dynamic behaviour of the core during reactivity transients such as rod ejection requires three dimensional kinetics codes to describe more realistically and as a reference for less elaborated calculations.	D	CORE	1.11	DESREV	III.1.1.6
II	QUALIFICATION OF SAFETY ANALYSIS	165	ANALYSIS WITH MODERN CODES When accident analysis is extended, it should be demonstrated that the computer codes used are valid for this applications, or more sophisticated codes should be used.	D	ACCIDENT	1.4	DESREV	III.6 2.2
II	QUALIFICATION OF SAFETY ANALYSIS	178	LIMITATIONS OF DINAMIKA CODE The DINAMIKA code when used in the analysis of loss of flow transients appears to have limited capability to model relief valves and steam condensation.	D	ACCIDENT	1.4	DESREV	6.4.4
II	QUALIFICATION OF SAFETY ANALYSIS	179	PUMP RUN-DOWN TEST Investigate the availability of results of plant specific tests of run down of main coolant pumps following disconnection of power supplies.	D	ACCIDENT	1.15	DESREV	6.4.6
II	QUALIFICATION OF SAFETY ANALYSIS	305	CORE CALCULATION CODES Validation of core calculation computer codes should be extended through the participation in available test problems.	D	CORE	1.4	BOHUNICE	7.3.(1)
II	QUALIFICATION OF SAFETY ANALYSIS	375	ADVANCED COMPUTER CODES Some of the accident analyses should be redone with more advanced computer codes.	D	ACCIDENT	1.11	BOHUNICE	11.2.(1)
II	QUALIFICATION OF SAFETY ANALYSIS	382	STEAM GENERATOR LEAK ANALYSIS For long term calculation of steam generator leaks a more suitable code should be used (such as RELAP5/mod2).	D	ACCIDENT	1 11	BOHUNICE	11.8.(1)
II	QUALIFICATION OF SAFETY ANALYSIS	586	FUEL PERFORMANCE CODE A fuel performance computer code should be obtained or developed to evaluate leak tightness over the cycle.	D	CORE	1.8	KOZLODUY	7.2.(2)
II	QUALIFICATION OF SAFETY ANALYSIS	589	CORE CALCULATION VALIDATION In core flux measurements should be used to validate neutronic computer codes.	D	CORE	1.4	KOZLODUY	7.4.(3)
II	QUALIFICATION OF SAFETY ANALYSIS	590	3-D CALCULATIONS Advanced three dimensional thermohydraulic codes should be obtained or developed and validated.	D	CORE	1.4	KOZLODUY	7.6.(1)
II	QUALIFICATION OF SAFETY ANALYSIS	591	COMPUTING RESOURCES Computer resources in Bulgaria need to be upgraded to use advanced thermohydraulic codes.	D	CORE	1.4	KOZLODUY	7.6.(2)
II	QUALIFICATION OF SAFETY ANALYSIS	682	PERSONNEL FOR ANALYSIS Considerably more personnel should be allocated to the field of accident analysis.	D	ACCIDENT	1.17	KOZLODUY	11.1.(3)
II	QUALIFICATION OF SAFETY ANALYSIS	683	COMPUTERS FOR ANALYSIS More computers should be made available to the support institutions.	D	ACCIDENT	1.11	KOZLODUY	11.1.(4)
II	QUALIFICATION OF SAFETY ANALYSIS	684	CODES FOR THE ANALYSIS A fast running code should be acquired for parametric studies.	D	ACCIDENT	1.11	KOZLODUY	11.1.(5)
II	QUALIFICATION OF SAFETY ANALYSIS	685	REACTIVITY DISTURBANCES A dynamics code should be acquired for the analysis of reactivity disturbances.	D	ACCIDENT	1.11	KOZLODUY	11.1.(6)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	QUALIFICATION OF SAFETY ANALYSIS	686	ADVANCED COMPUTER CODES The existing results with RELAP4/mod6 should be confirmed agains RELAP5/mod2 calculations.	D	ACCIDENT	1.11	KOZLODUY	11.1.(7)
II	QUALIFICATION OF SAFETY ANALYSIS	687	CODE VALIDATION Resources should be allocated to code validation.	D	ACCIDENT	1.11	KOZLODUY	11.1.(8)
II	QUALIFICATION OF SAFETY ANALYSIS	688	INTERNATIONAL COOPERATION Contacts with international organizations in code validation should be improved.	D	ACCIDENT	1.11	KOZLODUY	11.1.(9)
II	QUALIFICATION OF SAFETY ANALYSIS	698	RECRITICALITY Possibility of re-criticality after a steam line break should be analysed, using multidimensional neutron kinetics.	D	ACCIDENT	1.11	KOZLODUY	11.3.(2)
II	QUALIFICATION OF SAFETY ANALYSIS	702	DNB CORRELATION The limits of the DNB correlation should be checked. Possibly another correlation should be used.	D	ACCIDENT	1.11	KOZLODUY	11.4.(3)
II	QUALIFICATION OF SAFETY ANALYSIS	710	REACTIVITY TRANSIENTS A proper reactor dynamics code should be acquired and validated for the analysis of reactivity transients.	D	ACCIDENT	1.11	KOZLODUY	11.7.(1)
II	QUALIFICATION OF SAFETY ANALYSIS	718	MODERN CORE CALCULATION CODES Consider recalculating core and reloads with state-of-the-art codes.	D	CORE	1.11	NOVOVORONE	7.3.(1)
II	QUALIFICATION OF SAFETY ANALYSIS	844	DNB CORRELATIONS Analyses should use the same DNBR correlation (reactivity perturbations, loss of flow events).	D	ACCIDENT	1.11	NOVOVORONE	12.2.(5)
II	QUALIFICATION OF SAFETY ANALYSIS	1029	FEEDBACK FROM REVIEWERS A formal process for learning from errors identified by reload design reviewers should be established.	D	CORE	1.17	KOLA	7.3.(3)
II	QUALIFICATION OF SAFETY ANALYSIS	1030	CROSS-SECTION CALCULATIONS If reload enrichment is changed to 4.4w/o, the cross-section calculation methodology should be re-qualified.	D	CORE	1.4	KOLA	7.3.(4)
II	QUALIFICATION OF SAFETY ANALYSIS	1173	CODE VERIFICATION WITH EVENTS Measurements of load rejection test in 1982 in Kozloduy where BRU-K fail to open should be used for code verification.	D	ACCIDENT	1.11	KOLA	12.2.(1)
II	QUALIFICATION OF SAFETY ANALYSIS	1175	THREE - DIMENSIONAL CODE Three-dimensional core computer codes with coupled neutronic/thermohydraulic model should be used for control rod ejection events.	D	ACCIDENT	1.11	KOLA	12.4.(1)
II	QUALIFICATION OF SAFETY ANALYSIS	1185	VALIDATED CODE A validated advanced thermal-hydraulic code should be used in the design of new Emergency Core Cooling System.	D	ACCIDENT	1.11	KOLA	12.5.(10)

ISSUE NUMBER: Accident Analysis 6

ISSUE TITLE: Scope of accident and transient analysis

RANK OF ISSUE: III

ISSUE CLARIFICATION:

At present, no safety analysis report exists for some plants. Moveover, a systematic approach to accident analysis is necessary to ensure that all relevant accident/transients have been evaluated and that the analyses are adequate and that applicable acceptance criteria are fulfilled. This is necessary to ensure plant safety and to provide a basis for development of plant procedures and operator training.

RELATED ITEMS:

117, 164, 166, 167, 171-174, 177, 184-186,372, 376, 390, 680, 681, 691-693, 699, 700, 701, 703, 711-713, 720, 835, 837, 838, 839, 840, 843, 859, 860, 863, 867,868, 1023, 1165, 1166, 1167, 1169, 1170, 1172, 1174, 1187, 1189, 1192, 1194, 1196, 1197

JUSTIFICATION OF RANKING:

Although some analyses have been performed at the design stage and additional calculations have been performed at supporting institutions, the lack of a systematic approach does not allow a conclusion about the completeness of the analysis. Even for some accident already analyzed, the analysis need to be redone with different assumptions or completed to final stable conditions. Some analyses have to be redone with state-of-the-art computer codes.

CONCEPTUAL RECOMMENDATIONS:

A systematic approach should be taken to accident analysis. First by a methodological identification of accidents to be analyzed and the appropriate boundary conditions. Then by ensuring consistency of the analysis with actual plant specific data and expected operator action according plant procedures. The single failure criterion should be applied and common mode failure should be taken into account. Accidents not considered so far, including accidents beyond the design basis, have to be included in the analysis. All analyses should be carried out to final stable conditions and results should be compared with applicable acceptance criteria. Some realistic (rather than conservative) analysis should be performed to form a basis for development and optimization of operating procedures and operator training.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	117	SET POINT SPECIFICATIONS Technical specification contents with respect to set point calculations and margins contemplated in the design to cover instrument innaccuracies, drift and response time, should be reviewed.	D+O	ACCIDENT	1.21	DESREV 4.3.4.A
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	164	SYSTEMATIC ACCIDENT ANALYSIS It is recommended a complete safety assessment of the plants by a systematic analysis of initiating events and multiple failure. A set of conservative analysis, using assumptions which maximize the parameters of concern should carried out up to plant stable conditions. Best estimate analysis should be carried out to develope plant procedures and for operator training.	D	ACCIDENT	1.11	DESREV III.6.2.1
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	166	ANALYSIS TO STABLE CONDITIONS Analysis should be carried on until stable plant conditions are achieved. This is necessary to define operator actions.	D	ACCIDENT	1.11	DESREV III.6.2.3
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	167	PLANT SPECIFIC ANALYSIS Accident analysis should be plant specific, since many features important for the analysis vary from plant to plant.	D	ACCIDENT	1.11	DESREV III.6.2.4
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	171	CONSISTENCY ANALYSIS/OPERATION Review plant specific analysis for consistency with actual plant arrangements, scram signals and operating procedures.	D	ACCIDENT	1.11	DESREV III.6.2.7
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	172	IMCOMPLETE ACCIDENT ANALYSIS The following accidents apparently have not been analysed: Interfacing LOCA; Anticipated Transient Without Scram (ATWS); Accidents at shutdown or refuelling; Transients leading to thermal shock; Accidents resulting from common mode failure.	D	ACCIDENT	1.11	DESREV 6.1.5.2
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	173	USE OF SINGLE FAILURE CRITERIA The way single failure criteria (both active and passive failures) is applied in the accident analysis should be reviewed.	D	ACCIDENT	1.4	DESREV 6.1.8.1
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	174	OPERATIONAL TRANSIENT ANALYSIS Additional analysis of operational transients are required to further assess the ability of control systems to cope with them and to quantify operating margins.	D	ACCIDENT	1.11	DESREV 6.2.9
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	177	FAILURE OF AZ-IV A failure of AZ-IV in the event of a single rod drop should be discussed.	D	ACCIDENT	1.11	DESREV 6.3.8.A
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	184	SG TUBE RUPTURE ANALYSIS A complete study of all possible system failures involved in SG tube rupture should be performed (e.g. operation of gate valves, stuck open pressurizer valves).	D	ACCIDENT	1.11	DESREV 6.6.7
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	185	PRESSURIZED THERMAL SHOCK Overcooling and consequent Pressurized Thermal Shock (PTS) during small break LOCA needs plant specific analysis.	D	ACCIDENT	1.11	DESREV 6.6.8
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	186	WORST CASE STEAM LINE BREAK The full spectrum of initial and boundary conditions for steam line break should be investigated in order to identify the worst case (e.g break size and location, initial power, availability of power supply, single failure).	D	ACCIDENT	1.11	DESREV 6.7.5.2
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	372	BEST ESTIMATE ANALYSES Best estimate analyses using realistic assumptions should be performed to evaluate plant response, develope procedures and train operators.	D	ACCIDENT	1.11	BOHUNICE 11.1.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	376	COLD TEMPERATURE SHOCK Analyse the effect of cold water injection in the reactor vessel inlet nozzle during small breaks.	D	ACCIDENT	1.11	BOHUNICE 11.6.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	390	ATWS A review should be made to verify which further Anticipated Transient Without Scram (ATWS) events need to be analysed.	D	ACCIDENT	1.11	BOHUNICE 11.12.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	680	SCOPE OF ACCIDENT ANALYSIS The list of accidents to be analysed in the near future should be more specific. It should be reviewed by the regulatory body.	D	ACCIDENT	1.11	KOZLODUY 11.1.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	681	SCHEDULE OF THE ANALYSIS A realistic time table should be developed taken into account priorities and	D	ACCIDENT	1.11	KOZLODUY 11.1.(2)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
			availability of computer and personnel.				
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	691	ACCIDENT ANALYSIS RESULTS A more standardized format for reporting result of accident analysis should be used.	D	ACCIDENT	1.11	KOZLODUY 11.2.(3)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	692	ACCEPTANCE CRITERIA Acceptance criteria should be stated for each accident analysed.	D	ACCIDENT	1.11	KOZLODUY 11.2.(4)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	693	PRESSURIZED THERMAL SHOCK The possibility of pressurized thermal shock and the way it is analysed should be mentioned in LOCA results.	D	ACCIDENT	1.11	KOZLODUY 11.2.(5)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	699	SCOPE OF SECONDARY ACCIDENTS The decrease of feedwater temperature and the increase of steam flow should be analysed.	D	ACCIDENT	1.11	KOZLODUY 11.3.(3)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	700	PUMP RUNDOWN ANALYSIS A new pump rundown analysis with RELAP5/mod2 should be made with conservative pressure boundary conditions from the DNB point of view.	D	ACCIDENT	1.11	KOZLODUY 11.4.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	701	HOT CHANNEL ANALYSIS After the new pump rundown has been analysed with RELAP5/mod2 and appropriate boundary conditions, a new hot channel analysis should be performed.	D	ACCIDENT	1.11	KOZLODUY 11.4.(2)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	703	SCOPE OF FLOW PERTURBATIONS Seizure of main circulating pump rotor and inadvertent closing of a main isolation valve should be analysed.	D	ACCIDENT	1.11	KOZLODUY 11.4.(4)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	711	SCOPE OF TRANSIENT ANALYSIS At least the following transients should be analysed: uncontrolled control assembly withdrawal, control rod ejection, startup of an isolated colder primary loop.	D	ACCIDENT	1.11	KOZLODUY 11.7.(2)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	712	SCOPE OF ATWS ANALYSIS At least the following ATWS cases should be analysed: loss of feedwater, control assembly withdrawal.	D	ACCIDENT	1.11	KOZLODUY 11.7.(3)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	713	ACCIDENTS DUE TO SECONDARY Accidents due to secondary disturbances such as turbine trip, decrease in steam flow or loss of external power, should be analysed.	D	ACCIDENT	1.11	KOZLODUY 11.7.(4)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	720	INSERTED REACTIVITY RATE Evaluate if reactivity insertion rate is enough for all credible accidents.	D	CORE	3.5	NOVOVORONE 7.4.(2)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	835	USE OF SINGLE FAILURE CRITERIA The way the single failure criterion is applied throughout the accident analysis should be carefully reviewed.	D	ACCIDENT	1.11	NOVOVORONE 12.1.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	837	BEST ESTIMATE ANALYSIS Best estimate analyses using actual plant data, realistic assumptions with respect to equipment performance should be performed.	D	ACCIDENT	1.11	NOVOVORONE 12.1.(3)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	838	INCOMPLETE ACCIDENT ANALYSIS The scope of the accident analyses should be completed in accordance with international practices.	D	ACCIDENT	1.11	NOVOVORONE 12.1.(4)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	839	SAFETY ANALYSIS REPORT A complete safety assessement of the plant by a systematic and thorough analysis of initiating events and multiple failures should be conducted and incorporated in the safety analysis report.	D	ACCIDENT	1.11	NOVOVORONE 12.1.(5)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	840	OPERATION WITH 3-5 MCP The operational benefit of operating with 5-3 pumps should be evaluated versus challenge to safety.	D	ACCIDENT	1.11	NOVOVORONE 12.2.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	843	FLOW PERTURBATIONS Analyse the inadvertment closure of a main coolant isolation valve for Novovoronezh-4 specific data.	D	ACCIDENT	1.11	NOVOVORONE 12.2.(4)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	859	FEED WATER LINE BREAK Adequacy of the main feedwater system isolation should be assessed for all possible scenarios.	D	ACCIDENT	1.11	NOVOVORONE 12.4.(1)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	860	FEED WATER LINE BREAK Closure of the pump discharge valves should be contemplated to ensure reliable main feedwater system isolation.	D	ACCIDENT	1.11	NOVOVORONE 12.4.(2)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	863	SG TUBE RUPTURE ANALYSIS Analysis should be performed for various scenarios, including the failure to close the main coolant isolation valves.	D	ACCIDENT	1.11	NOVOVORONE 12.5.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	867	ATWS Future analyses should assume a complete failure of the reactor protection and safeguards systems.	D	ACCIDENT	1.11	NOVOVORONE 12.6.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	868	ATWS The calculations should be performed until stable conditions are reached.	D	ACCIDENT	1.11	NOVOVORONE 12.6.(2)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1023	CORE CALCULATIONS Accident spectrum should be enhanced and core design calculations scope should be increased to provide the required interface data.	D	CORE	1.11	KOLA 7.1.(5)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1165	ACCESS TO EARLIER CALCULATIONS Earlier accident analysis of WWER-440/230 should be compiled and made accessible and understandable to plant personnel.	D	ACCIDENT	1.11	KOLA 12.1.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1166	PLANT SPECIFIC ANALYSIS A complete set of analysis specific to the plant should be performed. It should be updated if its affected by plant modifications.	D	ACCIDENT	1.11	KOLA 12.1.(2)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1167	ACCIDENTS BEYOND DESIGN BASIS Accidents beyond the original design basis should be considered, such as ATWS, interfacing LOCA.	D	ACCIDENT	1.11	KOLA 12.1.(3)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1169	ANALYSIS TO STABLE CONDITIONS Accident analysis should be complete with respect of time period of calculations, i.e., up to stable conditions or to releases.	D	ACCIDENT	1.11	KOLA 12.1.(5)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1170	BEST ESTIMATE ANALYSIS Best estimate analysis should be performed for optimizing operaing procedures.	D	ACCIDENT	1.11	KOLA 12.1.(6)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1172	SYSTEMATIC ACCIDENT ANALYSIS Future accident analysis should be complete with respect to documentation: code and models used, initial and boundary conditions, acceptance criteria, results with plot of all relevant parameters and conclusions.	D	ACCIDENT	1.11	KOLA 12.1.(8)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1174	LOSS OF FLOW EVENTS A complete set of loss of flow events covereing all operating modes should be performed. This includes closing of gate valves and cost down of all 6 pumps.	D	ACCIDENT	1.11	KOLA 12.3.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1187	SG TUBE RUPTURE ANALYSIS Complete analysis of steam generator tube rupture should be performed with actual plant data. Best estimate analysis of various scenarios should be used to optimize operating procedures.	D	ACCIDENT	1.11	KOLA 12.6.(1)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1189	SG COLLECTOR RUPTURE Analysis of steam generator collector rupture should be continued and results should be documented. Emergency operating procedures should be revised based on the results.	D	ACCIDENT	1.11	KOLA 12.6.(3)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1192	RECRITICALITY Steam line rupture accident from zero power should be analysed to demonstrate that no recriticality will occur.	D	ACCIDENT	1.11	KOLA 12.7.(2)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1194	MULTIPLE STEAM LINE BREAKS An analysis of multiple rupture (up to 3) of steam lines should be performed.	D	ACCIDENT	1.11	KOLA 12.7.(4)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1196	LOSS OF FEEDWATER ANALYSIS Analysis of complete loss of main feedwater should be performed.	D	ACCIDENT	1.11	KOLA 12.7.(6)
III	SCOPE OF ACCIDENT OR TRANSIENT ANALYSIS	1197	ATWS A set of Anticipated Transient Without Scram should be analysed, including loss of feedwater, loss of power, rod withdrawal. Results should be used to dimension second shutdown system (boron).	D	ACCIDENT	1.11	KOLA 12.8.(1)

ISSUE NUMBER: Accident Analysis 7

ISSUE TITLE: Loss of coolant accidents

RANK OF ISSUE: III

ISSUE CLARIFICATION:

The scope and the quality of plant specific LOCA analysis is insufficient for some plants even within the original design basis

RELATED ITEMS:

168, 180, 181, 380, 694, 690, 696, 740, 793, 846, 847, 848, 849, 850, 851, 852, 853, 854, 857, 858, 1176, 1177, 1179, 1182, 1183, 1184

JUSTIFICATION OF RANKING:

Additional analysis are necessary to reach the international practice, especially when, the emergency core cooling systems are redesigned to cope with leaks larger than 32 mm in diameter.

CONCEPTUAL RECOMMENDATIONS:

A consistent analysis of the complete (with respect of break size and location and loop isolation condition) spectrum of loss-of-coolant accidents with best-estimate computer codes is recommended. The computer codes should be qualified by verification against a matrix of singe effect and integral thermal-hydraulic tests according to international practice. Single failure and repair cases should be taken into account as well as the aspect of long term core cooling. The analysis should be done on a plant specific basis. The analysis should be carried out until the coolability of the reactor core can be proven.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	LOSS OF COOLANT ACCIDENTS	168	INVESTIGATE LIMITING LOCA It is recommended an analysis of increased size Loss Of Coolant Accident (LOCA) to determine whoch size break the current safety systems can cope with. Essential plant parameters should be varied (e.g. available redundancies, power supply, etc).	D	ACCIDENT	1.11	DESREV III.6.2 5
III	LOSS OF COOLANT ACCIDENTS	180	RUPTURE OF INJECTION COLLECTOR The rupture of one safety injection collector should be analysed.	D	ACCIDENT	1.11	DESREV 6.5.7
III	LOSS OF COOLANT ACCIDENTS	181	POST LOCA LONG TERM COOLING Analysis of post LOCA long term cooling should be reviewed. The relative operating procedures should also be reviewed.	D+O	ACCIDENT	1.11	DESREV 6.6.6
III	LOSS OF COOLANT ACCIDENTS	380	ANALYSIS OF 200mm LOCA Conduct a detailed analysis of the minimum number of safety injection pumps necessary to avoid clad failure, assuming loss of power and Diesel capacity.	D	ACCIDENT	1.11	BOHUINCE 11.6.(5)
III	LOSS OF COOLANT ACCIDENTS	690	ANALYSIS TO STABLE CONDITIONS The LOCA analysis should be allways carried out to final stable conditions.	D	ACCIDENT	1.11	KOZLODUY 11.2.(2)
III	LOSS OF COOLANT ACCIDENTS	694	UNITS 1 AND 2 LOCA ANALYSIS The LOCA analysis should be extended to Units 1 and 2 specific conditions.	D	ACCIDENT	1.11	KOZLODUY 11.2.(6)
III	LOSS OF COOLANT ACCIDENTS	696	SCOPE OF LOCA ANALYSIS Analyse also steam generator collector break, surge line rupture and small breaks in hot leg and emergency water collector.	D	ACCIDENT	1.11	KOZLODUY 11.2.(8)
III	LOSS OF COOLANT ACCIDENTS	740	BORON CRISTALLIZATION Verify that in case of a hot leg break, the increase in boron concentration does not lead to boron cristallization.	D	SYSTEMS	3.6	NOVOVORONE 8.3.(2)
III	LOSS OF COOLANT ACCIDENTS	793	OPENING OF 2 SAFETY VALVES The safety analysis of inadvertent opening of two valves should be evaluated to ensure that this failure is within the design basis LOCA envelope.	D	I&C	3.1	NOVOVORONE 10.2.(2)
III	LOSS OF COOLANT ACCIDENTS	846	SINGLE FAILURE CRITERION Application of the single failure criterion should be reviewed and new analysis should be performed accordingly.	D	ACCIDENT	1.11	NOVOVORONE 12.3.(1)
III	LOSS OF COOLANT ACCIDENTS	847	LOCA SENSITIVITY STUDIES Sensitivity studies should be performed to demostrate the conservatism of the selected scenarios.	D	ACCIDENT	1.11	NOVOVORONE 12.3.(2)
III	LOSS OF COOLANT ACCIDENTS	848	LOCA SENSITIVITY STUDIES Sensitivity studies to different axial power shapes should be performed.	D	ACCIDENT	1.11	NOVOVORONE 12.3.(3)
III	LOSS OF COOLANT ACCIDENTS	849	CODE VALIDATION Computer codes validated for hot leg injection should be used.	D	ACCIDENT	1.11	NOVOVORONE 12.3.(4)
III	LOSS OF COOLANT ACCIDENTS	850	DATA TRANSFER Data transfer for DINAMIKA code to the UROVEN code should be improve.	D	ACCIDENT	1.11	NOVOVORONE 12.3.(5)
III	LOSS OF COOLANT ACCIDENTS	851	LOCA ANALYSIS Analyses shuold be extended to the time stable conditions are obtained.	D	ACCIDENT	1.11	NOVOVORONE 12.3.(6)
III	LOSS OF COOLANT ACCIDENTS	852	COLD LEG BREAK LOCA The analysis without safety injection actuation should be repeated for a cold leg break.	D	ACCIDENT	1.11	NOVOVORONE 12.3.(7)
III	LOSS OF COOLANT ACCIDENTS	853	COLD LEG BREAK LOCA The results obtained sick DINAMIKA code after the loss of circulation should be used with care.	D	ACCIDENT	1.11	NOVOVORONE 12.3.(8)
III	LOSS OF COOLANT ACCIDENTS	854	POST LOCA LONG TERM COOLING Analysis demostrating the long term capability of the safety systems to remove decay heat should be conducted.	D	ACCIDENT	1.11	NOVOVORONE 12 3.(9)
III	LOSS OF COOLANT ACCIDENTS	857	LARGE LOCA ANALYSIS Computer codes validated for the Novovoronezh NPP Large LOCA analysis with an upgraded safety injection system should be used.	D	ACCIDENT	1.11	NOVOVORONE 12.3.(12)
III	LOSS OF COOLANT ACCIDENTS	858	OPENING SAFETY RELIEF VALVCS Opening of two pressurizer safety valves in case of single failure in the logic should be further investigated.	D	ACCIDENT	1.11	NOVOVORONE 12.3.(13)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	LOSS OF COOLANT ACCIDENTS	1176	LOCA ANALYSIS WITH MODERN CODE The present LOCA results should be validated with a modern code covering the whole spectrum of thermo-hydraulic processes.	D	ACCIDENT	1.11	KOLA	12.5.(1)
III	LOSS OF COOLANT ACCIDENTS	1177	ADDITIONAL DBA ANALYSIS Calculation of 32 mm break, Design basis Accident with leak in the cold leg with reactor trip on primary system parameters and subsequent loss of power.	D	ACCIDENT	1.11	KOLA	12.5.(2)
III	LOSS OF COOLANT ACCIDENTS	1179	SENSITIVITY STUDY A sensitivity study of LOCA results to different axial power distribution should be performed.	D	ACCIDENT	1.11	KOLA	12.5.(4)
III	LOSS OF COOLANT ACCIDENTS	1182	SMALL BREAK LOCA ANALYSIS The 20 mm break analyiss should be extended in time up to leak flow equal to safety injection flow.	D	ACCIDENT	1.11	KOLA	12.5.(7)
III	LOSS OF COOLANT ACCIDENTS	1183	ANALYSIS OF 60 mm BREAK Analysis of 60 mm break should be performed with four EP-50 injection pumps only.	D	ACCIDENT	1.11	KOLA	12.5.(8)
III	LOSS OF COOLANT ACCIDENTS	1184	ANALYSIS OF 100 mm BREAK Calculation of 100 mm break should be continued until coolability of the core has been proven.	D	ACCIDENT	1.11	KOLA	12.5.(9)

ISSUE NUMBER: Accident Analysis 8

ISSUE TITLE: Radiological consequences

RANK OF ISSUE: II

ISSUE CLARIFICATION:

The ultimate objective of nuclear safety is to avoid indue radiological consequences to the public in case of a major accident. Therefore, in case of accidents contemplated in Accident Analysis 6 and 7 issues with outside release, the radiological consequences should be estimated and legal dose limits verified.

RELATED ITEMS:

388, 389, 695, 709, 732, 836, 864, 866, 1171, 1180, 1186, 1188, 1190, 1193

JUSTIFICATION OF RANKING:

For most of the accidents there is no radiation release outside the plant. For those with release, the amount of radioactivity has been estimated to be very low. However, no calculations in terms of dose to the public have been performed.

CONCEPTUAL RECOMMENDATIONS:

For accidents which involve release of radioactivity to the environment, the complete calculation of source terms and radiological consequences to the public should be calculated taking into account the actual leak tightness of the confinement.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	RADIOLOGICAL CONSEQUENCES	388	RADIOLOGICAL CONSEQUENCES Radiological consequences of the steam generator collector should be completed using conservative assumptions.	D	ACCIDENT	1 11	BOHUNICE	11.11.(1)
II	RADIOLOGICAL CONSEQUENCES	389	SOURCE TERMS Conservative source terms should be defined for the calculation of radiological consequences. As a minimum, Technical Specification values should be defined .	D	ACCIDENT	5.4	BOHUNICE	11.11.(2)
II	RADIOLOGICAL CONSEQUENCES	695	RADIOLOGICAL CONSEQUENCES The radiological consequences of LOCAs should be evaluated.	D	ACCIDENT	1.11	KOZLODUY	11.2.(7)
II	RADIOLOGICAL CONSEQUENCES	709	RADIOLOGICAL CONSEQUENCES The radiological consequences of the total blackout severe accident scenario should be evaluated.	D	ACCIDENT	5.4	KOZLODUY	11.6.(2)
II	RADIOLOGICAL CONSEQUENCES	732	STEAM GENERATOR HEADER RUPTURE Study steam generator collector head rupture combined with a blockage of the SG safety valve in the open position to estimate the induced radioactive releases.	D	SYSTEMS	1.11	NOVOVORONE	8 1.(3)
II	RADIOLOGICAL CONSEQUENCES	836	RADIOLOGICAL CONSEQUENCES Radiological consequence evaluations should be performed in accordance with international practices.	D	ACCIDENT	1.11	NOVOVORONE	12.1.(2)
II	RADIOLOGICAL CONSEQUENCES	864	SG TUBE RUPTURE CONSEQUENCES Establish radiological consequences to the environment by a conservative analysis.	D	ACCIDENT	1.11	NOVOVORONE	12.5 (2)
II	RADIOLOGICAL CONSEQUENCES	866	SGTR WITHOUT SG ISOLATION The steam/water releases to the environment obtained from an SGTR assuming analysis failure to isolate the steam generator should be used for radiological consequence calculation.	D	ACCIDENT	5.4	NOVOVORONE	12 5 (4)
II	RADIOLOGICAL CONSEQUENCES	1171	RADIOLOGICAL CONSEQUENCES Radiological consequence analyses should be performed for all relevant accidents	D	ACCIDENT	5.4	KOLA	12.1.(7)
II	RADIOLOGICAL CONSEQUENCES	1180	LOCA RADIOLOGICAL CONSEQUENCES Analysis of Design Basis LOCA radiological consequences should be performed, based on measured leaktightness of confinment.	D	ACCIDENT	1 11	KOLA	12.5.(5)
II	RADIOLOGICAL CONSEQUENCES	1186	NEW DBA CONSEQUENCE ANALYSIS Analysis of radiological consequences of the new Design Basis Accident should be performed, based on confinment leaktightness measurements.	D	ACCIDENT	1.11	KOLA	12.5.(11)
II	RADIOLOGICAL CONSEQUENCES	1188	SG TUBE RUPTURE CONSEQUENCES Calculation of radiological consequences of steam generator tube rupture should be performed.	D	ACCIDENT	1 11	KOLA	12.6.(2)
II	RADIOLOGICAL CONSEQUENCES	1190	COLLECTOR RUPTURE CONSEQUENCES Radiological consequences of steam generator collector rupture should be performed.	D	ACCIDENT	1.11	KOLA	12.6.(4)
II	RADIOLOGICAL CONSEQUENCES	1193	STEAM LINE AND SG TUBE BREAK The rupture of the steam line with subsequent rupture of a steam generator tube should be analysed, including radiological consequences.	D	ACCIDENT	1.11	KOLA	12.7.(3)

ISSUE NUMBER: Accident Analysis 9

ISSUE TITLE: Evaluation of Modifications

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Modifications and upgrades in systems with deficiencies in protection against single failures and high potential for common cause failures need to be evaluated using methods which can consider these problems in a systematic and methodological way.

RELATED ITEMS:

73, 111, 316, 373, 374, 618, 631, 741, 754, 756, 760, 767, 1071, 1074

JUSTIFICATION OF RANKING:

A systematic identification of design weaknesses of individual systems and the evaluation of possible modification options are of high safety importance. Risk based methods although not a formal requirement, have been recognized in may countries as an useful tool for supporting safety decisions.

CONCEPTUAL RECOMMENDATIONS:

A systematic evaluation of backfitting measures, including the risk impact (positive or negatives) of each measure in the overall plant safety should be conducted prior to any implementation.

Reliability analysis methods should be used to evaluate the risk impact of design options and to prioritize modifications.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	EVALUATION OF MODIFICATIONS	73	BACKFITTING EVALUATION AND PSA A systematic evaluation of backfitting measures, including the impact (positive and negative) of each measure in the overall plant safety should be conducted prior to any implentation steps. PSA presents an adequate complementary means to assess this safety impact.	D	SYSTEMS	1.11	DESREV	III.2.2.2
III	EVALUATION OF MODIFICATIONS	111	REACTOR PROTECTION SYSTEM The reliability of the reactor protection system should be evaluated in order to establish the potential weak points of the system.	D	I&C	3.5	DESREV	III.4.2.12
III	EVALUATION OF MODIFICATIONS	316	SAFETY SYSTEM IMPROVEMENTS Complete planned modifications. Also, perform a fault tree analysis of involved system, including support systems, to evaluate impact of modifications.	D	SYSTEMS	1.6	BOHUNICE	8.3.(2)
III	EVALUATION OF MODIFICATIONS	373	COMMOM MODE FAILURE STUDY A complete study of commom mode failures should be performed, including internal and external events to identify weak points.	D	ACCIDENT	1.6	BOHUNICE	11.1.(2)
III	EVALUATION OF MODIFICATIONS	374	PROBABILISTIC SAFETY ASSESSMEN Undertake a level-1 Probabilistic Safety Assessment according to international practices and to evaluate priority of modifications.	D	ACCIDENT	1.11	BOHUNICE	11.1.(3)
III	EVALUATION OF MODIFICATIONS	618	SAFETY SYSTEM IMPROVEMENTS Complete proposed backfitting measures. Also perform a fault tree analysis of involved systems, including support systems, to evaluate impact of modifications.	D	SYSTEMS	1.11	KOZLODUY	8.4.(1)
III	EVALUATION OF MODIFICATIONS	631	COMMON CAUSE FAILURES STUDY Perform a systematic integrated hazard analysis including fire, flooding, tank ruptures and earthquake.	D	SYSTEMS	1.6	KOZLODUY	8.6.(1)
III	EVALUATION OF MODIFICATIONS	741	ECCS - MODIFICATIONS Before undertaking important modifications, perform reliability analysis to select the most appropiate solution.	D	SYSTEMS	3.6	NOVOVORONE	8.4.(1)
III	EVALUATION OF MODIFICATIONS	754	LOSS OF ELECTRICAL POWER Perform probabilistic studies concerning the risk encountered from the complete loss of electrical power supply.	D	SYSTEMS	1.11	NOVOVORONE	8.7.(4)
III	EVALUATION OF MODIFICATIONS	756	LOSS OF SG FEEDWATER Perform probabilistic studies concerning the risk encountered from the complete loss of feedwater.	D	SYSTEMS	1.11	NOVOVORONE	8.8.(2)
III	EVALUATION OF MODIFICATIONS	760	LOSS OF SAFETY SYSTEM Perform a probabilistic study of the total loss of the spray system and/or the safety injection system.	D	SYSTEMS	1.11	NOVOVORONE	8.8.(6)
III	EVALUATION OF MODIFICATIONS	767	LOSS OF HEAT SINK Perform a probabilistic study concern the risk encountered from the complete loss of heat sink.	D	SYSTEMS	1.11	NOVOVORONE	8.10.(2)
III	EVALUATION OF MODIFICATIONS	1071	CONTROL ROOM DESTRUCTION A probebilistic study should be performed to evaluate the risk of destruction of the control room.	D	SYSTEMS	1.6	KOLA	8.6.(6)
III	EVALUATION OF MODIFICATIONS	1074	SERVICE WATER SYSTEM ANALYSIS A probabilistic safety study of service water system should be performed to evaluate proposed modifications.	D	SYSTEMS	1.6	KOLA	8.7.(2)

ISSUE NUMBER: Fire Protection 1

ISSUE TITLE: Fire Protection Analysis

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Further fire hazard analysis is needed for areas previously not studied and to analyze the effectiveness of previous upgrades.

RELATED ITEMS:

397, 399, 537, 398, 536, 1304, 1306, 1312, 991, 992, 993, 998, 1069, 816, 821, 1162, 1000, 1326

JUSTIFICATION OF RANKING:

Due to insufficient redundancy and segregation of safety related systems, fire hazard is one of the major sources of common cause failure of the safety functions.

CONCEPTUAL RECOMMENDATIONS:

Fire protection should be upgraded. To do it systematically, a fire risk evaluation should be conducted in each plant with the objective of defining precise recommendations in order to reduce significantly the fire risk .

CAT.	ISSUE	ITEM n	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	FIRE PROTECTION - ANALYSIS	397	FIRE HAZARDS ANALYSIS Fire hazards analysis should be done for the controled area and for conditions during refuelling.	O	FIRE	1.6	BOHUNICE 12.4.(1)
III	FIRE PROTECTION - ANALYSIS	398	ADDITIONAL FIRE ALARMS Decision on installation of fire alarm in the reactor building and other primary circuit rooms should be based on a fire hazards analysis.	O	FIRE	1.6	BOHUNICE 12.4.(2)
III	FIRE PROTECTION - ANALYSIS	399	FIRE PROTECTION UPGRADES A study assessing the contribution of the several proposed fire protection upgradings should be performed. This should lead to establishing priorities.	O	FIRE	1.6	BOHUNICE 12.4.(3)
III	FIRE PROTECTION ANALYSIS	536	FIRE HAZARDS ANALYSIS Fire hazard analysis should be carried out to determine the threat of fire spreading from one unit to the other.	O	FIRE	1.6	KOZLODUY 5.3.(2)
III	FIRE PROTECTION - ANALYSIS	537	CONTROL FIRE HAZARD ANALYSIS Fire hazard analysis of the control room should be carried out.	O	FIRE	1.6	KOZLODUY 5.3.(3)
III	FIRE PROTECTION - ANALYSIS	816	SWITCHGEAR ROOM PROTECTION Install a drainage system to remove the water or foam due to the extinguishing system from the switchgear room if the electrical equipment may be afected.	D	ELECTRICAL	3.3	NOVOVORONE 11.1.(4)
III	FIRE PROTECTION ANALYSIS	821	DG COMPARTMENTS Most relevant components and devices which contribute to fire load within each diesel compartment should be identified. Realize local improvements to reduce the risk of fire.	D	ELECTRICAL	1.6	NOVOVORONE 11.2.(2)
III	FIRE PROTECTION ANALYSIS	991	DETECTION AND SUPRESSION The fire detection and suppression systems should be extended to cover all plant areas where there is a risk of causing common mode failure of safety.	O	FIRE	1.6	NOVOVORONE 5.3.(3)
III	FIRE PROTECTION ANALYSIS	992	MITIGATION All buildings should be analysed relative to the fire risk, fire protection doors should be installed.	O	FIRE	1.6	NOVOVORONE 5.3.(4)
III	FIRE PROTECTION ANALYSIS	993	FIRE RISK ANALYSIS A comprehensive fire risk analysis should be conducted relative to the risk of fire spread and common cause failures of vital safety.	O	FIRE	1.6	NOVOVORONE 5.3.(5)
III	FIRE PROTECTION ANALYSIS	998	SMOKE INTRUSION All fire doors should be inspected for capability against smoke intrusion, and fire spread.	O	FIRE	1.6	NOVOVORONE 5.3.(10)
III	FIRE PROTECTION - ANALYSIS	1000	DG FIRE RISK A fire risk analysis of the whole diesel generator building should be performed.	O	FIRE	1.6	NOVOVORONE 5.3.(12)
III	FIRE PROTECTION - ANALYSIS	1069	BORON ROOM FIRE DETECTION Fire detection system should be installed in the boron room.	D	SYSTEMS	1.6	KOLA 8.6 (4)
III	FIRE PROTECTION - ANALYSIS	1162	FIRE PROTECTION OF DC CABLES Fire protection of DC cables in the electrical rooms should be carried out.	D	ELECTRICAL	3.3	KOLA 11.5.(4)
III	FIRE PROTECTION - ANALYSIS	1304	FIRE RISK ANALYSIS A fire risk analysis should be completed for controlled area and turbine hall. Fire detection should be extended to all plant areas where fire can cause common mode failure.	O	FIRE	1.6	KOLA 5.3.(2)
III	FIRE PROTECTION - ANALYSIS	1306	ANALYSIS OF FIRE BARRIERS A thorough analysis of adequacy of fire barriers should be done. Design and construction of new barriers should be expedited.	O	FIRE	1.6	KOLA 5 3 (4)
III	FIRE PROTECTION - ANALYSIS	1312	PROBABILISTIC FIRE RISK Fire risk probabilistic analysis should be performed for operational and outage conditions.	O	FIRE	1.6	KOLA 5.5.(1)
III	FIRE PROTECTION - ANALYSIS	1326	FIRE IN COMMUNICATION CENTER Review the protection against fire of the telephone communication equipment when room evacuated.	O	EP	5.2	KOLA 6.4.(7)

ISSUE NUMBER: Fire Protection 2

ISSUE TITLE: Fire Protection Equipment

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Many existing fire protection systems are inadequate and there is not sufficient fire protection in some areas. Many modifications to upgrade existing fire protection systems have been identified but not yet completed.

RELATED ITEMS:

392, 535, 540, 541, 543, 810, 832, 1002, 1302, 1305, 1307, 1313

JUSTIFICATION OF RANKING:

Fire protection equipment and systems, including fire detection and fire barriers are of high safety relevance and integral part of fire protection.

CONCEPTUAL RECOMMENDATIONS:

The adequacy of existing fire protection systems should be analyzed in the frame of the fire risk evaluation. The modification deemed necessary to improve or complete the existing equipment should then be implemented.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	FIRE PROTECTION - EQUIPMENT	392	FIRE DETECTION AND ALARM The installation of new fire detection and alarm system should be completed as soon as possible.	O	FIRE	1.6	BOHUNICE 12.2.(1)
III	FIRE PROTECTION - EQUIPMENT	535	FIRE DETECTION IN DIESEL TANKS Fire detection system should be installed in day tank of Unit 3/4 Diesel Generators.	O	FIRE	1.6	KOZLODUY 5.3.(1)
III	FIRE PROTECTION - EQUIPMENT	540	FIRE SUPPRESSION IN OIL TANKS The day tank of Diesel generators of Unit 3/4 should be protected by a fire suppression system.	O	FIRE	1.6	KOZLODUY 5.4.(1)
III	FIRE PROTECTION - EQUIPMENT	541	PROTECTIVE WALL FOR OIL TANKS Consider costructing a protective wall in the area were day tanks for Diesel generators of Unit 3 and 4 are located.	O	FIRE	1.6	KOZLODUY 5.4.(2)
III	FIRE PROTECTION - EQUIPMENT	543	UPGRADING FIRE PROTECTION Utility management is urged to provide adequate resources to complete the proposed programme for fire protection upgrading in a reasonable time.	O	FIRE	1.17	KOZLODUY 5.5.(1)
III	FIRE PROTECTION - EQUIPMENT	810	AUTOMATIC DOOR CLOSING Automatic door closing mechanisms should be provided on the main control room entrance door, glass doors should be replaced by fire doors.	D	I&C	2.4	NOVOVORONE 10.7.(13)
III	FIRE PROTECTION - EQUIPMENT	832	CABLE COATING Completely coat cables in unit 3 and 4 with flame retardant material.	D	ELECTRICAL	1.6	NOVOVORONE 11.5.(3)
III	FIRE PROTECTION - EQUIPMENT	1002	FIRE PROTECTION UPGRADING Conduct a review of proposals for upgrading fire protection.	O	FIRE	1.6	NOVOVORONE 5.5.(1)
III	FIRE PROTECTION - EQUIPMENT	1302	UPGRADING FIRE PROTECTION Implementation of fire protection upgrading plan should be given high priority.	O	FIRE	1.17	KOLA 5.2.(1)
III	FIRE PROTECTION - EQUIPMENT	1305	IMPLEMENTATION OF UPGRADINGS Expedite construction of designed fire detection and alarm systems.	O	FIRE	1.6	KOLA 5.3.(3)
III	FIRE PROTECTION - EQUIPMENT	1307	MAINTENANCE OF FIRE BARRIERS Maintenance of existing fire barriers should be improved.	O	FIRE	1.6	KOLA 5.3.(5)
III	FIRE PROTECTION - EQUIPMENT	1313	FIRE UPGRADING SCHEDULE The fire upgrading schedule should be revised, if possible shortened, and strickly followed.	O	FIRE	1.6	KOLA 5.5.(2)

ISSUE NUMBER: Fire Protection 3

ISSUE TITLE: Fire Protection. Inspection

RANK OF ISSUE: III

ISSUE OF CLARIFICATION:

Further actions are necessary to improve fire inspection activities, to eliminate fire hazards, and to assure fire equipment is properly maintained.

RELATED ITEMS:

391, 393-396, 531, 534, 538, 539, 542, 809, 818, 967, 989, 990, 994-997, 1303, 1308, 1309, 1310, 1311, 1321

JUSTIFICATION OF RANKING:

Inspections are a basic element to identify and prevent fire hazards and to ensure the operability of fire protection systems.

CONCEPTUAL RECOMMENDATIONS:

Fire inspection activities should be improved to make sure that the required level of protection is maintained throughout the plant lifetime.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	FIRE PROTECTION - INSPECTION	391	FIRE HAZARDS INSPECTION Fire hazards inspection should be performed by fire protection organization.	O	FIRE	1.6	BOHUNICE 12.1.(1)
III	FIRE PROTECTION - INSPECTION	393	EVACUATION ROUTES Evacuation routes in the plant should be more effectively marked and visible in black-out conditions.	O	FIRE	1.6	BOHUNICE 12.2.(2)
III	FIRE PROTECTION - INSPECTION	394	FIRE EQUIPMENT TESTING The fixed fire fighting equipment should be test in most unfavoreble conditions (e.g. Winter).	O	FIRE	1.6	BOHUNICE 12.3.(1)
III	FIRE PROTECTION - INSPECTION	395	FIRE EQUIPMENT MAINTENANCE More attention should be paid to fire fighting equipment maintenence. Tags should indicate last inspection check.	O	FIRE	1.6	BOHUNICE 12.3.(2)
III	FIRE PROTECTION - INSPECTION	396	FOAM SYSTEM TESTING Testing of foem fire fighting system should be repeated under conditions which will make the results credible.	O	FIRE	1.6	BOHUNICE 12.3.(3)
III	FIRE PROTECTION - INSPECTION	531	FIRE HAZARDS INSPECTION Thorough fire hazards inspection should be carried out routinely.	O	FIRE	1.6	KOZLODUY 5.1.(1)
III	FIRE PROTECTION - INSPECTION	534	FIRE PROTECTION STANDARDS Consider including fire protection standards spacific for nuclear power plants in a national or company standard.	O	FIRE	1.6	KOZLODUY 5.2.(1)
III	FIRE PROTECTION - INSPECTION	538	FIRE DOORS INSPECTION A stationwide inspection/maintenance programme of fire doors should be initiated.	O	FIRE	1.6	KOZLODUY 5.3.(4)
III	FIRE PROTECTION - INSPECTION	539	PENETRATION FIRE BARRIERS Cable and pipe penetration should be inspected to identify and repair missing fire barriers.	O	FIRE	1.6	KOZLODUY 5.3.(5)
III	FIRE PROTECTION - INSPECTION	542	RESTRAINING FIRE EXTINGUISHERS Free standing fire extinguishers should be restrained to prevent them from falling.	O	FIRE	1.6	KOZLODUY 5.4.(3)
III	FIRE PROTECTION - INSPECTION	809	FLOORING MATERIAL The flooring material should meet approved flammability requirements otherwise it should be replace with a material which does.	D	I&C	2.4	NOVOVORONE 10.7.(12)
III	FIRE PROTECTION - INSPECTION	818	ELECTRICAL DISTRIBUTION BOARDS Keep doors betwen sections and different trains permanently closed. Install a fire detection system.	D	ELECTRICAL	1.6	NOVOVORONE 11.1.(6)
III	FIRE PROTECTION - INSPECTION	967	FLOORING MATERIAL A better and more suitable material should be used to protect the floors in the controlled area.	O	MAINT	1.17	NOVOVORONE 4.2.(2)
III	FIRE PROTECTION - INSPECTION	989	FIRE DOORS INSPECTION Fire protection doors should be monitored strictly by the fire brigade (see 5.3.(4)).	O	FIRE	1.6	NOVOVORONE 5.3.(1)
III	FIRE PROTECTION - INSPECTION	990	FIRE RISK RELATED WORK Fire risk related work should be controlled by using fire protection blankets and barriers to eliminate risks from sparks.	O	FIRE	1.6	NOVOVORONE 5.3.(2)
III	FIRE PROTECTION - INSPECTION	994	FIRE DOORS A station wide inspection/maintenance programme should be initiated to make all the fire doors function as intented.	O	FIRE	1.6	NOVOVORONE 5.3.(6)
III	FIRE PROTECTION - INSPECTION	995	FIRE DOORS PROTECTION Minimize the need to run cables and hoses through fire doors.	O	FIRE	1.6	NOVOVORONE 5.3.(7)
III	FIRE PROTECTION - INSPECTION	996	FIRE DOORS Fire doors should be kept closed or a continuos fire watch set up.	O	FIRE	1.6	NOVOVORONE 5.3.(8)
III	FIRE PROTECTION - INSPECTION	997	FIRE BRIGADE The quality of the inspection by the Militarized Fire Brigade should be improved to ensure that fire doors remain closed.	O	FIRE	1.6	NOVOVORONE 5.3.(9)
III	FIRE PROTECTION - INSPECTION	1303	FIRE INSPECTIONS Fire brigade inspectors should inspect carefully fire fighting equipment in the plant and report deficiencies.	O	FIRE	1.6	KOLA 5.3.(1)
III	FIRE PROTECTION - INSPECTION	1308	ROOF / FLOOR FLAMABLE MATERIAL All flamable material used in the roofs and floor coverings should be replaced.	O	FIRE	1.6	KOLA 5.3.(6)
III	FIRE PROTECTION - INSPECTION	1309	EVACUATION ROUTES INDICATION Evacuation routes and emergency exits signs should be inspected and where necessary repainted or restablished. Signs should be visible under blackout conditions.	O	FIRE	1.6	KOLA 5.3.(7)
III	FIRE PROTECTION - INSPECTION	1310	FIRE FIGHTING EQUIPMENT Inspect fire hoses and portable fire extinguishers. Replace as necessary.	O	FIRE	1.6	KOLA 5.4.(1)
III	FIRE PROTECTION - INSPECTION	1311	FIRE HOSE NOZZLES Fire hose nozzles should be checked for their use and effectiveness.	O	FIRE	1.6	KOLA 5.4.(2)
III	FIRE PROTECTION - INSPECTION	1321	FLAMMABLES IN CONTROL CENTER Flammables containers and equipment for emergency present in the Emergency Control Center should be replaced by non-flammable material.	O	EP	5.2	KOLA 6.4.(2)

4. OPERATIONAL ISSUES

ISSUE NUMBER: Management 1

ISSUE TITLE: Management Involvement

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

Management should take an active role in station operation to ensure practices, policies, and standards are being properly implemented. This pertains to plant personnel as well as contractors. Setting management goals allows a means to measure the accomplishment of safety objectives through tools such as performance indicators, operation and maintenance daily meeting records outage meeting records, industrial safety performance, and plant inspections.

RELATED ITEMS:

230, 411, 458, 488, 490, 873, 874, 876, 880, 882, 944, 965, 974, 988
1201, 1202, 1205, 1206, 1209, 1240, 1241, 1258

JUSTIFICATION OF RANKING:

Effective management involvement and monitoring of station activities are necessary for ensuring an adequate approach to safety. Management bears the responsibility for ensuring unsafe conditions are prevented and corrected.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	MANAGEMENT INVOLVEMENT	230	MANAGEMENT SUPERVISION Plant managers and supervisors should make frequent tours around the plant.	O	OPS	1.17	BOHUNICE 3.1.(4)
IV	MANAGEMENT INVOLVEMENT	411	INDUSTRIAL SAFETY Industrial Safety practices must be strongly and consistently enforced by senior management. Priority should be given to removing safety hazards and correcting material conditions. Train the staff. Enforce use of safety equipment such as hard hats.	O	MAO	1.18	KOZLODUY 1.5.(1)
IV	MANAGEMENT INVOLVEMENT	458	MANAGEMENT SUPERVISION Operation management should be more effectively involved in shift activities.	O	OPS	1.17	KOZLODUY 3.1.(7)
IV	MANAGEMENT INVOLVEMENT	490	MANAGEMENT SUPPORT Strong management support should be provided to ensure correction of defficiencies on plant material conditions. Management should make an effort to change staff atitude towards safe operation and plant conditions.	O	OPS	1.17	KOZLODUY 3.4.(10)
IV	MANAGEMENT INVOLVEMENT	873	MANAGEMENT RESPONSIBILITY The management of should enforce housekeeping, industrial safety and radiation protection requirements.	O	MOA	1.17	NOVOVORONE 1.2.(1)
IV	MANAGEMENT INVOLVEMENT	874	MANAGEMENT TOOLS Performance indicators should be developed for the monitoring and improvement of plant safety and performance.	O	MOA	1.17	NOVOVORONE 1.2.(2)
IV	MANAGEMENT INVOLVEMENT	876	QA IMPLEMENTATION Managers and supervisors must be trained in the principles of quality management and be convinced to take an active part in the implementation of the QA programme.	O	MOA	1.17	NOVOVORONE 1.3.(2)
IV	MANAGEMENT INVOLVEMENT	880	INDUSTRIAL SAFETY Good industrial safety practices must be enforced by the senior management. Priority should be given to the removal of safety hazards.	O	MOA	1.17	NOVOVORONE 1.5.(1)
IV	MANAGEMENT INVOLVEMENT	882	RADIATION PROTECTION PRACTICE Radiological work protection practices should be enforced by senior plant management.	O	MOA	1.23	NOVOVORONE 1.5.(3)
IV	MANAGEMENT INVOLVEMENT	944	MANAGEMENT SUPERVISION Supervisors and management should carry out regular and frequent inspections of the plant to ensure the achievement of the highest standards of nuclear safety.	O	OPS	1.17	NOVOVORONE 3.5.(3)
IV	MANAGEMENT INVOLVEMENT	965	PERFORMANCE INDICATOR Use management tools and techniques such as performance indicators to monitor the departments of the maintenance organization.	O	MAINT	1.25	NOVOVORONE 4.1.(2)
IV	MANAGEMENT INVOLVEMENT	974	CONDUCT OF MAINTENANCE Regular walk-downs through all accessible parts of the regular controlled areas should be made by all levels of management.	O	MAINT	1.17	NOVOVORONE 4.4.(2)
IV	MANAGEMENT INVOLVEMENT	988	OUTAGE ORGANIZATION Take minutes of the staff meetings of the heads of the workshops held during the outage.	O	MAINT	1.26	NOVOVORONE 4.9.(2)
IV	MANAGEMENT INVOLVEMENT	1201	ASSESSMENT PROGRAMMES Management should develop assessment programmes, including direct observation, that will provide feedback on whether standards, requirements and policies are effective.	O	MOA	1.17	KOLA 1.2.(2)
IV	MANAGEMENT INVOLVEMENT	1202	CONTRACTORS OVERSIGHT Management should ensure that contractor personnel work at least to the same standards as required for station personnel.	O	MOA	1.17	KOLA 1.2.(3)
IV	MANAGEMENT INVOLVEMENT	1205	PERFORMANCE INDICATORS Performance indicators should be developed and provided to managers to monitor and immprove plant safety.	O	MOA	1.17	KOLA 1.2.(6)
IV	MANAGEMENT INVOLVEMENT	1206	MANAGEMENT GOALS Ensure that management goals and progress status are communicated to working levels. Post goals and progress in various locations in the plant.	O	MOA	1.17	KOLA 1.2.(7)
IV	MANAGEMENT INVOLVEMENT	1209	INDUSTRIAL SAFETY Industrial safety rules need to be communicated and enforced by all levels of management.	O	MOA	1.18	KOLA 1.5.(1)
IV	MANAGEMENT INVOLVEMENT	1240	DAILY MORNING MEETINGS Considerations should be given to formalize the daily phone meetings minutes and follow up the decisions more strickly.	O	OPS	1.17	KOLA 3.1.(5)
IV	MANAGEMENT INVOLVEMENT	1241	CORRECTIVE ACTIONS Corrective actions and management control on identified shift activities defficiencies should be improved.	O	OPS	1.17	KOLA 3.1.(6)
IV	MANAGEMENT INVOLVEMENT	1258	FORMAL MORNING MEETING A formal morning meeting should be held with all departments heads, including Radiation Protection and Industrial Safety.	O	OPS	1.19	KOLA 3.5.(1)

ISSUE NUMBER: Management 2

ISSUE TITLE: Management Development

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Actions are necessary to improve top management middle management and supervisory skills. Training assistance visits and international exchanges represent ways of implementing such actions.

RELATED ITEMS:

224, 225, 402, 405, 407, 926, 1200, 1203, 1231

JUSTIFICATION OF RANKING:

Management exerts a direct influence on nuclear power plant safety performance. Improving the skills of supervisory, middle, and upper level managers through formal training and exposure to international standards will result in an overall enhancement to safety.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	MANAGEMENT DEVELOPMENT	224	TRAINING OF MANAGERS Develope a plan for management and supervisory training to all grades requiring it. Pla may require off-site training.	O	TQ	1.20	BOHUNICE	2.7.(1)
III	MANAGEMENT DEVELOPMENT	225	MANAGEMENT DEVELOPMENT The company, in conjunction with the station, should implement a management development programme.	O	TQ	1.17	BOHUNICE	2.7.(2)
III	MANAGEMENT DEVELOPMENT	402	IMPROVE MANAGENT Take full advantage of WANO association to get advice to managers on how to manage a power plant in a free market economy.	O	MAO	1.17	KOZLODUY	1.1.(1)
III	MANAGEMENT DEVELOPMENT	405	MANAGEMENT TRAINING As a part of association with WANO and EdF, obtain advice and training in such topics as stablishing objectives, setting goals and developing performance indicators.	O	MAO	1.17	KOZLODUY	1.2.(3)
III	MANAGEMENT DEVELOPMENT	407	MANAGEMENT TRAINING ELEMENTS Management training should stress: Safety Culture, quality management, leadership, communication, monitoring, accountability, assessment of staff capabilities.	O	MAO	1.17	KOZLODUY	1.2.(5)
III	MANAGEMENT DEVELOPMENT	926	MANAGERS AND SUPERVISORS Develope a management training programme to upgrade the skills of the plant management.	O	TQ	1.17	NOVOVORONE	2.10.(1)
III	MANAGEMENT DEVELOPMENT	1200	TRAINING OF MANAGERS Provide training to management at all levels on standerds and spectations of top management.	O	MOA	1.20	KOLA	1.2.(1)
III	MANAGEMENT DEVELOPMENT	1203	INTERNATIONAL EXCHANGES Management should expand their programme of visits to other plants and hosting experts from other countries.	O	MOA	1.20	KOLA	1.2.(4)
III	MANAGEMENT DEVELOPMENT	1231	TRAINING OF MANAGERS Consideration should be given to increasing the number of developmental courses in managerial skills.	O	TQ	1.20	KOLA	2.9.(1)

ISSUE NUMBER: Management 3

ISSUE TITLE: Safety Culture

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

Safety culture embodies a top to bottom approach to plant operation from a safety perspective as detailed in INSAG-4. These principles should be effectively communicated by management to all station personnel including the role of procedure usage in accomplishing safety goals. Established policies on fines should not be inappropriately applied so as to detract from the identification and resolution of safety problems.

RELATED ITEMS:

191, 245, 406, 417, 418, 419, 456, 489, 932, 1204, 1211, 1255, 1295

JUSTIFICATION OF RANKING:

Safety culture as defined in INSAG-4 addresses the appropriate individual and collective attitude to create and maintain for ensuring required safety levels in all circumstances of operation. It is therefore a high safety concern.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	SAFETY CULTURE	191	SAFETY AWARENESS Consider starting a programme to promote safety awareness among plant personnel.	O	MOA	1.19	BOHUNICE 1.2.(3)
IV	SAFETY CULTURE	245	USE OF PROCEDURES Procedures should be used during normal operation and in transient conditions. Plant management should re-enforce the need to use procedures.	O	OPS	1.19	BOHUNICE 3.4.(2)
IV	SAFETY CULTURE	406	SAFETY CULTURE A true Safety Culture should be developed.	O	MAO	1.17	KOZLODUY 1.2.(4)
IV	SAFETY CULTURE	417	SALARIES Re-evaluate salary and wage structure in order to atract qualified new trainees.	O	MAO	1.17	KOZLODUY 1.7.(2)
IV	SAFETY CULTURE	418	IMPROVING LIVING CONDITIONS The managemnt and the Government should discuss ways of making Kozloduy a more atrctive place to live.	O	MAO	1.17	KOZLODUY 1.7.(3)
IV	SAFETY CULTURE	419	FINES POLICY Manegement should re-evaluate its policy relating to fines for commiting errors. Discipline should not encourage the concealment of errors.	O	MAO	1.17	KOZLODUY 1.7.(4)
IV	SAFETY CULTURE	456	MANAGEMENT SUPPORT Full support from management is necessary to ensure the recritment of necessary number of operators.	O	OPS	1.17	KOZLODUY 3.1.(5)
IV	SAFETY CULTURE	489	PLANT CONDITIONS STANDARDS Standards for acceptable condition of plant equipment should be established. Shift personnel should be trained in their understanding and in techniques for identifying defficiencies.	O	OPS	1.19	KOZLODUY 3.4.(9)
IV	SAFETY CULTURE	932	USE OF PROCEDURES The burden placed on operators to recall procedures from memory should be eliminated.	O	OPS	1.17	NOVOVORONE 3.3.(1)
IV	SAFETY CULTURE	1204	SAFETY CULTURE Consider formally implementing and communicating to all plant personnel the guidance of Safty Series 75-INSAG-4 "Safety Culture.	O	MOA	1.17	KOLA 1.2.(5)
IV	SAFETY CULTURE	1211	USAGE OF PROCEDURES Management should develope and implement a long range plan to increase the availability and usage of procedures.	O	MOA	1.19	KOLA 1.6.(2)
IV	SAFETY CULTURE	1255	USE OF PROCEDURES Written emergency operating procedures should be folloewd during transient situations. Management should reinforce their use.	O	OPS	1.19	KOLA 3.4.(1)
IV	SAFETY CULTURE	1295	USE OF MAINTENANCE PROCEDURES Workers should always refer to and use procedures when they are available.	O	MAINT	1.19	KOLA 4.4.(2)

ISSUE NUMBER: Management 4

ISSUE TITLE: Housekeeping

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Improved housekeeping conditions are necessary to reduce industrial safety hazards to personnel, to better maintain equipment, to diminish fire hazards and to establish improved working conditions.

RELATED ITEMS:

250, 968, 969, 1257, 1291

JUSTIFICATION OF RANKING:

Poor housekeeping can contribute to poor material conditions of the plant, higher fire risks, and industrial safety hazards.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	HOUSEKEEPING	250	HOUSEKEEPING A programme to improve housekeeping should be established.	O	OPS	1.19	BOHUNICE	3.4.(7)
II	HOUSEKEEPING	488	REPORTING DEFICIENT CONDITIONS Reporting of defficiencies in material conditions of equipment or housekeeping should be emphasized. Managers should conduct plant tours to ensure that conditions are reported and corrected.	O	OPS	1.19	KOZLODUY	3.4.(8)
II	HOUSEKEEPING	968	CLEANING PROGRAMME Regular cleaning for all operational areas in both the controlled and non-controlled zones should developed and implemented.	O	MAINT	1.25	NOVOVORONE	4.2.(3)
II	HOUSEKEEPING	969	CLEANING PROGRAMME Regular claening for working places to prevent unnecessary contamination of tools and materials should be implemented.	O	MAINT	1.25	NOVOVORONE	4.2.(4)
II	HOUSEKEEPING	1257	HOUSEKEEPING A programme for improving housekeeping and clentliness should be established. Managers should pay more attention to this issue.	O	OPS	1.19	KOLA	3.4.(3)
II	HOUSEKEEPING	1291	HOUSEKEEPING AND MAINTENANCE Maintenance personnel and sub contractors should be responsible for cleaning the workplace and removing all debris at the complition of the job.	O	MAINT	1.19	KOLA	4.2.(4)

ISSUE NUMBER: Management 5

ISSUE TITLE: Organization

RANK OF ISSUE: III

ISSUE CLARIFICATION:

An adequate organization provides for clear responsibilities, lines of communication, and enhances the plant's ability to accomplish common goals. The structure of the organization should insure that important areas for nuclear safety report to the plant manager. Within organizational units (e.g. maintenance, operations, etc) the responsibilities and lines of communication should also be well defined. Significant new work responsibilities will be undertaken by many groups of the plants (training, outages, maintenance). The organizational plans must ensure that adequate staff is available to accomplish those tasks and still allow for other initiatives external to the station such as Owner's Groups. Division of responsibilities between the local plant management and the central management of the operating organizations needs to be defined in a clear manner, emphasizing the decision making at the local level.

RELATED ITEMS:

189, 190, 208, 209, 277, 283, 403, 404, 422, 453, 455, 517, 524, 544, 512, 871, 872, 877, 891, 927, 929, 964, 1198, 1199, 1215, 1259, 1285, 1297

JUSTIFICATION OF RANKING:

The effectiveness of the organization structure is a safety concern. It has to reflect the important elements of the safety culture: responsibilities, communications, experience feedback, and proper staffing.

CAT. ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III ORGANIZATION	189	MAINTENANCE SECTION COVERAGE Maintenance section should cover all aspects of maintenance, including routine work being performed by shift personnel.	O	MOA	1.25	BOHUNICE 1.2.(1)
III ORGANIZATION	190	REORGANIZATION The support activities should be organized around functional lines of responsibilities. Operational activities should be organized on a plant basis.	O	MOA	1.25	BOHUNICE 1.2.(2)
III ORGANIZATION	208	TRAINING CENTER WORKLOAD The center should assess its future workload and ensure needed resources.	O	TQ	1.20	BOHUNICE 2.1.(5)
III ORGANIZATION	209	CENTRALIZED TRAINING The plant should establish a centralized training function.	O	TQ	1.20	BOHUNICE 2.1.(6)
III ORGANIZATION	277	CONTROL OF MODIFICATIONS An independent team should be organized and devoted to the complition of the large number of modifications, without being involved in the daily operation work.	O	TS	1.19	BOHUNICE 5.4.(1)
III ORGANIZATION	283	EMERGENCY PLAN COORDINATOR A person with clearly stated responsibility to coordinate emergency planning should be included in the organization.	O	EP	1.17	BOHUNICE 6.1.(1)
III ORGANIZATION	403	REDUCE STAFF Reduce the staff of Operation and Maintenance in order to improve productivity.	O	MAO	1.17	KOZLODUY 1.2.(1)
III ORGANIZATION	404	REORGANIZATION Subdivide organization in two operating units, one for Units 1 and 2 and other one for Units 3 and 4.	O	MAO	1.17	KOZLODUY 1.2.(2)
III ORGANIZATION	422	CENTRALIZED TRAINING Establish a strong centralized training function.	O	TQ	1.20	KOZLODUY 2.1.(1)
III ORGANIZATION	453	REORGANIZATION OF OPERATIONS Reorganiza the Operational Division to reduce the number of operational departments by consolidating some responsibilities for equipment.	O	OPS	1.17	KOZLODUY 3.1.(2)
III ORGANIZATION	455	STAFFING PLAN Operational division should develope a long range staffing plan considering new operational support activities being defined.	O	OPS	1.10	KOZLODUY 3.1.(4)
III ORGANIZATION	512	REORGANIZATION OF MAINTENANCE Consider dividing maintenace activities in 2 separate organization: normal maintenace and major overhauls.	O	MAINT	1.17	KOZLODUY 4.1.(1)
III ORGANIZATION	517	REORGANIZATION OF WORKSHOPS Workshop should be regrouped by specialities under same leadership.	O	MAINT	1.17	KOZLODUY 4.2.(5)
III ORGANIZATION	524	OUTAGE MANAGER Consider creating a position of Outage Manager reporting to the Chief Engineer to co-ordinate all outage activities.	O	MAINT	1.17	KOZLODUY 4.6.(1)
III ORGANIZATION	544	EMERGENCY PRPAREDNESS WORKLOAD The emergency preparedness workload should be reassessed and resources be made available to carry out all tasks.	O	EP	1.17	KOZLODUY 6.1.(1)
III ORGANIZATION	871	RESPONSIBILITIES Division of responsibilities betwen the centralized authorities and the local plant management should be taken in consideration by MNPI.	O	MOA	1.17	NOVOVORONE 1.1.(1)
III ORGANIZATION	872	WWER-440 M179/230 OWNER'S CLUB An ownwer's group of operators of WWER-440 model 179/230 reactors should be established in order that common approaches can be taken (safety analyses, preparation of technical specifications, etc.).	O	MOA	1.17	NOVOVORONE 1.1.(2)
III ORGANIZATION	877	QA SECTION REPORTING The QA section should report to the Site Director, it will be separated from the operating department and be able to function independently.	O	MOA	1.26	NOVOVORONE 1.3.(3)
III ORGANIZATION	891	TRAINING DEPARTMENT VACANCIES Fill the high number of vacant Training Department positions as quickly as possible.	O	TQ	1.17	NOVOVORONE 2.1.(1)
III ORGANIZATION	927	OPERATION REORGANIZATION All operations staff who may be involved in safety related activities should	O	OPS	1.17	NOVOVORONE 3.1.(1)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
			have one clear line of control and communication.				
III	ORGANIZATION	929	INTERCOM CONFERENCE RECORDING Record the list of actions agreed at 8.30 hours office intercom conference together with the name of position of the person on which the action has been placed.	O	OPS	1.17	NOVOVORONE 3.1.(3)
III	ORGANIZATION	964	MAINTENANCE ORGANIZATION Direct lines of responsability throughout the departments and the subdivisions should be defined.	O	MAINT	1.17	NOVOVORONE 4.1.(1)
III	ORGANIZATION	1198	ORGANIZATION CHART REVISION Revise organization chart and job description to reflect actual situation. Expand Safety Supervisor and Safety Engineer concept for the entire plant.	O	MOA	1.25	KOLA 1.1.(1)
III	ORGANIZATION	1199	DECENTRILIZED ORGANIZATION Continue to decentrilize and streamline organization to reduce control span of key managers and clarify responsabilities.	O	MOA	1.25	KOLA 1.1.(2)
III	ORGANIZATION	1215	TRAINING STAFF Training staff should be increased in order to achieve planned inprovements.	O	TQ	1.20	KOLA 2.1.(1)
III	ORGANIZATION	1259	ASSIGNMENT OF PRIORITIES The shift supervisor should have authority over all maintenance engineers to assign priority and to expedite any item related to safety.	O	OPS	1.19	KOLA 3.5.(2)
III	ORGANIZATION	1285	REORGANIZATION OF MAINTENANCE Maintenance should be improved by establishing direct line of responsabilities and by grouping activities and facilities.	O	MAINT	1.17	KOLA 4.1.(1)
III	ORGANIZATION	1297	PREVENTIVE MAINTENANCE More resources should be allocated to developement of preventive maintenance procedures.	O	MAINT	1.19	KOLA 4.5.(1)

ISSUE NUMBER: Management 6

ISSUE TITLE: Modification Control

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Modification control includes the process of performing safety evaluations, issuing appropriate drawings, modifying procedures, and assessing the performance of permanent and temporary modifications to the plant. An important aspect in the modification process is the independent safety oversight function provided by the Nuclear Safety Review Committee. The committee's activities should help to ensure that the modification is consistent with overall plant safety.

RELATED ITEMS:

231, 278, 420, 421, 508-511, 889, 1214, 1266

JUSTIFICATION OF RANKING:

Permanent and temporary modifications must be effectively controlled and reviewed to ensure the plants' design basis, defense in depth, and safety system functions are improved and are not inadvertently degraded.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	MODIFICATION CONTROL	231	PROCEDURES MODIFICATIONS Procedures modifications should be completed before modified system/equipment is approved for use. Text should be amrked in modified procedure.	O	OPS	1.19	BOHUNICE 3.1.(5)
III	MODIFICATION CONTROL	278	EVALUATION OF MODIFICATIONS A systematic programme to review the results of modifications should be established.	O	TS	1.19	BOHUNICE 5.4.(2)
III	MODIFICATION CONTROL	420	SAFETY REVIEW COMMITTEE Establish a Nuclear Safety Review Committee as soon as possible.	O	MAO	1.17	KOZLODUY 1.8.(1)
III	MODIFICATION CONTROL	421	EVALUATION OF MODIFICATIONS In order to properly evaluate modifications, the Technical Support Division should develope the capability to perform safety analysis.	O	MAO	1.11	KOZLODUY 1.8.(2)
III	MODIFICATION CONTROL	508	REVIEW OF MODIFICATIONS Safety/technical review should be performed for all safety related temporary modificatioons.	O	OPS	1.11	KOZLODUY 3.8.(1)
III	MODIFICATION CONTROL	509	INSTRUCTION FOR REVIEWS Instructions for review of temporary modifications should be revised to define purpose and include details, extend, documentation, testing, rediological aspects, etc.	O	OPS	1.11	KOZLODUY 3.8.(2)
III	MODIFICATION CONTROL	510	TRAINING OF REVIEWERS Personnel performing reviews of temporary modifications need to be trained in the procedures.	O	OPS	1.11	KOZLODUY 3.8.(3)
III	MODIFICATION CONTROL	511	PACKAGE OF MODIFICATIONS Associated revision of instructions and drawings related to temporary modifications should be issued simultaneously with, or slightly in advance of, the modification.	O	OPS	1.11	KOZLODUY 3.8.(4)
III	MODIFICATION CONTROL	889	NUCLEAR SAFETY COMMITTEE A nuclear safety Committee should be implemented at Novovoronezh NPP to review not only proposed modifications but also all safety related events and other matters of safety significance.	O	MOA	1.17	NOVOVORONE 1.8.(1)
III	MODIFICATION CONTROL	1214	MODIFICATION REVIEW The Nuclear Safety Department should be responsible for determining the need for further review of all plant modifications and special tests.	O	MOA	1.11	KOLA 1.8.(1)
III	MODIFICATION CONTROL	1266	TEMPORARY MODIFICATIONS Temporary modification procedure should be modified to enable authorization of lift leads and jumpers. Controls should be established.	O	OPS	1.19	KOLA 3.5.(9)

ISSUE NUMBER: Management 7

ISSUE TITLE: Document Management

RANK OF ISSUE: I

ISSUE CLARIFICATION:

A programme and the facilities necessary for the centralized storage, and distribution, of documents is necessary.

RELATED ITEMS:

201-203, 247, 271, 289, 414, 415, 478, 548, 885, 887, 972, 1248

JUSTIFICATION OF RANKING:

A document management programme is necessary in order to achieve effective management of operations.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
I	DOCUMENT MANAGEMENT	201	STORAGE OF QUALITY RECORDS Quality records should be kept in fire proof cabinets and in rooms equiped with smoke detectors.	O	MOA	1.19	BOHUNICE	1.6.(2)
I	DOCUMENT MANAGEMENT	202	COPY OF QUALITY RECORDS Copies of quality records should be kept in separate rooms.	O	MOA	1.19	BOHUNICE	1.6.(3)
I	DOCUMENT MANAGEMENT	203	VENDORS DRAWINGS A reproducible copy of vendor drawings should be made, and equipment to reproduce them should be available.	O	MOA	1.19	BOHUNICE	1.6.(4)
I	DOCUMENT MANAGEMENT	247	DETERIORATED DOCUMENTS Deteriorated documents and procedures in the control room should be replaced by new ones.	O	OPS	1.19	BOHUNICE	3.4.(4)
I	DOCUMENT MANAGEMENT	271	WORK ORDER KEEPING Complete work orders should be kept in a central location protected agains fire.	O	MAINT	1.19	BOHUNICE	4.3.(3)
I	DOCUMENT MANAGEMENT	289	EMERGENCY PROCEDURES Consideration should be given to have all emergency procedures and instructions in separate collection for easy use by staff and the Accident Commission.	O	EP	5.2	BOHUNICE	6.3.(3)
I	DOCUMENT MANAGEMENT	414	COPYING MACHINES More high quality copying machines should be purchased.	O	MAO	1.19	KOZLODUY	1.6.(2)
I	DOCUMENT MANAGEMENT	415	RECORDS MANAGEMENT SYSTEM Obtain assistance from WANO to develope a record management system.	O	MAO	1.19	KOZLODUY	1.6.(3)
I	DOCUMENT MANAGEMENT	478	DETERIOATED DOCUMENTS The readability of operating procedures should be improved.	O	OPS	1.19	KOZLODUY	3.3.(11)
I	DOCUMENT MANAGEMENT	548	EMERGENCY PLAN COPIES Copies of the emergency plan should be available in emergency control center at on and off site locations .	O	EP	1.19	KOZLODUY	6.1.(5)
I	DOCUMENT MANAGEMENT	885	DOCUMENT REVISION Use revision numbers to indicate the current revision level rather than relying on dates only.	O	MOA	1.19	NOVOVORONE	1.6.(2)
I	DOCUMENT MANAGEMENT	887	DETECTORS IN STORAGES Fire/smoke detectors should be installed in all record and document storage areas.	O	MOA	1.17	NOVOVORONE	1.6.(4)
I	DOCUMENT MANAGEMENT	972	MAINTENANCE RECORDS A coding and retrieval system for the documents in the centralized file should be adopted.	O	MAINT	1.25	NOVOVORONE	4.3.(2)
I	DOCUMENT MANAGEMENT	1248	PROCEDURE BINDING A loose leaf binding format for procedures and plant information should be implemented.	O	OPS	1.19	KOLA	3.3.(7)

ISSUE NUMBER: Management 8

ISSUE TITLE: Configuration Management

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Effective control, revision update and availability of key documents reflecting current plant conditions is deficient.

RELATED ITEMS:

413, 884, 1210

JUSTIFICATION OF RANKING:

Accurate plant drawings and up-to-date procedures are of high safety importance and need to be available to the plant and to those involved in plant safety evaluations. Lack of reliable documentation can lead to serious safety problems.

CAT.	ISSUE	ITEM n.	TIITLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	CONFIGURATION MANAGEMENT	413	CENTRALIZED RECORD SYSTEM There should be a records system under control of one unit, i.e., a centralized system controling revision, verification, approval, storage and distribution.	O	MAO	1.19	KOZLODUY 1.6.(1)
III	CONFIGURATION MANAGEMENT	884	DOCUMENT REVISION All pages in documents should contain an indication of latest revision status.	O	MOA	1.19	NOVOVORONE 1.6.(1)
III	CONFIGURATION MANAGEMENT	1210	DOCUMENT CONTROL SYSTEM Consideration should be given to centralizing the document control system to provide consistent distribution filing and storage.	O	MOA	1.19	KOLA 1.6.(1)

ISSUE NUMBER: Management 9

ISSUE TITLE: Experience Feedback

RANK OF ISSUE: III

ISSUE CLARIFICATION:

The scope, evaluation, tending, resolution, and feedback of operating experience should be properly defined and implemented.

RELATED ITEMS:

276, 459-467, 931

JUSTIFICATION OF RANKING:

Operating experience feedback is necessary to prevent the recurrence of events and to learn from the experiences of other nuclear power plants. The issue was also found relevant in the findings of the ASSET missions.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	EXPERIENCE FEEDBACK	276	OPERATING EXPERIENCE Emphasise trending and analysis of failure events.	O	TS	2.5	BOHUNICE	5.3.(1)
III	EXPERIENCE FEEDBACK	459	EVENT CLASSIFICATION CRITERIA The criteria for determining which events are significant enough to receive management review should be defined and formalized.	O	OPS	2.5	KOZLODUY	3.2.(1)
III	EXPERIENCE FEEDBACK	460	EVENTS REVIEW Continue to improve event reviewing. Conduct root cause training and increase number of personnel involved.	O	OPS	2.5	KOZLODUY	3.2.(2)
III	EXPERIENCE FEEDBACK	461	CORRECTIVE ACTIONS Responsibility for tracking corrective actions should be centralized. Event reports should be closed only after complition of corrective action.	O	OPS	2.5	KOZLODUY	3.2.(3)
III	EXPERIENCE FEEDBACK	462	PERIODICAL REVIEWS Event reports should be periodically reviewed to determine generic or common problems. Results of this reviews should be provided to senior management.	O	OPS	2.5	KOZLODUY	3.2.(4)
III	EXPERIENCE FEEDBACK	463	LESS IMPORTANT EVENTS The review of events that donot have a potential nuclear safety significance should continue to be improved.	O	OPS	2.5	KOZLODUY	3.2.(5)
III	EXPERIENCE FEEDBACK	464	STATIONWIDE EXPERIENCE Centralized stationwide operating experience review programme should be established.	O	OPS	2.5	KOZLODUY	3.2.(6)
III	EXPERIENCE FEEDBACK	465	SCOPE OF REVIEW The scope of the operating experience review should include all station and industry experience.	O	OPS	2.5	KOZLODUY	3.2.(7)
III	EXPERIENCE FEEDBACK	466	TRAINING OF REVIEWERS The personnel involved in operating experience review should be trained in the elements of the programme and in the techniques for the review and evaluation.	O	OPS	2.5	KOZLODUY	3.2.(8)
III	EXPERIENCE FEEDBACK	467	TRACKING IMPLEMENTATION The responsibility for tracking the implementation of lessons learned and corrective actions should be centralized or centraly co-ordinated to ensure timely implementation.	O	OPS	2.5	KOZLODUY	3.2.(9)
III	EXPERIENCE FEEDBACK	931	EXPERIENCE FEEDBACK TRAINING Reinforce the part of the experience feedback procedure which ensures a prompt understanding of the report content.	O	OPS	2.5	NOVOVORONE	3.2.(1)

ISSUE NUMBER: Management 10

ISSUE TITLE: Quality Assurance

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Overall quality assurance programs are needed to ensure consistent and verifiable support of nuclear plant operation and safety. In some instances, these programs must first be developed including an allowance for sufficient staff to implement the program. After the implementation stage, an independent assessment of program effectiveness should be considered.

RELATED ITEMS (AND PRIORITIES):

194-198, 273, 408, 527, 529, 528, 547, 875, 878, 971, 1207, 1208, 1300

JUSTIFICATION OF RANKING:

Quality assurance is a basic element to safe plant operations and accident prevention.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	QUALITY ASSURANCE	194	INDEPENDENT CHECK OF REPAIR Calibration of instruments of Health Physics Department should be done by a different employee than the one who did the repair.	O	MOA	1.17	BOHUNICE 1.3.(2)
III	QUALITY ASSURANCE	195	AUDITING An independent auditing group should be formed,which should be responsible for assessing quality of safety activities.	O	MOA	1.17	BOHUNICE 1.3.(3)
III	QUALITY ASSURANCE	196	QC PROCEDURES Procedures should be developed to control QC functions in the line departments using different employees.	O	MOA	1.17	BOHUNICE 1.3.(4)
III	QUALITY ASSURANCE	197	QUALITY INDICATORS A QA programme should be developed using quality indicators.	O	MOA	1.17	BOHUNICE 1.3.(5)
III	QUALITY ASSURANCE	198	REVIEW OF QA PROGRAMME Periodic review should be conducted on each of the plant quality programmes.	O	MOA	1.17	BOHUNICE 1.3.(6)
III	QUALITY ASSURANCE	273	REVIEW OF TEST RESULTS Test results should be independently reviewed by a second part.	O	MAINT	1.17	BOHUNICE 4.5.(2)
III	QUALITY ASSURANCE	408	QUALITY ASSURANCE PROGRAMME A QA programme should be implemented as soon as possible.	O	MAO	1.17	KOZLODUY 1.3.(1)
III	QUALITY ASSURANCE	527	LABELLING OF SPARES All spares of reasonable size should be labelled. Small items may be labelled inthe boxes.	O	MAINT	1.19	KOZLODUY 4.7.(2)
III	QUALITY ASSURANCE	528	QUALITY CONTROL OF SPARES Perform systematic quality control of spares on receipt.	O	MAINT	1.17	KOZLODUY 4.7.(3)
III	QUALITY ASSURANCE	529	SAFETY RELATED SPARES Spares for safety related equipment should be identified with special labels and preferably kept in separate location.	O	MAINT	1.17	KOZLODUY 4.7.(4)
III	QUALITY ASSURANCE	547	QA OF EMERGENCY PLAN The emergency plan should be subject to quality assurance.	O	EP	1.17	KOZLODUY 6.1.(4)
III	QUALITY ASSURANCE	875	QA PROGRAMME Steps should be taken to fully implement the QA programme at Novovoronezh NPP as soon as possible.	O	MOA	1.17	NOVOVORONE 1.3.(1)
III	QUALITY ASSURANCE	878	INDEPENDENT REVIEW OF QA After the QA programme has been implemented, invite an independent review of the programme and the effectiveness.	O	MOA	1.17	NOVOVORONE 1.3.(4)
III	QUALITY ASSURANCE	971	QC PROCEDURES A quality assurance programme should be set up for producing organizational and administrative procedures.	O	MAINT	1.14	NOVOVORONE 4.3.(1)
III	QUALITY ASSURANCE	1207	QA AUDIT AND INSPECTIONS Audits and inspections should be performed to assess effectiveness of Quality Assurance programme. This should be done by an independent group reporting directly to senior management.	O	MOA	1.17	KOLA 1.3.(1)
III	QUALITY ASSURANCE	1208	INSPECTION STAFF Evaluate the adequacy of staffing level to cover areas currently requiring inspection.	O	MOA	1.17	KOLA 1.3.(2)
III	QUALITY ASSURANCE	1300	SAFETY RELATED SPARES Spares for equipment important to safety should be identified with a special label.	O	MAINT	1.17	KOLA 4.8.(1)

ISSUE NUMBER: Management 11

ISSUE TITLE: Radiation Protection Practices

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Radiation protection measures should be properly implemented and followed by all personnel. Since radiation protection was not explicitly a part of the safety review mission, a systematic radiation protection review needs to be performed.

RELATED ITEMS:

251, 412, 883, 1279

JUSTIFICATION OF RANKING:

Effective implementation of radiation protection practices is necessary as part of the management policy.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	RADIATION PROTECTION PRACTICES	251	RADIATION PROTECTION Radiation protection measures should be strictly implememted. Areas should be properly posted.	O	OPS	1.23	BOHUNICE 3.4.(8)
II	RADIATION PROTECTION PRACTICES	412	RADIOLOGICAL PROTECTION Radiological Protection practices need to be enforced. Staff, including raiation protection tecnicians require refresher training in radiation protection.	O	MAO	1.23	KOZLODUY 1.5.(2)
II	RADIATION PROTECTION PRACTICES	883	ASSESSEMENT Independent assessement of radiation protection at Novovoronezh NPP could be conducted by the IAEA under the OSART programme.	O	MOA	1.23	NOVOVORONE 1.5.(4)
II	RADIATION PROTECTION PRACTICES	1279	RADIOLOGICAL PROTECTION Perform a radiological protection review following OSART Guidelines. Develope a plan for upgrading this area.	O	OPS	1.23	KOLA 3.8.(7)

ISSUE NUMBER: Management 12

ISSUE TITLE: Industrial Safety Practices

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Plant industrial safety practices and equipment for personnel protection are necessary.

RELATED ITEMS:

199, 226, 451, 881, 939, 975, 1001

JUSTIFICATION OF RANKING:

Poor industrial safety practices indicate a lack of safety culture and quality management.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	INDUSTRIAL SAFETY PRACTICES	199	PROTECTION OF WORKERS Plexiglass pannels should be installed around accid and caustic soda pumps.	O	MOA	1.18	BOHUNICE 1.5.(1)
II	INDUSTRIAL SAFETY PRACTICES	226	TRAINING ON INDUSTRIAL SAFETY Assess the trainee after receiving initial general training on industrial safety.	O	TQ	1.18	BOHUNICE 2.8.(1)
II	INDUSTRIAL SAFETY PRACTICES	451	LACK OF INDUSTRIAL SAFETY A root cause analysis should be conducted to determine why industrial safety principles, although aparently covered in training, are not applied in the plant.	O	TQ	1.18	KOZLODUY 2.4.(3)
II	INDUSTRIAL SAFETY PRACTICES	881	PROTECTION OF WORKERS Provide protective covers or warning signs for the generator sliprings.	O	MOA	1.18	NOVOVORONE 1.5.(2)
II	INDUSTRIAL SAFETY PRACTICES	939	OPERATOR AIDS The use of portable ladders and steps should be minimized and excluded from the immediate areas of control and safety equipment.	O	OPS	1.19	NOVOVORONE 3.4.(2)
II	INDUSTRIAL SAFETY PRACTICES	975	NOISE PROTECTION Warnings should be placed where the noise levels exeed the permissible limits, ear protection should be issued to all personnel in that area.	O	MAINT	1.19	NOVOVORONE 4.4.(3)
II	INDUSTRIAL SAFETY PRACTICES	1001	EMERGENCY LIGHTS The emergency light should be installed adjacent to the indication of evacuation routes in the reactor building.	O	FIRE	1.6	NOVOVORONE 5.4.(13)

ISSUE NUMBER: Management 13

ISSUE TITLE: Computer Utilization

RANK OF ISSUE: I

ISSUE CLARIFICATION:

Computers should be utilized in order to better control station planning, record keeping, to manage work, etc.

RELATED ITEMS:

193, 205, 280, 282, 521, 525, 886, 908, 987

JUSTIFICATION OF RANKING:

Computer utilization may assist in the easier resolution of higher priority issues, but is not essential.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
I	COMPUTER UTILIZATION	193	QC DOCUMENT CONTROL	O	MOA	1.19	BOHUNICE 1.3.(1)
			Start a computer-aided system for centralized control of all QC documents.				
I	COMPUTER UTILIZATION	205	ADMINISTRATION COMPUTER	O	TQ	1.20	BOHUNICE 2.1.(2)
			Consideration should be given to changing the administration personal computer if a new system is introduced in the plant.				
I	COMPUTER UTILIZATION	280	REFUELLING MACHINE	O	TS	1.8	BOHUNICE 5.6.(1)
			The refuelling machine should be upgraded with computer aided instructions and automatic functions.				
I	COMPUTER UTILIZATION	282	COMPUTER UTILIZATION	O	TS	2.3	BOHUNICE 5.7.(3)
			Extended utilization of computer should be developed.				
I	COMPUTER UTILIZATION	521	WORK ORDER CONTROL	O	MAINT	1.19	KOZLODUY 4.4.(1)
			Consider developing a computerized work order control system.				
I	COMPUTER UTILIZATION	525	COMPUTERIZED OUTAGE CONTROL	O	MAINT	1.17	KOZLODUY 4.6.(2)
			Consider computerizing preparation and executionof outage activities.				
I	COMPUTER UTILIZATION	886	RECORDING AND DATA HANDLING	O	MOA	1.19	NOVOVORONE 1.6.(3)
			Use computers for records and data management.				
I	COMPUTER UTILIZATION	908	TRACKING PLANT MODIFICATIONS	O	TQ	1.20	NOVOVORONE 2.2.(9)
			Aquire computer hardware and database software to aid in tracking the plant modifications and procedure changes.				
I	COMPUTER UTILIZATION	987	OUTAGE PLANNING	O	MAINT	1.26	NOVOVORONE 4.9.(1)
			Explore the benefits of a computer program for the planning and preparation of an outage.				

ISSUE NUMBER: Operating Procedures 1

ISSUE TITLE: Procedures. Program

RANK OF ISSUE: II

ISSUE CLARIFICATION:

The procedure programme should provide clear instruction on the preparation, format, content, review, updating, and approval of station procedures for all groups (maintenance, operations, etc). This programme should ensure that human factors considerations and feedback from those who utilize the procedures are used to produce the highest quality document.

RELATED ITEMS:

192, 200, 474-477, 237, 269, 518, 935, 937, 1246, 1247, 1292

JUSTIFICATION OF RANKING:

Procedures constitute the real interface between plant operators and the process. A procedure programme is needed to ensure the required consistency and quality in operation and to prevent human errors.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	PROCEDURES - PROGRAMME	192	UPDATING PROCEDURES Important administrative procedures should be revised every time a change occurs, not every 3 years.	O	MOA	1.19	BOHUNICE 1.2.(4)
II	PROCEDURES - PROGRAMME	200	LIST OF VALID PROCEDURES A list of valid procedures should be developed, kept with user and specially in the control room.	O	MOA	1.19	BOHUNICE 1.6.(1)
II	PROCEDURES - PROGRAMME	237	PROCEDURES WRITTING Instructions for writting administrative, normal and emergency operating procedures should be developed.	O	OPS	1.19	BOHUNICE 3.3.(6)
II	PROCEDURES - PROGRAMME	269	MAINTENANCE PROCEDURES Provide an index of all maintenance procedures, regardless which department use them.	O	MAINT	1.25	BOHUNICE 4.3.(1)
II	PROCEDURES - PROGRAMME	474	PROCEDURES WRITTING Instruction for writting operating procedures should be prepared and personnel should be trained in the methodology.	O	OPS	1.19	KOZLODUY 3.3.(7)
II	PROCEDURES - PROGRAMME	475	PROCEDURES PERIODICAL REVIEW A systematic process should be established for periodical review of operating procedures.	O	OPS	1.19	KOZLODUY 3.3.(8)
II	PROCEDURES - PROGRAMME	476	REISSUE OF PROCEDURES The existing requirement to re-issue a procedure whenever more than 3 revisions have been made should be enforced.	O	OPS	1.19	KOZLODUY 3.3.(9)
II	PROCEDURES - PROGRAMME	477	CHANGES IN PROCEDURES Changes in procedures should be marked to indicate to operators that changes have been made.	O	OPS	1.19	KOZLODUY 3.3.(10)
II	PROCEDURES - PROGRAMME	518	MAINTENANCE PROCEDURES Administrative instruction on preparation of maintenance procedures should be developed, specifying format, contents, review, updating and approval.	O	MAINT	1.25	KOZLODUY 4.3.(1)
II	PROCEDURES - PROGRAMME	935	PROCEDURE FORMAT The readability and content of the current operating procedure should be should be restructured to improve the human factor issues.	O	OPS	1.22	NOVOVORONE 3.3.(4)
II	PROCEDURES - PROGRAMME	937	PROCEDURE IDENTIFICATION Extend the use of coloured binders for the purpose of identification of the different categories of procedures.	O	OPS	1.22	NOVOVORONE 3.3.(6)
II	PROCEDURES - PROGRAMME	1246	OPERATING PROCEDURES REVIEW Operating procedures should be formally reviewed by shift supervisors, shift supervisors of reactor department, recator operators and turbine operators.	O	OPS	1.19	KOLA 3.3.(5)
II	PROCEDURES - PROGRAMME	1247	OPERATOR SUGGESTIONS Operator Suggestion Sheets for operating procedures modifications should be developed. They should be filled with the original procedure and be reviewed in the next procedure revision.	O	OPS	1.19	KOLA 3.3.(6)
II	PROCEDURES - PROGRAMME	1292	MAINTENANCE PROCEDURES A administrative procedure describing format, contents and review and aproval process of maintenance procedures should be developed.	O	MAINT	1.19	KOLA 4.3.(1)

ISSUE NUMBER: Operating Procedures 2

ISSUE TITLE: Emergency Operating Procedures

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

Adequate emergency procedures should be developed for all events, including ATWS, steamline break, large break LOCA, fire, remote shutdown, station blackout and other accidents. The emergency operating procedures should be developed to include human factor considerations and, to the extent practical, should be symptom-based. Prompt action is necessary to develop additional procedures and improve the quality of existing procedures. A step-by-step format should be used.

Note: This issue fully applies to Kozloduy even though no recommendations were made by the SRM Mission due to some on-going cooperative efforts in this area.

RELATED ITEMS:

239, 240, 241, 242, 243, 267, 612, 806, 812, 865, 933, 1044, 1064, 1252, 1253, 1254, 1270

JUSTIFICATION OF RANKING:

A number of procedures have not been developed for postulated events (i.e. ATWS, large break LOCA, fire, remote shutdown, etc) and the quality of the emergency procedures is very poor.

Adequate emergency procedures are necessary for the diagnosis and mitigation of plant events. It is recognized that full development of symptom-based procedures is a long-term effort.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	EMERGENCY OPERATING PROCEDURES	239	EMERGENCY OPERATING PROCEDURE A general emergency operating procedure should be written to enable operator to check function of safety systems, identify the emergency situation and select the correct emergency procedure.	O	OPS	3.9	BOHUNICE 3.3.(8)
IV	EMERGENCY OPERATING PROCEDURES	240	FIRE EMERGENCY OPERATION Emergency operating procedures for situation of plant fires should be developed.	O	OPS	3.9	BOHUNICE 3.3.(9)
IV	EMERGENCY OPERATING PROCEDURES	241	PARTITION OF PROCEDURES Emergency operating procedures should be divided into parts for easy handling. Include only opeartors actions in a step by step format.	O	OPS	3.9	BOHUNICE 3.3.(10)
IV	EMERGENCY OPERATING PROCEDURES	242	SYMPTON BASED PROCEDURES Sympton based procedures to recover from beyond design basis accident emergency situations should be developed.	O	OPS	3.9	BOHUNICE 3.3.(11)
IV	EMERGENCY OPERATING PROCEDURES	243	EMERGENCY CABLES INSTALLATION Procedures and charts for installation of emergency power cables should be developed.	O	OPS	3.9	BOHUNICE 3.3.(12)
IV	EMERGENCY OPERATING PROCEDURES	267	PROCEDURES FOR REMOTE SHUTDOWN Procedures for remote shutdown from otside the control room should be developed.	O	OPS	3.9	BOHUNICE 3.6.(12)
IV	EMERGENCY OPERATING PROCEDURES	612	EMERGENCY COOLING PROCEDURE Detailed operational and emergency procedures must reflect operator action requirements to interconnect feedwater system between units.	D	SYSTEMS	1.19	KOZLODUY 8.3.(1)
IV	EMERGENCY OPERATING PROCEDURES	806	EVACUATION INTERIM PLAN An interim plan should be developed to address control room evacuation before the remote shutdown capability is available.	D	I&C	2.4	NOVOVORONE 10.7.(9)
IV	EMERGENCY OPERATING PROCEDURES	812	EVACUATION PROCEDURE A procedure should be developed to deal with the main control room evacuation.	D	I&C	2.4	NOVOVORONE 10.7.(15)
IV	EMERGENCY OPERATING PROCEDURES	865	SGTR RECOVERY INSTRUCTIONS Emergency recovery instructions should be revised to cover multiple events such as SGTR coincident with a failure to isolate the ruptured steam generator.	D	ACCIDENT	4.4	NOVOVORONE 12.5.(3)
IV	EMERGENCY OPERATING PROCEDURES	933	SYMPTOM BASED PROCEDURE Complete the development of post trip symptom-based emergency procedures.	O	OPS	3.9	NOVOVORONE 3.3.(2)
IV	EMERGENCY OPERATING PROCEDURES	1044	FEED AND BLEED PROCEDURE A feed and bleed procedure should be developed to cope with total loss of feedwater.	D	SYSTEMS	3.9	KOLA 8.1.(2)
IV	EMERGENCY OPERATING PROCEDURES	1064	FEEDWATER PIPE RUPTURE Review the emergency operating procedure related to main feedwater pipe rupture.	D	SYSTEMS	3.9	KOLA 8.5.(3)
IV	EMERGENCY OPERATING PROCEDURES	1252	EMERGENCY OPERATING PROCEDURES Emergency operating procedures should be rewritten in step by step format and divided into parts for easy handling. All operating actions and precautions should be included, without the need to use other procedures.	O	OPS	3.9	KOLA 3.3.(11)
IV	EMERGENCY OPERATING PROCEDURES	1253	SYMPTOM BASED PROCEDURES Symptom based procedures should be developed.	O	OPS	3.9	KOLA 3.3.(12)
IV	EMERGENCY OPERATING PROCEDURES	1254	GENERAL EMEREGENCY PROCEDURE A general emergency operating procedure should be developed to select the correct emergency procedure.	O	OPS	3.9	KOLA 3.3.(13)
IV	EMERGENCY OPERATING PROCEDURES	1270	EMERGENCY CABLES INSTALLATION Procedures and drawings for installation of emergency power supply in emergency situations should be located in the cable storage areas.	O	OPS	3.9	KOLA 3.7.(1)

ISSUE NUMBER: Operating Procedures 3

ISSUE TITLE: Limits and Conditions

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Limits and conditions should clearly define plant operations within the design and safety envelope. Design limits, although used in the development of WWER designs, have not been formally established as a complete set of plant technical specifications or regulatory requirements.

RELATED ITEMS:

232, 233, 301, 302, 303, 468-472, 500, 583, 584, 592, 593, 715, 716, 729, 845, 936, 1020, 1021, 1024, 1034, 1042, 1249, 1250, 1251

JUSTIFICATION OF RANKING:

The establishment of a formal document which contains the essential limits and conditions for operation, the surveillance test requirements to verify them and fallback actions in case of identification of off-limit conditions is a safety priority. The limits and conditions for plant operations should be up to date and combined in a single book to help ensure the operation of the plant within its design basis.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	LIMITS AND CONDITIONS	232	UNIT LIMITS AND CONDITIONS Limits and conditions for operations should be written in separate books for each unit.	O	OPS	1.21	BOHUNICE 3.3.(1)
III	LIMITS AND CONDITIONS	233	LIMITS AND CONDITIONS Limits and conditions should be reformulated and supported by graphs as needed. Time limit for shutdown should be specified.	O	OPS	1.21	BOHUNICE 3.3.(2)
III	LIMITS AND CONDITIONS	301	MAXIMUM LINEAR HEAT RATE A limit should be specified for maximium linear heat rate in fuel rods. And this parameter should be controled.	D	CORE	2.1	BOHUNICE 7.1.(2)
III	LIMITS AND CONDITIONS	302	SHUTDOWN MARGIN A limit should be specified for the shutdown margin.	D	CORE	2.2	BOHUNICE 7.1.(3)
III	LIMITS AND CONDITIONS	303	MAXIMUM BURNUP Definite limits should be established for maximum burnup of fuel assemblies and rods.	D	CORE	1.8	BOHUNICE 7.1.(4)
III	LIMITS AND CONDITIONS	468	TECHNICAL SPECIFICATIONS Consider the benefits of preparing technical specifications for operations containing limits and conditions for operation, surveillance test requirements and fallback actions.	O	OPS	1.21	KOZLODUY 3.3.(1)
III	LIMITS AND CONDITIONS	469	TRAINING ON NEW SPECIFICATIONS If new technical specifications are adopted, training for all applicable shift personnel should be carried out.	O	OPS	1.20	KOZLODUY 3.3.(2)
III	LIMITS AND CONDITIONS	470	APPROVAL OF SPECIFICATIONS If new technical specifications are adopeted they should be submitted for approval of the regulatory body.	O	OPS	1 21	KOZLODUY 3.3.(3)
III	LIMITS AND CONDITIONS	471	SPECIFICATIONS IN PROCEDURES Consideration should be given to removing technical specifications from operating procedures.	O	OPS	1.21	KOZLODUY 3.3.(4)
III	LIMITS AND CONDITIONS	472	REVIEW OF INSTRUCTIONS Appropriate administrative instructions should be revised if new technical specifications are adopted.	O	OPS	1 21	KOZLODUY 3.3.(5)
III	LIMITS AND CONDITIONS	500	UPDATED SURVEILLANCE TEST Requirements for periodic surveillance tests should be updated and included in a controlled Technical Specification document.	O	OPS	1.25	KOZLODUY 3.7.(1)
III	LIMITS AND CONDITIONS	583	SHUTDOWN MARGIN Limits should be established for minimum shutdown margin.	D	CORE	2.2	KOZLODUY 7.1.(4)
III	LIMITS AND CONDITIONS	584	MAXIMUM ROD WORTH Limits should be stablished for the maximum control rod worth.	D	CORE	1.4	KOZLODUY 7.1.(5)
III	LIMITS AND CONDITIONS	592	THERMOHYDRAULIC LIMITS Thermohydraulic limits , including DNBR, pin and clad temperatures and heat flux, should be established.	D	CORE	1.4	KOZLODUY 7.6.(3)
III	LIMITS AND CONDITIONS	593	SUBCRITICALITY AT REFUELLING Subcriticality limit at refueling should be calculated and corresponding Boron concentration specified.	D	CORE	2 2	KOZLODUY 7.8.(1)
III	LIMITS AND CONDITIONS	715	SHUTDOWN MARGIN A minimun fixed amount of negative reactivity should be available at HZP conditions.	D	CORE	2.2	NOVOVORONE 7.1.(1)
III	LIMITS AND CONDITIONS	716	REACTIVITY INSERTION RATE Limits for maximun reactivity insertion rate should be established.	D	CORE	2 2	NOVOVORONE 7.1.(2)
III	LIMITS AND CONDITIONS	729	LIMIT ON POWER TILT Establish a limit on power tilt in order to warrant that the uncertainties applied on the calculations are valid.	D	CORE	2.1	NOVOVORONE 7.8.(2)
III	LIMITS AND CONDITIONS	845	LOSS OF FLOW EVENTS The resulting number permissible plant operating conditions is large and the possibility of error exist. Reduce both administratively and technically the number of permissible conditions.	D	ACCIDENT	1.11	NOVOVORONE 12.2.(6)
III	LIMITS AND CONDITIONS	936	TECHNICAL SPECIFICATIONS Prepared separately bound documents to contain the plant technical specifications.	O	OPS	1.22	NOVOVORONE 3.3.(5)
III	LIMITS AND CONDITIONS	1020	MEASUREMENT UNCERTAINTIES Measurement uncertainties should be defined and used in defining permissible power level if peaking factor is liable to be exceeded.	D	CORE	2.2	KOLA 7.1.(2)
III	LIMITS AND CONDITIONS	1021	ACTIONS FOR PEAKING FACTORS Steps to be taken if peaking factor is exceeded should be defined Continued operation should be based on a safety evaluation.	D	CORE	2.2	KOLA 7.1.(3)
III	LIMITS AND CONDITIONS	1024	PEAKING FACTOR UNCERTAINTIES Components of peaking factor uncertainties should be defined individually to ensure that all unceratinties are included.	D	CORE	1.8	KOLA 7.1.(6)
III	LIMITS AND CONDITIONS	1034	RELOADING SUBCRITICALITY The required subcriticality during reloading should be raised to 5%.	D	CORE	2.2	KOLA 7.7.(2)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS		REFERENCE
III	LIMITS AND CONDITIONS	1042	LIMIT ON FAILED DETECTORS Evaluation should be made for continued operation with a large number of failed detectors but with increased uncertainty in measured power distribution.	D	CORE	2.1	KOLA	7.8.(4)
III	LIMITS AND CONDITIONS	1249	LIMITS AND CONDITIONS BOOK A new Limiting Conditions for Operation book should be developed according to international practices. The book should be organized by system and operating modes.	O	OPS	1.21	KOLA	3.3.(8)
III	LIMITS AND CONDITIONS	1250	LIMITS AND CONDITIONS CONTENTS All information important to plant safe operation should be inserted in the Limits and Conditions for Operations book.	O	OPS	1.21	KOLA	3.3.(9)
III	LIMITS AND CONDITIONS	1251	SYSTEM STATUS CHANGES The shift supervisors of each block should be required to sign that they have been informed of any changes on safety system status.	O	OPS	1.21	KOLA	3.3.(10)

ISSUE NUMBER: Operating Procedures 4

ISSUE TITLE: Procedures. Operation

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Operating personnel should be provided with detailed instructions to control locked valves, operate systems, coordinated plant startup/shutdown, conduct shift turnovers and respond to alarms and off-normal conditions. When appropriate, properly dated signatures or initials should be utilized to establish responsibility and traceability of important changes to safety system configurations.

RELATED ITEMS:
234, 235, 236, 238, 248, 479, 482, 483, 484, 485, 487, 596, 930, 934, 1059, 1242-1245, 1256

JUSTIFICATION OF RANKING:

In normal and off-normal conditions, human errors in plant operation may endanger the defense in depth and the lines of defense. Adequate operating procedures and systematic turnover checklists are of high importance.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	PROCEDURES - OPERATION	234	UNIT PROCEDURES Operational procedures should be written as separate procedures for each unit.	O	OPS	1.19	BOHUNICE 3.3.(3)
II	PROCEDURES - OPERATION	235	PROCEDURE FORMAT Procedures should be rewritten for plant and systems. They should include operators actions as wellas field operators. Step by step actions should be defined.	O	OPS	1.19	BOHUNICE 3.3.(4)
II	PROCEDURES - OPERATION	236	CHECK LIST Check lists should be developed for start up, shut down, surveillance tests, systems line-ups, etc.	O	OPS	1.19	BOHUNICE 3.3.(5)
II	PROCEDURES - OPERATION	238	SHIFT TURNOVER Check lists should be developed and used to transfer information between shifts.	O	OPS	1.19	BOHUNICE 3.3.(7)
II	PROCEDURES - OPERATION	248	FIELD INSTRUMENT READING Field instruments monitored should have limits marked on instruments or limiting values should be in the log sheets.	O	OPS	1.19	BOHUNICE 3.4.(5)
II	PROCEDURES - OPERATION	479	ALARM PROCEDURES Alarm procedures, including cause and actions, should be developed for each annunciator panel.	O	OPS	1.19	KOZLODUY 3.3.(12)
II	PROCEDURES - OPERATION	482	LOCK OF VALVES AND BREAKERS The accident analysis should be used to review and select the valves to be kept locked and the breakers to be frequently inspected.	O	OPS	2.3	KOZLODUY 3.4.(2)
II	PROCEDURES - OPERATION	483	LIST OF LOCKED VALVES A consolidated list of valves required to be locked into position during operation should be developed and available for control room and field operators.	O	OPS	1.19	KOZLODUY 3.4.(3)
II	PROCEDURES - OPERATION	484	CHECK OF LOCKED VALVES Locked valve list should be checked at least before startup. Periodical checking should also be considered.	O	OPS	1.19	KOZLODUY 3.4.(4)
II	PROCEDURES - OPERATION	485	METHOD FOR LOCKING VALVES Modification should be introduced on valve handwheels or adjacent structures to allow proper locking of valves.	O	OPS	1.19	KOZLODUY 3.4.(5)
II	PROCEDURES - OPERATION	487	CHECK OF CIRCUIT BREAKERS Operators logsheet should be revised to list each circuit breaker that he is expected to check and its position.	O	OPS	1.19	KOZLODUY 3.4.(7)
II	PROCEDURES - OPERATION	596	LEAK IDENTIFICATION Until leak detection system system is installed, relevant operating procedures should be emphasized. Prepare additional procedures covering sequence of events, monitoring of airborne activity, makeup water system perfprmance, MIV closure, etc.	D	SYSTEMS	1.10	KOZLODUY 8.1.(1)
II	PROCEDURES - OPERATION	930	AUTHORIZATION OF CHANGES Include the date, time and signature of persons when changes are made.	O	OPS	1.17	NOVOVORONE 3.1.(4)
II	PROCEDURES - OPERATION	934	ALARM RESPONSE Alarm response procedures should be developed which assist the operator to anticipate and avoid the need for emergency actions.	O	OPS	1.22	NOVOVORONE 3.3.(3)
II	PROCEDURES - OPERATION	1059	COOLDOWN THROUGH BRU-K Procedures to cool the reactor through the turbine by-pass (BRU-K) down to cold shutdown conditions should be developed.	D	SYSTEMS	3.9	KOLA 8.4.(1)
II	PROCEDURES - OPERATION	1242	VALVE POSITION LIST The list of manual valve positions should be included in the operating procedures and aproved as an integral part of the procedure.	O	OPS	1.19	KOLA 3.3.(1)
II	PROCEDURES - OPERATION	1243	SIGNATURE IN THE PROCEDURES Space for operator's signature should be included in both general and system operating procedures.	O	OPS	1.19	KOLA 3.3.(2)
II	PROCEDURES - OPERATION	1244	STEP BY STEP PROCEDURES To reduce chance of operator error, procedures should be written in a single step format.	O	OPS	1.19	KOLA 3.3.(3)
II	PROCEDURES - OPERATION	1245	ALARM PROCEDURES Alarm response procedures should be developed to cover all alarms in control room and auxiliary panels.	O	OPS	1.19	KOLA 3.3.(4)
II	PROCEDURES - OPERATION	1256	FIELD OPERATOR LOG SHEETS Field operator log sheets should contain normal parameters and limiting values.	O	OPS	1.19	KOLA 3.4.(2)

ISSUE NUMBER: Plant Operations 1

ISSUE TITLE: Surveillance Program

RANK OF ISSUE: II

ISSUE CLARIFICATION:

The surveillance program provides the guidance on how surveillance tests are tracked, trended, and scheduled.

RELATED ITEMS:

275, 502-505, 962, 963, 1280, 1283

JUSTIFICATION OF RANKING:

This issue is strongly linked to Procedures. Surveillance. The surveillance program is to be enhanced for better usage of the test results, which would help to prevent defense in depth degradation. Nevertheless, surveillance procedures are judged more urgent and were given higher priority.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	SURVEILLANCE PROGRAMME	275	SURVEILLANCE PROGRAMME Improve surveillance test programme by analysis of trends of test results, and review of results by Failure Committee.	O	TS	1.25	BOHUNICE 5.2.(2)
II	SURVEILLANCE PROGRAMME	502	TRACKING TEST SCHEDULE Establish tracking system for tests which are not executed on schedule.	O	OPS	1.25	KOZLODUY 3.7.(3)
II	SURVEILLANCE PROGRAMME	503	PERMISSIBLE TEST DELAY Establish time criteria for slippage of test schedule.	O	OPS	1.25	KOZLODUY 3.7.(4)
II	SURVEILLANCE PROGRAMME	504	DISPLAY OF OUTSTANDING TESTS Consideration should be given to visually displaying outstanding surveillance tests to operators.	O	OPS	1.25	KOZLODUY 3.7.(5)
II	SURVEILLANCE PROGRAMME	505	TEST RECORDS Improve test record keeping. Record results together with acceptance criteria. Keep second copy separated.	O	OPS	1.19	KOZLODUY 3.7.(6)
II	SURVEILLANCE PROGRAMME	962	PARAMETER TRENDING Parameter trend analysis should be routinely carried out to identify any degradation.	O	OPS	3.3	NOVOVORONE 3.8.(2)
II	SURVEILLANCE PROGRAMME	963	SURVEILLANCE TESTS Conduct regular checks of logbooks or reports of surveillance tests.	O	OPS	1.25	NOVOVORONE 3.8.(3)
II	SURVEILLANCE PROGRAMME	1280	SURVEILLANCE TEST SHEETS Surveillance test data sheets should be filed, instead of transfering the data to logbooks.	O	OPS	1.15	KOLA 3.9.(1)
II	SURVEILLANCE PROGRAMME	1283	PERMISSIBLE TES DELAY Include time deviation tolerance (%) to facilitate surveillance test programme.	O	OPS	1.25	KOLA 3.9.(4)

ISSUE NUMBER: Plant Operations 2

ISSUE TITLE: Procedures. Surveillance

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Personnel should be provided with detailed instructions and acceptance criteria for tests that verify important safety parameters and functionalities of systems and trains. These procedures should encompass all data necessary to determine the performance of plant equipment.

RELATED ITEMS:

274, 501, 800, 801, 961, 1281, 1282, 1284

JUSTIFICATION OF RANKING:

Adequate surveillance procedures are necessary to ensure safety system operability as designed. Since the WWER 440-230 plants have safety margins difficult to assess now, surveillance of component integrity and functionalities is of paramount importance to ensure adequate defense in depth.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	PROCEDURES - SURVEILLANCE	274	SURVEILLANCE TEST PROCEDURES Test procedures for each surveillance test should be developed, with cross reference to Technical Specifications.	O	TS	1.25	BOHUNICE 5.2.(1)
III	PROCEDURES - SURVEILLANCE	501	TEST ACCEPTANCE CRITERIA The acceptance criteria for surveillance tests must be defined and should be included in the test procedures.	O	OPS	1.25	KOZLODUY 3.7.(2)
III	PROCEDURES - SURVEILLANCE	800	FAILED LAMP CHECKING Operating procedures should be revised to require frequent checking for failed lamps.	D	I&C	1.25	NOVOVORONE 10.7.(3)
III	PROCEDURES - SURVEILLANCE	801	FAILED LAMP REPLACEMENT Operating procedures should be revised to require that failed lamps be replaced immediately upon detection.	D	I&C	1.25	NOVOVORONE 10.7.(4)
III	PROCEDURES - SURVEILLANCE	961	DATA RECORDING All data necessary to determine the performance of plant equipment should be recorded together with acceptance criteria.	O	OPS	1.25	NOVOVORONE 3.8.(1)
III	PROCEDURES - SURVEILLANCE	1281	TEST ACCEPTANCE CRITERIA Surveillance test acceptance criteria should be included in the procedures.	O	OPS	1.25	KOLA 3.9.(2)
III	PROCEDURES - SURVEILLANCE	1282	LIMITS AND CONDITION REFERENCE Include Limiting Condition for Operation reference in surveillance test procedures.	O	OPS	1.25	KOLA 3.9.(3)
III	PROCEDURES - SURVEILLANCE	1284	LEAK RATE MEASUREMENT Surveillance procedure for measuring primary system leak rate should be written.	O	OPS	1.25	KOLA 3.9.(5)

ISSUE NUMBER: Plant Operations 3

ISSUE TITLE: Work Control

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Adequate programmes should exist to control the identification and scheduling of maintenance activities, and for the isolation, release for work, and return to service of equipment.

RELATED ITEMS:

252-255, 941, 942, 943, 946, 973
493, 494, 495, 1260-1263, 1265

JUSTIFICATION OF RANKING:

Inadequate control of work can lead to high personnel risks and risks to the plant if safety systems are inadvertently left out of service.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	WORK CONTROL	252	TAGGING SYSTEM Tagging of isolated equipment should be implemented in the plant and in the control room.	0	OPS	1.19	BOHUNICE 3.5.(1)
III	WORK CONTROL	253	WORK ORDER Work request should be numbered consecutively and have copies for use in different places. They should be clearly marked for which unit they were issued.	0	OPS	1.19	BOHUNICE 3.5.(2)
III	WORK CONTROL	254	WORK REQUEST Work request should be possible to be initiated by any one who finds a defect.	0	OPS	1.19	BOHUNICE 3.5.(3)
III	WORK CONTROL	255	REVIEW OF WORK ORDER An independent safety enginee post should be created to review plant modifications and and work orders related to safety systems.	0	OPS	1.19	BOHUNICE 3.5.(6)
III	WORK CONTROL	493	DEFFICIENCY TAGGING SYSTEM Consideration should be given to the use of a defficiency tagging system so that operators can readly determine if the defficiency has been reported.	0	OPS	1.19	KOZLODUY 3.5.(1)
III	WORK CONTROL	494	COORDINATION OF WORK The schedule of maintenance work should be coordinated with surveillance testing in order to avoid the need to repeat test.	0	OPS	1.19	KOZLODUY 3.5.(2)
III	WORK CONTROL	495	ISOLATION OF EQUIPMENT Adherence to requirements for isolation of equipment should be strengthned to ensure personal safety during performance of the work.	0	OPS	1.19	KOZLODUY 3.5.(3)
III	WORK CONTROL	941	TAGGING SYSTEM Enforce tagging and/or locking for all work where there is danger to personnel.	0	OPS	1.19	NOVOVORONE 3.4.(4)
III	WORK CONTROL	942	WORK PLANNING Construct a short term plan each day which collates the work programmes of all departments and sections for each 24 hours period.	0	OPS	1.19	NOVOVORONE 3.5.(1)
III	WORK CONTROL	943	WORK PRIORIZATION A formal priority rating system for both operational and maintenance work should be established.	0	OPS	1.19	NOVOVORONE 3.5.(2)
III	WORK CONTROL	946	CONTROL SYSTEM A more flexible control system is required to secure plant components against interference.	0	OPS	1.19	NOVOVORONE 3.5.(5)
III	WORK CONTROL	973	WORK ORDER Simplify the work order/permit forms to reduce preparation time of an order.	0	MAINT	1.25	NOVOVORONE 4.4.(1)
III	WORK CONTROL	1260	WORK AUTHORIZATION Work authorization should be signed by plant shift supervisor before work starts and after its complition.	0	OPS	1.19	KOLA 3.5.(3)
III	WORK CONTROL	1261	WORK AUTHORIZATION FORM One form only should be used for all work (I&C, Electrical, Mechanic, etc) authorization.	0	OPS	1.19	KOLA 3.5.(4)
III	WORK CONTROL	1262	TAGGING SYSTEM A more effective tagging system should be implemented. Tags should be numbered and listed in the work authorization.	0	OPS	1.19	KOLA 3.5.(5)
III	WORK CONTROL	1263	RADIATION WORK AUTHORIZATION Radiation work authorizations should be filled (not destryed in 30 days) and their data kept for statistical purposes.	0	OPS	1.23	KOLA 3.5.(6)
III	WORK CONTROL	1265	POST MAINTENANCE TESTING Post maintenance testing requirements should be clearly identified in work authorizations and results should be recorded and approved.	0	OPS	1.19	KOLA 3.5.(8)

ISSUE NUMBER: Plant Operations 4

ISSUE TITLE: Organization of Shifts

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Shift organization structure should provide for clear responsibilities, lines of communication, and enhance the shift's ability to accomplish common goals. Due to the poor control room design, increased emphasis should be given to the adequacy of the number of control room personnel present at all times. Shift supervisory personnel should maintain a qualification level consistent with the personnel they are required to supervise.

RELATED ITEMS:

227, 228, 244, 452, 454, 928, 940, 1236-1239

JUSTIFICATION OF RANKING:

Taking into account the poor control room design and the necessity to operate in emergency situations both from the control room and the back panels, operators constitute the ultimate line of defense and therefore proper staffing and qualification are a high safety concern. It not fulfilled, immediate corrective action is required.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	ORGANIZATION OF SHIFTS	227	SHIFT ORGANIZATION Shifts should be reorganized. Field operators should report to unit supervisors.	O	OPS	1.17	BOHUNICE	3.1.(1)
III	ORGANIZATION OF SHIFTS	228	SHIFT GROUPS Consideration should be given to having field operators and control room operators working the same shift to enhance team work.	O	OPS	1.17	BOHUNICE	3.1.(2)
III	ORGANIZATION OF SHIFTS	244	CONTROL ROOM PERSONNEL Number of shift personnel in the control room should be increased.	O	OPS	1.17	BOHUNICE	3.4.(1)
III	ORGANIZATION OF SHIFTS	452	SHIFT REORGANIZATION Reorganize shift teams such that control room and field oparators responsible for system and equipment in each unit report to USS and those responsible for system and equipment not associated to a single unit report to SSS.	O	OPS	1.17	KOZLODUY	3.1.(1)
III	ORGANIZATION OF SHIFTS	454	TRAINING AFTER REORGANIZATION After reorganization, afected operators should be retrained to understand the new job responsibilities.	O	OPS	1.20	KOZLODUY	3.1.(3)
III	ORGANIZATION OF SHIFTS	928	SHIFT REORGANIZATION A new shift pattern should be introduced which includes the working periods of all six shift teams.	O	OPS	1.17	NOVOVORONE	3.1.(2)
III	ORGANIZATION OF SHIFTS	940	SHIFT REORGANIZATION The plant tour routines and duties of the shift staff should be restructured to encourage and develop a sense of ownership.	O	OPS	1.19	NOVOVORONE	3.4.(3)
III	ORGANIZATION OF SHIFTS	1236	CONTROL ROOM STAFFING Two qualified reactor operators should be required in both control rooms at all times. One of them should be qualified and responsible for the supervision of both blocks.	O	OPS	1.17	KOLA	3.1.(1)
III	ORGANIZATION OF SHIFTS	1237	SHIFT ORGANIZATION Establish a Deputy plant Shift Suprvisor position or a 1st. Stage Shift Supervisor position that would supervise the operation of both block control room.	O	OPS	1.17	KOLA	3.1.(2)
III	ORGANIZATION OF SHIFTS	1238	DEPUTY PLANT SUPERVISOR As a minimum, the recommended Deputy Plant Shift Supervisor should required to maintain a reactor operator qualification.	O	OPS	1.17	KOLA	3.1.(3)
III	ORGANIZATION OF SHIFTS	1239	IMPROVED SHIFT ORGANIZATION Shift organization should be simplified to improve comunication. All control room operators and block field operators should report to the reactor operator supervising the block operations.	O	OPS	1.17	KOLA	3.1.(4)

ISSUE NUMBER: Plant Operations 5

ISSUE TITLE: Labels and Operation Aids

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Measures should be taken to properly identify plant equipment and color code station systems for use by station personnel. Operator aids should be kept up to date.

Means should be provided in order to ensure operator aids (such as system flowcharts and operating instructions) posted in the plant for personnel use are kept up to date.

RELATED ITEMS:

249, 266, 481, 492, 953, 954, 955, 1268

JUSTIFICATION OF RANKING:

Proper identification of plant equipment and proper use of operator aids are necessary to reduce the risk of human error.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	LABELS AND OPERATION AIDS	249	LABELLING Labelling of plant componets should be significantly upgraded.	O	OPS	1.19	BOHUNICE	3.4.(6)
II	LABELS AND OPERATION AIDS	266	AUXILIARY CONTROL ROOMS System and components in auxiliary control rooms should be better marked to which unit they belong.	O	OPS	2.3	BOHUNICE	3.6.(11)
II	LABELS AND OPERATION AIDS	481	OPERATOR INFORMATION UPDATE A formal system should be eatablished to ensure that information provided to operators through drawings and other means are kept updated.	O	OPS	1.19	KOZLODUY	3.4.(1)
II	LABELS AND OPERATION AIDS	492	LABELLING Labels should be installed in all plant components.	O	OPS	1.19	KOZLODUY	3.4.(12)
II	LABELS AND OPERATION AIDS	953	COLOUR CODING PLANT ITEM Change the policy of colour coding plant items to one which provides improved identification of differing duties and/or systems.	O	OPS	1.19	NOVOVORONE	3.6.(7)
II	LABELS AND OPERATION AIDS	954	LABELLING Enhance the standard labelling to accomodate valves of all sizes, configurations and locations.	O	OPS	1.19	NOVOVORONE	3.6.(8)
II	LABELS AND OPERATION AIDS	955	LABELLING All valves and/or pipelines of instruments should be clearly labelled (valve number, instrument name or number, any special function).	O	OPS	1.19	NOVOVORONE	3.6.(9)
II	LABELS AND OPERATION AIDS	1268	LABELLING More efficient system for labelling and colour coding should be developed.	O	OPS	1.19	KOLA	3.6.(2)

ISSUE NUMBER: Plant Operations 6

ISSUE TITLE: Chemistry

RANK OF ISSUE: I

ISSUE CLARIFICATION:

Measures identified to improve condenser leak detector testing, quality of secondary makeup water, on-line monitoring equipment, control of chemicals used on primary system, and maintenance of historical chemistry data.

RELATED ITEMS:

769, 1273, 1274, 1275, 1276, 1278

JUSTIFICATION OF RANKING:

These are mostly secondary chemistry concerns that address lack of modern instrumentation and methods. Control of chemicals used on the primary system, or that could enter the plant system, also needs some improvement. The chemistry area was not reviewed in depth by the team.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
I	CHEMISTRY	769	STRESS CORROSION MONITORING Water chemistry of the primary circuit requires utmost attention. Aggressive impurities will not lead to stress corrosion cracking.	D	COMPONENTS	1.10	NOVOVORONE 9.1.(2)
I	CHEMISTRY	1273	CONDUCTIVITY MEASUREMENT On-line feedwater conductivity measuring equipment should be installed.	O	OPS	2.3	KOLA 3.8.(1)
I	CHEMISTRY	1274	DEMINERALIZED WATER QUALITY Quality of demineralized water should be improved. Planned mixed bed demineralizers should be expedited.	O	OPS	2.3	KOLA 3.8.(2)
I	CHEMISTRY	1275	CONDENSER LEAK DETECTION More modern condenser tube leak detection system should be used (e.g., helium detectors).	O	OPS	2.3	KOLA 3.8.(3)
I	CHEMISTRY	1276	MAKEUP WATER O2 CONTENT Water storage tanks should be upgraded to prevent the absortion oxygen. Water for condenser should be supplied from tanks.	O	OPS	2.3	KOLA 3.8.(4)
I	CHEMISTRY	1278	HISTORICAL CHEMISTRY DATA Graphs of historical data of main chemical parameters of primary and secondary should be maintained.	O	OPS	2.3	KOLA 3.8.(6)

ISSUE NUMBER: Maintenance 1

ISSUE TITLE: Maintenance Program

RANK OF ISSUE: II

ISSUE CLARIFICATION:

This issue encompasses recommendations for the maintenance program to improve maintenance standards, equipment history, procurement and storage of spare parts; corrective, preventive, and predictive maintenance.

RELATED ITEMS:
268, 496, 515, 520, 523, 526, 600, 890, 970, 977-981, 986,
1264, 1286, 1287, 1290, 1293, 1294, 1301

JUSTIFICATION OF RANKING:

A proper maintenance programme is necessary for equipment to perform as designed.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	MAINTENANCE PROGRAMME	268	CLEANINESS OF MAINTENANCE AREA A foreign material exclusion programme should be developed and implemented during maintanance work.	O	MAINT	1.19	BOHUNICE 4.2.(1)
II	MAINTENANCE PROGRAMME	496	MAINTENANCE DOCUMENTATION Details of maintenace work, at least on safety related equipment, should be documented for future planning and for trending equipment performance.	O	OPS	1 19	KOZLODUY 3.5.(4)
II	MAINTENANCE PROGRAMME	515	MAINTENANCE STANDARDS Standards for maintenance should be established, addressing: activities, procedures, quality control, requalification tests.	O	MAINT	1.25	KOZLODUY 4.2.(3)
II	MAINTENANCE PROGRAMME	520	MAINTENANCE RECORDS All equipment passaports and protocols should be stored in a document center.	O	MAINT	1.19	KOZLODUY 4.3.(3)
II	MAINTENANCE PROGRAMME	523	PREDICTIVE MAINTENANCE Develope a predictive maintenance programme.	O	MAINT	1.25	KOZLODUY 4.5.(2)
II	MAINTENANCE PROGRAMME	526	PROCUREMENT OF SPARE PARTS Procurement of spare parts process should be simplified, allowing direct contact between plant and suppliers.	O	MAINT	1.17	KOZLODUY 4.7.(1)
II	MAINTENANCE PROGRAMME	600	MAIN VALVE MAINTENANCE Maintenance of main isolation valves should be enforced and additional inspection should be performed to avoid degradation.	D	SYSTEMS	1.25	KOZLODUY 8.1.(5)
II	MAINTENANCE PROGRAMME	890	PROCUREMENTS OF SPARE PARTS Direct contacts betwen the power plants and the fabricators of nuclear components should be taken for delivering of components.	O	MOA	1.17	NOVOVORONE 1.8.(2)
II	MAINTENANCE PROGRAMME	970	ELECTRIC MOTORS Work area for electric motor overhaul and repair should be expanded and made suitable for the disassembly of motors of all sizes.	O	MAINT	1.25	NOVOVORONE 4.2.(5)
II	MAINTENANCE PROGRAMME	977	REPORTS PREVENTIVE MAINTENANCE Evaluate all preventive maintenance reports in order to enhance the preventive maintenance programme.	O	MAINT	1.25	NOVOVORONE 4.5.(2)
II	MAINTENANCE PROGRAMME	978	PREDICTIVE MAINTENANCE Vibration monitoring of rotating equipment should be developed into a predictive maintenance tool.	O	MAINT	1.25	NOVOVORONE 4.5.(3)
II	MAINTENANCE PROGRAMME	979	MONITORING TECHNIQUES Monitoring techniques should be employed to assess the condition of rotating and static plant items.	O	MAINT	1.25	NOVOVORONE 4.5.(4)
II	MAINTENANCE PROGRAMME	980	CORRECTIVE MAINTENANCE Special effect record form should be developed for the initiation and recording of the repair procedure of the failure.	O	MAINT	1.25	NOVOVORONE 4.6.(1)
II	MAINTENANCE PROGRAMME	981	MAINTENANCE PROGRAMME Make defect database available for the maintenance department. Use the special record form as recommended in 4 6.(1)	O	MAINT	1.25	NOVOVORONE 4.6.(2)
II	MAINTENANCE PROGRAMME	986	SPARE PARTS Spare parts with a limited shelf life should be appropriately identified.	O	MAINT	1 25	NOVOVORONE 4.8.(4)
II	MAINTENANCE PROGRAMME	1264	WORK AUTHORIZATION FILES Books used to record work authorization complition should be substituted by work authorization files.	O	OPS	1.19	KOLA 3.5.(7)
II	MAINTENANCE PROGRAMME	1286	MAINTENANCE OF BOP EQUIPMENT Balance of Plant equipment should be maintained to the same standards as equipment important to safety or plant availability.	O	MAINT	1.19	KOLA 4.1.(2)
II	MAINTENANCE PROGRAMME	1287	MAINTENANCE OF SERVICE WATER Service water system should be maintened as a safety related system, using requirements for Class 2 safety related equipment.	O	MAINT	1.25	KOLA 4.1.(3)
II	MAINTENANCE PROGRAMME	1290	MAINTENANCE STANDARDS Maintenance standards should be established. This involves: developing procedures, motivating workers to use procedures, increasing the a quality control group.	O	MAINT	1.25	KOLA 4.2.(3)
II	MAINTENANCE PROGRAMME	1293	MAINTENANCE RECORDS Consideration should be given to storing all equipment documentation in a unique documentation center.	O	MAINT	1.19	KOLA 4.3.(2)
II	MAINTENANCE PROGRAMME	1294	MAINTENANCE RECORDS ACCESS Access to computerized work control system should not require the use of a department code.	O	MAINT	1.19	KOLA 4.4.(1)
II	MAINTENANCE PROGRAMME	1301	ROTATING SPARE MOTORS A programme for rotating periodically spare motor in the warehouses should be developed.	O	MAINT	1.6	KOLA 4.8.(2)

ISSUE NUMBER: Maintenance 2

ISSUE TITLE: Procedures. Maintenance

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Maintenance personnel should be provided with appropriate instructions, specifications, and drawings to perform repairs and preventive maintenance activities.

RELATED ITEMS:

270, 272, 519, 522, 945, 976, 1296

JUSTIFICATION OF RANKING:

Reliable performance of plant equipment and components is a prerequisite for ensuring defense in depth and safety system function. Furthermore, human errors in maintenance may be hidden until the equipment or component is actuated. Appropriate procedures are required for all safety-related maintenance activities.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	PROCEDURES - MAINTENANCE	270	DETAILS OF PROCEDURES Include related drawings and vendors instructions in maintenance procedures.	O	MAINT	1.25	BOHUNICE 4.3.(2)
II	PROCEDURES - MAINTENANCE	272	TOLERANCES IN TEST SHEETS Provide acceptable tolerances for set points of relays and control devices on the test sheets.	O	MAINT	1.25	BOHUNICE 4.5.(1)
II	PROCEDURES - MAINTENANCE	519	DETAILS OF PROCEDURES Include related drawings, vendors instructions and control hold points in maintenance procedures.	O	MAINT	1.25	KOZLODUY 4.3.(2)
II	PROCEDURES - MAINTENANCE	522	PREVENTIVE MAINTENANCE Resources should be committed to develope procedures for different types of preventive maintenance activities.	O	MAINT	1.25	KOZLODUY 4.5.(1)
II	PROCEDURES - MAINTENANCE	945	PROCEDURE FORMAT The operations procedures and work orders should be restructured to separate the actions taken to ensure personnel safety from those which control plant availability.	O	OPS	1.17	NOVOVORONE 3.5.(4)
II	PROCEDURES - MAINTENANCE	976	PREVENTIVE MAINTENANCE Detailed working procedures for the preventive maintenance of components should be developed.	O	MAINT	1.25	NOVOVORONE 4.5.(1)
II	PROCEDURES - MAINTENANCE	1296	REACTOR MAINTENANCE PROCEDURE Procedures should describe actions to be taken in case of failure of diferent equipment used during the handling of reactor components.	O	MAINT	1.19	KOLA 4.4.(3)

ISSUE NUMBER: Maintenance 3

ISSUE TITLE: Equipment Material Conditions

RANK OF ISSUE: IV

ISSUE CLARIFICATION:

Equipment should be maintained in a state of readiness so that it can reliably operate. Immediate action is required to restore safety equipment to their design conditions.

RELATED ITEMS:

491, 513, 514, 799, 833, 966, 1153, 1154, 1288, 1289,

JUSTIFICATION OF RANKING:

The condition of the systems important to safety must be maintained in a highly reliable state and in accordance with design to ensure operability. Failure of safety systems in accident conditions can result in unacceptable consequences. The issue was identified mostly due to the conditions prevailing at Kozloduy at the time of the mission. Conditions at other plants were significantly better.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
IV	EQUIPMENT MATERIAL CONDITIONS	491	REMOVED VALVE HANDWHEELS Removed valve handwheels should be replaced. Valves to be kept in a fixed position shopuld be locked.	O	OPS	1.19	KOZLODUY 3.4.(11)
IV	EQUIPMENT MATERIAL CONDITIONS	513	POOR PLANT CONDITIONS Imediate actions should be taken to restore safety equipment to their design standards. Including instrumentation and power systems.	O	MAINT	1.25	KOZLODUY 4.2.(1)
IV	EQUIPMENT MATERIAL CONDITIONS	514	EQUIPMENT RESTORATION PLAN A plan should be developed to restore all equipment to its design standards. The plan should be implemented promptly.	O	MAINT	1.25	KOZLODUY 4.2.(2)
IV	EQUIPMENT MATERIAL CONDITIONS	799	CONTROL ROOM INDICATOR LAMPS All lamps should be inspected and replaced if necessary.	D	I&C	2.3	NOVOVORONE 10.7.(2)
IV	EQUIPMENT MATERIAL CONDITIONS	833	CABLE CONNECTIONS Repair all cable connections which are not in their professional state.	D	ELECTRICAL	1.25	NOVOVORONE 11.6.(1)
IV	EQUIPMENT MATERIAL CONDITIONS	966	CABLE TERMINATIONS Resolve the generic deficiencies of electric cable terminations in order to return the safety and environmental qualifications to the required standard.	O	MAINT	1.25	NOVOVORONE 4.2.(1)
IV	EQUIPMENT MATERIAL CONDITIONS	1153	WATER IN ELECTRICAL ROOMS A solution should be found to prevent water infiltration into the electrical rooms.	D	ELECTRICAL	1.25	KOLA 11.3.(1)
IV	EQUIPMENT MATERIAL CONDITIONS	1154	ELECTRICAL CABLE SUPPORTS Possible sliding of electrical cables from the supports should be prevented.	D	ELECTRICAL	1.25	KOLA 11.3.(2)
IV	EQUIPMENT MATERIAL CONDITIONS	1288	RESTORATION OF SERVICE WATER Actions should be taken to restore service water to its design standars. This includes restoration of integrity of its power supply.	O	MAINT	1.25	KOLA 4.2.(1)
IV	EQUIPMENT MATERIAL CONDITIONS	1289	EQUIPMENT RESTORATION PLAN Develope a plan to restore degraded equipment to design standards. Identify priorities and establish schedule.	O	MAINT	1.25	KOLA 4.2.(2)

ISSUE NUMBER: Maintenance 4

ISSUE TITLE: Warehouse

RANK OF ISSUE: I

ISSUE CLARIFICATION:

Warehouse should be upgraded in order to provide a good storage place and to protect the spare parts from dust and dirt.

RELATED ITEMS:

530, 983, 984, 985

JUSTIFICATION OF RANKING:

Bad conditions of storage of spare parts which are safety related may later create functional or quality problems.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
I	WAREHOUSES	530	IMPROVE WAREHOUSES The existing warehouses should be improved by improving door seals and windowsand installing ventilation.	O	MAINT	1.19	KOZLODUY 4.7.(5)
I	WAREHOUSES	983	SPARE PARTS CLEANNESS The centralized warehouse and the spare parts should be kept clean.	O	MAINT	1.19	NOVOVORONE 4.8.(1)
I	WAREHOUSES	984	STAINLESS STEEL A special store should be used for stainless steel.	O	MAINT	1.19	NOVOVORONE 4.8.(2)
I	WAREHOUSES	985	HOLD STORE A separate "hold" store should be set up for spare parts that await quality control checks.	O	MAINT	1.19	NOVOVORONE 4.8.(3)

ISSUE NUMBER: Training 1

ISSUE TITLE: Training program

RANK OF ISSUE: III

ISSUE CLARIFICATION:

The training programs must systematically assess the training needs of all station personnel and provide effective instruction to them in order to enhance their performance. The basic element of an effective training program are explained in NUSS. The training program should not only provide instruction to operators, but also to maintenance, chemistry, technical staff, the general employee and other appropriate members of the plant. The most effective method to ensure basic training needs are met is to perform a systematic analysis of what the individual needs to know to perform their job. After these initial training needs are addressed, the skills should be reinforced through appropriate periodic retraining. The training program should also contain elements to objectively assess the trainee and instructor's performance.

RELATED ITEMS:

204, 206, 210, 212, 215, 220, 221, 222, 229, 416, 423-435, 445-450, 457, 480, 486, 499, 516, 656, 892, 893-898, 909, 912-924, 1216-1218, 1225-1227, 1228, 1229, 1230, 1232-1235

JUSTIFICATION OF RANKING:

All station personnel must be adequately trained and qualified to ensure they can effectively operate and maintain the plant, and reduce the risk of occurrence of events and their consequences. A more effectively structured training program will result in an overall enhancement in defense in depth.

CAT. ISSUE	ITEM n	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III TRAINING PROGRAMME	204	INSTRUCTION TO INSTRUCTORS Part-time instructors should be provided with appropriate instructional techniques training.	O	TQ	1.20	BOHUNICE 2.1.(1)
III TRAINING PROGRAMME	206	COMPUTER TRAINING RESOURCES Considerations should be given to the resources requirements to introduce computer based training.	O	TQ	1.20	BOHUNICE 2.1.(3)
III TRAINING PROGRAMME	210	TRAINING ON SHIFT Make shift engineer responsible for training activities of staff on his shift.	O	TQ	1.20	BOHUNICE 2.1.(7)
III TRAINING PROGRAMME	212	TRAINING REQUIREMENTS Prepare a document which put together all training requirements and defines training profile for each position.	O	TQ	1.20	BOHUNICE 2.1.(9)
III TRAINING PROGRAMME	215	TRAINING NEEDS Consider reviewing training needs for each post while producing training profiles.	O	TQ	1.20	BOHUNICE 2.1.(12)
III TRAINING PROGRAMME	220	ON THE JOB TRAINING ASSESSMENT An independent person should assess the trainee after completion of on the job training by an operator.	O	TQ	1 20	BOHUNICE 2.4.(1)
III TRAINING PROGRAMME	221	TRAINING ON MODIFICATIONS More systematic approach should be used to ensure training on plant modifications and procedures changes.	O	TQ	1.20	BOHUNICE 2.4.(2)
III TRAINING PROGRAMME	222	RADIATION PROTECTION TRAINING Introduce standard training profiles for posts based on skill required	O	TQ	1.20	BOHUNICE 2.6 (1)
III TRAINING PROGRAMME	229	TEAM TRAINING Field operators should receive retraining together with control room operators.	O	OPS	1.20	BOHUNICE 3.1.(3)
III TRAINING PROGRAMME	416	HIRING OF NEW PERSONNEL Establish minimum qualification satandards for hiring of new personnel Conduct aptitude tests.	O	MAO	1.20	KOZLODUY 1.7.(1)
III TRAINING PROGRAMME	423	TRAINING RESPONSIBILITY The document describing training responsibilities should be revised to refelect changes in the organization.	O	TQ	1.20	KOZLODUY 2.1 (2)
III TRAINING PROGRAMME	424	INSTRUCTION TO INSTRUCTORS The need for instructors and tutors to be given training on instructional techniques should be formalized.	O	TQ	1 20	KOZLODUY 2 1.(3)
III TRAINING PROGRAMME	425	EVALUATION OF INSTRUCTORS A process to evaluate instructor performance should be established.	O	TQ	1 20	KOZLODUY 2.1.(4)
III TRAINING PROGRAMME	426	LEARNING OBJECTIVES Learning objectives which specify the expected level of knowledge should be prepared for all training programme.	O	TQ	1.20	KOZLODUY 2.1.(5)
III TRAINING PROGRAMME	427	PRACTICAL TRAINING The practical content of the training programmes should be specified.	O	TQ	1 20	KOZLODUY 2.1.(6)
III TRAINING PROGRAMME	428	PERFORMANCE OBJECTIVES Performance objectives for the practical part of the training programmes should be developed.	O	TQ	1 20	KOZLODUY 2.1.(7)
III TRAINING PROGRAMME	429	STRUCTURED EXAMINATION A structured examination system should be developed for all qualification and requalification exams.	O	TQ	1.20	KOZLODUY 2.1.(8)
III TRAINING PROGRAMME	430	QUESTIONS BANK For each Job position, banks of question and answers should be developed covering all topics.	O	TQ	1.20	KOZLODUY 2.1.(9)
III TRAINING PROGRAMME	431	CONTENTS OF EXAMINATIONS The contents of all qualification and requalification exams should be documented.	O	TQ	1.20	KOZLODUY 2.1.(10)
III TRAINING PROGRAMME	432	PASS/FAIL CRITERIA A pass/fail criteria should be established for all qualification and requalification exams.	O	TQ	1.20	KOZLODUY 2.1.(11)
III TRAINING PROGRAMME	433	TRAINING ON EXAMINATION The need for training on examination techniques for the examination team should be formalized.	O	TQ	1.20	KOZLODUY 2.1.(12)
III TRAINING PROGRAMME	434	TRAINING OF EXAMINERS Training on examination techniques and methods should be organized for the examiners	O	TQ	1.20	KOZLODUY 2 1.(13)
III TRAINING PROGRAMME	435	ASSESSING SKILLS A structured process should be developed for assessing whether the candidate possesses all skills required for qualification. This is particular important for operators and shift supervisors.	O	TQ	1.20	KOZLODUY 2.2.(14)
III TRAINING PROGRAMME	445	SUPERVISORS TRAINING PROGRAMME Practical content of SRO,USS and SSS should be specifird in detail.	O	TQ	1.20	KOZLODUY 2.3.(3)

CAT. ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III TRAINING PROGRAMME	446	SUPERVISORS PERFORMANCE Performance objectives should be developed for the practical part of the SRO, USS and SSS training programmes.	O	TQ	1.20	KOZLODUY 2.3.(4)
III TRAINING PROGRAMME	447	SUPERVISORS TASK ANALYSIS An anlysis of the tasks performed by SROs and SSSs should be made to identify training needs on plant operating and emergency procedures.	O	TQ	1.20	KOZLODUY 2.3.(5)
III TRAINING PROGRAMME	448	SUPERVISORS REFRESHER TRAINING Refresher training of SROs and SSSs should be developed on the basis of their training needs.	O	TQ	1 20	KOZLODUY 2.3.(6)
III TRAINING PROGRAMME	449	TASK ANALYSIS An analysis of tasks performed for each field operator position should be made to identify refresher training needs for each position.	O	TQ	1 20	KOZLODUY 2 4.(1)
III TRAINING PROGRAMME	450	REFRESHER TRAINING Refresher courses should be developed for each field operator position on the basis of the task analysis.	O	TQ	1.20	KOZLODUY 2.4.(2)
III TRAINING PROGRAMME	457	SCREENING OF CANDIDATES Candidates for operator training should be screened to ensure they have the necessary capability and personal atributes	O	OPS	1.20	KOZLODUY 3.1 (6)
III TRAINING PROGRAMME	480	EMERGENCY PROCEDURES TRAINING Thorough knowledge of Emergency Operating Procedures should be emphasized and ensured. This should be checked during examinations.	O	OPS	1.20	KOZLODUY 3 3.(13)
III TRAINING PROGRAMME	486	VALVE LOCKING TRAINIG Operators should be trained to understand the locking requirements and methods of applying locking devices.	O	OPS	1.20	KOZLODUY 3.4.(6)
III TRAINING PROGRAMME	499	EMERGENCY PROCEDURES TRAINING Operators should use emergency operating procedures during emergency drills.	O	OPS	1.19	KOZLODUY 3.6.(3)
III TRAINING PROGRAMME	516	MAINTENANCE TRAINING Maintenance training program should be developed including concepts of nuclear safety in order to modify the personnel atitute towards work in the field.	O	MAINT	1.20	KOZLODUY 4.2.(4)
III TRAINING PROGRAMME	532	TRAINING OF FIRE INSPECTORS Fire inspectors should be trained in their duties.	O	FIRE	1.6	KOZLODUY 5.1.(2)
III TRAINING PROGRAMME	656	SG INSPECTION PROGRAMME In order to avoid interruption in the SG inspection programme when equipment is transfered to plant, initiate training of personnel as soon as possible.	D	COMPONENTS	1.10	KOZLODUY 9.8.(1)
III TRAINING PROGRAMME	892	EVALUATION OF INSTRUCTORS Ensure that the instructors are periodically observed and coached on identified weaknesses.	O	TQ	1 20	NOVOVORONE 2.1.(2)
III TRAINING PROGRAMME	893	REVIEW OF EVALUATION All instructor observation should be reviewed annually to identify common weaknesses.	O	TQ	1.20	NOVOVORONE 2.1.(3)
III TRAINING PROGRAMME	894	SIMULATOR INSTRUCTORS Simulator instructors should receive specialized instructional skills training.	O	TQ	1 20	NOVOVORONE 2.1.(4)
III TRAINING PROGRAMME	895	PRIORITIES Complete the development of the Training Department's instructional skills training programme prior to filling the majority of the vacant instructor positions.	O	TQ	1.17	NOVOVORONE 2.1.(5)
III TRAINING PROGRAMME	896	TRAINING MATRIX Each programme's job task list should be expanded to provide a cross reference to specific training material coverage for each task.	O	TQ	1.20	NOVOVORONE 2.1.(6)
III TRAINING PROGRAMME	897	ADEQUACY OF TRAINING An anlysis of the above job positions should be conducted to identify the list of tasks performed by each.	O	TQ	1.20	NOVOVORONE 2.1.(7)
III TRAINING PROGRAMME	898	EFFECTIVENESS Once individuals are trained and qualified and authorized to work independently, a post-training evaluation should be conducted	O	TQ	1.20	NOVOVORONE 2.1.(8)
III TRAINING PROGRAMME	909	EVALUATING SKILLS Trainee knowledge should be tested more frequently and should include objective evaluation methods.	O	TQ	1.20	NOVOVORONE 2.3.(1)
III TRAINING PROGRAMME	912	EXAMINATION Add an in plant walk-through final examination to the licensed and non-licensed operator programmes consisting of oral knowledge questions and demostrations of practical skills.	O	TQ	1.20	NOVOVORONE 2.3.(4)
III TRAINING PROGRAMME	913	ON THE JOB TRAINING The on-the-job training programmes should be made performance-based in two steps: the individual is trained in how to perform the task; then he is observed and evaluated while performing the task independently.	O	TQ	1 20	NOVOVORONE 2.3.(5)
III TRAINING PROGRAMME	914	LICENSED OPERATOR TRAINING Programme and associated regulations should be revised to permit the trainee to operate the plant controls while in on-the-job training.	O	TQ	1.20	NOVOVORONE 2 3 (6)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	TRAINING PROGRAMME	915	LICENSED OPERATOR TRAINING The amount of retraining and the frequency of training sessions should be increased.	O	TQ	1.20	NOVOVORONE 2.6.(1)
III	TRAINING PROGRAMME	916	TIME EXPENSE The amount of the time spent in retraining by operators should be increased.	O	TQ	1.20	NOVOVORONE 2.6.(2)
III	TRAINING PROGRAMME	917	ANNUAL TWO WEEK TRAINING Reduce the frequency of review of these topics from annually to biennially.	O	TQ	1.20	NOVOVORONE 2.6.(3)
III	TRAINING PROGRAMME	918	EMERGENCY PROCEDURE TRAINING Review the contents of all emergency procedures in the retraining programme at least once every two years.	O	TQ	1.20	NOVOVORONE 2.6.(4)
III	TRAINING PROGRAMME	919	INFORMATION EXCHANGE SKILLS A course on control room communications and team skills should be developed and provided to each operating shift.	O	TQ	1.20	NOVOVORONE 2.6.(5)
III	TRAINING PROGRAMME	920	NON LICENSED OPERATORS Maintenance technicians and supervisors should receive overview training on the plant process systems.	O	TQ	1.20	NOVOVORONE 2.8.(1)
III	TRAINING PROGRAMME	921	MAINTENANCE TRAINING The on-the-job training programme should be made performance-based in two steps (ref 2,3(5)).	O	TQ	1.20	NOVOVORONE 2.8.(2)
III	TRAINING PROGRAMME	922	TECHNICAL STAFF Provide the technical support staff with plant specific orientation to the plant systems, principles of operation, design bases and basic operating characteristics.	O	TQ	1.20	NOVOVORONE 2.9.(1)
III	TRAINING PROGRAMME	923	TECHNICAL STAFF The technical staff should also be trained in details of nuclear power plant safety concepts, including: leak before break concept; INSAG-3, etc.	O	TQ	1.20	NOVOVORONE 2.9.(2)
III	TRAINING PROGRAMME	924	TECHNICAL STAFF A continuing training programme should keep the staff aware of new international developments in nuclear power plant safety, the outcomes of large conferences, etc.	O	TQ	1.20	NOVOVORONE 2.9.(3)
III	TRAINING PROGRAMME	1216	TRAINING OF INSTRUCTORS A formal programme of continuous training for instructors skills should be established.	O	TQ	1.20	KOLA 2.1.(2)
III	TRAINING PROGRAMME	1217	EVALUATION OF INSTRUCTORS A formal feedback programme should be established to enhance instruction performance, including evaluation of instructor technical and instruction skills.	O	TQ	1.20	KOLA 2.1.(3)
III	TRAINING PROGRAMME	1218	STUDENT FEEDBACK Expand current student feedback process and request that they evaluate course and the instructor for all programmes.	O	TQ	1.20	KOLA 2.1.(4)
III	TRAINING PROGRAMME	1225	TASK ANALYSIS / LESSON PLANS Use performance based approach to training, including task analysis and standardized lesson plans.	O	TQ	1.20	KOLA 2.3.(1)
III	TRAINING PROGRAMME	1226	OBJECTIVE TESTING Implement an objective testing methodology (written exames) based on a systematic approach to training in all programmes.	O	TQ	1.20	KOLA 2.3.(2)
III	TRAINING PROGRAMME	1227	OBJECTIVE EVALUATION Implement objective evaluation process for people returning to duty after annual training programme. This includes written examination linked to the position task analysis.	O	TQ	1.20	KOLA 2.3 (3)
III	TRAINING PROGRAMME	1228	CONTINUING TRAINING Implementa formalized continuing training programme based on a systematic approach to training.	O	TQ	1.20	KOLA 2.4.(3)
III	TRAINING PROGRAMME	1229	MAINTENANCE TRAINING Maintenance on the job training programme should be based on systematic analysis at the task level. Each task should be evaluated separately.	O	TQ	1.20	KOLA 2.5.(1)
III	TRAINING PROGRAMME	1230	CHEMISTRY TRAINING Implement a formalized continuous training programme for chemistry personnel based on systematic approach to training. Provide a chemistry instructor in the Training Department.	O	TQ	1 20	KOLA 2.7.(3)
III	TRAINING PROGRAMME	1232	GENERAL EMPLOYEE TRAINING Require that appropriately approved lesson plans be used in the general employee training.	O	TQ	1.20	KOLA 2.10.(1)
III	TRAINING PROGRAMME	1233	COMBINED GENERAL TRAINING Combine all general employee training into one lesson plan to be conducted by the training department.	O	TQ	1.20	KOLA 2.10.(2)
III	TRAINING PROGRAMME	1234	REVIEW OF GENERAL TRAINING Review the subjects being taught during general employee training. Consider requirement for periodical retraining of each individual employee (annually).	O	TQ	1.20	KOLA 2.10.(3)
III	TRAINING PROGRAMME	1235	GENERAL TRAINING EXAMINATION Conduct a short examinationat the conclusion of gerenal employee training.	O	TQ	1.20	KOLA 2.10.(4)

ISSUE NUMBER: Training 2

ISSUE TITLE: Training of plant operators

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Effective training is necessary to reinforce management policies, improve operator skills, improve supervisory command and control and build team skills.

For operator training, apart from full scope simulators other methods should be used to provide effective training on procedure usage, communications, and control room/field operator team skills and coordination.

RELATED ITEMS:

216-219, 439, 440, 444, 902, 903, 910, 911, 925, 1222-1224

JUSTIFICATION OF RANKING:

Industry experience has shown that effective simulator training improves the operator's abilities to diagnose and manage plant events. Sufficient defense in depth cannot be assured without adequate operator training.

CAT.	ISSUE	ITEM n.	TITILE/Description	ASPECT	AREA	CLASS	REFERENCE
III	TRAINING OF PLANT OPERATORS	216	SIMULATOR TRAINING Define new policy for operator training with respect to simulator. Current plan is inadequate. New plan should include control room skills and team work.	O	TQ	1.20	BOHUNICE 2.2.(1)
III	TRAINING OF PLANT OPERATORS	217	CONTINGENCY TRAINING PLAN Develope contingency plan for operator training in case video simulator is delayed. Submit plns to regulatory body.	O	TQ	1.20	BOHUNICE 2.2.(2)
III	TRAINING OF PLANT OPERATORS	218	NON PLANT SPECIFIC SIMULATOR Review the decision of not using V-2 simulator for V-1 operator training.	O	TQ	1.20	BOHUNICE 2.2.(3)
III	TRAINING OF PLANT OPERATORS	219	TRAINING WITH PROCEDURES Procedures should be used when training in simulator. Practices should reinforce the use of procedures.	O	TQ	1.19	BOHUNICE 2.2.(4)
III	TRAINING OF PLANT OPERATORS	439	SIMMULATOR TRAINING Make immediate arrangements for full scope simulator training for control room personnel.	O	TQ	1.20	KOZLODUY 2.2.(3)
III	TRAINING OF PLANT OPERATORS	440	FULL SCOPE SIMULATOR Serious considerations should be given to aquire a full scope simulator for the training center.	O	TQ	1.20	KOZLODUY 2.2.(4)
III	TRAINING OF PLANT OPERATORS	444	INITIAL SIMULATOR TRAINING Extensive simulator training should be given to control room operators before their initial qualification.	O	TQ	1.20	KOZLODUY 2.3.(2)
III	TRAINING OF PLANT OPERATORS	902	SIMULATOR The WWER-440 simulator should be replaced by a new simulator of modern capabilities.	O	TQ	1.20	NOVOVORONE 2.2.(3)
III	TRAINING OF PLANT OPERATORS	903	SIMULATOR EQUIPMENT Ensure that the simulators contain the same updated reference materials, operator aids and procedures found in the plant control room.	O	TQ	1.20	NOVOVORONE 2.2.(4)
III	TRAINING OF PLANT OPERATORS	910	EXAMINATION The Simulator Examination Commission composition should be adjusted to include a technically qualified representative from the plant Operations Department.	O	TQ	1.20	NOVOVORONE 2.3.(2)
III	TRAINING OF PLANT OPERATORS	911	TRAINEE PERFORMANCE EVALUATION Develope a systematic method to evaluate trainee performance during simulator examinations.	O	TQ	1.20	NOVOVORONE 2.3.(3)
III	TRAINING OF PLANT OPERATORS	925	TECHNICAL STAFF Provide an opportunity for the plant technical staff to receive part task or full scope simulator training.	O	TQ	1.20	NOVOVORONE 2.9.(4)
III	TRAINING OF PLANT OPERATORS	1222	SIMULATOR TRAINING Aquire a full scope simulator alowing full use of plant specific procedures. An alternative would be to have a simulator a Novovoronezh but use Kola instructors and procedures.	O	TQ	1.20	KOLA 2.2.(3)
III	TRAINING OF PLANT OPERATORS	1223	CONTINGENCY TRAINING PLAN Until full scope simulator is available, training at Novovoronezh shoud be more frequent or use of part-task simulator should be expanded.	O	TQ	1.20	KOLA 2.2.(4)
III	TRAINING OF PLANT OPERATORS	1224	TRAINING ON PROCEDURES Use of procedures inthe part-task simulator may be very limited, none the less use of procedures should be emphasized.	O	TQ	1.20	KOLA 2.2.(5)

ISSUE NUMBER: Training 3

ISSUE TITLE: Training Facilities

RANK OF ISSUE: **II**

ISSUE CLARIFICATION:

The effectiveness of training could be improved with better facilities and equipment.

RELATED ITEMS:

437, 438, 900, 901, 1220, 1221

JUSTIFICATION OF RANKING:

Better facilities would enhance the effective delivery of training but are not essential. The actual safety benefit versus the cost, for the near term, must be considered.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	TRAINING - FACILITIES	437	TRAINING CENTER Imediate action should be taken to complete the construction of the training center.	O	TQ	1.20	KOZLODUY	2.2.(1)
II	TRAINING - FACILITIES	438	TRAINING CENTER EQUIPMENT Equip the training center with the all the workshops and laboratories required for training all categories of employees.	O	TQ	1.20	KOZLODUY	2.2.(2)
II	TRAINING - FACILITIES	900	EQUIPMENT Higher quality chalk boards, white-marker boards overhead transparency projectors, tranparency films and projection screens should be provided at both the plant Training Department and the Novovoronezh Training Centre.	O	TQ	1.20	NOVOVORONE	2.2.(1)
II	TRAINING - FACILITIES	901	EQUIPMENT Dedicated maintenemance training facilities and equipment should be developed.	O	TQ	1.20	NOVOVORONE	2.2.(2)
II	TRAINING - FACILITIES	1220	CLASS ROOM EQUIPMENT Resources should be provided to upgrade existing class room equipment.	O	TQ	1.20	KOLA	2.2.(1)
II	TRAINING - FACILITIES	1221	COMPUTER BASED TRAINING Expand number of computers to optimize the developing computer based training programmes.	O	TQ	1.20	KOLA	2.2.(2)

ISSUE NUMBER: Training 4

ISSUE TITLE: Training materials

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Adequate and updated training materials are necessary for effective and consistent training of plant personnel and instructors. All substantial modifications in the plant and experience feedback should be incorporated in the training materials.

RELATED ITEMS:

207, 213, 214, 223, 441, 442, 443, 904-907

JUSTIFICATION OF RANKING:

Plant personnel should be systematically trained and retrained with effective training materials. Quality training materials are an essential building block of an effective training program that enhances overall defense in depth and risk reduction.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	TRAINING MATERIAL	207	TEACHING MATERIAL Improve teaching material according to lesson plan format and keep it updated with respect to the plant.	O	TQ	1.20	BOHUNICE	2.1.(4)
III	TRAINING MATERIAL	213	TRAINING MATERIAL Develope adequate training material.	O	TQ	1.20	BOHUNICE	2.1.(10)
III	TRAINING MATERIAL	214	UPDATED TRAINING MATERIAL Provisions should be made to ensure updating of training material.	O	TQ	1.20	BOHUNICE	2.1.(11)
III	TRAINING MATERIAL	223	UPDATED RADIATION TRAINING Ensure that radiation protection training is promptly updated when changes occurs.	O	TQ	1.20	BOHUNICE	2.6.(2)
III	TRAINING MATERIAL	441	TRAINING MATERIAL Training material should be developed in acordance with pedagogical standards.	O	TQ	1.20	KOZLODUY	2.2.(5)
III	TRAINING MATERIAL	442	UPDATED TRAINING MATERIAL Introduce system to ensure that training material is updated and reflect plant modifications and changes in procedures.	O	TQ	1.20	KOZLODUY	2.2.(6)
III	TRAINING MATERIAL	443	TRAINING OF OPERATORS Adequate training material should be developed for Senior reactor operators, unit supervisors and shift supervisors.	O	TQ	1.20	KOZLODUY	2.3.(1)
III	TRAINING MATERIAL	904	DOCUMENT QUALITY Lesson plans and simulator exercise guides should be formally type written, approved and filed for use by differents instructors.	O	TQ	1.20	NOVOVORONE	2.2.(5)
III	TRAINING MATERIAL	905	TRAINING OBJECTIVE Lesson plans and simulator execise guides should include the learning objectives.	O	TQ	1.20	NOVOVORONE	2.2.(6)
III	TRAINING MATERIAL	906	COMPUTER HARD AND SOFTWARE Acquire computer hardware and wordprocessing software to aid in the development of lesson plans and exercise guides.	O	TQ	1.20	NOVOVORONE	2.2.(7)
III	TRAINING MATERIAL	907	UPDATED TRAINING MATERIAL Establishe a systematic method to maintain training materials up-to-date as plant modifications and procedures changes occur.	O	TQ	1.20	NOVOVORONE	2.2.(8)

ISSUE NUMBER: Training 5

ISSUE TITLE: Training Records

RANK OF ISSUE: I

ISSUE CLARIFICATION:

Measures should be taken to centralize control and management of training records.

RELATED ITEMS:

211, 436, 899, 1219

JUSTIFICATION OF RANKING:

Better management of training records would enhance their retrievability, quality and consistency.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
I	TRAINING RECORDS	211	TRAINING RECORDS Install computerized central training records.	O	TQ	1.19	BOHUNICE	2.1.(8)
I	TRAINING RECORDS	436	TRAINING RECORDS Establish a central records system of training and qualification, preferably on a computer.	O	TQ	1.20	KOZLODUY	2.2.(15)
I	TRAINING RECORDS	899	RECORDS Maintain records of completed training and the results of training.	O	TQ	1.20	NOVOVORONE	2.1.(9)
I	TRAINING RECORDS	1219	TRAINING RECORDS Centralize control of training records within training department. Maintain records for 10 years.	O	TQ	1.20	KOLA	2.1.(5)

ISSUE NUMBER: Emergency Planning 1

ISSUE TITLE: Emergency Response Programme

RANK OF ISSUE: III

ISSUE CLARIFICATION:

An effective Emergency Response Programme must address all essential aspects of accident assessment and classification, on-site planning, off-site planning and coordination.

RELATED ITEMS:

284, 285, 286, 287, 545, 546, 549, 556, 559, 561, 577, 578, 579, 1003, 1004, 1006, 1007, 1008, 1010, 1015, 1018, 1315, 1316, 1319

JUSTIFICATION OF RANKING:

Deficiencies in on-site preparations and off-site coordination plans increase the potential consequences to the public in the event of a plant emergency.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	EMERGENCY RESPONSE PROGRAMME	284	ON SITE EMERGENCY PLAN Comprehesive emergency plan should be prepared, including: actions to correct abnormal conditions, assessmen of potential consequences, activating emergency arrangements, recommending protective measures. It should describe the organizational units, their functions and tasks.	O	EP	5.2	BOHUNICE 6.2.(1)
III	EMERGENCY RESPONSE PROGRAMME	285	ON OFF SITE INTERFACE The on site emergency plan should outline off site organization and measures and define coordination with them.	O	EP	5.2	BOHUNICE 6.2.(2)
III	EMERGENCY RESPONSE PROGRAMME	286	GRADED EMERGENCY RESPONSE An emergency classification system should be developed based on a graded response according to accident severity.	O	EP	5.3	BOHUNICE 6.2.(3)
III	EMERGENCY RESPONSE PROGRAMME	287	SAFETY STATUS ASSESSMENT Procedures to assess the safety status of the plant and to evaluate development of accident should be implemented.	O	EP	5.2	BOHUNICE 6.3.(1)
III	EMERGENCY RESPONSE PROGRAMME	545	LIASION WITH OTHER COUNTRIES Liasion with neighbouring country (Romania) on emergency planning should provide similar protection to population of both countries.	O	EP	5.2	KOZLODUY 6.1.(2)
III	EMERGENCY RESPONSE PROGRAMME	546	UPDATING EMERGENCY PLANNING Method and responsibility for updating emergency plans annually should be described in station procedures.	O	EP	5.2	KOZLODUY 6.1.(3)
III	EMERGENCY RESPONSE PROGRAMME	549	REVIEW OF EMERGENCY PLAN The review of the emergency plan currently in progress should be completed and a new documented issued as soon as possible.	O	EP	5.2	KOZLODUY 6.1.(6)
III	EMERGENCY RESPONSE PROGRAMME	556	EMERGENCY PLAN BASIS A probabilistic safety assessment should be made to determine the most severe accident to be taken into account in emergency planning.	O	EP	5.4	KOZLODUY 6.2.(7)
III	EMERGENCY RESPONSE PROGRAMME	559	ON SITE EMERGENCY PLAN The requirements for on site plan should be analysed, tasks identified and procedures and means to implement them should be developed.	O	EP	5.2	KOZLODUY 6.3.(1)
III	EMERGENCY RESPONSE PROGRAMME	561	PROCEDURES UPDATING An organization should be set up charged with reviewing emergency plan procedures periodically. Demostration of procedures is necessary.	O	EP	5.2	KOZLODUY 6.3.(3)
III	EMERGENCY RESPONSE PROGRAMME	577	INFORMATION TO MEDIA Arrangements for communication to international media should be reviewed for adequacy.	O	EP	5.2	KOZLODUY 6.6.(2)
III	EMERGENCY RESPONSE PROGRAMME	578	PUBLIC INFORMATION ARRANGEMENT The arrangements for public information should be described in the On-site and Civil Defense emergency plans.	O	EP	5.2	KOZLODUY 6.6.(3)
III	EMERGENCY RESPONSE PROGRAMME	579	PUBLIC INFORMATION OFFICER Consider nominating a member of station staff as a link with public and media information persons at the Communication Minister and the Committee on Atomic Energy.	O	EP	5.2	KOZLODUY 6.6.(4)
III	EMERGENCY RESPONSE PROGRAMME	1003	GRADED EMERGENCY RESPONSE The emergency classification should be reconsidered and further developed.	O	EP	5.3	NOVOVORONE 6.2.(1)
III	EMERGENCY RESPONSE PROGRAMME	1004	ON SITE EMERGENCY PLAN Proper dissemination of a concise instruction for the general workers, including workers on the construction site, in the event of an emergency should be implemented.	O	EP	5.2	NOVOVORONE 6.2.(2)
III	EMERGENCY RESPONSE PROGRAMME	1006	CRITERIA FOR EVACUATION The criteria to evacuate and shelter the population should be stated in the off-site plan.	O	EP	5.2	NOVOVORONE 6.2.(4)
III	EMERGENCY RESPONSE PROGRAMME	1007	GRADED OFF-SITE RESPONSE Criteria should be developed allowing a graded off-site response.	O	EP	5.2	NOVOVORONE 6.2.(5)
III	EMERGENCY RESPONSE PROGRAMME	1008	PLANT SAFETY STATUS Procedures to assess the safety status of the plant and to evaluate the development of the accident should be developed.	O	EP	4.6	NOVOVORONE 6.3.(1)
III	EMERGENCY RESPONSE PROGRAMME	1010	ON-OFF SITE INTERFACE A copy of the Civil Defence off-site plan implementing procedures should be held in the station emergency management centre.	O	EP	5.2	NOVOVORONE 6.3.(3)
III	EMERGENCY RESPONSE PROGRAMME	1015	SHELTERING INSTRUCTIONS A specification should be developed of the requirements for sheltering.	O	EP	5.2	NOVOVORONE 6.4.(5)
III	EMERGENCY RESPONSE PROGRAMME	1018	PUBLIC INFORMATION The arrangements for public information should be covered by the emergency plan.	O	EP	5.2	NOVOVORONE 6.6.(1)
III	EMERGENCY RESPONSE PROGRAMME	1315	OFF-SITE SUPPORT ORGANIZATIONS The station management should ensure that they are kept aware of any changes in the off site support structure.	O	EP	5.2	KOLA 6.1.(2)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	EMERGENCY RESPONSE PROGRAMME	1316	EMERGENCY CLASSIFICATION Emergency classification should be reviewed. It should include an alert state and a graded appoach to radiation and non-reactor accidents.	O	EP	5.2	KOLA	6.2.(1)
III	EMERGENCY RESPONSE PROGRAMME	1319	INITIAL RADIATION MONITORING Consideration should be given to perform initial off-site radiation monitoring under the control of the station director. Later stages should be done by regional authorities.	O	EP	5.2	KOLA	6.3.(2)

ISSUE NUMBER: Emergency Planning 2

ISSUE TITLE: Emergency Response Procedures

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Procedures that support the Emergency Response Programme should be properly developed. Additional procedures will also be necessary based on anticipated changes to the Programme.

RELATED ITEMS:

295, 299, 550-555, 557, 558, 560, 573, 576, 1009, 1314, 1318, 1322

JUSTIFICATION OF RANKING:

Deficiencies in emergency planning procedures increase the potential consequences to the public in the event of a plant emergency.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	EMERGENCY RESPONSE - PROCEDURES	295	EMERGENCY EQUIPMENT LIST Systems and equipment available for emergencies should be listed in the emergency plan (monitors, respirators, communications).	O	EP	5.2	BOHUNICE 6.4.(6)
III	EMERGENCY RESPONSE - PROCEDURES	299	INFORMATION TO THE PUBLIC Consideration should be given to develope a procedure for coordinating release of information to the public during an emergency.	O	EP	5.3	BOHUNICE 6.6.(1)
III	EMERGENCY RESPONSE - PROCEDURES	550	ON-SITE EMERGENCY INITIATION Tha level of authority for sounding the on-site siren should be reviewed. The station shift supervisor should be empowered to do so.	O	EP	5.2	KOZLODUY 6.2.(1)
III	EMERGENCY RESPONSE - PROCEDURES	551	STANDBY TEAM MEMBERS A formal standby system should be introduced for key members of emergency control organization.	O	EP	5.2	KOZLODUY 6.2.(2)
III	EMERGENCY RESPONSE - PROCEDURES	552	INSTRUCTION FOR WORKERS Actions required for non essential workers and the location of shelters should be displayed on notices at entrance of buildings and throughfares.	O	EP	5.2	KOZLODUY 6.2.(3)
III	EMERGENCY RESPONSE - PROCEDURES	553	SHELTERING INSTRUCTIONS Sheltering instructions should be amended, made practical and written as a station procedure.	O	EP	5.2	KOZLODUY 6.2.(4)
III	EMERGENCY RESPONSE - PROCEDURES	554	END-OF-SHELTERING CRITERIA Criteria for the decision to order workers to leave the shelters should be stated in the emergency plan.	O	EP	5.2	KOZLODUY 6.2.(5)
III	EMERGENCY RESPONSE - PROCEDURES	555	CONTROL OF PERSONNEL Consider making a record all persons on-site to show that they have taken KI tablets and the time each one was evacuated.	O	EP	5.2	KOZLODUY 6.2.(6)
III	EMERGENCY RESPONSE - PROCEDURES	557	CRITERIA FOR EVACUATION The criteria for public evacuation, or resumption of normal life, should be stated in the civil defence plan and appended to on site plan.	O	EP	5.4	KOZLODUY 6.2.(8)
III	EMERGENCY RESPONSE - PROCEDURES	558	SELECTIVE EVACUATION CRITERIA Evacuation criteria should be develope using both on and off site information and data which distinguish between accident classes, permiting division of 30 km zone for evacuation purposes.	O	EP	5.4	KOZLODUY 6.2.(9)
III	EMERGENCY RESPONSE - PROCEDURES	560	ON OFF SITE INTERFACE A copy of the Civil Defense procedures concerned should be held in the station emergency management center.	O	EP	5.2	KOZLODUY 6.3.(2)
III	EMERGENCY RESPONSE - PROCEDURES	573	EMERGENCY EQUIPMENT LIST The number and type of instruments and equipment to be held in readness for an emergency should be listed in the plan.	O	EP	5.2	KOZLODUY 6.4.(12)
III	EMERGENCY RESPONSE - PROCEDURES	576	INFORMATION TO THE PUBLIC Develope procedures for the release of information to the public at regular intervals, following an emergency.	O	EP	5.2	KOZLODUY 6.6.(1)
III	EMERGENCY RESPONSE - PROCEDURES	1009	RECOVERY AND RE-ENTRY Procedures for recovery from an emergency and re-entry and resuming plant activities should be developed.	O	EP	4.6	NOVOVORONE 6.3.(2)
III	EMERGENCY RESPONSE - PROCEDURES	1314	EMERGENCY PLAN AIDS Continue developing reference aids for key personnel in the emergency organization.	O	EP	5.2	KOLA 6.1.(1)
III	EMERGENCY RESPONSE - PROCEDURES	1318	OFF-SITE MONITORING ROUTES Off-site radiation monitoring routes should be described in the plant and Polyarny Zori plans.	O	EP	5.2	KOLA 6.3.(1)
III	EMERGENCY RESPONSE - PROCEDURES	1322	EMERGENCY INSTRUCTIONS Emergency information should be displayed in corridors, stairways and reception areas.	O	EP	5.2	KOLA 6.4.(3)

ISSUE NUMBER: Emergency Planning 3

ISSUE TITLE: Emergency Response Facilities

RANK OF ISSUE: III

ISSUE CLARIFICATION:

Facilities and equipment should be available to properly monitor, coordinate and respond to possible accident conditions. Emphasis should be provided to obtain the necessary equipment (meteorological monitoring, dosimeters, etc) for response to accident conditions.

RELATED ITEMS:

290, 291, 292, 296, 562, 563, 565, 566-572, 1005, 1011, 1012, 1013, 1016, 1317, 1320, 1323, 1324, 1325, 1327, 1328, 1329, 1330

JUSTIFICATION OF RANKING:

Proper emergency planning can reduce the risk to both site personnel and the public. Proper protection equipment and monitoring tools are necessary to reduce the overall risks.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
III	EMERGENCY RESPONSE - FACILITIES	290	TECHNICAL SUPPORT CENTER A technical support center should be installed closed to the control room.	O	EP	1.24	BOHUNICE 6.4.(1)
III	EMERGENCY RESPONSE - FACILITIES	291	EMERGENCY CONTROL CENTER An adequate emergency control center should be established, equipped and described in the emergency plan.	O	EP	5.3	BOHUNICE 6.4.(2)
III	EMERGENCY RESPONSE - FACILITIES	292	EMERGENCY RESOURCES The technical support center and the emergency control center should have means for accident management such as procedures,plant layouts, schematics, status board and adequate communication system.	O	EP	1.24	BOHUNICE 6.4.(3)
III	EMERGENCY RESPONSE - FACILITIES	296	HERMETIC ZONE MONITORING Planned monitoring instruments for the hermetic zone should be installed and procedures to evaluate source term should be developed.	O	EP	4.6	BOHUNICE 6.4.(7)
III	EMERGENCY RESPONSE - FACILITIES	562	EMERGENCY CONTROL CENTER A second emergency management center should be povided, located in oposite side of the site.	O	EP	5.3	KOZLODUY 6.4.(1)
III	EMERGENCY RESPONSE - FACILITIES	563	LOCATION OF EMERGENCY CENTER Costruction of an emergency control center remote from the rectors should be given priority.	O	EP	5.3	KOZLODUY 6.4.(2)
III	EMERGENCY RESPONSE - FACILITIES	565	REARRANGING CONTROL CENTER Review emergency commission work and rearrange working spaces, seating accomodations, etc.	O	EP	5.3	KOZLODUY 6.4.(4)
III	EMERGENCY RESPONSE - FACILITIES	566	METEOROLOGICAL DATA Arrangements should be made to provide meteorological data to the Emergency Commission on demand.	O	EP	5.2	KOZLODUY 6.4.(5)
III	EMERGENCY RESPONSE - FACILITIES	567	RADIOLOGICAL MONITORING Assessment should be made of the radiological hazard outside the Emergency Center, and monitoring equipment should be installed.	O	EP	5.4	KOZLODUY 6.4.(6)
III	EMERGENCY RESPONSE - FACILITIES	568	SHELTERING SPECIFICATIONS Specifications should be drawn for sheltering facilities. Only basements meeting these specifications should be designated.	O	EP	5.4	KOZLODUY 6.4.(7)
III	EMERGENCY RESPONSE - FACILITIES	569	EMERGENCY RESOURCES Assess number and types of monitoring equipment and protective clothes needed in an emergency and obtain them.	O	EP	5.2	KOZLODUY 6.4.(8)
III	EMERGENCY RESPONSE - FACILITIES	570	PRIORITY ITEMS FOR EMERGENCIES Priority should be given to obtain righ range dosimeters, air samplers, doseratemeters and breathing apparatus for emergencies.	O	EP	5.2	KOZLODUY 6.4.(9)
III	EMERGENCY RESPONSE - FACILITIES	571	RESPIRATORS FILTERS Invetigate the possibility of obtaining respirator filters given good protection agains iodine, for emergencies.	O	EP	5.2	KOZLODUY 6.4.(10)
III	EMERGENCY RESPONSE - FACILITIES	572	EMERGENCY TOOLS Assess need for tools and equipment in an emergecncy and store them in the emergency control center.	O	EP	5.2	KOZLODUY 6.4.(11)
III	EMERGENCY RESPONSE - FACILITIES	1005	ON-SITE ORGANIZATION The paving of the road connecting the station with Daavidovka should be completed.	O	EP	5.3	NOVOVORONE 6.2.(3)
III	EMERGENCY RESPONSE - FACILITIES	1011	EMERGENCY CONTROL CENTRE The construction and commissioning of the new emergency management centre should be given top priority.	O	EP	5.3	NOVOVORONE 6.4.(1)
III	EMERGENCY RESPONSE - FACILITIES	1012	EMERGENCY CONTROL CENTRE The emergency management centre should be equipped with displays of essential plant safety parameters.	O	EP	5.3	NOVOVORONE 6.4.(2)
III	EMERGENCY RESPONSE - FACILITIES	1013	EMERGENCY CONTROL CENTRE The alternative location of the emergency management centre should have the same arrangement as the on-site centre.	O	EP	5.3	NOVOVORONE 6.4.(3)
III	EMERGENCY RESPONSE - FACILITIES	1016	EMERGENCY EQUIPMENT The project to install fixed monitoring posts, the meteorological facility and the related computer system should be pursued as a priority.	O	EP	5.3	NOVOVORONE 6.4.(6)
III	EMERGENCY RESPONSE - FACILITIES	1317	FIXED RADIATION MONITORS Installation of planned fixed radiation monitors should be completed. Data should be used to assist accident assessment and declaration of emergency.	O	EP	5.2	KOLA 6.2.(2)
III	EMERGENCY RESPONSE - FACILITIES	1320	EMERGENCY CONTROL CENTER An alternative should be found for the Emergency Control Center (or for the personnel assembly located in the same shelter).	O	EP	5.2	KOLA 6.4.(1)
III	EMERGENCY RESPONSE - FACILITIES	1323	CONTROL CENTER REVIEW Review the equipment of the Emergency Control Center, including furniture, documents, communications, availability of plant parameters and metereological information.	O	EP	5.2	KOLA 6.4.(4)
III	EMERGENCY RESPONSE - FACILITIES	1324	SHELTER VENTILATION The ventilation of shelter n. 2 should be provided with iodine filtration.	O	EP	5.2	KOLA 6.4.(5)

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
III	EMERGENCY RESPONSE - FACILITIES	1325	IODINE TABLETS STORAGE Iodine tablets should be wrapped in foil and stored in containers indicating type of tablets and expiration date.	O	EP	5.2	KOLA	6.4.(6)
III	EMERGENCY RESPONSE - FACILITIES	1327	EVACUATION ROUTES Indication of shortes routes to emergency assembly should be provided. Signs should be visible in restricted light and smoke.	O	EP	5.2	KOLA	6.4.(8)
III	EMERGENCY RESPONSE - FACILITIES	1328	OFF-SITE CONTROL CENTER An area should be identified end equiped as a off-site emergency control center for managing any type of civil emergency.	O	EP	5.2	KOLA	6.4.(9)
III	EMERGENCY RESPONSE - FACILITIES	1329	OFF-SITE EMERGENCY EQUIPMENT Establish an inventory of stabndby equipment required for managing civil emergencies including radiological accidents.	O	EP	5.2	KOLA	6.4.(10)
III	EMERGENCY RESPONSE - FACILITIES	1330	MONITORING VEHICLES One or more vehicles should be equiped and dediceted solely to off-site radiological monitoring in emergencies.	O	EP	5.2	KOLA	6.4.(11)

ISSUE NUMBER: Emergency Planning 4

ISSUE TITLE: Emergency Response. Training

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Emergency plans are infrequently used in practice. Training and drills should be used to ensure that the plant staff can adequately manage and coordinate on-site and off-site activities.

RELATED ITEMS:

297, 298, 564, 574, 960, 1017, 1331, 1332

JUSTIFICATION OF RANKING:

Emergency plan training drills and staff experience are necessary to ensure that plant emergencies can be properly managed.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE
II	EMERGENCY RESPONSE - TRAINING	297	EMERGENCY DRILL Periodic drills should be developed and conducted to assess and maintain emergency preparedness.	O	EP	4.5	BOHUNICE 6.5.(1)
II	EMERGENCY RESPONSE - TRAINING	298	EMERGENCY SCENARIOS Accident management aspects (evaluation of plant status, simulated corrective actions, flow of information) should be included in the scenarios of emergency exercises.	O	EP	5.2	BOHUNICE 6.5.(2)
II	EMERGENCY RESPONSE - TRAINING	564	EMERGENCY COMMISSION EXERCISE Whilst the present emrgency center continues in service, Emergency Commission exercises should demonstrate they can manage emergecies without leaving the center.	O	EP	5.3	KOZLODUY 6.4.(3)
II	EMERGENCY RESPONSE - TRAINING	574	EMERGENCY DRILL An unified system of training and drills should be developed demostrating the effectiveness of the emergency plan for essential and non essential workers.	O	EP	5.2	KOZLODUY 6.5.(1)
II	EMERGENCY RESPONSE - TRAINING	960	COMPUTER SIMULATION Use simulator facility to exercise the shift operations staff in handling accident situations.	O	OPS	4.5	NOVOVORONE 3.7.(4)
II	EMERGENCY RESPONSE - TRAINING	1017	DRILL AND EXERCISES A general site sheltering/evacuation exercise should be planned and performed in the programme.	O	EP	5.1	NOVOVORONE 6.5.(1)
II	EMERGENCY RESPONSE - TRAINING	1331	FREQUENCY OF STATION EXERCISES Full scale integrated Station Emergency Planning exercise should take place every year including interfaces with off-site organization.	O	EP	5.2	KOLA 6.5.(1)
II	EMERGENCY RESPONSE - TRAINING	1332	EMERGENCY EXERCISE FEEDBACK Formal tracking of implementation of recommendation from emergancy exercises should be introduced.	O	EP	5.2	KOLA 6.5.(2)

ISSUE NUMBER: Emergency Planning 5

ISSUE TITLE: Post Accident Sampling

RANK OF ISSUE: II

ISSUE CLARIFICATION:

Plants should have a capability to assess core damage and post-accident radiological conditions through appropriate sampling systems.

RELATED ITEMS:

293, 294

JUSTIFICATION OF RANKING:

A post-accident sampling system is necessary in order to properly assess radiological consequences of accidents to minimize the impact on plant staff and to the public.

CAT.	ISSUE	ITEM n.	TITTLE/Description	ASPECT	AREA	CLASS	REFERENCE	
II	POST ACCIDENT SAMPLING	293	SAMPLING DURING ACCIDENT Evaluate the possibility of taking samples in accident conditions from the dose point of view. Develope adequate procedures.	O	EP	4.5	BOHUNICE	6.4.(4)
II	POST ACCIDENT SAMPLING	294	HERMETICAL ZONE SAMPLING Procedures should be developed to take samples of hermetical zone air samples in accident conditions.	O	EP	4.5	BOHUNICE	6.4.(5)

REFERENCES

RD - Reference Documents
SC - Steering Committee (information/Review)

WWER RD 022	Bohunice Safety Review Mission (4-26 April 1991)
WWER RD 032	Evaluation of the Safety Status of the NPP Jaslovaske Bohunice V-I Report of the Austrian Expert Commission July 1991
WWER RD 033	Kozloduy Safety Review Mission (1-21 June 1991)
WWER SC 025	Novovoronezh Safety Review Mission (12-30 August 1991)
WWER SC 026	Kola Safety Review Mission (9-27 September 1991)

LIST OF PARTICIPANTS

Project Review Meeting
Safety of WWER 440 Model 230 Plants
19-23 August 1991

BULGARIA

Mr. B. Dimitrov	Institute ENERGOPROEKT 1407 Sofia 51 anton Ivanov blvd
Mr. E. Balabanov	Institute ENERGOPROEKT 1407 Sofia 51 anton Ivanov blvd

FINLAND

Mr. J. Laaksonen (Chairman)	Finnish Centre of Radiation and Nuclear Safety (STUK) P.O. Box 268 SF-00101 Helsinki

GERMANY

Mr. J. P. Weber	Gesellschaft fur Reaktorsicherheit Forschungsgelaende 8046 Garching

SPAIN

Mr. A. Alvarez Menendez	Empresarios Agrupados Magallanes 3 28015 Madrid

USA

Mr. M. Case	U.S. Nuclear Regulartory Commission Office of Nuclear Reactor Regulation Washington D.C. 20555
Mr. G. Chipman	US DOE Contractor Tenera 7272 Wisconsin Avenue Suite 300 Bethesda Maryland 20814

THE RUSSIAN FEDERATION

Mr. V. Vaishnis	Kola Nuclear Power Plant 184152 Poliazinje Zori Murmansk region

UNITED KINGDOM

Mr. P. Tonks	Nuclear Electric plc Barnett Way Barnwood Gloucester 9L4 7RS

THE COMMISSION OF EUROPEAN COMMUNITIES (CEC)

Mr. Deffremmes	CEC Rue de la Loi 200 B-1049 Bruxelles Belgium

IAEA PARTICIPANTS

Mr. L. Lederman	- Scientific Secretary - NENS/SAS
Mr. C. Almeida	- Safety Assessment Section/NENS
Mr. B. Gachot	- Safety Assessment Section/NENS
Mr. R. Havel	- Safety Assessment Section/NENS
Mr. A. Erwin	- NPP Operational Safety Services/NOSS

Project Review Meeting
Safety of WWER 440 Model 230 Plants
28 October to 1 November 1991

AUSTRIA

Mr. G. Weimann	Austrian Research Centre Seibersdorf Vienna

BULGARIA

Mr. B. Dimitrov	Institute Energoproekt 1407 Sofia 51 Anton Ivanov blvd
Mr. R. Ovtcharov	Bulgarian Atomic Committee 55 Chapaev str 1547 Sofia

CZECHOSLOVAKIA

Mr. Jiri Suchomel	Nuclear Power Plant Research Institute Okruzna 5, 91864 Trnava

FINLAND

Mr. J. Laaksonen (Chairman)	Finnish Centre of Radiation and Nuclear Safety (STUK) P.O. Box 268 SF-00101 Helsinki

FRANCE

Mr. F. Wald	Electricite de France 22/30 Avenue de Wagram 75382 Paris Cedex 08

GERMANY

Mr. J. P. Weber	Gesellschaft fur Reaktorsicherheit Forschungsgelande, 8046 Garching

SPAIN

Mr. A. Alvarez Menendez

Empresarios Agrupados
Magallanes 3
28015 Madrid

USA

Mr. M. Case

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington D.C. 20555

Mr. D. Morris

US Dept of Energy Contractor
Tenera, LP
7272 Wisconsin Ave
Bethesda MD 20814

THE RUSSIAN FEDERATION

Mr. P. Vaishnis

Kola Nuclear Power Plant
184151 Poliarniye Zori
Murmansk region

UNIDED KINGDOM

Mr. P. Tonks

Nuclear Electric plc
Barnett Way
Barnwood
Gloucester
9L4 7RS

THE COMMISSION OF EUROPEAN COMMUNITIES (CEC)

Mr. Deffrennes

CEC DG XVII
Rue de la Loi 200
B-1049 Bruxelles
Belgium

IAEA PARTICIPANTS

Mr. L. Lederman	- Scientific Secretary - NENS/SAS
Mr. C. Almeida	- Safety Assessment Section/NENS
Mr. J. Hoehn	- Safety Assessment Section/NENS
Mr. B. Gachot	- Safety Assessment Section/NENS
Mr. R. Havel	- NENF
Mr. A. Erwin	- NPP Operational Safety Services/NOSS
Ms. A. Carnino	- Advisor, NENS
Mr. B. Moore	- NPP Operational Safety Services/NOSS
Mr. J. Dular	- NPP Operational Safety Services/NOSS

Steering Committee Meeting
Safety of WWER 440 Model 230 Plants
9-13 December 1991

BULGARIA

Mr. B. Georgiev	Permanent Mission Schwindgasse 8 A-1040 Vienna
Mr. Janev	Bulgarian Committee on the Use of Atomic Energy for Peaceful Purposes 55A Chapaev str. 1547 Sofia

CZECHOSLOVAKIA

Mr. Z. Kriz	State Nuclear Safety Inspectorate Slezska 9, 12029 Prague 2

FRANCE

Mr. Y. Cornille	IPSN-CEA CEN de Fontenay-aux-roses B. P. no 6 F-92265 Fontenay-aux-roses Cedex

FINLAND

Mr. J. Laaksonen	Finnish Centre of Radiation and Nuclear Safety (STUK) P.O. Box 268 S.F. 00101 Helsinki

GERMANY

Mr. F. W. Heuser	Gesellschaft Fur Reaktorsicherheit Schwertnergasse 1 D 5000 Koeln 1
Mr. P. Kelm	Gesellschaft Fur Reaktorsicherheit Schwertnergasse 1 D 5000 Koeln 1

SPAIN

Mr. A. Alonso | Polytechnical University of Madrid
Escuela de Ingenieros Industriales
Jose Gutierrez Abascal, 2
28006 Madrid

SWITZERLAND

Mr. A. Voumard | Swiss Federal Nuclear Safety Inspectorate
CH-5232 Villigen HSK

Mr. E. Knoglinger | Paul Scherrer Institut
Laboratory for Reactorphysics
and Systems Engineering
CH-5232 Villigen PSI

USA

Mr. G. Chipman | Tenera, 7272
Wisconsin Avenue, Suite 300
Bethesda
Maryland 20814

UNITED KINGDOM

Mr. D. Goodison
Chairman | Nuclear Installations Inspectorate
St Peter's House
Stanley Precinct
Bootle, Merseyside L20 3LZ

THE RUSSIAN FEDERATION

Mr. A. M. Kirichenko | Ministry of Atomic Power and Industry
of the USSR
Kitaisky Projezd 7
103074 Moscow
USSR

Mr. V. A. Vikin | Novovoronezh NPP

Mr. J. V. Kolomtsev | Kola NPP

Mr. N. G. Pavlenko | Novovoronezh NPP

COMMISSION OF THE EUROPEAN COMMUNITIES (CEC)

Mr. Cibrian	CEC Rue de la Loi 200 B-1049 Bruxelles Belgium
Mr. J. C. Charrault	CEC Rue de la Loi 200 B-1049 Bruxelles Belgium
Mr. H. W. Kalfsbeek	CEC DG XII/D/1 Rue de la Loi 200 B-1049 Bruxelles Belgium

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT NUCLEAR ENERGY AGENCY (OECD/NEA)

Mr. J. Royen	OECD/NEA 38 Boulevard Suchet 75016 Paris France

WORLD ASSOCIATION OF NUCLEAR OPERATORS (WANO)

Mr. L. Gilly	WANO - Paris 71 Rue de Miromesnil 75008 Paris

WORLD BANK

Mr. A. G. Adamantiades	1818 H Street N.W. Washington D.C. 20433 USA

IAEA PARTICIPANTS

Mr. M. Rosen	- DIR/NENS
Mr. L. Lederman	- Scientific Secretary - NENS/SAS
Mr. C. Almeida	- Safety Assessment Section/NENS
Mr. F. Niehaus	- Head, Safety Assessment Section/NENS
Mr. J. Hoehn	- Safety Assessment Section/NENS
Ms. A. Carnino	- Advisor NENS
Mr. B. Gachot	- NENS
Mr. K. Hide	- Acting Head, NOSS
Mr. J. P. Bemer	- NOSS
Mr. L. Kabanov	- Head, ES

92-00295