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REPORT

OF

THE TECHNICAL COMMITTEE MEETING

1997 ANNUAL WORKSHOP ON ASSET EXPERIENCE AND FEEDBACK

24-26 JUNE 1997
IAEA HEADQUARTERS, VIENNA

THE ASSET SERVICE

EXPERIENCE, FEEDBACK AND DEVELOPMENT

- Development of the ASSET Service since 1996 Workshop
- Feedback from the Plant Self-Assessment and Associated ASSET Peer Review Process
- Review of the Recommendations of the August 1996 PPAS on the ASSET Service
- Conclusions and Recommendations

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Vienna, 1997

We regret that some of the pages in this report may not be up to the proper legibility standards, even though the best possible copy was used for scanning

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EXECUTIVE SUMMARY

30 participants from 18 countries attended the 1997 Technical Committee Meeting (TCM) and, therefore, an excellent international forum was available to review the progress of the ASSET methodology. Since the 1996 TCM, the IAEA ASSET service has continued to encourage the utilization of plant self-assessment together with a subsequent international Peer Review. This approach has proved both beneficial in:

- enhancing ownership of the assessment process and corrective actions by the plant; and
- generating better teamwork during the Peer Review.

All countries represented at the workshop made oral presentations. The themes of these presentations varied from experience with the ASSET methodology as a customer or a reviewer, to national operational feedback developments. The main themes being:

- Improvement in Safety Performance by utilization of the ASSET service.

- Encouraging ASSET self assessment by adapting the service to align with national event analysis methods where possible.

- Encouragement of "open reporting" by generating a "blame free" culture at all levels of the organization.

- Improving the analysis by enlarging the population of events considered.

- Enhancing the peer review process by better utilization of time and improved training.

The workshop's objectives were:

- to review the plant self-assessment reports of Krško NPP, Dukovany NPP and Balakovo NPP; and

- to review the recommendations regarding the ASSET service made by the Consultants' Meeting of 26-30 August 1996 on "Performance of the IAEA Operational Safety Services".

The more significant conclusions reached from these reviews are detailed below:

1. ASSET should incorporate into its guidelines for Self-Assessment the ability to accept a plant's, or nation's, established Event Analysis system, provided that it addresses the seven basic ASSET questions. A flexible approach may encourage more Member States to undertake assessments and request peer reviews. This approach would also reduce the resource commitment required to prepare for a Self-Assessment by a plant with an established Event Analysis system.

2. ASSET should encourage plants to analyse a broader population of events to ensure that pending safety problems including their precursors are adequately identified. Events of less safety significance (out of scale) could be included in the analysis. It would be necessary for ASSET to establish guidelines on the selection of non safety relevant events.

3. ASSET should further consider the schedule of Review mission activities to allow time for pre-briefing the experts and more time for detailed discussion with counterparts (and possibly time for an interchange of information on good practices between reviewers and counterparts.)

4. ASSET should review the training given to reviewers prior to the mission to ensure an adequate understanding of the process. Also, whenever possible, group leaders of the ASSET Peer Review should be experienced in the process by participating in a previous Review mission either as a reviewer or counterpart.

5. With regard to the future of the IAEA operational safety services it was considered that the IAEA should be encouraged to promote the ASSET programme and to provide adequate financial and human resources to meet all future requests. The IAEA should also ensure that qualified professional IAEA staff have the high level of competence and experience necessary to support the service to the customers' requirements. The ASSET service provided to a number of the power plants of Member States has resulted in measurable improvements in their safety performance.

1. INTRODUCTION

30 participants attended the 1997 ASSET workshop, representing 18 countries. This high level of continued support ably demonstrates the interest in the ASSET methodology from the customer. The Agenda of the meeting and List of Participants are included in this report as Attachments 1 and 5 respectively.

Papers and presentations were made by all participating countries and provided a wide range of perspectives on the use of the ASSET methodology. Generally, the views expressed were positive, however, there were comments on areas were the service could be improved or enhanced.

1.1. The decision to encourage and support ASSET self-assessment was seen as a very positive step and results to date have demonstrated the success of this approach.

1.2. In some countries the ASSET methodology has been be adapted to interface with and enhance the existing comprehensive event analysis programmes, and this flexibility was seen as another positive move in ensuring the continued enhancement of safety performance throughout the world. Countries with developed systems were encouraged to explore the possibilities of enhancing their own systems by adopting this approach. This approach also has the added advantage of reducing resource requirements needed to conduct a self-assessment and subsequent review.

1.3. The continued improvement in safety performance has reduced the occurrence of safety significant events. It may, therefore, be necessary to broaden the scope of the assessment to include events of less safety significance to ensure that a realistic population of events is analysed to identify the pending safety problems.

1.4. A review of the working schedule of the Peer Review process may be beneficial in improving its effectiveness through enhanced training of experts and additional time for preparation and discussion.

The workshop was divided into three task groups to analyse the self-assessments conducted at Krško NPP, Slovenia; Dukovany NPP, Czech Republic; and Balakovo NPP, Russian Federation. In addition, they were tasked to comment on the recommendations on the ASSET service made by the Consultants' Meeting of 26-30 August 1996 on "Performance of the IAEA programme on Operational Safety Services".

A presentation was made by Mr. B. Thomas to remind delegates of the ASSET methodologies, and Mr. V Sivokon demonstrated the latest developments of computer software available for assisting in the plant Self-Assessment process.

2. POINTS FROM PRESENTATIONS

Copies of the presentations given by participants together with supporting documentation are included in this report as Attachment 4. The significant points presented in these reports were:

2.1. The ASSET Self-Assessment process together with Peer Review is applicable to current conditions at most NPPs, however, the ability to respond to specific requests should be maintained.

2.2. A flexible approach to the utilisation of the ASSET methodology is advantageous when enhancing existing and well established event analysis programmes.

2.3. Conducting ASSET Self-Assessment to the existing ASSET guidelines can be resource intensive to a utility that has well established event analysis programme.

2.4. To enhance the identification of the pending safety problems suitable guidelines are necessary to include events falling below level 0 in the INES system in the analysis.

2.5. Policies to encourage a higher level of open reporting are to be supported.

2.6. The mission schedule for conducting Peer Reviews could include time for: additional training of the experts; team preparation prior to meetings with counterparts; and more counterpart discussion and exchange of information on event reporting and analysis techniques.

3. WORKING GROUP REPORTS

This is a synopsis of the full reports which form Attachment 3 of this report. Suggestions have been highlighted.

3.1. GROUP "A" Mr. C. Phipps, Leader KRŠKO NPP

Task 1. Provide suggestions to refine, whenever necessary, the ASSET guidance for plant self-assessment and the associated ASSET Peer Review process

1.1. Population of Operational Events Considered

The group concluded that the Krško selection of events was a good representation of safety relevant events. To improve their analysis, Krško selected some non-safety relevant events for their review. **The IAEA should consider providing guidance on selection, screening and analysis of the lower level events to attempt to capture precursors to pending safety problems.**

It was very resource intensive for Krško to transfer information from its existing Events Analysis programme into the ASSET presentation. **The IAEA should consider accepting that a plant can use its own methodology for event analysis providing it addresses the seven basic ASSET questions.**

1.2. Identification of Pending Safety Problems

The group was very satisfied with the approach used by Krško to identify the Pending Safety Problems.

1.3. Thoroughness of the Action Plan

In general, the plant addressed the Action Plan well.

1.4. Working Schedule of the ASSET Peer Review

The working programme for Krško was difficult to achieve within the 5 day Monday to Friday schedule. However, since the Krško Peer Review the review schedule has been altered to include a weekend and the difficulty may now be resolved.

Task 2. Recommendations to IAEA regarding ASSET and other services

2.1. Observations and comments regarding the recommendations made regarding the ASSET programme at the 1996 Consultants' Meeting on IAEA Operational Safety Services.

2.1.1. The group fully supported the Executive Summary statement of the report of the Consultants' Meeting held on 26-30 August 1996 on "Performance of the IAEA Operational Safety Services". **"The ASSET assistance provided to a number of member countries' power plants has resulted in measurable improvements in their performance. The Agency should continue to promote the ASSET assistance programme which to date has helped achieve measurable improvements in the performance of a number of NPPs. The Agency should ensure that adequate resources are available to meet all future requests."**

2.1.2. The group supported the majority of the recommendations, however, did express concern about the recommendation to merge the IAEA services of ASCOT, ASSET and OSART. It was felt that rationalisation would lose some of the ownership and applicability of the services and hence their usefulness to the customer.

2.2. Suggest a list of possible improvements/enhancements

2.2.1. **The group suggested ways that the ASSET service could be improved by increasing the number of events screened as part of the Self-Assessment process.**

2.2.2. **The group suggested that the ASSET methodology be flexible so that individual established event analysis programmes could be utilised . However, it is important that the seven basic questions are addressed.**

3.2. GROUP B Mr. G. Löwenhielm, Leader
DUKOVANY NPP

Task 1. Provide suggestions to refine, whenever necessary, the ASSET guidance for plant self-assessment and the associated ASSET peer review process

1.1. Population of Operational Events Considered

The comments were similar to those in the report of Group A with the addition of the recommendation that **the self-assessment be supported by experts at the beginning of the self-assessment.**

1.2. Identification of Pending Safety Problems

The comments reflected the concern that "home blindness" could possibly affect the identification of Pending Safety Problems during a self-assessment if there was not independent input at the start of the process. **Recommendation for solution is similar to that for 1.1.**

1.3. Thoroughness of Action Plan

It would be advantageous for Action Plans to contain priorities and schedule for completion.

1.4. Working Schedule of the ASSET Peer Review

Similar comments to Group A with the additional comment that **Guidelines current at the time of the Self Assessment should also be utilised for the Peer Review.**

Task 2. Recommendations to IAEA regarding ASSET and other services

Group B comments, both in support and in areas of concern, reflected those expressed by Group A.

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3.3. GROUP C Mr. T. Ganchev, Leader
BALAKOVO NPP

Task 1. Provide suggestions to refine, whenever necessary, the ASSET guidance for plant self-assessment and the associated ASSET peer review process

1.1. Population of Operational Events Considered

The group considered that the population of events considered was a good representation of safety relevant issues. However, the group had similar comments to Group A concerning increasing the number of events considered by including those of less significance.

1.2. Identification of Pending safety Problems

The group considered that some of the Pending Safety Problems identified had been resolved and were no longer applicable.

1.3. Thoroughness of the Action Plan

The Self-Assessment report did not contain a comprehensive Action Plan and the comment by Group B on Dukovany regarding prioritisation and schedule is also applicable to Balakovo.

1.4. Working Schedule of the ASSET Peer Review

The Balakovo Peer Review was conducted over seven days and included a weekend, however, the group identified the need **to increase the time available pre-briefing of the experts and for discussion between counterparts and experts.**

Task 2. Recommendations to IAEA regarding ASSET and other services

2.1. Observations and comments regarding the recommendations made regarding the ASSET programme at the 1996 Consultants Meeting on IAEA Operational Safety Services.

2.1.1. The comments of Group C were in general agreement with those of Groups A and B and again stressed the importance of maintaining the current professional assistance that is available to plants in enhancing their safety performance through the ASSET programme. Any proposal to rationalise the service by combining it within other IAEA services was seen as detrimental to the high level of regard it has among its current users.

4. CONCLUSIONS OF THE WORKING GROUPS

4.1. The ASSET Peer Review of plant Self-Assessment missions was a logical development of ASSET methodology and is now a proven and demonstrable technique.

4.2. Guidance on the criteria for selecting events of lower significance for analysis is required.

4.3. Guidance is required on integrating the ASSET methodology into current established event analysis programmes.

5. RECOMMENDATIONS OF THE ASSET WORKSHOP MEETING

5.1. ASSET should incorporate into its guidelines for Self-Assessment the ability to accept a plant's, or nation's, established Event Analysis system, provided that it addresses the seven basic ASSET questions. A flexible approach may encourage more Member States to undertake assessments and request peer reviews. This approach would also reduce the resource commitment required to prepare for a Self-Assessment by a plant with an established Event Analysis system.

5.2. ASSET should encourage plants to analyse a broader population of events to ensure that pending safety problems including their precursors are adequately identified. Events of less safety significance (out of scale) could be included in the analysis. It would be necessary for ASSET to establish guidelines on the selection of non safety relevant events.

5.3. ASSET should further consider the schedule of Review mission activities to allow time for pre-briefing the experts and more time for detailed discussion with counterparts (and possibly time for an interchange of information on good practices between reviewers and counterparts.)

5.4. ASSET should review the training given to reviewers prior to the mission to ensure an adequate understanding of the process. Also, whenever possible, group leaders of the ASSET Peer Review should be experienced in the process by participating in a previous review mission either as a reviewer or counterpart.

5.5. With regard to the future of the IAEA operational safety services it was considered that the IAEA should be encouraged to promote the ASSET programme and to provide adequate financial and human resources to meet all future requests. The IAEA should also ensure that qualified professional IAEA staff have the high level of competence and experience necessary to support the service to the customers' requirements. The ASSET service provided to a number of the power plants of Member States has resulted in measurable improvements in their safety performance.

ATTACHMENT 1

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TECHNICAL COMMITTEE MEETING
ANNUAL WORKSHOP ON
ASSET EXPERIENCE AND FEEDBACK

IAEA Head Quarters, Vienna
Conference Room C07-V
24-26 June 1997

TENTATIVE AGENDA

Tuesday 24 June 1997

9:30	Opening remarks • Welcome address by Chairman of the meeting	Mr. R. C. Nichols
	• Scientific Secretary	Mr. P. Bliselius
9:40	IAEA report on the developments of the ASSET Service since the 1996 ASSET meeting	Mr. B. Thomas

	• The ASSET procedures for:
	  * Plant self-assessment of operational events reflecting
	    - safety performance
	    - safety problems
	    - safety culture
	  * Peer Review of plant self-assessments	

	• Experience and feedback (requests, trends and future developments)	
10:30	Coffee break	
11:00	Presentation by participants • Experience with the ASSET service • Observations and suggestions	
12:30	Lunch break	
14:00	Presentation by participants (cont'd)	
15:30	Coffee break	
15:50	"ASSET computerized aids designed to assist in analysing events and in producing event analysis reports, i.e. supporting plant self-assessment" by Mr. V. Sivokon, Kurchatov Institute, ASSET Branch, Moscow.	
16:20	Presentation by participants (cont'd)	

17:00 Preparation for the Working Group sessions

- **Working Group A**
  "Review of the Krško Self-Assessment and of the 1996 assessment of the ASSET service"
- **Working Group B**
  "Review of the Dukovany Self-Assessment and of the 1996 assessment of the ASSET service"
- **Working Group C**
  "Review of the Balakovo Self-Assessment and of the 1996 assessment of the ASSET service"

17:30 Cocktail party

<u>Wednesday, 25 June</u>

9:00 - 15:00

- Working Groups A (Krško), B (Dukovany), C (Balakovo)

  (I) Review of the plant Self-Assessment Report and of the ASSET Peer Review Report: Groups A (Krško), B (Dukovany), C (Balakovo)
  - *Please provide your suggestions to refine, whenever necessary, the ASSET guidance for Self-Assessment and Peer Review.*

  (II) Review the report of the consultants' meeting of 26-30 August 1996 to assess the IAEA programme on operational safety services.
  - *Please provide your observations on the recommendations made regarding the ASSET service.*
  - *Please suggest an order of priority and a concrete action plan to implement these recommendations.*

15:00 Plenary session

15:00 - 15:40 Presentation of the conclusions of Working Group A - Discussions

15:40 - 16:20 Presentation of the conclusions of Working Group B - Discussions

16:20 - 17:00 Presentation of the conclusions of Working Group C - Discussions

17:00 Drafting of the Working Groups reports

<u>Thursday, 26 June</u>

8:00 - 10:00 Drafting and typing

10:00 - 12:30 Review of the Working Groups reports

12:30 Closing of the meeting

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ANNUAL WORKSHOP ON
ASSET EXPERIENCE AND FEEDBACK
24-26 June 1997

GUIDANCE FOR THE WORKING GROUPS

Task 1

Based on the review of feedback from Self Assessments carried out by the Krško, Dukovany and Balakovo NPPs **(Documents 7, 8 and 9 in your folder** and the attached **"Examples of Feedback from ASSET Missions 1996-97 by Plant Counterparts and ASSET Members") the three Working Groups should:**

> *provide suggestions to refine, whenever necessary, the ASSET guidance for Plant Self-Assessment and the associated ASSET Peer Review process (this ASSET guidance is attached as* ***Documents 4 and 5*** *in your folder).*

1.1 Review experience and feedback from **"Population of operational events considered"**. Please see **Attachment 6, Section 2** of the Krško report and **Attachment 6, Section 1** of the Dukovany report and **Section 2** of the Balakovo Self Assessment report. See also attached Figure 1.

* What could be learned from this review to further improve the ASSET Self Assessment process?

- Are the population of operational events a good representation of what happened at the plant?
- Are there any missing events?
- Were there any difficulties for the plant in assessing this task?
- Anything else?

1.2 Review the experience and feedback from **"Identification of the pending safety problems"**. Please see **Attachment 6, Section 3** of the Krsko report and **Attachment 6, Section 1.3** of the Dukovany report and **Sections 2.3 and 2.4** of the Balakovo Self Assessment report.

* What could be learned from this review to further improve the ASSET Self Assessment process?

- Are you satisfied with the events reflecting operational safety performance (Krško and Dukovany)/safety culture issues (Balakovo)?
- Are you satisfied with the selected events for root cause analysis?
- Were there any difficulties for the plant in assessing this task?
- Anything else?

1.3 Review the experience and feedback from the **"Thoroughness of the Action Plan".** Please see **Attachment 6, Section 6** of the Krško report and **Attachment 6, Section 4** of the Dukovany report and **Section 5** of the Balakovo Self Assessment report.

* What could be learned from this review to further improve the ASSET Self Assessment process?

  - Are you satisfied with the listed actions for implementation?
  - Were there any difficulties for the plant in assessing this task?
  - Anything else?

1.4 Review the **"Working schedule of the ASSET Peer Review"**. Please see the **latest Working schedule of the Balakovo ASSET mission, Document 5.**

* What are your comments on this Working Schedule?

  - The number of days?
  - The length of review sessions?
  - The content of the programme calendar?
  - Anything else?

Task 2

Based on the review of the "Report of the Consultants' Meeting to review the IAEA programme on operational safety services as part of the Programme Performance Assessment System (PPAS) within the IAEA (Vienna, 26-30 August 1996)", **Document 13 in your folder**, the **three Working Groups should:**

* *Provide observations on the recommendations made regarding the ASSET service;*
* *And also suggest an order of priority and a concrete action plan to implement these recommendations.*

2.1 - What are your observations on and comments to the recommendations made regarding the ASSET service in **Document 13, (Executive Summary and section 2)?**

- Based on your experience with ASSET could you suggest any other recommendations to improve the ASSET service?

2.2 - Suggest a priority list of the recommendations.

- Produce a concrete Action Plan to implement these recommendations regarding the ASSET service.

1997-06-17

FEEDBACK FROM ASSET MISSIONS 1996 - 1997
BY
PLANT COUNTERPARTS & ASSET MEMBERS

EXAMPLES

(1) The duration of the mission is too short. (The members of the ASSET team need 3 days to fully understand the plant situation and then time to peer review the plant self assessment and to draft their conclusions.)

(2) The morning and afternoon review sessions by plant counterparts and ASSET members are too short. (4 hours instead of 3 hours).

(3) The interpretation process (English -- host country's language -- English) is a waste of time. (Plant counterpart should be fluent in English or ASSET members should all speak the language of the host country).

(4) The members of the ASSET team should all be familiar with the guidance for plant self assessment and knowledgeable about the ASSET procedures for analysing the consequences and causes of operational events reflecting safety performance, safety problems and safety culture. (A compromise should be found between the 2 hour briefing of the members of the ASSET team and the 3 day seminar to the plant counterparts).

(5) The population of events considered by the plant self assessment should also include the events which are not safety relevant (out of scale). (Plants have made a lot of progress in the prevention of safety relevant events while failures are still occurring during operation. 20 safety relevant events plus 100 events out of scale for 4 units over 3 year period provide a sounder basis for self assessment of performance and safety culture. The internal reporting criteria should have lower thresholds. The more events the better for learning the lessons from failures.)

(6) The plant self assessment reports do not strictly comply with the ASSET guidance. (This is fine as long as the seven basic questions are thoroughly answered. The ASSET peer review is not meant to check compliance but thoroughness of the plant self assessment.) The performance of the plant is assessed on the basis of the operational events that have occurred. Some indicators may also be considered by plant management. Trends may help to prevent failures during operation by monitoring plant capabilities of identifying safety issues, of assessing their importance, and of learning the lessons (Safety Culture definition, INSAG-4, 1991).

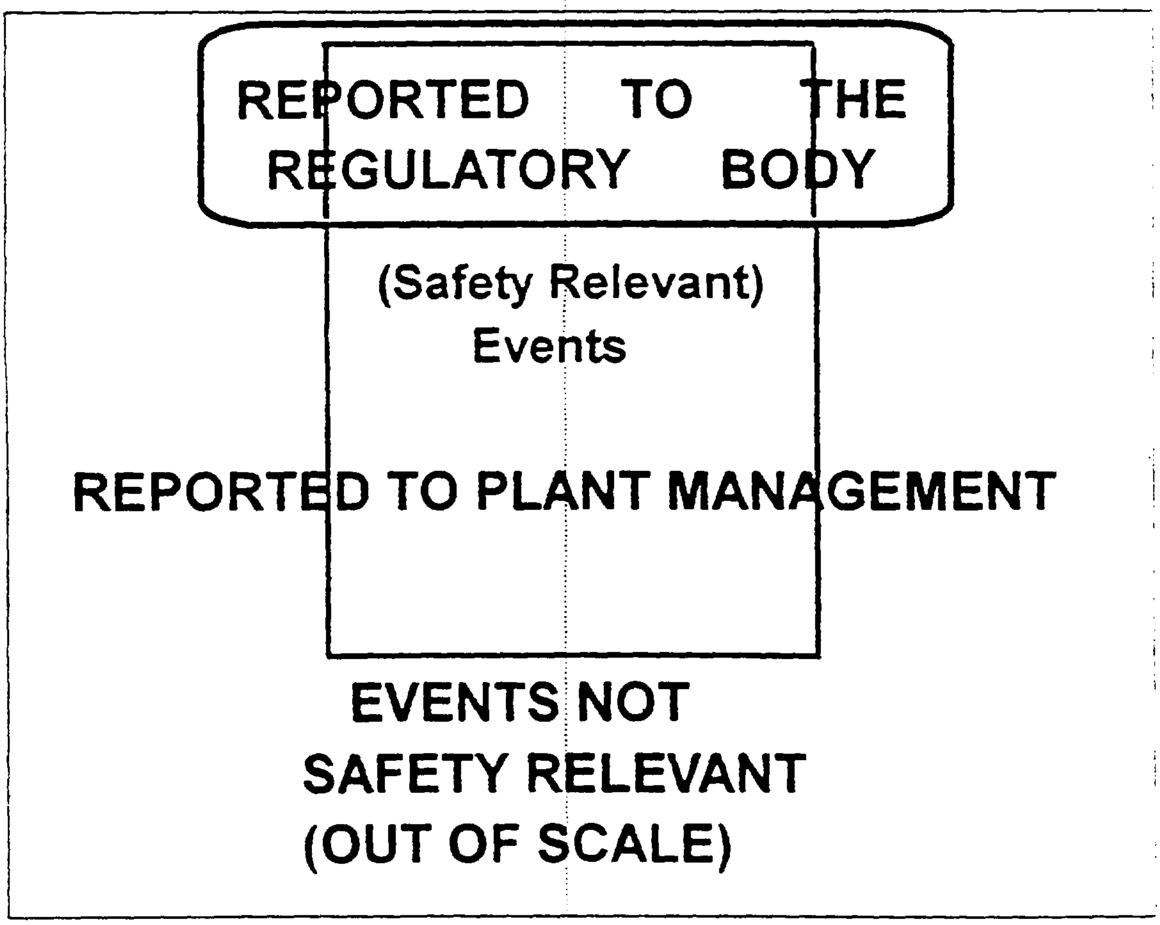
(7) The ASSET peer review guidance is suggesting an approach by direct causes (why did it happen?) by root causes, safety culture (why was it not prevented?) in order to reach practical conclusions on what should be improved to eliminate and prevent recurrence of the problems. Some ASSET members would prefer an approach by problems. The risk is to have more attention to be paid to the consequences of the problems (what or who failed?) than to the causes of the problems. This would be detrimental to the quality of the ASSET conclusions and to the relevance of the recommendations expected to contribute to enhancement of plant safety culture.

Figure 1

POPULATION OF OPERATIONAL EVENTS AT NUCLEAR INSTALLATIONS

- **GOOD EVENTS**
  resulting from
  "DEFICIENCIES"
  discovered by routine
  surveillance
  testing and inspection

- **BAD EVENTS**
  resulting from
  "FAILURES"
  during operation



GUIDANCE for SELF ASSESSMENT

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I) WHAT ARE THE PENDING SAFETY PERFORMANCE OR SAFETY CULTURE PROBLEMS?

II) HOW IMPORTANT?
(Significance to safety, reliability, etc...)

III) WHY DID THEY HAPPEN?
(Direct Cause)

IV) WHY WERE THEY NOT PREVENTED?
(Root Cause)

V) HOW TO ELIMINATE THE SAFETY PERFORMANCE OR SAFETY CULTURE PROBLEMS? (Repairs)

VI) HOW TO PREVENT THEIR RECURRENCE?
(Remedies)

VII) WHAT CORRECTIVE ACTIONS SHOULD BE IMPLEMENTED?
(Action Plan)

TECHNICAL COMMITTEE MEETING

ANNUAL WORKSHOP ON
ASSET EXPERIENCE AND FEEDBACK

24-26 June 1997

LIST OF DOCUMENTS IN FOLDER

1. ASSET Information Leaflet.

2. List of ASSET Services as of May 1997.

3. History of the ASSET Services, IAEA Newsbrief, Nov/Dec 1996.

4. ASSET Guidance for "Self Assessment"

5. ASSET Guidance for "Peer Review"

6. ASSET User's Manual (Extracts) 96-05-06.

7. Peer Review of the Krško NPP Self Assessment of Operational Events Reflecting Safety Performance, ASSET Report, September 1996.

8. Peer Review of the Dukovany NPP Self Assessment of Operational Events Reflecting Safety Performance, ASSET Report, October 1996.

9. Report of the Self Assessment of Operational Events Reflecting Safety Culture carried out by the Balakovo NPP, April 1997.

10. ASSET Peer Review Report of the Balakovo Self-Assessment, 3-10 June 1997.

11. Flow chart of "INES and ASSET Computerized Aids".

12. Event Root Cause Analysis Tool and Database (ERCATD), User's Manual, June 1997.

13. Report of a Consultants' Meeting to Review the IAEA Programme on Operational Safety Services as Part of the Programme Performance Assessment System (PPAS) within the IAEA", Vienna, 26-30 August 1996.

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IAEA

REPORTS ON GLOBAL ACTIVITIES
OF THE INTERNATIONAL
ATOMIC ENERGY AGENCY
VIENNA, AUSTRIA

Newsbriefs

Volume 11, Number 4 (73)
NOVEMBER/DECEMBER 1996

ASSET safety service marks 10th anniversary

ANALYSIS AND SCREENING OF SAFETY EVENTS TEAM (ASSET). Since the service started a decade ago, the IAEA has organized 120 nuclear safety missions to more than two dozen countries within the framework of its ASSET programme. The service was launched in 1986 to assist countries having nuclear power plants in areas of safety assessment and analysis. Missions completed so far have included 69 training sessions in 28 countries to demonstrate the practical use of ASSET analysis procedures, and 51 analytical missions in 19 countries that focused on assessing the root causes of safety prob-

lems that have affected the plant's operational safety. Krsko nuclear power plant in Slovenia hosted the first ASSET mission in 1986 and it was the site where ASSET experts recently conducted a mission marking the 10th anniversary of the service.

ASSET was initiated shortly after the Chernobyl accident in 1986, and at the time the idea of having IAEA expert teams invited to assess operational events at nuclear power plants was viewed as quite progressive for an intergovernmental organization. Over time, operating organizations and nuclear plant regulators became attracted to ASSET's technical procedures for analyzing root causes and to the usefulness of conclusions directed at the prevention of incidents. By 1990, the ASSET analytical process started to be used as a technical tool to enhance the performance of a plant's operational safety. A notable case in point was Germany's request for an ASSET mission to the Greifswald nuclear plant before its decision to close down four WWER 440/230 operating units and to stop construction of four WWER 440/213 units.

The ASSET methodology has not changed over the past decade and still provides guidance on how to answer the basic questions: What happened? Why did it happen? Why was it not prevented? However, the specific uses of the ASSET methodology have changed dramatically over the years to meet the needs of operating and regulatory organizations. Early on, the IAEA anticipated that Member States would mostly be interested in the analysis of root causes for single events of higher significance to plant safety. In fact, requests from Member States were directed to the application by ASSET teams of the analysis procedures to the whole population of operational events, especially deviations of little or no significance. This was because the analysis of such events is known to provide the basis for enhancing efforts for the prevention of incidents and accidents.

In 1994, in recognition of the progress made in plant analysis capabilities and incident prevention, IAEA Member States urged the ASSET service to shift its emphasis to the promotion of plant self-assessments of safety performance. This should be done, they said, on the basis of the analysis of the operational events which reflect safety problems or deficiencies in safety culture and in association with peer reviews of the self-assessment results by international ASSET teams. This feature is now receiving greater attention as States work to comply with their reporting commitments in the framework of the international Convention on Nuclear Safety.— *More information may be obtained from the IAEA Department of Nuclear Safety.*

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ATTACHMENT 3

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WORKING GROUP "A" (KRŠKO NPP)

Task 1: Provide suggestions to refine, whenever necessary, the ASSET guidance for plant Self-Assessment and the associated ASSET Peer Review process.

1.1. Population of Operational Events Considered

(a) Are the population of operational events a good representation of what happened at the plant?

The plant has considered a population of 450 events over a period covering 1991 to 1995 inclusive. Of these events 44 were reported to the regulatory body and 406 to plant management. Of these 322 events were considered to be safety relevant and "self-assessment" was completed on all events.

The self-assessment identified 216 events as discovered by surveillance (good events) all rated at INES Level 0 and 106 events as originating from operational process (bad events) of which 4 events were INES Level 1 and 102 events INES Level 0.

This group concludes that the Krško selection of events was a good representation of the safety relevant events.

(b) Are there any missing events?

The question needs to be redefined as "were there events at the plant that could have been usefully included in the review?" For Krško they have defined in their report that they did not select all of the non-safety relevant events for the review. IAEA should consider providing guidance on selection, screening and analysis of the lower level events to try and capture precursors to higher level events/incidents.

(c) Were there any difficulties for the plant in assessing this task?

It was not difficult for the plant to transfer the technical presentation of analysed events including training for this ASSET, but it was highly manpower intensive, i.e. 10 man months.

IAEA should consider accepting that a plant can use its own methodology for event analysis providing it addresses the seven basic ASSET questions and defines the system, and any training required, prior to ASSET arrival at the plant and that such a system uses an appropriate database. This group, however, recommends that for plants without a developed event analysis system that the ASSET methodology be adopted.

1.2. What could be learned to improve the ASSET self-assessment process?

(a) Are you satisfied with the events reflecting operational safety performance at Krško?

The groups considers that the events selected were representative of the pending safety problems.

(b) Are you satisfied with the selected events for root cause analysis?

Krško have presented their selection of 10 events in their report. The selection of events was based on a logical, well defined screening process that was based not only on safety significance but included clusters of more low level events (precursors). Group A is very satisfied with the Krško approach.

(c) Were there any difficulties in assessing this task?

No.

1.3. Thoroughness of the Action Plan

(a) Are you satisfied with the listed action for implementation?

In general, the plant addressed the Action Plan well. But as the report identified an independent review by "experts" can always enhance on Action Plan.

(b) Were there any difficulties for the plant in assessing this task?

No specific problems were encountered.

1.4. Working schedule of the ASSET Peer Review

What are your comments on this working schedule?

(a) The number of days

The five day schedule was not sufficient for the programme defined for the Krško ASSET to be completed within reasonable working hours.

(b) The length of review sessions

At Krško the staffing of the operational experience group complemented the ASSET team hence review sessions were not a problem.

(c) The content of the programme

The content was very comprehensive and difficult to achieve in a 5 day schedule. It is understood that later missions have included a weekend as a buffer and this group supports this approach.

Task 2: Recommendations to IAEA regarding ASSET and other services

2.1. What are your observations on and comments to the recommendations made regarding ASSET services in the 1996 Consultants' Meeting?

Group A agrees with the paragraph in the Executive Summary of the 1996 Consultants' Meeting report: "The ASSET assistance provided to a number of member countries whose power plant has resulted in measurable improvements in their performance. The Agency should continue to promote the ASSET assistance programme which to date has helped achieve measurable improvements in the performance of a number of NPPs. The Agency should ensure that adequate services are available to meet future requests."

2.2. Suggest a list of possible improvements/enhancements

1. IAEA should consider providing guidance on the selection, screening and analyzing of the "non relevant safety event" population. This will identify possible precursors to events/incidents.

2. As part of 1 above, it would be helpful to define how far back it is recommended to go to screen the plant event database.

3. IAEA should incorporate into its guidelines the ability to accept a plant's or nation's Event Analysis system, provided that it answers the seven basic ASSET questions. If this approach is accepted for the ASSET mission the details of the plant's event analysis system must be advised to team members prior to the mission taking place.

4. Plants should be encouraged to include in their Action Plan details of persons responsible for ensuring milestones are achieved.

2.3. Action Plan

1. Co-ordination of all assistance programmes to plants must be encouraged to <u>ensure that duplication is eliminated as far as is reasonably practicable.</u>

2. ASSET is supported and used by the utilities and has responded to their changing needs. <u>Staffing level of its IAEA team should be sufficient to enable the demand to be met.</u>

3. ASSET should be retained at a level and content that meet the users' needs. The 1996 consultancy services report identifies ASSET as a key safety enhancement approach.

4. ASSET follow up missions should only be at the request of the utility.

5. IAEA must maintain the ability to react to users' needs and be capable of recruiting suitable staff to form "Peer Review" teams.

6. Group A does not support the merging of the IAEA services (ASCOT, ASSET and OSART), user demand should set the requirement, or not, of a service.

7. Training and appropriate experience are an essential ingredient for any IAEA service. It is also important that "Team Building" is encouraged before each mission and should include any training for the plant specific methodology if this is being used.

8. It is important that ASSET, OSART, ASCOT retain their individuality. Without this the foresight and ownership aspects will be lost and the services will not then be required by the utilities.

WORKING GROUP "B" (DUKOVANY NPP)

Task 1: Provide suggestions to refine, whenever necessary, the ASSET guidance for plant Self-Assessment and the associated ASSET Peer Review process.

General: The Group considered it more appropriate to comment the ASSET process and how it worked at the Dukovany plant. Therefore, the Group did not consider the results of the Dukovany self assessment. The general feeling was that it is not possible to reach conclusions in a few hours more valid than the conclusions of the Peer Review team.

1.1. Population of operational events considered

One of the difficulties encountered is how to transfer plant procedures to ASSET guidelines. The conclusion of the Group was that this is the task of the plant. If the plant procedures are not adopted to ASSET methodology it is important that the Peer Review team has a chance to learn the procedures of the plant before the peer review.

The Group suggests that the Agency considers some "good examples" of reporting criteria to be included in the ASSET Guidelines.

It was pointed out by the Group that the INES classification may be too limited. Problems with low significant safety events might be discarded. Another problem is how "near misses" are recorded.

Recommendation: It would be helpful if the self assessment could be supported by experts in the beginning of the self assessment (after selection of Pending Safety Problems). Input from experts at that stage can enhance the value of the report. This recommendation is also relevant to task 1.2.

1.2. Identification of the Pending Safety Problems

The criteria for selection of the Pending Safety Problems are not clearly defined in the ASSET Guidelines. Therefore, the Group recommends that the Agency improves the Guidelines in this aspect.

It was pointed out that the problem with "home blindness" may be more difficult to cope with after the ASSET missions have changed to a Peer Review of a plant self assessment. However, the Group recognizes the benefits of a self assessment and suggests that the Peer Review group is observant on the risk of "home blindness".

1.3. Thoroughness of the Action Plan

The experience of the Dukovany plant was that very few of the actions was the result of the ASSET work. Most of the problems were already known. However, this is also a confirmation of the validity of the plant procedures.

It is important that the action plan of the plant self-assessment includes priorities and time table for implementation.

1.4. Working Schedule of the ASSET Peer Review

The Group felt anonymously that a peer review of only five working days is too short. In Balakovo the programme also included a weekend, which could be used as a buffer for the work not possible to finish previous days. The general feeling in the Group was that this should be sufficient.

The Group recommends that during the ASSET process the same version of the ASSET Guidelines is used.

The Group had no further suggestions on how to improve the agenda for the Peer Review team. However, it is important for both the Peer Review group and plant counterparts to be given sufficient time to discuss specifics.

Task 2: Recommendations to IAEA regarding ASSET and other services

The Group also considered the recommendations concerning ASSET in "Report of a Consultants' Meeting to review the IAEA programme on Operational Safety Services as part of the Programme Performance Assessment system (PPAS) within the IAEA", Executive Summary and Section 2. The following comments are given:

* The Group felt that WANO services are different from the ASSET mission. It is the decision of the nuclear power plant management to ask for respective service.

* As long as the demand for the ASSET service exists it is obvious that adequate resources are necessary to perform good ASSET service to the power plants. The Group felt that there are several reasons to continue ASSET missions:

  - independent verification of the plant's own feedback system
  - enhance the existing system
  - an answer to the public demand for the evaluation of safe operation
  - safety indicators improved after ASSET missions
  - ASSET helps to avoid "home blindness"
  - to improve international credibility of the plant safety.

* The group disagreed with the recommendation that the ASSET mission should be mixed and/or matched together with OSART and ASCOT. The ASSET work is very systematic and cannot be broken down to smaller pieces. However, it is important that plant requests are satisfied to the extent possible. The purpose of each programme should be stated clearly.

* The Group felt that follow-up missions should be on demand from the customer, i.e. the plant owner.

* The group supported the recommendation that the professionalism of the ASSET Group at the Agency is maintained and appropriate training is provided to the ASSET group at the Agency. Resources and professionalism is vital for a continued interest in the ASSET missions. It is also important that at least one of the experts in each group in the Peer Review team has experience of ASSET missions. However, it is preferable that the two group leaders of the Peer Review team have experience of ASSET missions.

* The Group disagreed strongly on the recommendation that the programme groups ASSET, ASCOT and OSART should be merged together. We feel that there is a risk that the competence will be diluted. However, it may be useful for experts in one program group to gain insight in other programmes by occasionally joining in the missions in those programmes.

WORKING GROUP "C" (BALAKOVO NPP)

Task 1: Suggestions to refine the ASSET guidance for Plant Self-Assessment and the associated Peer Review process

1.1. Review of the experience and feedback from "Population of operational events considered" (Section 2 of the Balakovo Self-Assessment report)

(a) For a time period of 3 years 133 events were reported from the four Units of Balakovo NPP (WWER-1000 reactors) in accordance with the reporting criteria. 23 out of a population of 133 events reported fell into the category of safety relevant events. Within this population the dominant portion had a degradation of defence-in-depth related to inoperability of equipment, which is not consistent with the international experience, where failures due to the procedures and personnel are the dominant.

The population of operational events was considered by the group to be a good representation of what happened at the plant.

(b) The number of internally reported events is relatively low when compared with the international experience. The thresholds for internal reporting are fairly high which does not facilitate the integrated collection of a wide scope of events from which latent weaknesses could be better identified. Many minor events are reported into the various department logs. The trends of minor events have not been used as a specific indicator of safety culture issues.

(c) There was no evidence for some serious difficulties for the plant in assessing this task. The main problem is related to the plant monitoring and trending of indicators of safety culture. The third safety culture indicator: prevention of recurrent failures (capability of learning lessons from plant safety issues) was not calculated by the plant. As a result the capability of plant staff to learn lessons from safety relevant events cannot be assessed. The main reason for the above mentioned difficulties is the fact that the third safety indicator is not very well described in the ASSET Guidance for Plant Self Assessment. Obviously some additional clarifications of this indicator are needed.

1.2. Review of the experience and feedback from "Identification of pending safety problems"

(a) The list of pending safety culture problems is developed on the basis of the screening of the events by the means of the Table of Self-Assessment of Operational Events. The pending safety problems are identified in the areas of the three main aspects of the safety culture, namely:

- identifying safety problems;
- assessing their safety significance; and
- learning the lessons.

During the peer review of the self-assessment it was found that the NPP did not take into account the corrective actions sufficiency and implementation, the list of still pending safety problems could be significantly reduced. It was considered that although the control and insertion time problem is generic for WWER-1000 reactors, effective compensatory measures had been taken in the meantime and it reduced the number of events to one, which could not represent a family of recurrent failures. It was also considered that some pending safety problems identified by the plant have been already solved or have low safety significance, or did not cause events and, therefore, they are not a part of the population of events analysed.

It was noted that capability and load factors are not always appropriate for indicators of safety problems because they depend on the demand of the national grid. In this respect, more strict indicators could be proposed in the ASSET Guidance in order to properly assess the management impact on the plant reliability.

(b) The main difficulties for the plant in assessing this task have been mainly related to the defining of the real list of still pending safety problems, assessing their significance for the plant safety and reliability, and finally, with ranking and prioritization of the problems.

1.3. Review of the experience and feedback from the "Thoroughness of the Action Plan"

(a) The plant Action Plan is not defined in the three areas of overriding priority described in the safety culture definition. Some proposed corrective actions are of a general nature. The Action Plan does not contain any proposed timescales for completion of the actions. The prioritization of pending safety problems is not taken into account in the plant Action Plan.

1.4. Review of the "Working schedule of the ASSET Peer Review"

(a) Longer duration of the mission would allow experts to become more familiar with the plant situation in terms of events reported and then to peer review of the plant self assessment and to draft the report.

(b) The morning and afternoon review sessions could be extended in order to have enough time for discussions with the plant counterparts.

(c) ASSET experts should be well prepared before the mission (they should be familiar with the ASSET process for analysis of the consequences and causes of operational events, reflecting different aspects of the NPP safety). The ASSET experts should have enough time to discuss the tasks before starting the peer review of the self assessment.

Task 2: Observations on the recommendations made regarding ASSET and other services

2.1. Observations and comments to the recommendations made regarding the ASSET service

Recommendation: ASSET - Close co-ordination with WANO is suggested to prevent the development of unnecessary duplicated services.

Comment: There is no danger of development of duplicated services. Both ASSET and WANO missions are requested by the customers. This is the customer's right to choose the service.

Recommendation: ASSET - The Agency should ensure that adequate resources are available to meet all future requests.

Comment: The IAEA should ensure that appropriate resources (manpower and funds) are available to meet all the requests of the customers. It appears in this review that there is an imbalance of resources allocated to different services (ASSET and OSART).

Recommendation: ALL - Services can be improved by tailoring them to meet requested need, including not only the use of OSART modular concepts but also the mixing and matching of the programmes. All three programmes can be enhanced by the sharing and use of their individual current techniques.

Comment: The working group strongly disagrees with the recommendation. Sharing and use of the individual current techniques is not appropriate.

Recommendation: All - A follow-up of all missions within a reasonable interval to ensure the expected results are being achieved and/or identified issues are appropriately addressed.

Comment: The IAEA could recommend the customers to conduct follow-up missions. The decision to invite follow-up missions rests with the customer.

Recommendation: All - Maintain the ability to assess the integrated activities of the NPPs. The continuing retention and attraction of competent, professional team leaders is essential.

Comment: The team leaders should be the IAEA professionals from the relevant services. IAEA should avoid inviting as a team leader professionals from other services.

Recommendation: All - Significant improvements by aligning the separate programmes under a single working level management to more effectively co-ordinate the integration and management of these programmes.

Comment: The working group supports the recommendation.

Recommendation: All - Training the appropriate staff to be capable of in the techniques applied by the three programmes.

Comment: The staff could be acquainted with the techniques applied by the three programmes in order to improve his knowledge and proficiency.

Recommendation: All - Interchangeably assigning the appropriate staff to the three programmes as needed.

Comment: The working group does not support the recommendation. The WG is of the opinion that the necessary permanent professional ASSET staff should be kept in order to ensure the quality of the services maintained to the customer's requirements.

Recommendation: All - Continuously upgrading the appropriate staff proficiency to enhance programme objectives.

Comment: The WG supports the recommendation.

Recommendation: All - IAEA better co-ordinate ASSET and OSART activities and clarify and define any possible potential duplication with WANO and thus minimize these duplications.

Comment: The same opinion as for recommendation concerning WANO missions.

Recommendation: Assign resources to ASSET taking into account its great positive influence at NPP's performance and self-assessment process.

Comment: The WG has additional proposal to the above recommendations: The IAEA should continue its ASSET services, and thereby, respond to the needs of the customers. At the same time, it is not recommended to use the staff dedicated to other types of the IAEA safety services in ASSET activities on the case by case basis because this could result in the dilution of ASSET service professionalism.

2.2. Priority list of recommendations

The WG suggests the following priority list of recommendations:

1. The IAEA should continue its ASSET services, and thereby, respond to the needs of the customers.

2. The IAEA should ensure that appropriate resources (manpower and funds) are available to meet all the requests of the customers of the ASSET services for 1997, 98 and 99, as well as for future requests.

3. It is not recommended to use the staff dedicated to other types of the IAEA safety services in ASSET activities on the case by case basis because this could result in the dilution of ASSET service professionalism.

4. All other recommendations listed in the same order as in the Report of a Consultants' Meeting (26-30 August 1996).

2.3. Action Plan

The first two recommendations are of highest priority and they should be considered by the IAEA as soon as possible, but not later than the end of 1997. The high confidence of the customers and good reputation of the ASSET services should not be discredited.

3f

ATTACHMENT 4

PRESENTATIONS BY PARTICIPANTS

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XA9745014

- THE ASSET SERVICE -

WILL ANOTHER ACCIDENT

OCCUR

in the

NUCLEAR INDUSTRY?

- - - - - -

IN WHICH

COUNTRY ?

- - - - -

W H E N ?

B. Thomas, IAEA
ASSET Workshop
24 - 26 June 1997

- THE ASSET SERVICE -

PREVENTION of ACCIDENTS

is the

CHALLENGE

of

NUCLEAR INSTALLATIONS

MANAGEMENT

- - - - - - - - - -

- **Prevention of incidents**
- **Prevention of failures during operation**
- **Prevention of degradations (safety issues, safety problems, weaknesses, deficiencies, etc...)**
- **Quality Control (Meeting acceptance criteria)**
- **Preventive Maintenance (Foreseen degradations)**
- **Surveillance Periodic Testing (Unforeseen degradations)**

45

PROMOTION

of

SELF ASSESSMENT

of

NUCLEAR POWER PLANT

SAFETY

GUIDANCE FOR OPERATIONAL EVENTS

CONSEQUENCES and CAUSES ASSESSMENT

INES RATING PROCEDURES

ROOT CAUSES ANALYSIS PROCEDURES

HISTORICAL DEVELOPMENT
OF THE USE OF
THE ASSET METHODOLOGY
AS A
MANAGEMENT TOOL

FROM 1995

SELF-ASSESSMENT
(BY PLANT STAFF)

TO ASSIST IN

KEEPING
NUCLEAR INSTALLATIONS

SAFE
(NO FAILURE DURING OPERATION)

****

FROM 1986 TO 1994

EXTERNAL-ASSESSMENT
(BY OUTSIDE SPECIALISTS)

TO ASSIST IN

MAKING
NCULEAR INSTALLATIONS
SAFER

45

GUIDANCE for SELF ASSESSMENT

I) WHAT ARE THE PENDING SAFETY PERFORMANCE OR SAFETY CULTURE PROBLEMS?

II) HOW IMPORTANT?
(Significance to safety, reliability, etc....)

III) WHY DID THEY HAPPEN?
(Direct Cause)

IV) WHY WERE THEY NOT PREVENTED?
(Root Cause)

V) HOW TO ELIMINATE THE SAFETY PERFORMANCE OR SAFETY CULTURE PROBLEMS? (Repairs)

VI) HOW TO PREVENT THEIR RECURRENCE?
(Remedies)

VII) WHAT CORRECTIVE ACTIONS SHOULD BE IMPLEMENTED?
(Action Plan)

B. Thomas
The ASSET service
1996

THE ASSET METHODOLOGY

1986 - 1996

DISTURBANCES TO

NUCLEAR INSTALLATIONS

SAFETY PERFORMANCE

(1) WHAT HAPPENED?: EVENTS

OCCUR AND RECUR

BECAUSE OF

SAFETY PROBLEMS

(2) WHY DID IT HAPPEN?: DIRECT CAUSES

DUE TO

SAFETY CULTURE

(3) WHY WAS IT NOT PREVENTED?: ROOT CAUSES

B. Thomas
THE ASSET SERVICE

EVENTS OCCUR

BECAUSE OF

UNRELIABLE PREVENTIVE MEASURES

EVENTS RECUR

BECAUSE OF

INEFFECTIVE EXPERIENCE FEEDBACK

OPERATIONAL EVENTS TO BE REPORTED

GOOD EVENT	**BAD EVENT**
RESULTS FROM A "DEFICIENCY" IN	RESULTS FROM A "FAILURE" OF
• PERSONNEL PROFICIENCY • PROCEDURE ADEQUACY • EQUIPMENT OPERABILITY	• PERSONNEL • PROCEDURE • EQUIPMENT
WHILE BEING TESTED OUT OF OPERATION	WHILE WORKING DURING NORMAL OPERATION
SURVEILLANCE PROGRAM FOR	**MONITORING PROGRAM** FOR
PERIODIC ASSESSMENT OF OPERABILITY, ADEQUACY, PROFICIENCY (STAND BY ELEMENTS = DEFENCE IN DEPTH = SAFETY FUNCTIONS = HARD + SOFTWARE)	EARLY DETECTION OF FAILURES OF THE OPERATING ELEMENTS
PERIODIC TESTING • PERSONNEL • PROCEDURES • EQUIPMENT	**PARAMETERS MONITORING** • MEASUREMENTS • RECORDS, TRENDS • ALARMS • ETC. ...

THE ASSET METHODOLOGY (I)

- SAFETY -

(1988 DOC-INSAG 3 - BASIC SAFETY PRINCIPLES)

FUNDAMENTAL SAFETY OBJECTIVES

NO ACCIDENT

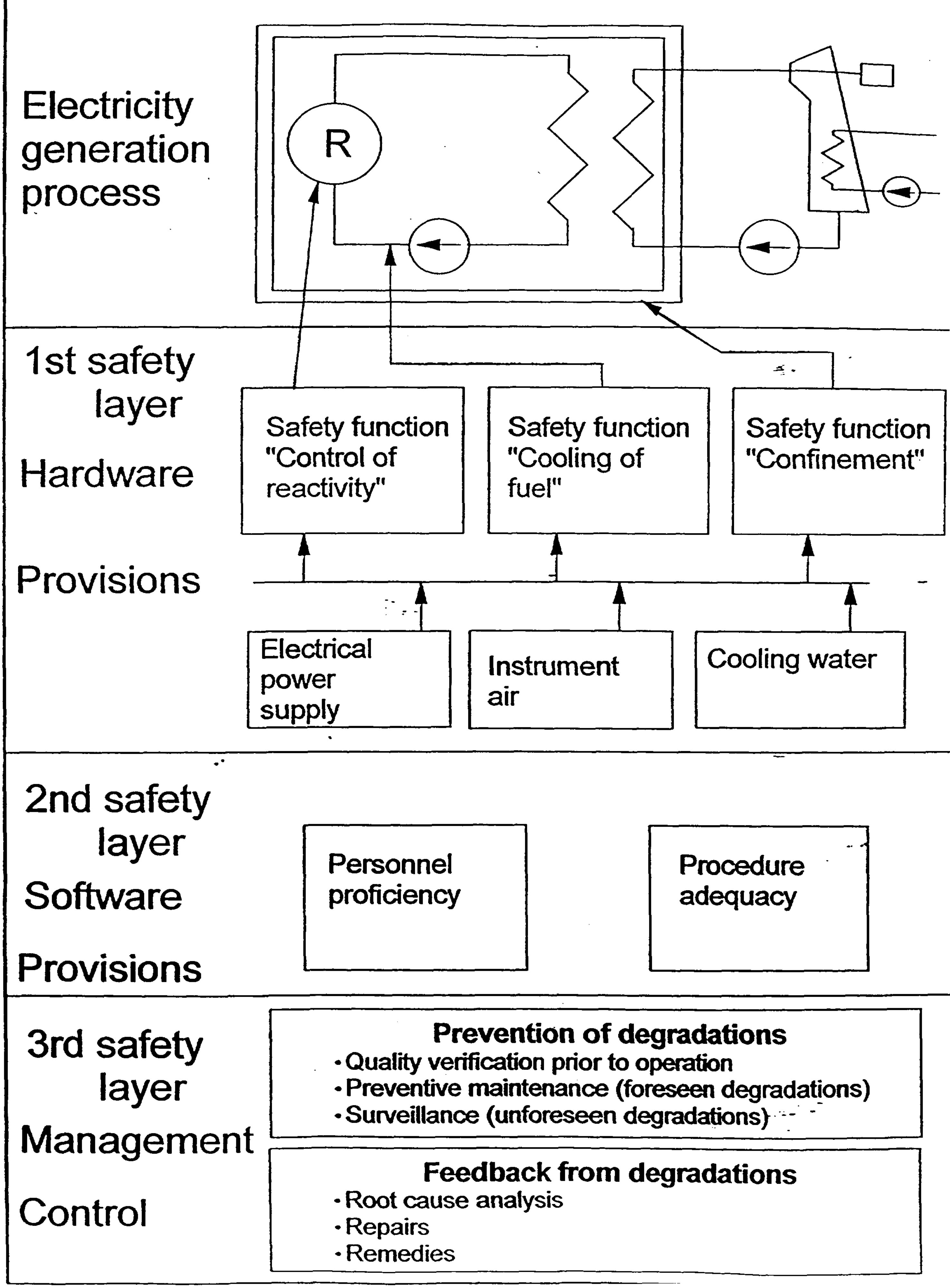
IS MET BY DEPLOYMENT OF AN EFFECTIVE

DEFENCE IN DEPTH

AS A RESULT OF A SOUND

SAFETY CULTURE

Plant defence in depth



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bthomas.93

SAFETY CULTURE

IS THAT ASSEMBLY OF CHARACTERISTICS AND ATTITUDES IN ORGANIZATIONS AND INDIVIDUALS WHICH ESTABLISHES THAT, AS AN OVERRIDING PRIORITY, NUCLEAR POWER PLANT **SAFETY ISSUES** RECEIVE THE **ATTENTION** WARRANTED BY THEIR **SIGNIFICANCE.**

(INSAG, "Safety Culture" 1991)

COMMON UNDERSTANDING (operators and regulators)

- **SAFETY ISSUES** SHOULD BE IDENTIFIED
- **SIGNIFICANCE TO SAFETY** SHOULD BE ASSESSED
- **ATTENTION** SHOULD BE PAID THROUGH SYSTEMATIC ROOT CAUSE ANALYSIS

WITH A VIEW TO ENHANCING

PREVENTION OF ACCIDENTS,

THE PRIMARY **SAFETY OBJECTIVE**

ANALYSIS OF

EVENTS, PROBLEMS, ISSUES, ETC....

THERE IS ONLY

ONE

ANALYSIS METHOD

(NRC, INPO, HPES, MORT, ... ASSET, ...ETC.)

****

TO ANSWER ACCURATELY

THE 3 BASIC QUESTIONS

(1)	WHAT FAILED?	(PERSONNEL, EQUIPMENT PROCEDURE)
(2)	WHY DID IT FAIL?	(DIRECT CAUSES)
(3)	WHY WAS IT NOT PREVENTED?	(ROOT CAUSES)

****

TO LEARN FROM OPERATIONAL FAILURES

TO PREVENT

ACCIDENTS

√3

OPERATING EXPERIENCE FEEDBACK

ANY FAILURE
(EQUIPMENT, PERSONNEL, PROCEDURE)

THAT OCCURS DURING OPERATION

REQUIRES

IMPLEMENTATION OF

AT LEAST

FOUR CORRECTIVE ACTIONS

ONE — **To eliminate the latent weakness of the element that failed.**

THREE — **To prevent recurrence of similar failures by enhancing effectiveness of the programmes related to:**

- **Quality verification or preventive maintenance**
- **Detection or restoration of weaknesses**
- **Surveillance or feedback policies**

The ASSET service
B. Thomas 1996

OPERATIONAL SAFETY

ASSESSMENT TECHNIQUES

- - - - - - - - - - - -

- Problems may be generic

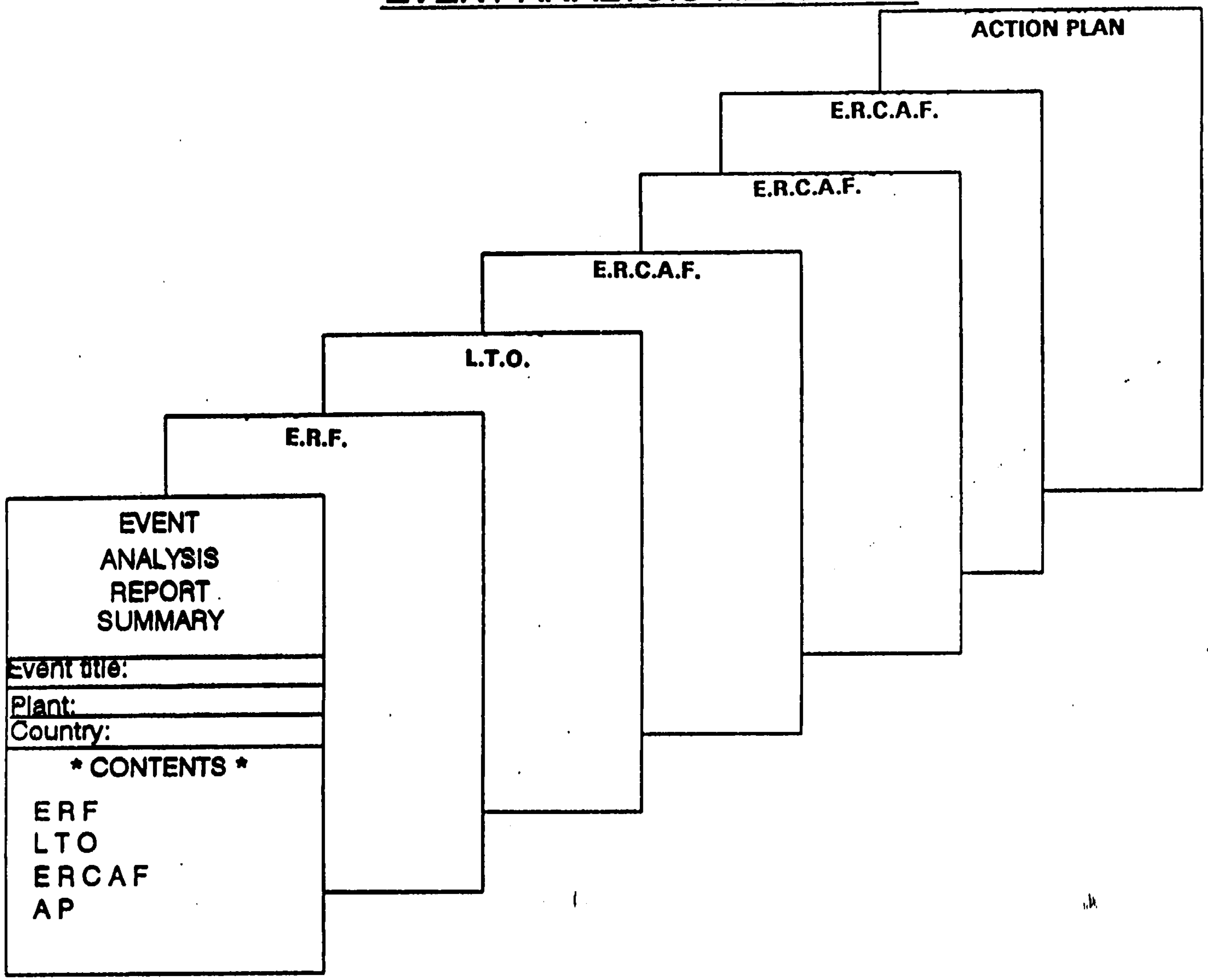
however

- Recommendations are always specific to each nuclear power plants

because

They are meant to complement the existing provisions already implemented by plant management.

ASSET
EVENT ANALYSIS REPORT



J P

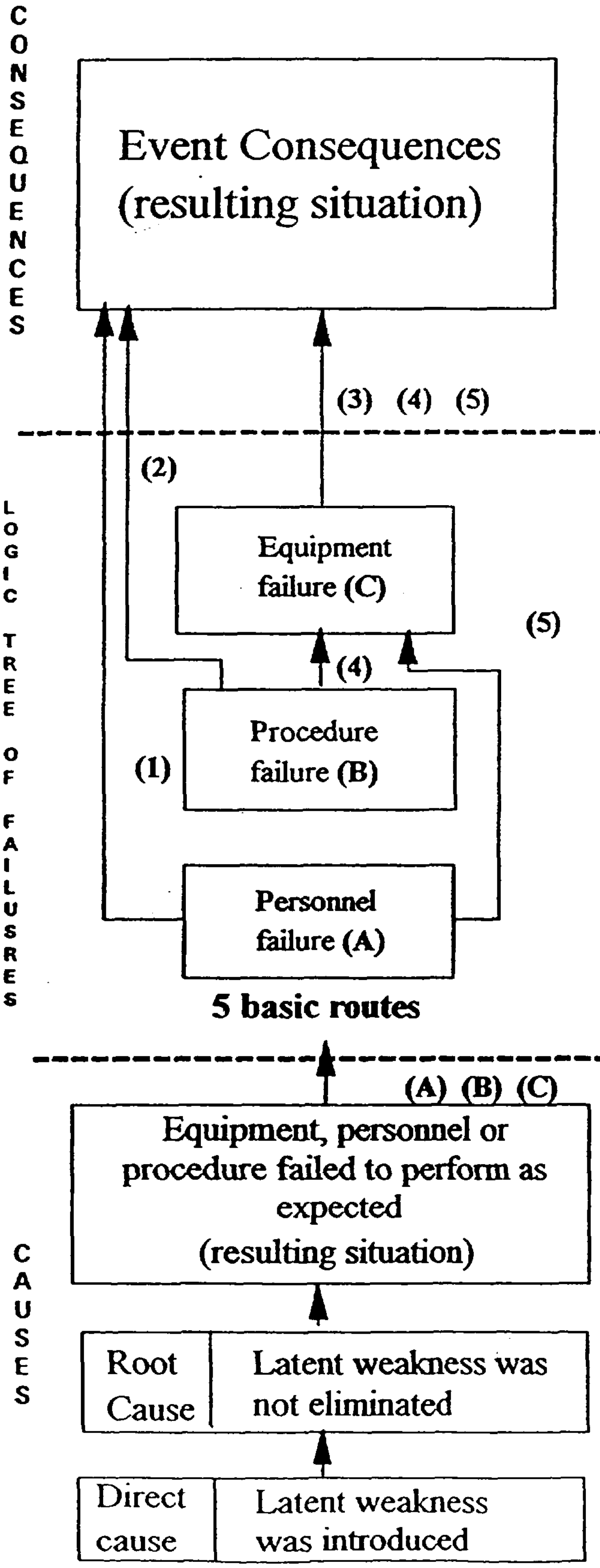
The ASSET Service Experience (1986-1996)

B. Thom

(Analysis and Screening of Safety Event Teams

Learning from operational failures to prevent accident

EVENTS MECHANISM
Dominant Consequences, Failures, Causes



Dominant Consequences of Failures	
Off-site impact	1%
On-site impact	1%
Degradation of defence in depth	98%

Dominant Failures What failed?		
Equipment	I & C 10% Electrical 5% Mechanical 5%	20%
Procedure	Operating 5% Maintenance 20% Testing 5%	30%
Personnel	Operating 5% Maintenance 40% Testing 5%	50%

Dominant Causes of Failures		
Safety Culture: (INSAG 4, 1991)	1. Identification of safety issues 2. Assessment of significance 3. Learning the lessons	
Direct cause Why did it fail? The weakness was introduced due to:	Quality verification (Prior to operation)	50%
	Preventative maintenance (During operation)	50%
Root Cause: Why was it not prevented? The weakness was not eliminated due to:	Detection capability (Surveillance)	70%
	Correction capability (Feedback)	30%

√7

GUIDANCE
FOR
ASSET
PEER-REVIEW

---

1) COMMENTS OF THE ASSET ON THE PLANT SELF-ASSESSMENT RESULTS:

   - ANSWERS TO THE 7 BASIC QUESTIONS

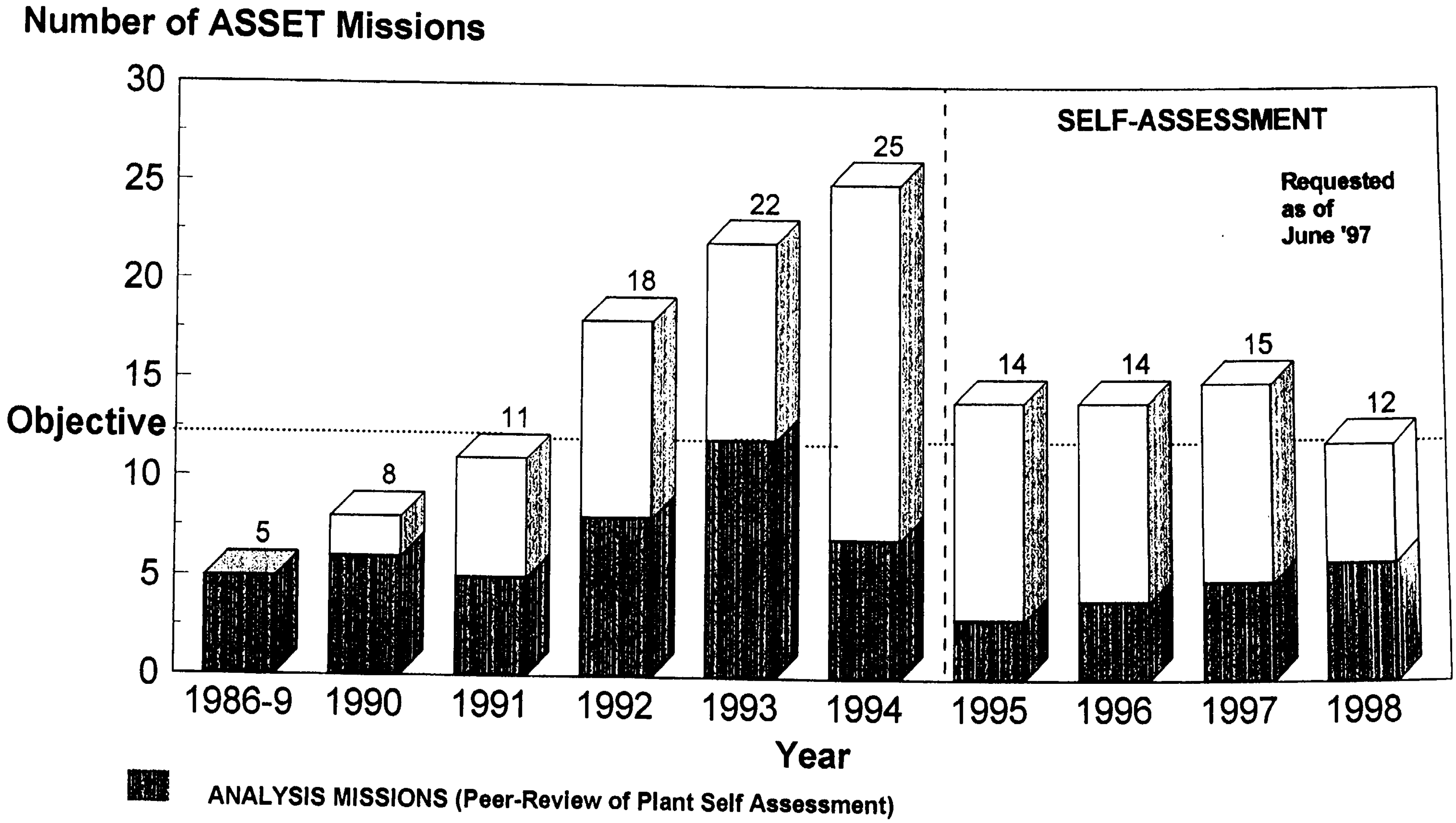
2) CONCLUSIONS OF THE ASSET PEER-REVIEW

   - THOROUGHNESS
   - PLANT DEFENCE IN DEPTH
   - PREVENTION OF DEGRADATIONS
   - FEEDBACK FROM DEGRADATIONS
   - PLANT SAFETY CULTURE
   - ASSET RECOMMENDATIONS

3) RESPONSE OF THE OPERATING ORGANIZATION TO THE ASSET RECOMMENDATIONS

B. Thomas
The ASSET service
1996

ASSET MISSIONS CONDUCTED AT THE REQUEST OF THE IAEA MEMBER STATES



- THE ASSET SERVICE -

• TRENDS ON SELF ASSESSMENT

REQUESTS FOR TRAINING SEMINARS:

1995	1996	1997	1998
China	Slovakia	Russia	Russia
Russia (Kursk)	Russia	Ukraine	Russia
Czech Rep.	Slovenia	Bulgaria	Russia
Sweden	Bulgaria	Romania	Ukraine
Hungary	Switzerland	Armenia	Ukraine
Bulgaria	Kazakstan	Hungary	Ukraine
Russia (Smolensk)	Ukraine	Spain	
Ukraine (Chernobyl)	South Africa	Canada	
Romania	Finland	Sweden	
Ukraine (Khmelnitski)	China	Russia	
		Kazakstan	

REQUESTS FOR PEER REVIEW MISSIONS:

1995	1996	1997	1998
Hungary	Sweden	Russia (Smolensk)	Romania
Russia	Russia	Russia (Balakovo)	Russia (Novovoronezh)
	Slovenia	Ukraine (Rovno)	Russia (Kalinin)
	Czech Rep.	Bulgaria (Kozloduy)	Ukraine (S. Ukraine)
			Ukraine (Chernobyl)
			Ukraine (Khmelnitski)

PROCEDURE FOR EVALUATION OF THE CONSEQUENCES TO SAFETY OF NUCLEAR EVENTS

(THE INTERNATIONAL NUCLEAR EVENT SCALE)

SAFETY ATTRIBUTES												
OFF-SITE IMPACT	ON-SITE IMPACT	DEGRADATION OF DEFENCE IN-DEPTH										
		MAXIMUM POTENTIAL CONSEQUENCES										
		Level 2	Levels 3 or 4	Level 5			Levels 6 or 7					
							Did an Initiator Occur? Yes or No					
					Safety Layers Remaining	Safety Function Availability	Expected		Possible		Unlikely	
							Yes	No	Yes	No	Yes	No
* RADIOACTIVE RELEASES * DOSE TO THE PUBLIC	* DAMAGE TO CORE OR PLANT STRUCTURE * CONTAMINATION * IRRADIATION OF WORKERS	0	0	0	>3	Full	0	0	1	0	2	0
		0	0	1	3	Within OLC	1/2	0	2/3	0	2/3	0
		0	1	2	2	Adequate	2/3	1/2	2/3	1	2/3	1
		1	2	3	1 or 0	Inadequate	3+	3	3+	2	3+	1
INES LEVELS 3 TO 7	INES LEVELS 2 TO 5	INES LEVELS 0 TO 3										

- **MAXIMUM POTENTIAL CONSEQUENCES:** When the entire radioactive inventory (source term) is released to the environment.
- **SAFETY LAYERS:** Number of hardware and software barriers meant to prevent the maximum potential consequences.
- **SAFETY FUNCTIONS:** To ensure when an initiator occurs, control of reactivity, cooling of fuel, confinement.
- **INITIATOR:** Probable event selected by the designer that may disturb the basic process and require assistance from a safety function.

BULGARIA

63

Technical Committee Meeting
Annual Workshop on ASSET Experience
"Experience and Feedback from ASSET Peer Review Missions"
24-26 June 1997, Vienna, Austria

FEEDBACK FROM PEER REVIEW MISSIONS OF THE SELF-ASSESSMENT OF OPERATIONAL EVENTS REFLECTING SAFETY CULTURE" (Leningrad, Smolemsk and Balakovo NPP's, the Russian Federation)

Tinko Gantchev
Committee on the Use of Atomic Energy for Peaceful Purposes,
Bulgaria

1997

1. CRITERIA FOR REPORTING EVENTS INSIDE NPP's

Internal reporting criteria are applied for events which does not fit to criteria for reporting outside the NPP

PROBLEM AREAS:

- internal reporting criteria do not fully cover all safety relevant deviations;
- criteria are formulated in rather general way, do not always contain thresholds, values or limits;
- mechanism for reporting failures during surveillance is not clearly defined;
- criteria do not contain reporting of such events like common mode failures, failures during testing, fuel handling events;
- thresholds for reporting are relatively high;
- many minor events are investigated within departments or shops;

RESULTS:

- number of internally reported events is relatively low when compared with international experience;
- limited opportunities for integrated collection of wide scope of events from which latent weaknesses could be better identified;

2. SCREENING OF THE PLANT OPERATIONAL EVENTS

Table of Self-Assessment of operational events: As a general quality of screening is good

PROBLEM AREAS:

- **safety culture issue is not always properly defined;**
- **corrective action/sufficiency is not always identified by the plant (LNPP, SNPP);**

RESULTS:

- **pending safety problems sometimes are represented by events, for which corrective actions are defined as appropriate, comprehensive and are implemented;**

3. THIRD SAFETY CULTURE INDICATOR

Prevention of recurrent failures (Capability of leaning lessons from plant safety issues)

PROBLEM AREAS:

- indicator is not calculated by NPP's;
- trends in the number of recurrent failures during the years are not presented;
- indicator is not commented in the ASSET Guidance for Plant Self Assessment;

RESULTS:

- the capability of plant staff to learn lessons from safety relevant events can not be assessed;
- additional IAEA guidance is needed;

4. LIST OF THE PENDING SAFETY PROBLEMS

PROBLEM AREAS:

- **list of pending safety problems identified by the plant is often different from the ASSET list;**
- **NPP's do not take into account corrective action sufficiency or implementation;**
- **NPP's list of pending safety problems does not clearly define areas of the problem for the aspects: capability of assessing significance and capability of learning lessons;**

RESULTS:

- **list of pending safety problems often contains problems, which have been already solved;**
- **the majority of the pending safety problems is related to equipment failures, which is not consistent with the international experience;**

5. SIGNIFICANCE OF THE SAFETY PROBLEMS FOR PLANT RELIABILITY

PROBLEM AREAS:

- **actual significance of events is estimated through the availability and load factors, which depend on the demand of the national grid;**

RESULTS:

- **availability and load factors are not always appropriate for indicators of safety problems;**
- **management impact on plant reliability can not be properly assessed;**

6. PRIORITISATION OF THE SAFETY CULTURE ISSUES

Balance between number of improvements, resources allocated and time available should be achieved

PROBLEM AREAS:

- **lack of prioritisation of pending safety problems by the NPP's;**
- **prioritisation could be mainly based on judgement process, with respect to the importance for plant safety, reliability and economy;**
- **method of ranking the pending safety problems in terms of "relative safety impact" id not promoted for the plant self-assessment;**

RESULTS:

- **prioritisation of the pending safety problems is not contributing the development of an effective action plan;**
- **prioritisation of safety problems is not taken into account to ensure that important actions are timely implemented;**

7. ACTION PLAN

PROBLEM AREAS:

- some corrective actions are of a general nature;
- prioritisation of the pending safety problems is not taken into account;
- actions are not specified in the three areas of priority described in the safety culture definition;
- timescales for completion of actions are not defined;

RESULTS:

- action plan is not fully practicable and effective;

The ASSET Service Experience (1986-1996)

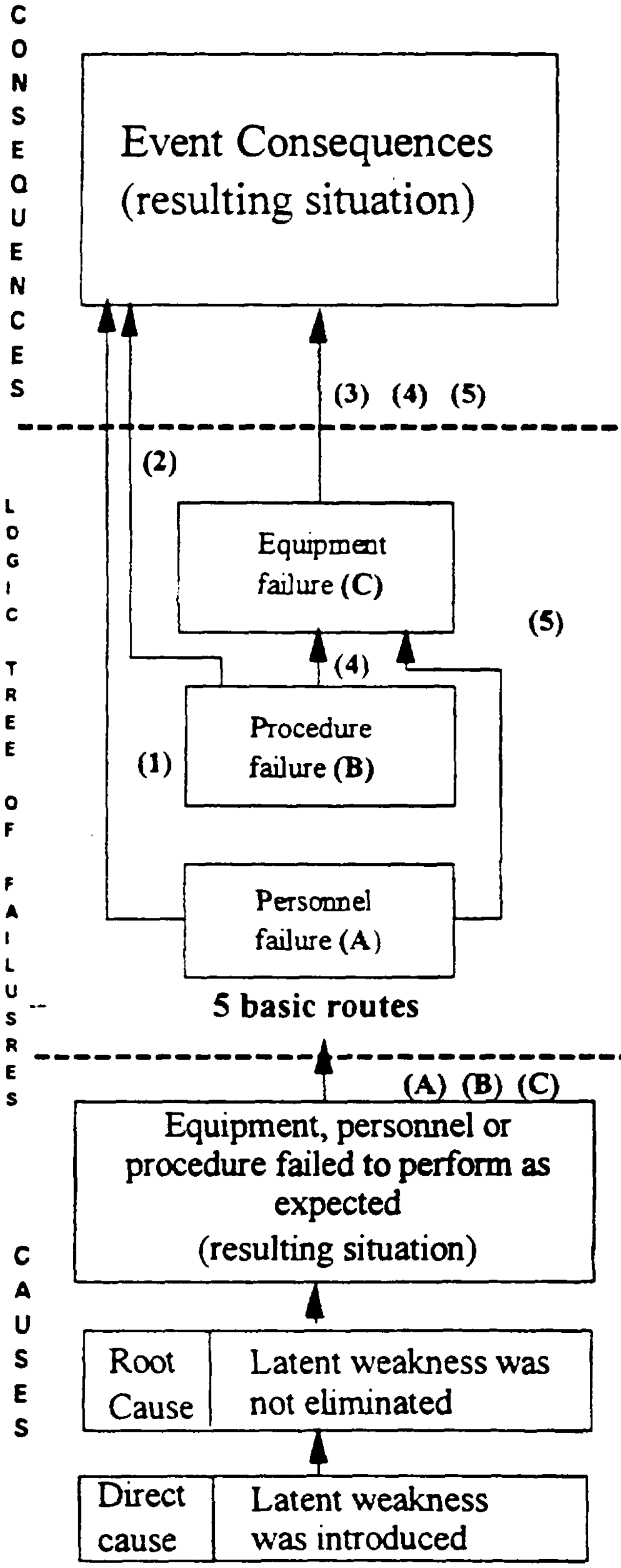
B. Thomas

(Analysis and Screening of Safety Event Teams

Learning from operational failures to prevent accident

EVENTS MECHANISM

Dominant Consequences, Failures, Causes



Dominant Consequences of Failures	
Off-site impact	1%
On-site impact	1%
Degradation of defence in depth	98%

Dominant Failures What failed?		
Equipment	I & C 10% Electrical 5% Mechanical 5%	20%
Procedure	Operating 5% Maintenance 20% Testing 5%	30%
Personnel	Operating 5% Maintenance 40% Testing 5%	50%

Dominant Causes of Failures		
Safety Culture: (INSAG 4, 1991)	1. Identification of safety issues 2. Assessment of significance 3. Learning the lessons	
Direct cause Why did it fail? The weakness was introduced due to:	Quality verification (Prior to operation)	50%
	Preventative maintenance (During operation)	50%
Root Cause: Why was it not prevented? The weakness was not eliminated due to:	Detection capability (Surveillance)	70%
	Correction capability (Feedback)	30%

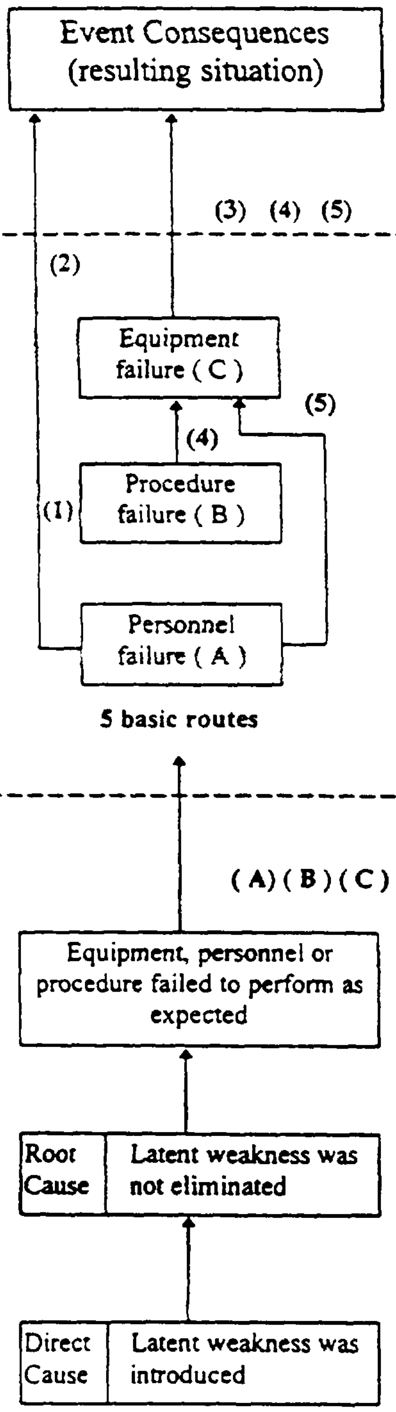
TABLE 2

ASSET MISSION TO SMOLENSK NPP
(Analysis and Screening of Safety Event Teams)
19-25 FEBRUARY 1997

Learning from operational failures to prevent accidents

EVENTS MECHANISM

Dominant Consequences, Failures, Causes



CONSEQUENCES

Dominant Consequences of Failures	
Off-site impact	0 %
On-site impact	0 %
Degradation of defence in depth	100 %

LOGIC TREE OF FAILURES

Dominant Failures What failed?			
Equipment	I&C	5 %	73 %
	Electrical	32 %	
	Mechanical	36 %	
Procedure	Operating	1 %	5 %
	Maintenance	4 %	
	Testing		
Personnel	Operating	17 %	22 %
	Maintenance	5 %	
	Testing		

CAUSES

Dominant Causes of Failures		
Safety Culture: (INSAG 4, 1991)	1. Identification of safety issues 2. Assessment of significance 3. Learning the lessons	
Direct cause **Why did it fail?**	Quality verification (Prior to operation)	29 %
The weakness was introduced due to:	Preventive maintenance (During operation)	71 %
Root Cause: **Why was it not prevented?**	Detection capability (Surveillance Testing)	38 %
The weakness was not eliminated due to:	Restoration capability (Operating Feedback)	62 %

In accordance with PNAE G-12-005-91 the events at NPPs relevant to failures and damages of equipment, erroneous actions of personnel and Unit unloading which does not fit to criteria listed above are being investigated and registrated as shop's (reported inside the plant) events in the order determined at NPP.

At Balakovo NPP the events reported inside the plant are catecorised according to the following criteria:

Criteria for events reporting inside Balakovo NPP

No.	CRITERIA
1.	Failure of equipment and system, which has led to power decrease by 25% or more during 3 hours (at rated power) or failure during operation at power level from 3 up to 25% which could lead to any power decrease for more than for 3 hours
2	Failure of water-chemical monitoring system of 1-st and 2-nd circuits
3.	Failure of equipment and systems which are caused by I&C elements failures
4	Failures of equipment or systems caused by freezing, floting or moisture ingress
5	Any deviations have to be followed by repair
6	Failures of safety system which should not be reported outside the plant according to the document on events investigation
7.	The events caused delay in planned preventive maintenance
8.	The events relevant to exceeding of determined limits of radiation safety

TABLE OF ASSESSMENT

Date 14/3/96

IAEA ASSET to Smolensk NPP   Group ____ from ____ to ____   ERCATD's Sheet No 1

1	2	3	4		5	6									7						8							9		10								11			12		
Ev. No.	Date	UNIT	Reported		Safety relevant	Attribute									INES rating						Nature of the event							Discovered by		Safety problem								Safety culture issue			Corrective action/ Sufficiency		
						Site impact					Degradation defence in depth				ASSET					NPP	Equip.			Pers.		Proc.				Safety function													
						Off		On																						Degradation				Activation									
			Out side NPP	In side NPP		a	b	c	d	e	f	g	h	i	0	1	2	3	4		Mech	Elec	I & C	Oper	Main	Oper	Main	Surv	Oper	CR	CF	C	S	CR	CF	C	S	ISP	AS	LL	Appropriate	Comprehens.	Implemented
1	28/7/93	1	X																	Out																							
2	3/8/93	1	X		X						X				X					0	X								X			X								X			
3	19/8/93	3	X		X							X				X				1				X					X	X									X				
4	19/8/93	3	X		X								X		X					0				X					X					X					X				
5	16/9/93	3	X		X						X				X					0		X							X				X							X			
6	18/9/93	3	X		X						X				X					0			X						X				X							X			
7	25/9/93	3	X																	Out																							
8	30/10/93	2	X																	Out																							
9	19/1/94	3	X																	Out																							
10	29/3/94	2	X		X								X		X					0		X	X	X		X			X					X					X				
11	6/6/94	2	X		X							X			X					0	X							X						X									
12	13/9/94	1	X		X								X		X					0				X					X					X					X				
13	5/10/94	3	X		X								X		X					0				X					X					X					X				
14	19/11/94	1	X		X							X			X					0	X						X	X						X				X					
15	28/6/95	3	X		X								X		X					0		X		X					X					X					X				
16	8/8/95	3	X		X							X			X					0		X		X					X					X				X					
17	13/9/95	1	X		X							X			X					0	X							X			X							X					
18	4/10/95	1	X		X								X		X					0	X			X			X		X			X						X					
19	7/10/95	2	X		X							X			X					0	X							X						X									
20	8/10/95	2	X		X							X			X					0	X								X														
21	8/10/95	2	X		X								X		X					0				X					X					X				X					
22	20/10/95	2	X																	Out																							
23	2/11/95	1	X		X							X			X					0	X							X				X								X			
24	4/11/95	2	X																	Out																							

a) Radiation dose to public
b) Radiation release
c) Radiation dose to personal
d) Contamination
e) Damage to reactor core

f) Inoperability of safety system
g) Operational limits and conditions
h) Procedures or personnel
i) Management systems

CR = Safety function "Control of Reactivity"
CF = Safety function "Cooling of Fuel"
C = Safety function " Confinement"
S = Safety function "Support"

ISP = Identification of Safety Problems
AS = Assessment of their Significance
LL = Learning the Lessons

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CHINA

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IAEA TCM Annual Workshop
on ASSET Experience- " Experience and Feedback
from ASSET Peer Review Missions "
24 ~ 26 June 1997, Vienna

Application of ASSET Methodology and Operational Experience Feedback of NPPs in China

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Application of ASSET Methodology and Operational Experience Feedback of NPPs in China

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The introductive presentation of ASSET methodology to China started in March 1992, 3 experts from the IAEA held the ASSET Seminar in Wuhan, China. Three years later, an IAEA seminar on ASSET Method and Operational Experience Feedback proceeded in Beijing on 20-24 March 1995. Another ASSET seminar on Self-Assessment and Operational Experience Feedback was held at Guangdong NPP site on 2-6 December 1996, the NNSA and the GNPP hosted the seminar, 2 IAEA experts, 55 participants from the NPPs, research institutes, the regulatory body(NNSA) and its regional offices attended the seminar.

1. Reporting System and Operational Events Analysis

The requirements for reporting system are specified in:

HAF0502(1) Rules for the Implementation of Regulations on the Safety Regulation for Civilian Nuclear Installations of the People's Republic of China,

Part Two: Safety surveillance of Nuclear Installations

HAF0502(1)-1 Appendix One:

The Reporting System for Operating Organization of Nuclear Power Plant.

(Promulgated by NNSA on June 14, 1995)

HAF0502(1)-2 Appendix Two:

The Reporting System for Operating Organization of Research Reactor

(Promulgated by NNSA on June 14, 1995)

HAF0502(1)-3 Appendix Three:

The Reporting System for Operating Organization of Nuclear Fuel Cycle Installation

(Promulgated by NNSA on June 14, 1995)

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The reports submitted by the NPPs are defined as follows:

- Regular report
- Notification of important activities
- Event report in the stage of construction
- Event report in the stage of operation
- Emergency report of nuclear accident

The International Nuclear Events Scale (INES) is widely applied for all the nuclear installations in China, including NPP, research reactors and the nuclear fuel cycle facilities.

The operational events(OEs) are reported to NNSA and its regional offices in time. The OEs are also analyzed in the responsible division of the NPP and the results of the analysis are reported to the plant management and distributed to the relevant divisions(or departments) of the plant for review, verification or monitoring respectively

The examples of the OE analysis process in the nuclear power plants are shown in Fig. 1 and Fig. 2.

2. Plant Self-Assessment

The significant operational events reported by Qinshan NPP0 (QNPP) in 1996 are listed in Table 1. The nature of the causes are listed in Table 2.

Table-1, Significant Operational Events Occurred in 1996

Classification of Events (INES)	Number of Events	Percentage (%)
Level 0	3	60
Level 1	2	40
Level 2	0	0
Total	5	100

Table-2, Nature of Causes for Significancy OEs Occurred at QNPP

Nature of Causes	Human Factor	Procedure Deficiency	Equipment Defect	Installation Problem	Design Fault	Unknown Cause	Total
Number of Events	3	0	2	0	0	0	5
Pecentage (%)	60	0	40	0	0	0	100

The significant OEs occurred at Guangdong Daya Bay NPP (QNPP) in 1996 are shown in Table 3. The nature of the causes are shown in Table 4.

Table-3, Significant OEs occurred in 1996 at GNPP

Classification of Events (INES)	Unit 1		Unite 2	
	Number of Events	Percentage (%)	Number of Events	Percentage (%)
Level 0	12	100	11	78.6
Level 1	0	0	3	21.4
Level 2	0	0	0	0
Total	12	100	14	100

Table-4, Nature of Causes for Significancy OEs Occurred at GNPP

Cause Category	Unit 1		Unit 2	
	Number of Events	Percentage (%)	Number of Events	Percentage (%)
Human Factor	4	33.3	12	85.7
Procedure Error	0	0	0	0
Equipment Defect	7	58.3	1	7.15
Installation Quality	0	0	0	0
Design Fault	0	0	1	7.15
Unknown Causes	1	8.4	0	0
Total	12	100	14	100

The OEs occurred from 1994 to 1996 are listed in Table 5.

Table-5, OEs occurred from 1994 to 1996

Year / Level	1994	1995	1996	Accumulative Total
0	20	28	23	71
1	9	7	3	19
Total	29	35	26	90
Percentage of level 1 OEs	31%	20%	11.5%	

From the last row of Table 5, it is not difficult to see that the effectiveness of the prevention of incidents was getting higher. In other word, the effectiveness ratio of the incident prevention should be 69%(1994), 80%(1995), 89.5%(1996) respectively.

The methodology of OEs analysis applied in GNPP is not 100% of the ASSET methodology, but in the OE analysis process, many steps of the analysis, for example, the root causes analysis, the application of the safety performance indicators, the safety trends evaluation, the corrective actions to be taken are reflecting the feature of ASSET methodology.

3. Regulatory activities related to the ASSET Methodology

- Review the safety performance by the Safety Performance Indicators (based on the events reports). Three indicators are:

◆ Plant safety performance- effectiveness of surveillance,

◆ Effectiveness of prevention of incidents- number of events below scale as fraction of all safety relevant events,

◆ Significance of safety relevant events- number and level of the events.

- OEs Analysis & assessment

The operational events reported by the NPPs to NNSA are analyzed and assessed by NNSA staff and the experts from the Nuclear Safety Centers (SSTC NSC and Suzhou NSC). The content of the analysises covers the direct cause, root cause, pending safety issues or recurrent failures, and the recommendations of the corrective actions.
(lists)

◆ Direct causes could be the reason from personnel, procedure, equipment and design..

◆ Root causes could be the reason from quality control, preventive maintenance, surveillance and experience feedback.

◆ Recommendation to correction or improvement should be focused on top-level management to the respective area where root cause exists .

- Safety trends analysis

Safety trends analysis is usually conducted on annual or year by year bases. The conclusions are informed to the operation organizations through the NNSA reports and the annual conversation between NNSA and the operation organizations.

- Promoting and reviewing Self- Assessment

The nuclear power plants are highly encouraged to conduct self-assessment by NNSA. GNPP conducted a workshop on self- assessment in 1996, selected 12 OEs were analyzed by the technical staff of the plant before the IAEA seminar in December 1996. QNPP is planning to conduct a self-assessment this year.

- Promoting operation experience feedback

The NNSA organizes the operational experience feedback exchange meeting annually to promote the effective operation of the feedback system of the NPPs. The inter-plant and the international exchange in operation safety experiences are getting intensive and comprehensive in China recent years. The NNSA and its technical supporting institutes have started to evaluate the effectiveness of the feedback system of the NPPs, Meanwhile, the NNSA also attaches importance to itsown regulatory practice feedback system.

- Monitoring the corrective actions and the improving plans

The performances of the corrective actions and the improving plans worked out through the OE analysis by the plant itself, and the implementation of the relevant requirements raised by the regulatory side are fully monitored in the regulatory routine inspections or a follow-up inspection.

As for the effective improving measures, by our experience, the attention should be focused on the management levels, the safety culture of the nuclear power plants staff and the interfaces between human factor, implementation procedure and the reliability of equipment at the NPPs.

4. The Operational Experiences Feedback Mechanism

The operational experience feedback system is shown in Fig.3. It contains at least four feedback Cycles as follows:

- Plant internal feedback cycle
- Inter-plant feedback cycle : operational experience exchange between NPPs

Periodical information communication and experience exchange channel between GNPP and QNPP is continuously clear, and the annual operation safety experience exchange meetings are jointly convened by QNPP and GNPP every year.

- International operational experience exchange

The GNPP has joined the WANO (in Paris) operational information exchange network and QNPP joined the WANO (in Tokyo) operational information network respectively.

- The feedback cycle covering regulatory practice on the operation safety

The feedback system of the regulatory practices in the supervision on operation safety mainly includes three sectors. they are:

- Safety review (including the review of the OEs reported by the NPPs)
- Regulatory inspection

◆ Nuclear safety regulations, safety guides and the technical documents

The feedback system through the sectors highly enhanced the effectiveness of the regulatory practice, improved the revising of the regulatory documents, the safety review process, and the continuity and the objectivity of regulatory inspection.

5. Further Consideration of Analysis and Assessment on Operational Events in the Civilian Nuclear Installations

- NNSA's independent assessments on the operational events using ASSET methodology. The assessments conducted by the regulatory body, its regional offices and its technical supporting groups are focused on the safety significant events reflecting the generic issues, and focusing on the tendency of the operation safety conditions of the NPPs.
- Review of the Plant Self-Assessment activity. The NNSA is to organize the review teams to the NPP self-assessment on operational events reflecting the safety significant topics.
- Assessment of operational events and operation experiences for the research reactors. A comprehensive analysis and assessment program on the operational events have been extended to the research reactors, the regulatory body, the operation institutions and the research institutes are involved in the program.
- Compiling relevant technical documents. The NNSA is preparing reference technical documents containing the requirements and methodology for analysis of the safety significant events.
- The topical workshops on ASSET methodology and the annual exchange meetings on the operational experience feedback will continue.
- Improvement of the operational events database.
- Enhancement of monitoring the performance and effectiveness of the corrective actions. The effectiveness and the compliance of the implementation with the improving decisions made by the plant management should be monitored and verified according to the result of

ASSET methodology and experience feedback process through the routine inspections or a special inspection.

OEs Analysis in QNPP

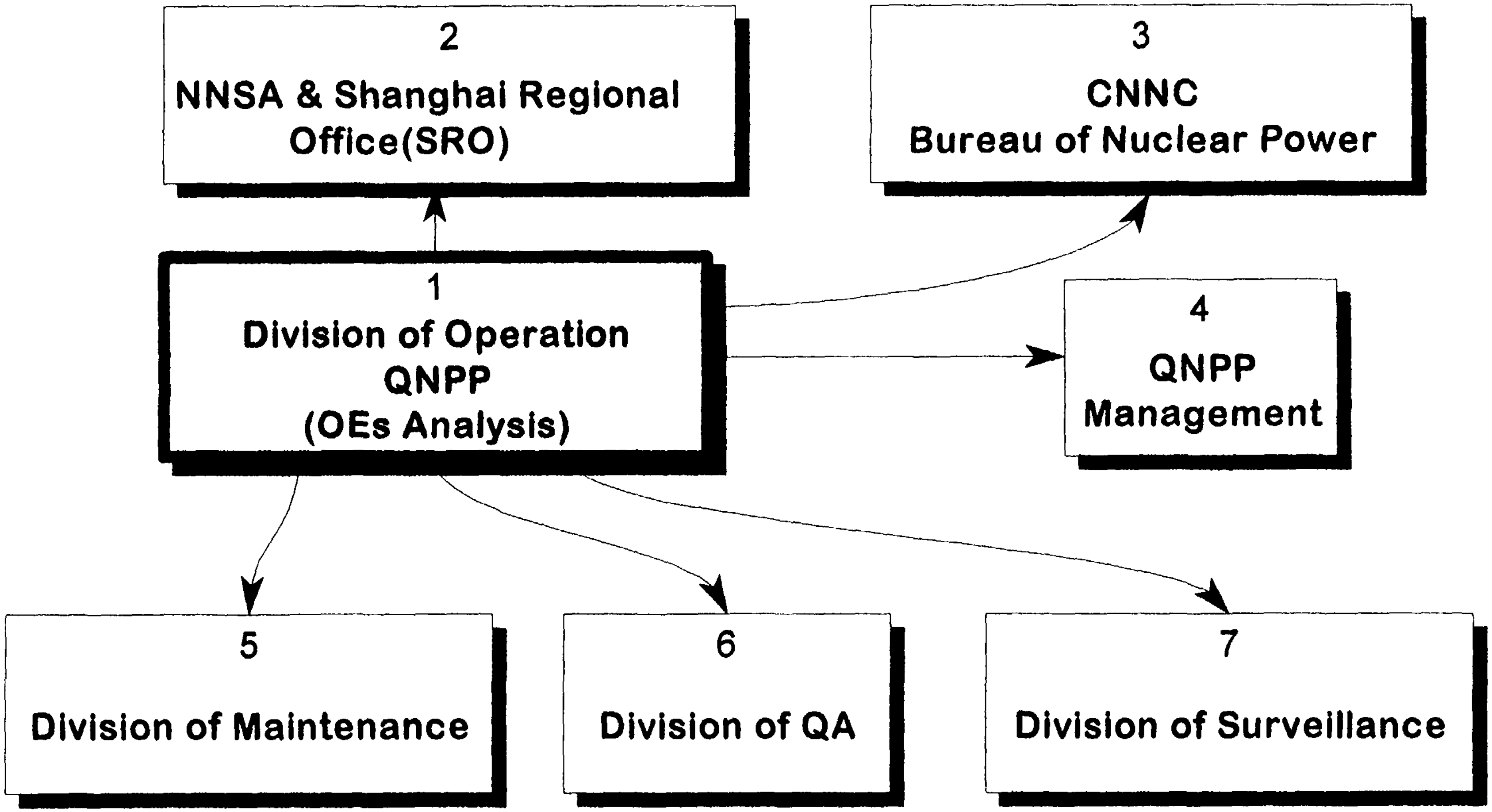

Fig. 1

OEs Analysis in GNPP

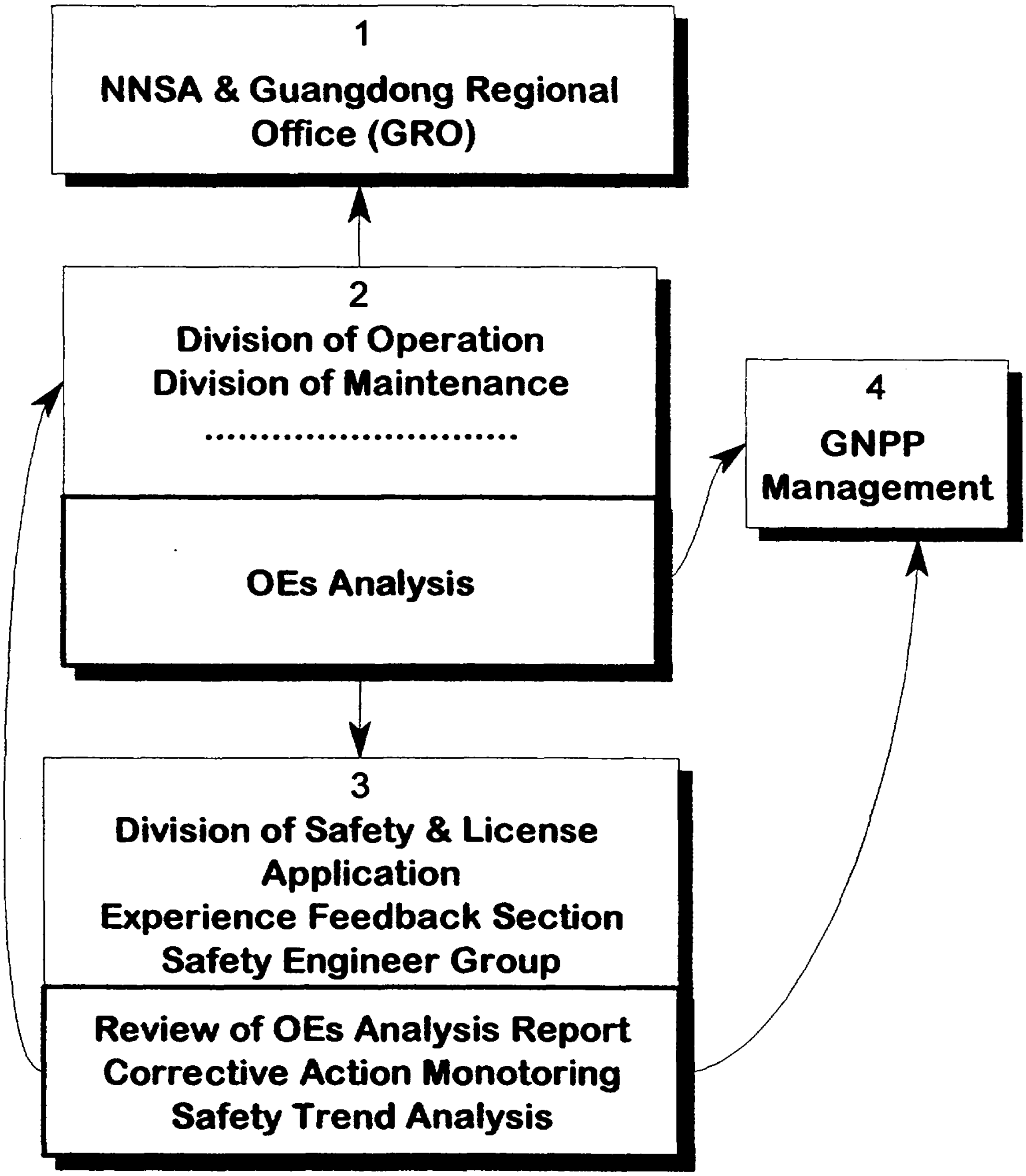

Fig. 2

The Operation Experiences Feedback Mechanism

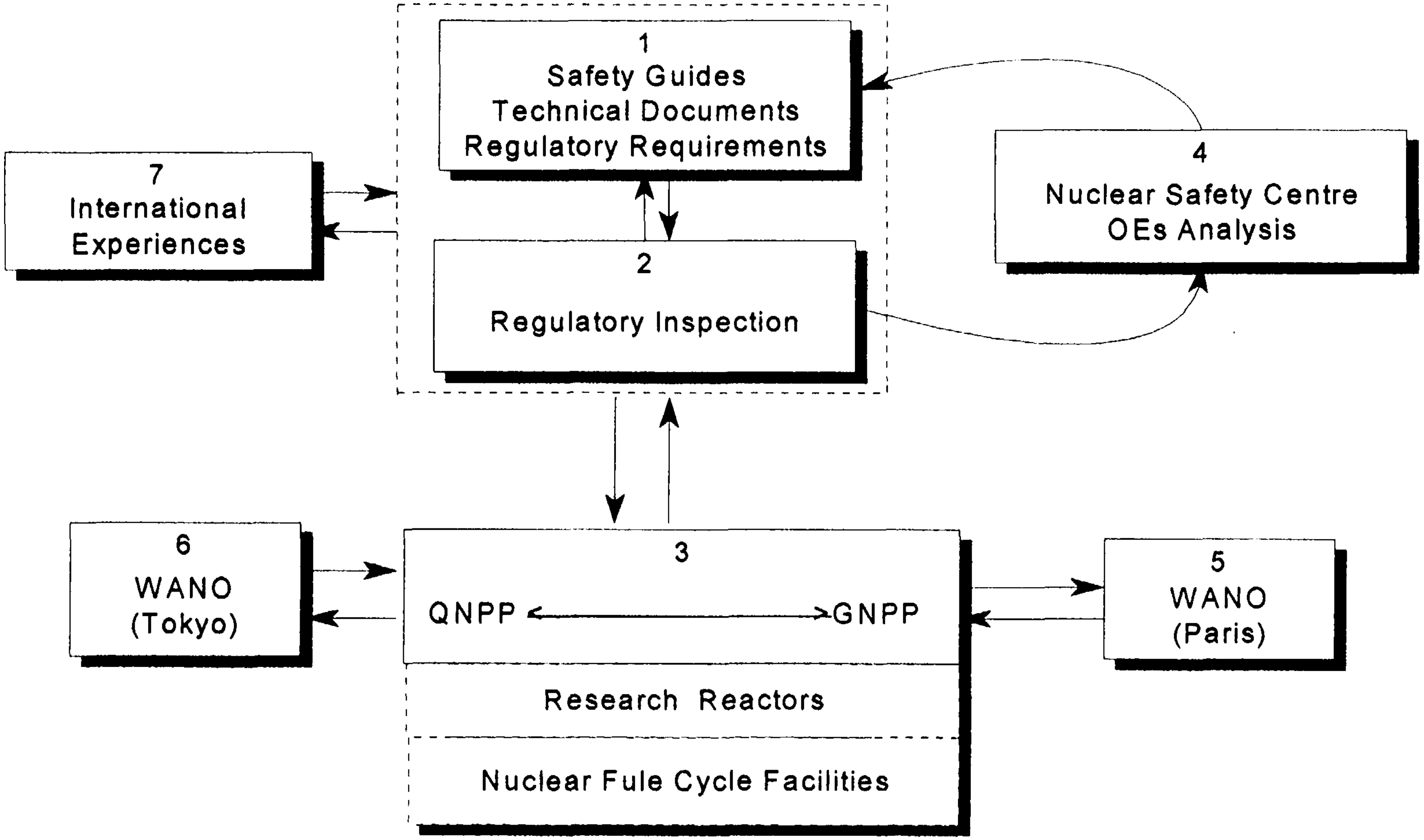

Fig. 3

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XA9745017

ASSET TCM Annual workshop
on Experience and feedback
24 ~ 26 June, 1997

SOME THOUGHTS ABOUT ASSET METHODOLOGY

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Abstract

This article describes the author's view on ASSET methodology and its usage according to her own experience in using that, and gives some suggestions regarding ASSET services.

1. Introduction

After the nuclear accident at Chernobyl nuclear power station, a series of significant efforts have been successfully and continuously made by the International Atomic Energy Agency to strengthen the Agency's contribution to ensuring the safety of nuclear power plants worldwide. Offering IAEA safety services to operating nuclear power plants such as ASSET, OSART, ASCOT and design review services etc. is one of these important efforts which covers assessment of design, operation management, operation performance and safety culture of nuclear power plants, and which is commonly recognized as very useful and helpful to the operating organizations, especially to the countries with new developed nuclear power programs to enable their operating of the plants based on the worldwide accumulated experiences and to avoid the deficiencies or defects which have been experienced by other plants as regard to management or technical aspects.

Among these services, ASSET service is one which is worldwidely welcome and is playing an important role for helping the member states to improve the operational safety of the NPPs by the Agency.

2. Specificities of ASSET methodology

ASSET methodology was formally introduced to China by an IAEA ASSET seminar in 1992 in Wuhan and then a seminar ~~at the beginning of 1995 which was a~~ follow up action of IAEA International Regulatory Body Peer Review mission in 1994 invited by the Chinese regulatory body, the National Nuclear Safety Administration. Since then, the ASSET methodology began to be utilized in China by the Regulatory body and by the NPPs as well, as one of the methodologies used for event root cause analysis.

It is obvious that in order to have a safe and reliable operation of a nuclear power plant, preventing any incident is the major objective of every plant utitity. In order to achieve this , to analyze the events or incidents occurred, to find the causes, and to avoid their recurrences is neccessary and is what every plant is making. But a good method for doing the analysis is very important for ensuring the effectiveness and the thoroughness of the analysis, to find out the real direct causes and root causes so that the effective corrective actions could be taken to eliminate the latent weaknesses.

ASSET methodology is such a good one for the event root cause analysis which was created according to the working experience of the IAEA staff in charge of that , I believe, and also the experience of defferent countries have been taken into account during its perfection process. Though I haven't got much experience in using this method, but by attending some ASSET seminars and ASSET Peer review missions and by some own work practice, I feel that ASSET methodology has following specificities:

a. Logicality of the ASSET philosophy

The ASSET philosophy declared in its user's manual is :

"EVENTS result from preceeding occurrences (failures to perform as expected) due to LATENT WEAKNESSES that were not prevented by QUALITY CONTROL prior to operation, or by PREVENTIVE MAINTENANCE during operation and that were also not timely detected by the SURVEILLANCE programme or not promptly eliminated by the FEEDBACK programme".

This philosophy expressed by only one sentence highly summarizes the direct cause and the root cause of any event and is very logical and reasonable.

b. Simplified description of the analysis process by answering three questions:

What is the problem? occurrence
Why did it happen? direct cause and contributors
Why was it not prevented? root cause and contributors

This simplification makes users easy to understand and easy to practice.

c. Standardized definition of direct cause - latent weakness, contributors and the root cause - deficiency to timely eliminate the latent weakness by detection and restoration process and the contributor, surveillance, feedback programme for the three weakness elements: equipment, personnel and procedure.

d. Comprehensive guidance given in the manual for the direct cause and root cause analysis of personnel, procedure and equipment failures.

The guidance is very comprehensive, complete, therefore is very helpful for the users.

e. Its wide use in the world thanks to the various ASSET services including the training seminars and peer review missions etc. offered by the Agency.

The numbers of the seminars and missions already carried out and still requested by the member states demonstrate that the ASSET services are widely welcome in the world.

3. Discussion about how to use ASSET methodology

a. Importance of the sufficient and correct information about events to be analysed.

To get sufficient information is most important for finding out the real latent weaknesses and the real deficiency for eliminating the latent weaknesses so that the right and effective corrective measures can be taken.

For ensuring that, not only the plant safety culture and the plant policy about the apparentness, award and punition are important, the timely investigation is also important, because if not, some important information would be lost when the time flies. So when some safety relevant events occurred, the detailed investigation for the causes should be carried out in time, especially for the events chosen for root cause analysis.

As regard to the analysis made by the regulatory bodies when they perform the review of the licensing event reports submitted by the operating organization, this will be of more importance, because normally their analysis will be based on the information contained in the reports provided by the plant. And it seems that in case of necessity for some important events or incidents occurred, the regulatory body needs to go to the plant to get the first hand information in order to get correct conclusions of the analyses.

b. ASSET peer review of plant self assessment report on safety performance or safety culture.

ASSET peer review services offered by the Agency provide a good opportunity to the plant who requests the peer review to exchange practical experience of using ASSET methodology in making the self assessment of safety performance, to shere good practices and to get the comments and recommendations, from the mission which consists of qualified experts worldwidely chosen by IAEA, on the plant pending safety problems, their root cause analysis and on the plant action plan to further enhance incident prevention. The discussion is friendly, and efficient, takes only a few days (usually 5 days), and doesn't involve two many people of the plant, i.e. doesn't have much interference to the plant normal operation.

One suggestion is that sometimes, it may be of benefit to have one day more during the mission to have an introduction by the experts of the mission on the other methodologies used in the world in order to widen and deepen the knowledge on root cause analysis methodology, and to get better use of it.

c. The ASSET user's manual is a good guidance document, but in order to get better understanding by some new users, including some more detailed analysis examples in the manual may be of value.

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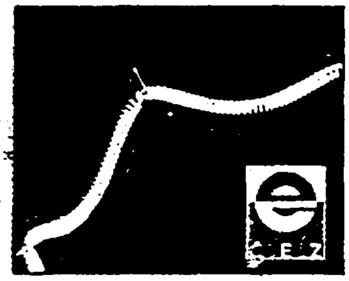
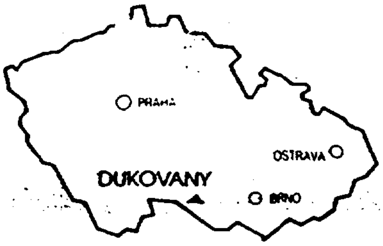
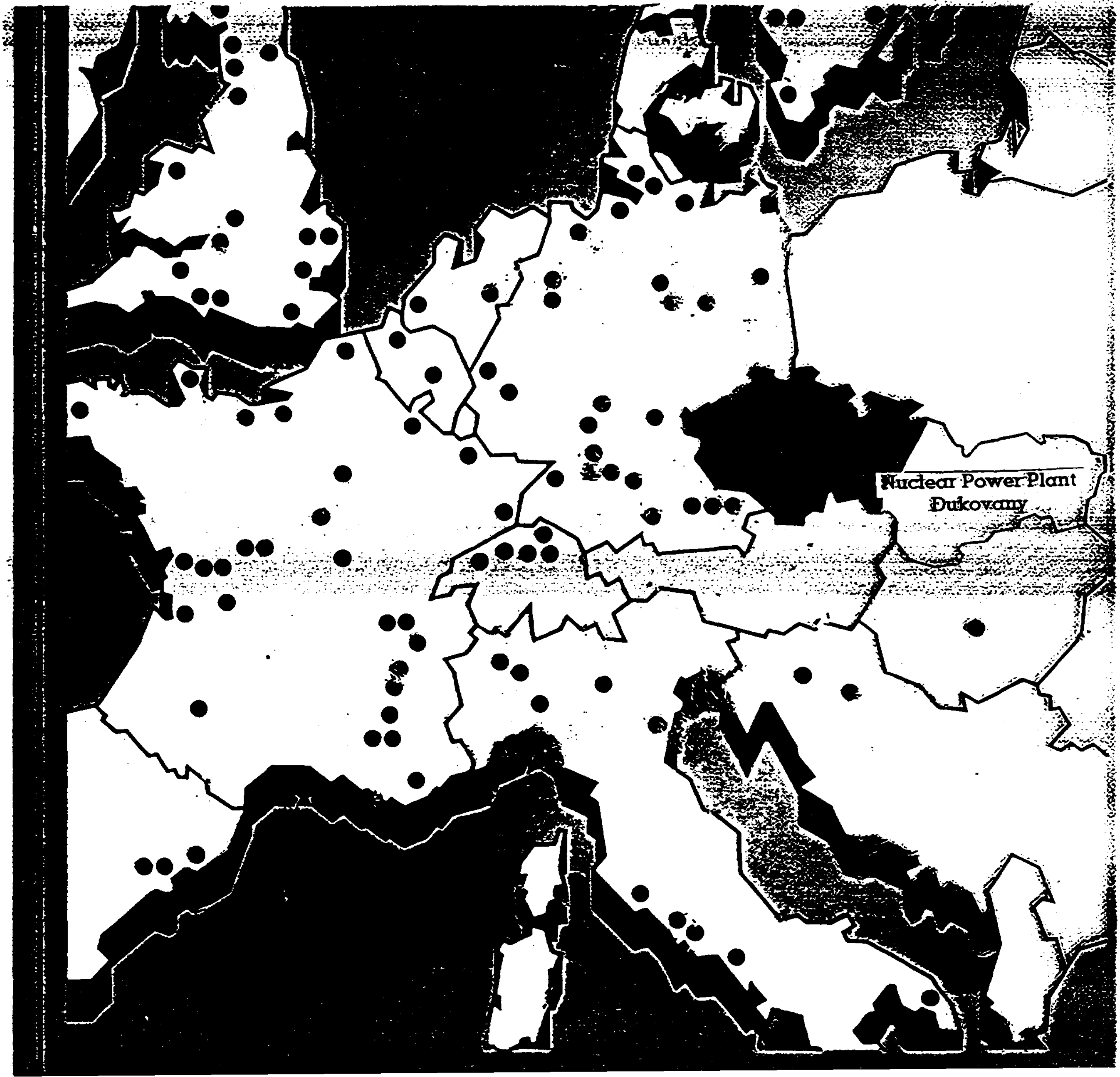
POWER PLANT
DUKOVANY



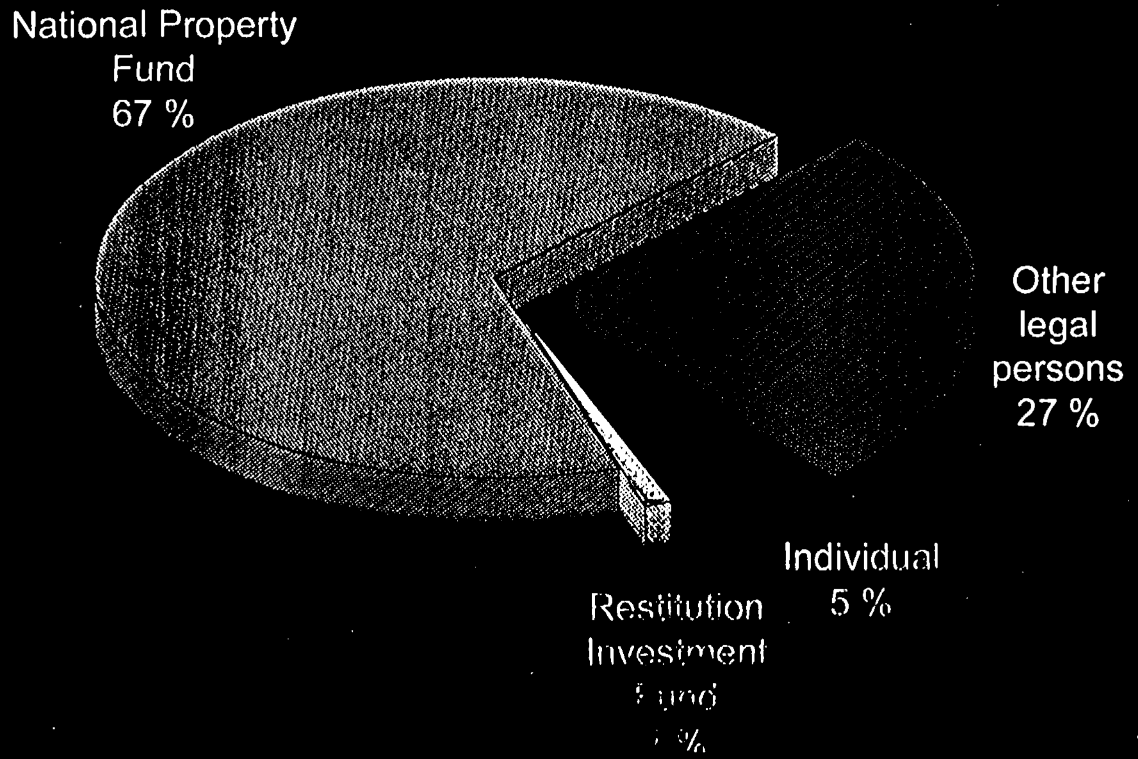


Generating capacity: 4x440 MW, 4x1375 MW_h

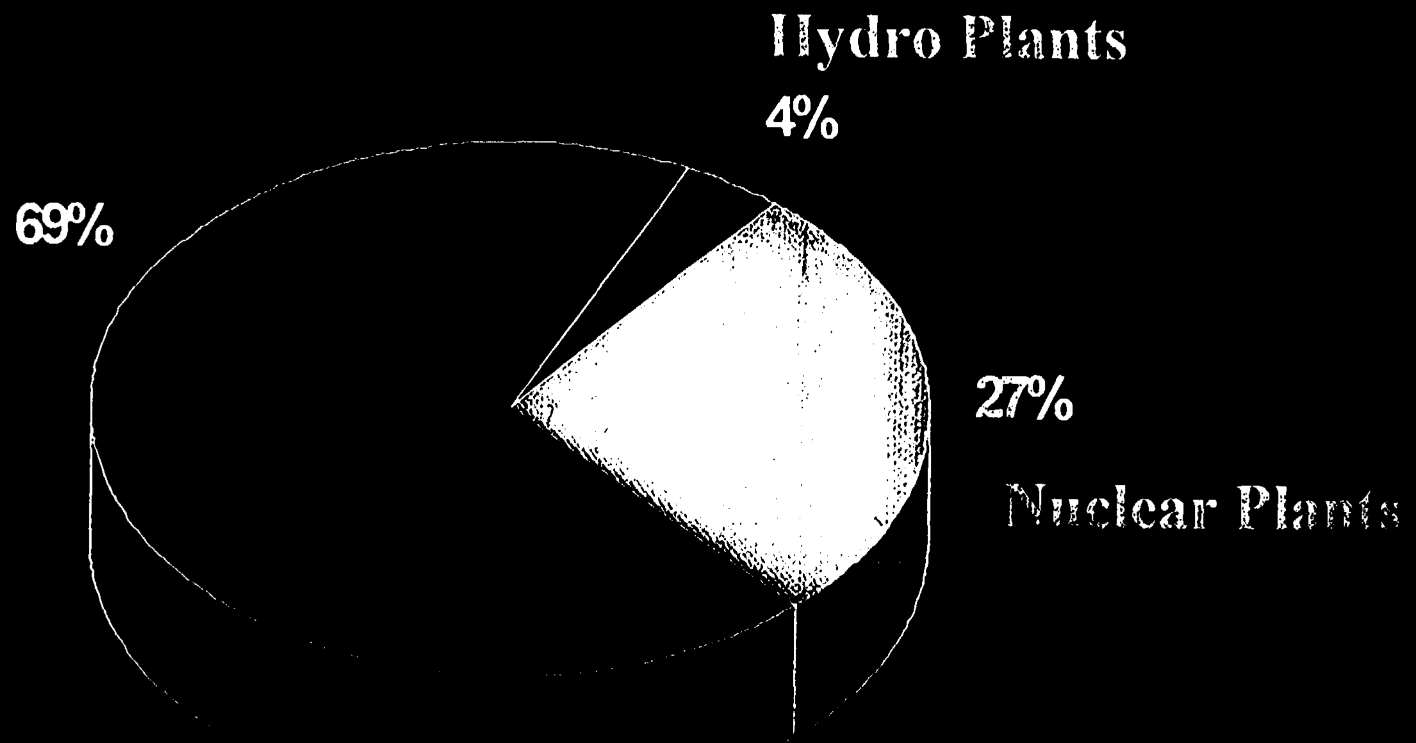


Electricity generation in the Czech Republic

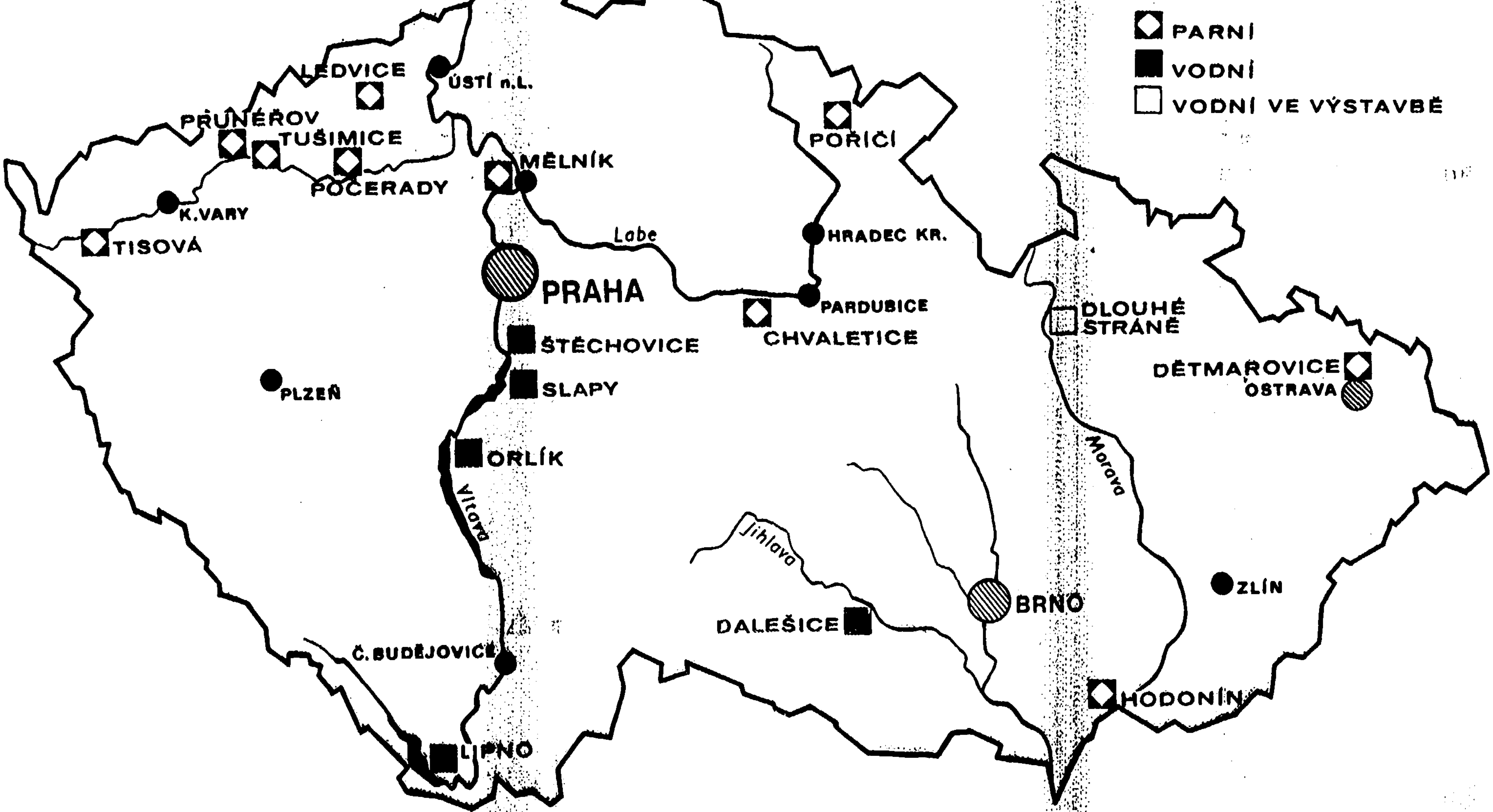
The Shareholders of ČEZ, a. s.



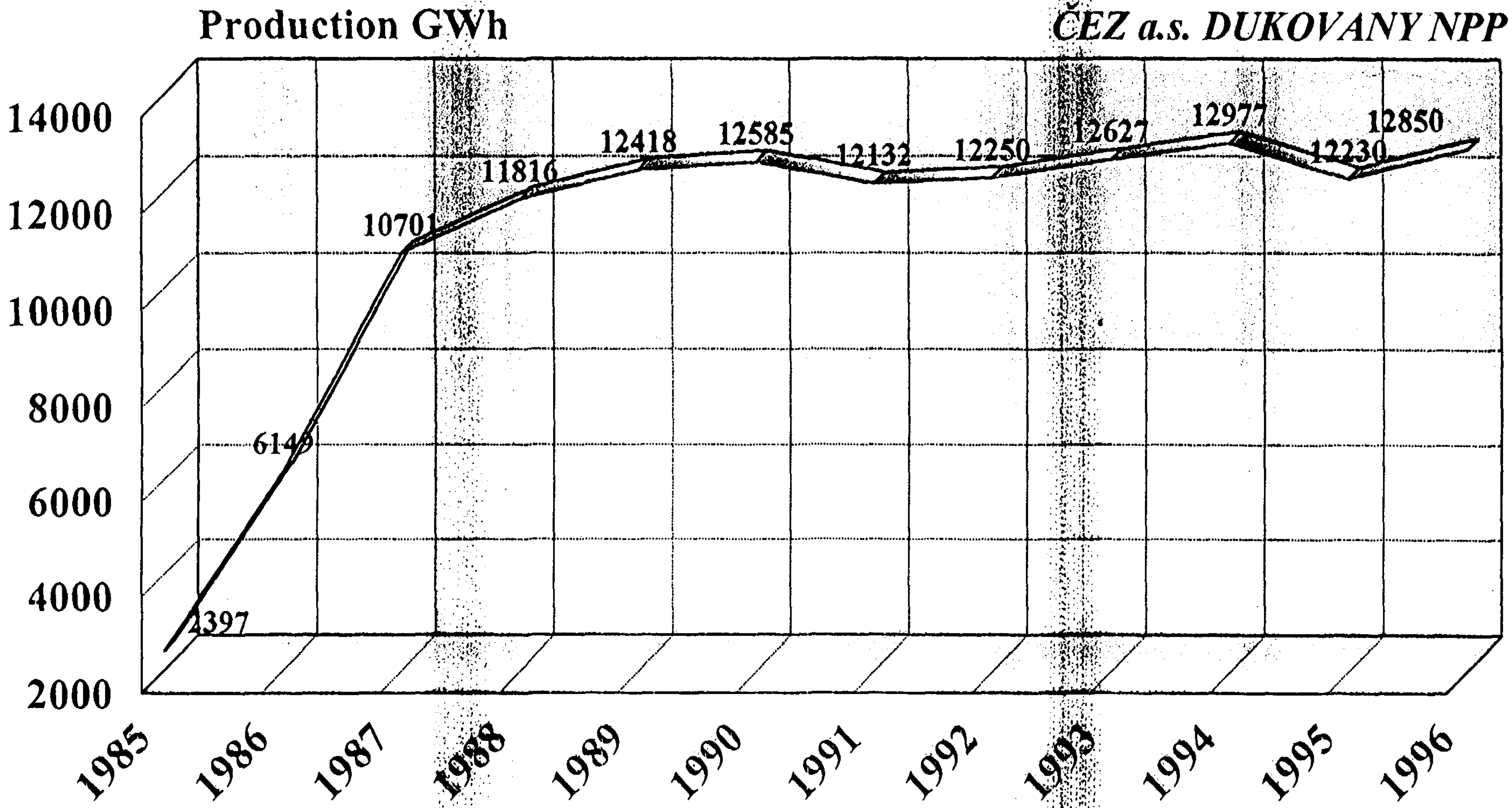
Structure of electricity generation by CEZ



ELEKTRÁRNY ČEZ



ELECTRICITY PRODUCTION



Total production 131 132 GWh

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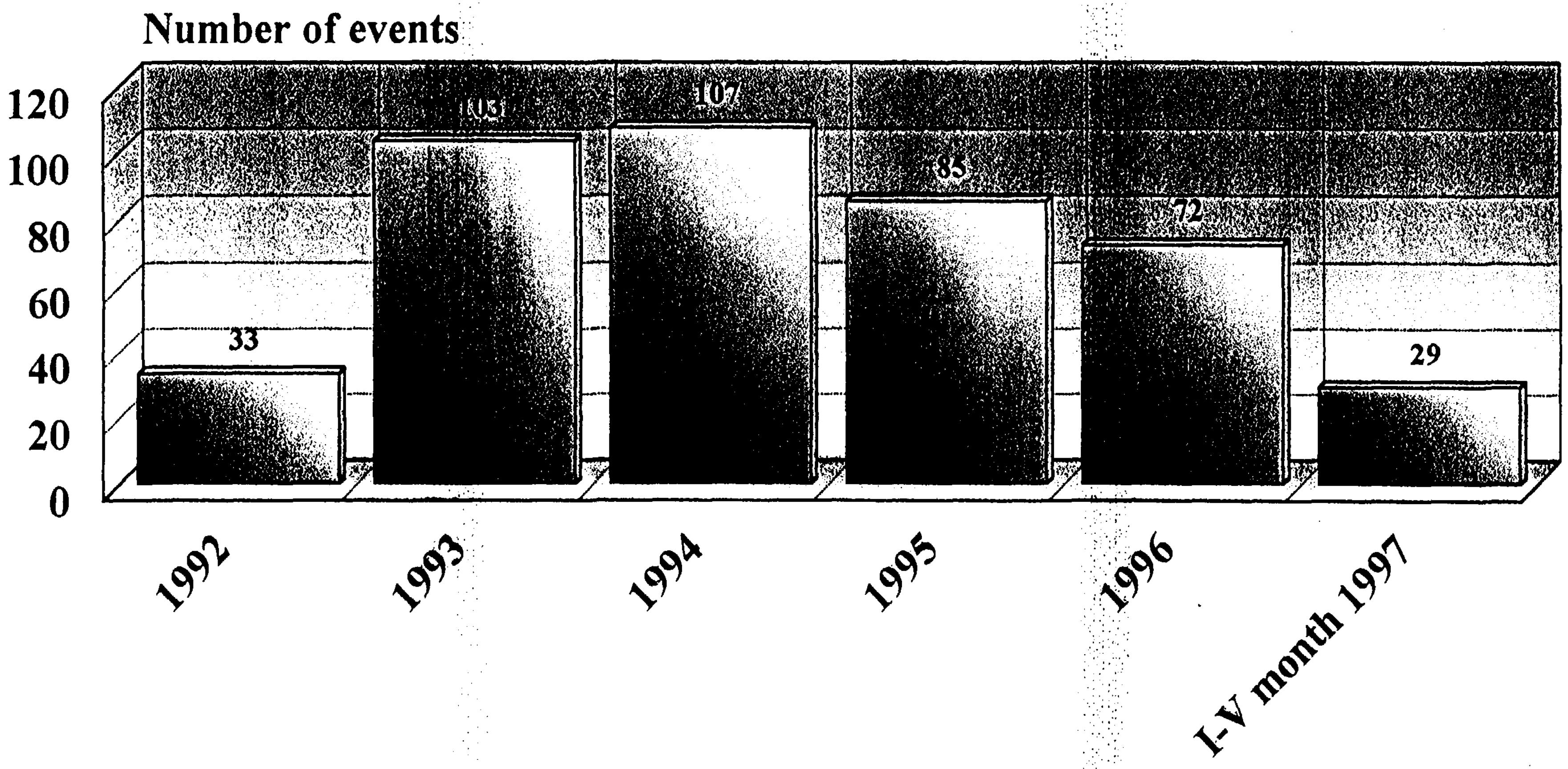
Nuclear Power Plant
Dukovany

INTERNAL OPERATION FEEDBACK SYSTEM

103

ČEZ
Nuclear Power Plant
Dukovany

NUMBER OF EVENTS CLASSIFIED = 0 ON INES SCALE
POČET UDÁLOSTÍ INES = 0



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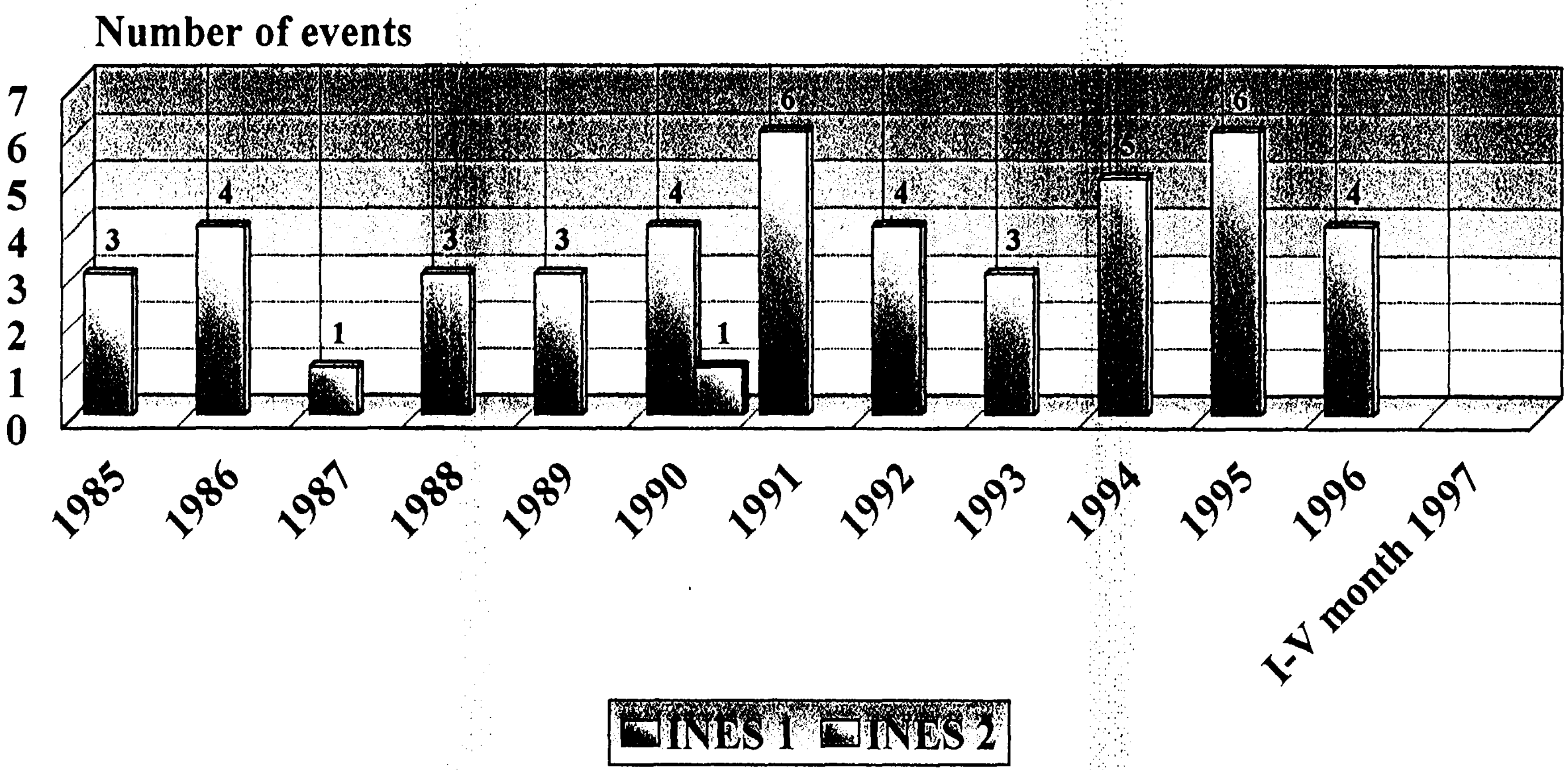
Nuclear Power Plant
Dukovany

NUMBER OF EVENTS CLASSIFIED > 0 ON INES SCALE
POČET UDÁLOSTÍ INES > 0



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DUKOVANY NPP ASSET

ASSET 1993	- 2 weeks	
SELF ASSESMENT 1996	- 7. - 11. 10. 1996	
Team leader:	IAEA:	Mr. Thomas
Deputy team leader	IAEA:	Mr. Kříž
Experts:	UK:	Mr. Dyer
	South Africa:	Mr. Nicholls
	Japan:	Mr. Fujii
	Switzerland:	Mr. Stejskal
	Romania:	Mr. Serbanescu
	Russia:	Mr. Škarovský

Czech representatives - Ministry of Industry
- ČEZ headquarters
- SONS

observes from - NPP Temelín

Slovak republic - NPP Bohunice

CONCLUSIONS AND RECOMMENDATIONS

1) Plant management should put in place an arrangement for clearly differentiating between events associated with procedures and human factors. The 'no blame' policy operated by the plant is fully supported.

2) Plant management should ensure that the new equipment which is being installed has the appropriate procurement and surveillance requirements for the safety function to be fulfilled. This should minimise the possibility of recurrence of some of the current problems.

3) Plant management should consider implementation of a S.T.A.R. (Stop, Think, Act, Review) policy to encourage a culture of intolerance of incorrect procedures. Staff should be required to stop any activity involving a faulty procedure until it is correct.

4) Plant management should encourage the wide use of their system for identifying recurrent failures and trending. The value of this has been demonstrated by the analysis carried out by staff for the internal ASSET.

5) Plant management should consider implementation of an annual Self Assessment of Operational Safety Performance based upon their existing annual review document. These should be reviewed at the site or company level by an independent group.

FINLAND

IAEA TECHNICAL COMMITTEE MEETING ON
"ANNUAL WORKSHOP ON ASSET EXPERIENCE AND FEEDBACK FROM ASSET PEER REVIEW MISSIONS"

WIEN 24.-26.6.1997

Antti Piirto
Teollisuuden Voima Oy (TVO)
Finland

PLAN TO REDUCE REACTOR SCRAMS AND ASSET RELATED ANALYSIS

TVO is a power company operating with two 710 MW BWR units at Olkiluoto. In terms of capacity factors, the production results have been very good. The average capacity factor for the past ten years is 93 %. However, more emphasis should be given to reduction of production disturbances in general and specially reduction of reactor scrams. In this respect, analysis and improvment of human performance is an essential part of operation experience feedback work in future. The ASSET methodology may be a practical framework for root cause analysis, prevention of recurrence and corrective actions.

The reportation of events at the plant follows established rules. Basically, three categories of reports exist: firstly, the reactor scram report, secondly, the operational disturbance report and thirdly, the special report. The last named category covers events defined by authorities. It concentrates on safety related events, for example on failures to follow the requirements stipulated in the plant's Technical Specifications. In general, special events are nuclear safety on the plant, the safety of the plant personnel or overall, the radiation safety in the plant's vicinity.

In the TVO's experience feedback activity the greatest emphasis is put on events at the TVO plant. The events on the same type of plants come second. Due to limited resources, somewhat less attention is paid to events on the other types of plants. However, the experience feedback should become wider in practise so that it would be a part of everyday life in nuclear power plant operation.

1
SCRAM REDUCTION MEASURES

In some countries, already from the beginning of 80's the number of reactor scrams has been about one decade lower than in our case. Also because of their low numbers of other disturbances and deviations there is still much to learn for us. Influencing factors to this development might have been beforehand prevention of disturbances and regard to human factors. A noteworthy reduction in the amount of scrams can be achieved by moving from reactive procedures/modes of action to analysing, precautionary measures and to the usage of statistical methods.

For instance, the following provisions could be advantageous:

1. Analysing the scram and operation disturbance reports has to be developed for the clarification of the root causes. Every event should be handled with a written report, in order to attempt to estimate the influential factors behind the immediate cause. As a result, disturbances could be prevented by learning from the operation experience and in general, the performance could be continuously improved.

   Accomplishing root cause analyses should become accustomed. Increase in analysis efficiency by concentrating on lesser but potentially noteworthy incidences should be considered. Such incidences are for example near miss - situations, recurrent events and common mode failures.

2. There should be developed methods of analysis for the reduction of human failures. These should be suitable for practical work, that they could also be understood, accepted and applied in practise by the management and the employees.

3. The operating instructions should be analysed carefully. Confusions could be avoided by changing the lay-out of the instructions, by amending notations and adding some illustrative figures. On the whole, clearness could be improved and eventual lapses should be avoided. Cautions should also be added. In general, argumentation should be replenished. Also the assesment of the adequacy of assurance and securing measures should be done.

4. The periodic test instructions should be improved for the minimization of disturbances. Provisional couplings and the time when a protective chain is in tripped state should be minimized. On the whole total scheming of functional tests associated with modification works would be needed.

5. One should yearly identify at least ten significant operation measures , which can lead to a scram or operation disturbancy - analyse them and verify the sufficiency of instructions, operator training, assurance measures etc.

6. A qualitative availability analysis should be done for the production process for example the same way as the failure mode and effect analysis.

7. The program for preventive maintanance should be adjusted in order to reduce operation disturbances. Consequently, which part of the program supports the reduction activities the best?

2
SELF ASSESSMENT OUTLINE FOR TVO OPERATION INCIDENCES BY THE ASSET METHOD

2.1
GENERAL BACKGROUND

The ASSET-services of the IAEA, which are associated with the operational safety of nuclear power stations, have been developed during the last few years to a way that the stations analyse their safety significant events themselves instead of external group. The gain of the analysis thus remains in the organization of the power plant, which later on can make similar operational safety analyses by itself.

The purpose of this is to answer the following basic questions:

1. What are the pending safety problems?
2. How important are they?
3. Why did they happen?
4. Why were they not prevented beforehand?
5. How to eliminate the safety performance or safety culture problems?
6. How to prevent their recurrence?

A seminar on the ASSET analysis methodology was given by the IAEA on 26.-28.11.1996.

On the whole, the operational history of both units of TVO should be summarized. Uniting and linking observation is always good for refreshing the entirety. In fact, the matter under consideration would be the incidences that are included in the operating experience analysis record. All occurences shold be taken into account from the very beginning for statistical purposes. Also the results of INES - classification made by STUK and TVO should included in the summary.

The main purpose of the ASSET-classification is to define the character of the incidence - wheather it is a device fault, human error or procedure deficiency, and to identify the unsolved safety problems.

2.2
PROCEDURE

2.2.1
Event Registering

The registration of the incidences is continued to blank forms as already started. All in all, there already are the occurences from the beginning of the operation to the end of 1995. The incidence data base, which includes the results and conclusions of operating experience analysis group can also be used as a subject matter.

2.2
Event Analysing

The blank forms are filled to classify and estimate the importance of the events. This is made with crosses/ check marks to each issue of concern.

2.2.3
Selection of the events to primary cause analysis

In the first place the operation disturbances of the years 1992-1996 should be taken into account. Secondly, within the resources, other significant operation incidences should be noted.

2.2.4
Analysation of the selected events

The case in consideration is constructed into a form of an occurance tree, thus into a form of logical series of occurance process where the initial incidence has created safety or operation consequences. There are incidences in the occurance tree, in which some factor such as a person, procedure or equipment has not worked as expected.

2.2.5
Analysation of the incidences

One or several consequential incidences are sifted out to primary cause analysis. As a result the following instances are determined of the incidence:

- immediate reason (why did the deviation occur/happen?)
- initial cause (why was it not prevented before it occured/took place?)
- repairing/correcting actions/arrangements(how is the deviation excluded?)
- proposals for improvement (how is the recurrence of the deviation excluded?)
- time schedule for corrective actions etc

3
DEVELOPMENT PROGRAMMES

Motivation programme for safety and operation quality

Management systems 1993 - 1995:
Operation processes and their development
Management of quality and function
Supporting cost planning and accounting

Leadership education programme

Enterpreuner skills 1993-1995
Leadership skills
Setting up objectives and goals

Continuous improvement in the operation

Management systems, 1995
Development proposals, 150 per year
Development of working routines and other non-technical issues

The Performance Indicator system for the operation

State Research Center, 1995-1996

The quality assessment for the operation

Scandinavian Center for Maintenance Management, registered associety of Finland, 1996-1997

ASSET analysis suits very well as a natural continuation for the before mentioned programmes. From now on it should be taken in usage in a way, that in association with the reportation of incidences the statements for the analysis would be made. What is more, with the help of these wider measure recommendations than before would be gained. In conclusion, the most considerable target for reform would be the reportation system of occurences.

THE LONG TERM GOALS IN PRODUCTION AND OPERATION

- Operational Disturbance Exclusion
- Capacity Factor Over 90 %
- To Maintain Technical Condition Similar to New
- Continuous Development of Operations
- To Reduce the Production Cost

Where Other Nuclear Power Plants Have Been Improving

- Fewer Fuel Leakages
- Lower Number of Reactor Scrams
- Shorter Refuelling Outages

Where We Should Improve

- Analysis of Human Performance and Prevention of Human Errors to Reduce the Number of Operational Disturbances
- Team Work, Specially in Small Multiskilled Groups
- Change of Company Culture Towards Continuous Learning and Development of Knowledge, Operations and Effectiveness

HUNGARY

Technical Committee Meeting
"Annual Workshop on ASSET Experience and Feedback from ASSET Peer Review Missions"

24-26 June 1997, Vienna

ASSET Experience at Paks NPP

Istvan Szabo
Operational Safety Department
of Paks NPP

International reviews and inspections

At Paks NPP special attention has been paid to international reviews since the very beginning of operation. Several international teams visited Paks in order to provide independent assessment of plant performance, conditions and safety. The most important reviews conducted at Paks are listed below:

- OSART (IAEA)
- Follow-up OSART (IAEA)
- ASSSET (IAEA)
- Follow-up ASSET (IAEA)
- WANO Peer Review
- WANO Peer Review Follow-up
- Assessment of Safety Upgrading Measures (IAEA)

Paks NPP Management has the further intention to invite international reviews regularly (yearly) in future as well.
The experience gained during these reviews helped to establish a unified process of preparation for the reviews, performing them and handling the results. The Safety Department is in charge of organisation of the whole process.

All these reviews have their specific features and they are focused on different areas. The ASSET review provides the assessment of plant performance and safety through the analysis of safety significant events, which have occurred at the nuclear power plant. This approach makes this review specific and different from the other ones.

ASSET services at Paks NPP

The following ASSET services were provided to Paks NPP up to now:

1990 September	ASSET workshop - Introduction of ASSET Methods, Process
1992 June	ASSET workshop - Preparation for mission
1992 November	ASSET mission
1994 December	ASSET workshop - Root Cause Analysis
1995 March	ASSET follow-up mission (Peer Review)
1995 June	ASSET workshop - Evaluation of the consequences of events

Root Cause Analysis

Before the first ASSET mission root cause analysis was not implemented at Paks NPP for analysis of operational events. Although the events were investigated the systematic approach was missing and the analysis not always determined the root causes. The first international reviews already indicated this problem. In order to focus on safety significant events Paks management decided to invite the ASSET services. When preparing for the ASSET missions a systematic root cause analysis was performed using the ASSET methodology. Although the personnel were trained and the root cause analysis method was applied, the follow-up review discovered some problems in implementation.
The methodology very often led the analysts to management related problems as root causes. The determination of effective corrective actions to eliminate those root causes was very difficult and for most of the cases unsuccessful. It resulted in loss of credit to practical applicability of the method. In order to solve this problem the development of a plant specific root cause procedure is underway now. The new method will represent a mixture of different wellknown and widely implemented root cause analysis techniques (including some elements of ASSET) taking into account the specific needs and features of Paks NPP.

Benefits of ASSET services

The main and direct benefit for the plant is the implementation of the corrective actions based on the results of ASSET missions. However, the period when the plant is preparing for the mission and conducting the self-assessment is considered also very useful. The new form of plant evaluations by peer reviews will just strengthen this feature.

Paks NPP prepared the special Hungarian version of INES handbook. This document is a useful tool for operators and regulators who make the classification of events. In addition to the translation of IAEA document it includes all the necessary plant specific information about the initial events, their frequency, the safety functions and the systems required to fulfil them.

The safety evaluation techniques at Paks reflect the elements of ASSET methodology. The safety evaluation part of Annual Reports has similar structure to the ASSET report, and uses similar categorisation for trending. When the assessment of safety related events was performed for Periodic Safety Review the evaluation technique of ASSET was used too. Generally, the ASSET services played an important role in improvement of internal and national standards for evaluation of operational safety.

Communication with the members of international expert teams performing the reviews at Paks and participation of specialists from Paks in reviews conducted at other power plants also should be emphasised as major benefit resulting in information exchange and gained experience.

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ASSET Experience at Paks NPP

Istvan Szabo
Safety Engineer

Paks NPP

Operational Safety Section

International Reviews at Paks NPP

- OSART (IAEA)
- Follow-up OSART (IAEA)
- ASSSET (IAEA)
- Follow-up ASSET Peer Review (IAEA)
- WANO Peer Review
- WANO Peer Review Follow-up
- Assessment of Safety Upgrading Measures (IAEA)

ASSET services provided to Paks NPP:

- 1990 September
  ASSET workshop:
  Introduction, Guidelines, Methods
- 1992 June
  ASSET workshop:
  Preparation for mission
- 1992 November
  ASSET mission
- 1994 December
  ASSET workshop:
  Root Cause Analysis
- 1995 March
  ASSET Follow-up Mission (Peer Review)
- 1995 June
  ASSET Workshop:
  Evaluation of the consequences of events

Root Cause Analysis

- **Systematic root cause analysis process was not used at Paks NPP before the ASSET mission**

- **Other reviews also indicated this problem**

- **ASSET preparation - ASSET Root Cause Methodology**

- **Problems in implementation:**
  - ⇒ **Follow-up ASSET discovered problems**
  - ⇒ **Criticism from personnel and management**

- **Development of a new plant specific root cause analysis procedure is underway**

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Some benefits of ASSET services

⇒ Action plan for implementation of corrective actions based on ASSET recommendations

⇒ INES handbook in Hungarian with plant specific amendments

⇒ Plant safety evaluation techniques

- Annual reports
- Periodic Safety Review

⇒ Improvement of internal and national standards

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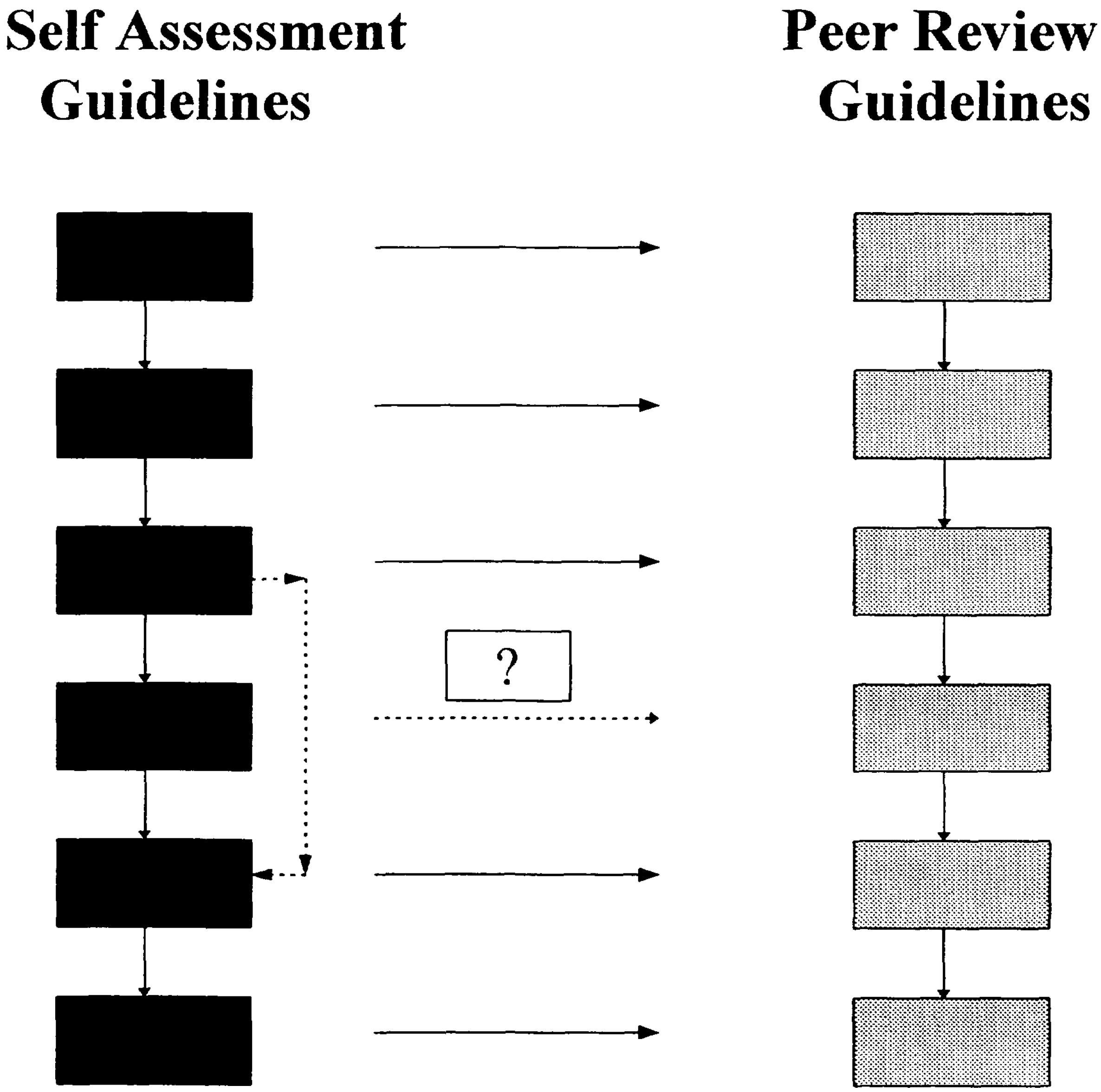
Peer Review of Self Assessment



INDIA

IMPLEMENTATION OF ASSET CONCEPT IN INDIA

by
Jaharlal Koley
Operating Plants Safety Division
A E R B
Mumbai, INDIA

Abstract

The paper presents a retrospective assessment of the use of ASSET methodology in India since the first ASSET seminar organised by IAEA in collaboration with the Atomic Energy Regulatory Board, India(AERB) in May, 1994. The first ASSET seminar was organised to initiate the spread of idea among operating and research organisations and regulatory body personnel. The participants were carefully chosen from various fields and with different levels of experiences to generate teams with sufficiently wide spectrum of knowledge base. AERB took initiative in leading by example and formed ASSET teams to carry out the first ASSET reviews in India. These teams at the instance of AERB carried out ASSET review of three Safety Related Events, two at Nuclear Power Plants and one at Research Reactor. This paper describes the outcome of these ASSET studies and subsequent implementation of the recommendations. The initiative taken by the regulatory body has led to formation of ASSET teams by the utilities to carry out ASSET study on their own. The results of these studies are yet to be assessed by the regulatory body. The result of the ASSET experience reveals the fact that it has further potential in improving the safety performance and safety culture and bringing in fresh enthusiasm among safety professionals of Indian Nuclear Utilities.

1.0 BACKGROUND

India has ten Nuclear Power Units in operation with a total installed capacity of about 2000 MWe and four more Units of 220 MWe, each in different stages of construction. In addition there are three high power research reactors. The Atomic Energy Regulatory Board (AERB) is the Regulatory Body vested with the responsibility of training and enforcing safety regulations envisaged in the Atomic Energy Act of India, 1962, in all the nuclear installations. The primary responsibility to maintain safety of these installations rests with the Chief Executives of these installations. The routine and periodic safety review of the Nuclear Power Plants and other nuclear facilities is carried out through a multi-tiered hierarchy of Safety Committees at -

(a) Atomic Energy Regulatory Board	- Constituted by Government of India, with membership drawn from public.
(b) Regulatory level	- Safety Review Committee for Operating Plants (SARCOP), constituted by AERB.
(c) Unit level	- Unit Safety Committee, constituted by SARCOP.
(d) Plant level	- Station Operation Review committee, constituted under the provision of Technical Specification approved by SARCOP.

Organisationally, this multi-tiered system of Safety review by a hierarchy of Safety Committees, is working on management by exception principle in order of increasing authority.

2.0 INCIDENT REVIEW PROCESS

The safety significant events are reported by the utilities as per a well laid out reporting criterion as defined in the Technical Specifications, within the operating organisation as well as to the Regulatory Body. These incidents and the related investigations get reviewed in the appropriate level of the multi-tiered system of Safety Committees as warranted by their safety significance. In each of these stages of review, experts scrutinize the root-causes of the events and identify appropriate corrective measures which are subsequently implemented to eliminate root causes and enhance safety. Periodic safety review for renewal of authorisation is done once in five years. During this time all the incidents and the overall safety performance of the plants are reviewed in detail. India has been an active participant in the Incident Reporting System of IAEA. In addition we have been sending information to IAEA on safety related incidents of interest after assessments in the INES scale too.

3.0 INCIDENT ANALYSIS

Formal introduction to analysis for root cause of events by ASSET methodology was given to the regulators and nuclear utilities in India during the ASSET seminar organised jointly by IAEA and Atomic Energy Regulatory Board (AERB) in May 1994. About thirty professionals from the nuclear industry having wide range of experience in various fields had participated in this seminar. This helped in developing a rich bank of experts in root cause analysis with sufficiently wide spectrum of knowledge base.

Shortly after the ASSET seminar, AERB constituted a team to carry out ASSET review of an incident in one of the research reactors in India, viz. CIRUS. This review brought to the focus the need for some systemic and procedural modifications. Being inspired by the success of this mission, AERB constituted another team to review a power rise incident in one of the Indian standard PHWRs, viz. Narora Atomic Power Station (NAPS). This was followed by further ASSET reviews in which two safety significant events of Kakrapar Atomic Power Station(KAPS) were analysed. Presently NPC, the operating organisation, has set up a system for in-house ASSET review programme. Results of these reviews, in the form of reports, are submitted to AERB for peer review.

4.0 ASSET FUNCTIONS AND FOLLOW UP

ASSET functions consist of three stages of activity (1) PRE-ASSET incident review, (2) ASSET review and (3) POST-ASSET follow-up. The PRE-ASSET review is already an integral part of the incident review scheme in the existing regulatory frame-work. All the incidents are reviewed by the multi-tiered system of Safety Committees. During these reviews, if it is felt that ASSET review of certain incidents could help in improving Safety Performance and Safety Culture, expert teams are constituted for detailed ASSET studies.

Experts in R & D, operation, management and regulatory activity form members of the ASSET team. This team goes into detail of the incident, study all the relevant cases, analyses their consequences and impact on overall safety of the plant and gives its findings and recommendations in the form of ASSET review report. Findings of the ASSET team and its recommendations are peer reviewed by the regulatory body. The recommendations, after review of the feasibility and its overall impact on safety, are followed up for implementation within a time frame.

All the recommended changes in procedures, managerial activities and training programmes are implemented as early as possible. If any changes in system or hardware

are required that need capital investment and long plant shutdown, these are implemented in long term.

5.0 ASSET REVIEWS CARRIED OUT IN INDIA

Some of the highlights of ASSET reviews carried out in India are described below. A brief description of the events followed by major findings, recommendations of the ASSET teams and its implementations are also given.

5.1 NAME OF THE INCIDENT

Degradation in cooling of irradiated fuel rod during transfer in CIRUS.

5.1.1 BRIEF DESCRIPTION

During removal of the irradiated fuel assembly from the reactor, cooling water was not provided to the transfer flask due to oversight.

5.1.2 OBSERVATIONS AND COMMENTS

Procedures for fuel handling at the plant was not up-to-date. There were no check lists to ensure fulfillment of the pre-requisites at different stages of the job. The flow meter provided for confirmation of the cooling water flow to the fuel transfer flask was not legible due to masking by dirt and the meter was located in an area with poor illumination. The mechanism for obtaining feed-back from operation to the plant management was poor.

5.1.3 IMPLEMENTATION STATUS OF RECOMMENDATIONS

A mechanism has been constituted to periodically review and revise all the operating procedures at regular intervals to incorporate feed back from the operations.

Station has constituted a committee for analysis of human performance in operations for giving feed back to management.

5.2 NAME OF THE INCIDENT

Flooding of Turbine building basement resulting in non-availability of certain safety related equipment in Kakrapar Atomic Power Station.

5.2.1 BRIEF DESCRIPTION

Due to heavy rains, water level in the nearby Lake increased and resulted in flooding of plant premises. Flood water backed up through some underground cable tunnels which did not have proper sealing, caused submergence of certain equipment located in the turbine building basement affecting availability of the normal channel to ultimate heat sink. Core cooling was maintained by injection of fire water to the shutdown cooling heat exchangers.

5.2.2 OBSERVATIONS AND COMMENTS

The increase in Lake water level was due to unprecedented heavy rains, flash floods and blocking of the outlet gates by huge chunks of grass with roots and weeds. The invert level of the pipe and cable tunnel was below the design basis flood level for the plant and did not have any proper sealing. Though flooding incidents had been experienced at other plants, adequate flood prevention measures were not taken by the plant prior to onset of monsoon.

5.2.3 IMPLEMENTATION STATUS OF RECOMMENDATIONS

The cable entry point were raised. The existing tunnel entry points have been sealed by RCC wall. Instrumentation has been provided to indicate water level in plant water pump house. A spillway weir has been constructed in the lake to ensure that the water level does not rise to unacceptable level. Hydrology review and capacity survey of the Lake were done. A system was instituted for periodic desilting of the lake and flushing of weeds before every monsoon. A system was developed for proper feedback of experience, including action taken for prevention of recurrence of such incidents among the operating plants and projects.

5.3 NAME OF THE INCIDENT

Reactor Regulating System(RRS) fails to limit increase in reactor power in Narora Atomic Power Station.

5.3.1 BRIEF DESCRIPTION OF THE EVENT

In Unit-1 of Narora Atomic Power Station, when the reactor was operating at 130 MWe, the reactor power increased steadily on its own and reached 147 MWe. The reactor power was brought down by manual intervention. The reactor power increased due to 'trimming up' of the Set(Demand) Power in two of the triplicate RRS channels resulting in cumulative increase in the actual reactor power.

5.3.2 OBSERVATIONS AND COMMENTS

The incident occurred due to design deficiency in RRS. The root cause of the event was insufficient visualisation of disturbance conditions by the designers which could result in unlimited trim action by reactor regulating system.

5.3.3 IMPLEMENTATION STATUS OF RECOMMENDATIONS

In absence of any limit on trim action, the reactor demand power can change cumulatively in one direction i.e. up or down. To rectify this, the cumulative trim action is limited to 3% FP around the demand power by a design modification. As a long term solution to improve the system design, the reactor power control was decided to be based on the corrected linear neutron power signal instead of the differential temperature signal. For eliminating the root cause of the weakness in RRS design, the ASSET recommended to institute a systematic process to obtain operational feedback on a continuous basis.

6.0 CONCLUSION

Introduction to ASSET methodology, being structured and user friendly, has improved efficiency of the already existing system of root cause analysis in India. ASSET helped in rectifying inadequacies in procedures and surveillance programme. AERB now takes a closer look into the station surveillance programmes which are defined in the station policy document. Appropriate surveillance method has the capability to detect weak links in the system much before it actually fails.

JAPAN

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XA9745022

Japanese Views on ASSET

Masashi HIRANO

Department of Reactor Safety Research
Japan Atomic Energy Research Institute

Presented at
Technical Committee Meeting
"Annual Workshop on ASSET Experience"
Vienna, 24-26 June, 1997

Japanese Participation in ASSET Activities

- Japanese experts had participated in totally 18 ASSET missions to VVERs and RBMKs until the meeting in 1996, but not participated after that.
- We have requested neither an ASSET mission nor a seminar yet.

Views to ASSET Activities

- The ASSET contributed to prevail the common understanding that it is important to derive lessons learned based on the root cause analysis.
- The ASSET methodology has played an important role not only to supply a practical tool for the root cause analysis, but also to clarify the meaning of the "root causes".

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Views to ASSET Activities(Cont'd)

- It is agreeable that the "Peer Review" of plant "Self Assessment" is considered to be a natural evolution of the ASSET activity.
  - Many plants have already been involved in the ASSET activities, and
  - The ASSET methodology becomes well understood by these plants.

Recent Operating Experience in Japan

- Two incidents took place recently and they brought about large social impacts, though the off-site radiological impacts were nothing or very small. One is the **sodium leakage** incident at the prototype FBR **Monju** and the other one is the **fire and explosion** incident at the bituminization demonstration facility in the fuel reprocessing plant at **PNC Tokai** Works.

Recent Operating Experience in Japan(Cont'd)

- **Monju Incident** (Dec. 8, 1995)
  - Two incident investigation teams were formed by the NSC (Nuclear Safety Commission) and STA (Science and Technology Agency) respectively and they already issued several incident investigation reports.
  - In addition, the STA established the "**Monju General Inspection Team**" in Oct., 1996, in order to review:
    - Not only the Monju facilities,
    - But also, the technical specifications, operating manuals, etc.
  - The team will evaluate the appropriateness of the measures taken from the view points of:
    - the lessons learned from the incident, and
    - the findings from the general inspection review.

Recent Operating Experience in Japan(Cont'd)

- **Fire and Explosion at PNC Tokai Works** (March 11, 1997)
  - The incident investigation team was formed by the STA on March 12.
  - The STA issued the preliminary incident investigation report on May 8. It is stated in the report:
    - **The lessons learned from the Monju incident were not fed back.**
  - The STA established **the Advisory Committee for PNC Reorganization.**

- The lessons learned so far from these two incidents emphasized the needs for improving:
  - **Safety culture in the organization level**, and
  - **Operating experience feedback**

  on which the ASSET activities have focuses for many years.

Future ASSET Activities

- It is desired that the ASSET continues to contribute to the promotion of the operating experience feedback, especially **the promotion of the root cause analysis**.
- It is also desired that the ASSET continues to be improved by following **the needs and demands of the member countries**.
- Linkage among various safety missions should be sought in order to avoid duplication and to enhance effective usage of a limited budget and human resources.

LITHUANIA

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IAEA TCM

"Annual Workshop on ASSET Experience and Feedback"

24 - 26 June 1997, Vienna

The use of ASSET methodology at Ignalina NPP in Lithuania

by

Anatolij Glazunov

In 1996 Lithuania produced 16.55 billion kW-h of electric power, which is by 3.7 billion kW-h more than in 1995. The INPP produced 13.04 billion kW-h, which is by 3.0 billion kW-h more than in 1995. Consequently, the share of the nuclear power in the total electricity production balance in Lithuania is more than 83 percent.

Some technical and economical indicators regarding the operation of each power unit of the INPP are shown on the slide.

	INPP	Unit 1	Unit 2
Power generation (GWh)	13040	6315	7625
Capacity factor (%)	61,05	55,3	66,8
Availability factor (%)	68,85	61,9	75,8
Unplanned scrams	7	5	2
Safety significant events	22	12	10
Level "1" on INES scale	6	4	2
Level "0" on INES scale	16	8	8
Number of events	162		

From this data, one can visualize an important role of the Ignalina NPP for the Lithuanian power industry.

We strive to work, not only improving our economic indicators, but first of all upgrading safety. In safety upgrading we assign an exclusive part to analysis of operational events, and the ASSET methodology is an indispensable tool to do that. Lithuania gained the first experience of using the ASSET methodology in order to analyze the operational events in 1989 when the first ASSET mission was carried out at the INPP. The members of the team that carried out the mission demonstrated to the INPP staff advantages of the ASSET methodology as compared to the event-analysis practice which existed at that time. Since then the Ignalina NPP has been using the ASSET methodology in practice.

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The first step in this direction was training of experts. Already in 1990 two engineers of the plant were certified for the ASSET methodology at a seminar which was held at the Khmelnitsky NPP (Ukraine).

In 1992 an analogous seminar was held at the Ignalina NPP, during which about 15 experts of the INPP and regulatory body of Lithuania have got the IAEA certificates on the mastering of the ASSET methodology.

The plant personnel has gained the greatest experience in application of the ASSET methodology while preparing the follow up ASSET mission, which was held in February of 1993. About 200 events of different levels were analyzed in the course of the preparations for that mission. The later effected mission confirmed that the INPP staff correctly employed the ASSET methodology.

At present the ASSET methodology is widely used at the INPP in order to analyze all operational events which correspond to the reporting criteria to outside and inside of the plant. It should be noted that, for the analysis, we use the major part of the ASSET methodology but not all of them. For example, the event-analysis results record purposes, we use the report form that is conventionally used in Russia and Ukraine.

A significant progress has been attained in application of the ASSET methodology at the INPP, the fact marked as in the SAR, as in the report of the follow up OSART mission, which was held in June 1997. But we are not standing still regarding our analysis of the events and are trying to improve it, restrictly using other analysis methods and to improve procedures for analysis.

DIFFICULTIES

At the same time, when using the ASSET methodology, there exist some difficulties, which, may be, have a local character. Difficulties are shown on the slide.

Problems	Safety Culture	Human Factor
Aspects	Management Policy Assessment of events	Openness of the personnel Human mistakes

First of all, this is regarding the Safety Culture. Here one can pinpoint two aspects:

The first aspect of this difficulty is: understanding of the ASSET methodology by the administration, as a tool for identification of the causes of what has taken place, rather than for that of the guilty persons.

The second aspect of this difficulty is: assessment of events significance.

As to the first aspect, we sometimes face requirements on the part of different managers and regulators regarding identification and punishment of the guilty persons. This is not the best practice, and it does not facilitate our event analysis. With the second aspect, everything is clear regarding the identification of the safety problems and learning of lessons. The situation is more complicated with assessment of the safety significance of events, because the relation of one or another event to safety is often not obvious at all. Assessment of such events from the viewpoint of the potential consequences is not always justifiable and applicable.

The second aspect in this difficulty is: the hardly understandable nature of the human mistakes. The personnel that analyzes events sometimes faces difficulties, when a participant of an event himself cannot explain, why he acted in such a way and not otherwise. A given event participant has a good reputation, training, experience, he is in good conditions, he has many times carried out such a work, and unexpectedly he commits a mistake. Everyone of us has faced such situations in the real life. Logical explanations are not suitable for the events of such a kind and we can only imply "Why did it happen?" It is difficult to work out corrective actions.

SUGGESTIONS

1. The plant receives various information about the operation of the nuclear industry enterprises from many sources. But the information received almost does not contain any news about the ASSET. We learn about them by chance when meeting the colleagues. Maybe the Agency will find a possibility to publish a periodic information bulletin about the ASSET.

2. We need a software for the ASSET methodology as a tool to provide practical use of it.

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PAKISTAN

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ASSET EXPERIENCE IN PAKISTAN

Mohammad Iqbal

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ISLAMABAD
PAKISTAN

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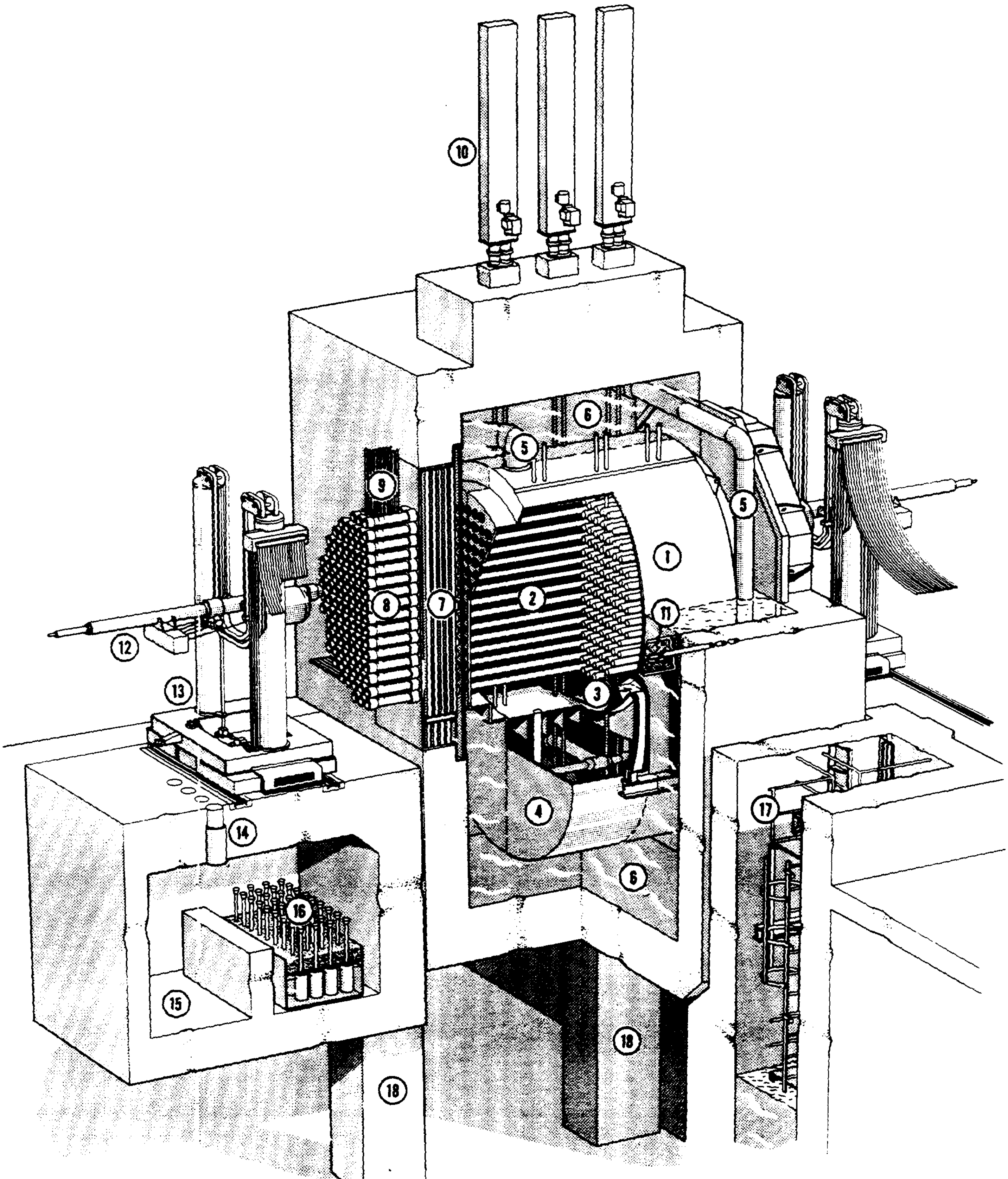
- **FUELLING PROCESS**
- **FUELLING PROBLEM**
- **CAUSES OF THE PROBLEM**

KARACHI NUCLEAR POWER PLANT

- CONSTRUCTION STARTED IN AUGUST 1966
- FIRST CRITICALITY ACHIEVED ON AUGUST 1, 1971
- COMMERCIAL OPERATION STARTED ON OCTOBER 4, 1972
- 137 MWe GROSS AND 125 Mwe NET
- A PRESSURIZED HEAVY WATER TYPE REACTOR
- NATURAL URANIUM OXIDE FUEL
- HORIZONTAL CALANDRIA
- 208 FUEL CHANNELS
- BI-DIRECTIONAL FLOW OF COOLANT IN ADJACENT CHANNELS
- ON-POWER FUELLING

FUELLING PROCESS

- FUELLING MACHINES ARE PREHEATED AND GIVEN OPERATIONAL CHECK
- NEW FUEL BUNDLES ARE LOADED TO THE FUELLING MACHINES
- THE FUELLING MACHINE LOCKS AND SEALS TO EACH ENDS OF THE CHENNEL TO BE FUELLED
- ONE MACHINE INSERTS THE FUEL BUNDLE
- MACHINE ON THE OTHER END RECEIVES THE IRRADIATED FUEL
- SEVEN FUEL BUNDLES CAN BE LOADED AT ONE FUELING OPERATION



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FUELLING PROBLEMS

- **FIRST FUELLING PROBLEM EXPERIENCED IN OCTOBER 1983**
- **THE FUELLING MACHINE COULD NOT LOCK TO THE DESIRED CHANNEL**
- **PROBLEM WAS RESOLVED BY RESETTING THE GAP BETWEEN FUELLING MACHINE JAW AND THE END FITTING OF THE CHANNEL** 162
- **IN AUDGST 1995 THE UNLOCKING PROBLEM WAS RESOLVED BY USING A THICKER SEAL**
- **IN FABRUARY 1986 ALL ATTEMPTS OF ON POWER FUELLING WERE UNSUCCESSFUL**

CAUSES OF THE PROBLEM

- MECHANICAL DEFORMATION DUE TO EXTERNAL FORCES TO THE END FITTINGS
- INTERNAL FORCES DUE TO FUEL LOAD AND IRRADIATION GRADIENT
- CORROSION BETWEEN END FITTING AND CALANDRIA EXTENSION TUBE
- DEFICIENT PRESSURE CONTROL OF CARBOMDIOXIDE ANNULUS GAS SYSTEM

ROMANIA

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XA9745025

The Specific Aspects for the ASSET Methodology Implementation in Romania

Dr.ing.Dan Serbanescu
INES & IRS National Officer
PSA & Severe Accidents Expert

1. Specific Aspects of the Implementation of the ASSET Methodology for Cernavoda 1 NPP

The main aspects of the implementation of a root cause analysis methodology are as follows:

(1) The Test Operating Licence requires that a systematichal root cause analysis method for the event analysis to clarify the three questions from the ASSET methodology has to be implemented.

(2) A Training seminar on the ASST methodology for the plant staff was performed at Cernavoda 1 NPP in April 1997, with the IAEA support.

(3) The self assessment process for the events which occurred during commissioning phases has to be performedby the plant up to the end of this year.

(4) An ASSET Peer Review of the Plant Self Assessment is planned in 1998.

(5) The Regulatory Authority has the task to evaluate independently the plant conclusins on various events. The tool used by CNCAN is the ASSET methodology.

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2. The principles of the method used in the event analysis requirements related to the Cernavoda 1 NPP, as Unplanned Event Reports (UER) during the commissioning phases

A EVENT ANALYSIS METHODS

(1) Licensee analysis using a specific method based mainly on expert opinion.

(2) Independent evaluation by the Regulatory Authority on the events defined as safety significant, using the ASSET methodology.

(3) IAERA support by the use of ASSET service (ASSET mission in July 1994 for a single event)

B. REPORTING REQUIREMENTS

(1) The UER reports comply with the INES and IRS requirements and are similar to the AECB R-99 requirements. These requirements are included in the Revised Commissioning Licence for Phase C.

A separate regulatory document exists and is based on these requirements and the experience gained with the existing system.

(2) The reporting requirements are included in a station procedure. The differences between this procedure and the licence requirements are mainly related to the report timing to CNCAN and are not of a nature to be an impediment in defining a good reporting environment.

* These requirements were implemented in addition to and in parallel with the existing system of Commissioning Unplanned Event Reports (CUER). The CUER reports are defined by a station procedure accepted by CNCAN.

* The criteria for CUER and UER are different: UER is oriented on safety aspects, while CUER is mainly oriented on hazards, abnormal situations and less on safety aspects.

* Some important aspects related to the CUER - UER specific aspects are presented in figures attached.

* The CUER system was used by the licensee and its use encouraged by CNCAN due to the fact that it could be used as a tool for the evaluation of the feedback from commissioning activities to the initial safety evaluations and test procedures.

These requirements are included in the Cernavoda 1 NPP Commissioning Licence -Revision 1996. The NPP station instruction reflect these requirements to comply with the INES and IRS systems. During the reporting period one INES event was reported to IAEA and no IRS reports were issued.

(3) CNCAN is udeveloping its own database and assessment of these events using the ASSET methodology. An IAEA ASSET mission at Cernavoda 1 NPP for a commissioning event (RSW water hammer) held in August 1994 confirmed completness and comprehensiveness of the regulatory decisions taken based on the analysis of this event done with the ASSET methodology.

Since the reporting depended on the commissioning phases, the main licensing steps for Cernavoda 1 NPP are presented in Table I for the clarity of the presentation.

RUSSIAN FEDERATION

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XA9745026

TECHNICAL COMMITTEE MEETING
«Annual Workshop on ASSET Experience and Feedback»
(Vienna, 24-26 June, 1997)

E.N. Pozdyshev

President, Rosenergoatom, Russian Federation

Rosenergoatom (REA) is the operating organization of the Russian nuclear power plants. It comprises all Russian NPP's, except for the Leningrad NPP, research centres, supporting organizations and factories. 8 NPP's of REA (25 Units) are listed below in Table 1.

Table 1

Nuclear power Plant	Unit	Reactor Type	Capacity, MWe
Balakovo	1	VVER-1000	1 000
	2	VVER-1000	1 000
	3	VVER-1000	1 000
	4	VVER-1000	1 000
Kalinin	1	VVER-1000	1 000
	2	VVER-1000	1000
Kola	1	VVER-440	440
	2	VVER-440	440
	3	VVER-440	440
	4	VVER-440	440
Novovoronezh	3	VVER-440	417
	4	VVER-440	417
	5	VVER-1000	1 000
Beloyarsk	3	BN-600	600
Kursk	1	RBMK-1000	1 000
	2	RBMK-1000	1 000
	3	RBMK-1000	1 000
	4	RBMK-1000	1 000
Smolensk	1	RBMK-1000	1 000
	2	RBMK-1000	1 000
	3	RBMK-1000	1 000
Bilibino	1	EGP-6	12
	2	EGP-6	12
	3	EGP-6	12
	4	EGP-6	12

Contribution of the Russian NPP's in total production of electricity of the country is approximately 12 %. In 1996 NPP's produced 89,1 billions of KWh of electricity that is 10,9 % more than in 1995. The capacity factor has increased by 5,3 %.

Paying attention to the importance of reliable generation of electricity, REA as the operating organization at the same time considers safety issues as high priority ones. In published «Nuclear Power Policy Statement», REA management clearly defines the priority of NPP safety assurance over the other tasks of the nuclear power industry. Behind this acknowledgement stands great work of all REA staff on implementation of NPP upgrade programmes, introduction of safety culture principles, as well as study and implementation of the experience of foreign partners and International Organizations.

ASSET programme of IAEA is one of the vital components of REA efforts aiming at enhancement of NPP safety. REA is one of the most active participants of this programme. ASSET missions and workshops were conducted at 6 of 8 REA NPP's (see details in Table 2). Many REA experts including higher level management took part in the missions in foreign countries.

Table 2

Nuclear Power Plants	ASSET Workshops	ASSET Missions	ASSET Follow-up Missions
Balakovo	September 1993	October 1992	October 1994 June 1997
Kalinin	February 1994	July 1994	
Kola		April 1991	October 1993
Kursk	April 1995	July 1992	September 1995
Novovoronezh		May 1991	November 1993
Smolensk	June 1994 July 1995	July 1993	February 1997

ASSET missions, plant staff training and personal participation of many experts in the missions during several years prepared good basis for the implementation of the ASSET methodology at Russian NPP's for analysing mechanism of the operational events.

The results of the first ASSET missions were carefully analysed. It was noted that ASSET methodology may be very useful for event investigation at Russian NPP's. The decision was made at the joint meeting of REA, IAEA, Kursk NPP, Novovoronezh NPP and VNIIAES (Technical Support) to implement this methodology in routine plant operation practices. The respective guidance was issued by REA in 1993.

Based on this document the following actions were carried out:

1. «General Terms of Reference for the Group Responsible for the NPP Operational Event Analysis Based on ASSET Methodology» and «Recommendations on the Direct and Root Cause Analysis of NPP Operational Events» were worked out and implemented at the plants.
2. Official IAEA documents: ASSET Guidance (IAEA-TECDOC-632) and Guidance on INES were translated into Russian and distributed to the plants for use by the groups responsible for NPP operational event analysis.
3. REA NPP's set up special groups for NPP operational event analysis mainly comprising staff of the divisions of nuclear safety and/or technical inspectorate. Terms of reference for the groups were prepared as well.
4. Training of NPP staff on ASSET methodology was arranged through domestic workshop: «Analysis of NPP Operational Event Based on the ASSET Methodology» and several workshops on ASSET and INES conducted by IAEA at our plants.
5. Representatives of the Groups on NPP operational event analysis participate in the Commissions on investigation of operational events on the regular basis.
6. ASSET methodology is included in the training programmes of the NPP Training Centres.

Implementation of ASSET methodology opened an avenue to a more efficient investigation of failures and to better identification of the direct and root causes of the events as well as to more appropriate planning of the corrective actions. Safety culture also generally increased. The attitude of the staff to the event investigation became more adequate. This progress resulted in improvement of the plant performance indicators. For example, Table 3 shows the trend of diminishing of the number of operational events and their significance.

Table 3

Operational Events (INES Scale)

Year	Below Scale	Level 0	Level 1	Level 2	Level 3	Total
1992	-	165	29	3	-	197
1993	23	107	27	-	2	159
1994	11	108	8	1	-	128
1995	19	78	3	1	-	101
1996	24	57	2	-	-	83

Number of reactor SCRAM's by emergency protection actuation has decreased within the past five years from 1,4 per unit in 1992 to 0,4 per unit in 1996.

During the year passed since the last ASSET TCM, two missions were conducted at Russian NPP's. These missions were ASSET peer review missions on safety culture related event investigation performed by Smolensk NPP (February 1997) and Balakovo NPP (June 1997). The experts made their conclusions that safety culture, i.e. ability of the NPP to identify safety issues, assess their significance and to learn lessons, increased since previous missions to these plants.

The operating organization and the plants appreciated highly professional work of the ASSET experts. Their recommendations will be used as the basis for preparing a plan of the corrective actions. In particular, regarding the mission to Balakovo NPP, which is planned to be analysed in detail by one of the working groups of this Committee, the following measures will be implemented in accordance with the experts recommendations:

- improvement of maintenance procedure development;
- paying more attention to the issues of basic and refreshing training of the maintenance personnel;
- solving the problem of exceeding of control rods insertion time.

In general after several years of active participation in the ASSET programme and watching its progress, I could make some observations.

1. At present, ASSET methodology is a close-ended logical structure. Its use for dismantling mechanism of the operational events is an important component ensuring high level of the operational safety.
2. Experience of implementation of the ASSET methodology at REA NPP's confirms its usefulness in increasing the level of safety culture and performance indicators (diminishing of the number and significance of operational events).
3. In our opinion, at present, the most useful are the peer reviews based on the ASSET methodology on the results of the plant event analysis. This approach encourages plant staff to better study the methodology and to systematically apply it in routine operational activities.
4. An efficient type of missions is also topical missions, which analyse events related to certain operational areas (i.g. failures of some specific equipment components or events related to carrying out certain type of operational or maintenance works). These missions motivate personnel involved in the plant specific «bottle-neck» activities to study and apply the ASSET methodology.
5. As a recommendation, I would like to propose that the IAEA ASSET group develop an additional reference material which would contain a number of various examples of NPP operational event analysis based on the ASSET methodology. This guidance compiling the results of the previous missions

might be very helpful for wide-range implementation at the ASSET methodology as well as for the training programmes.

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SSC RIAR IS THE LARGEST CENTRE OF RESEARCH REACTORS

V.V.Kalygin, State Scientific Centre
Research Institute of Atomic Reactors, Russia

IAEA TECHNICAL COMMITTEE MEETING

"Annual Workshop on ASSET Experience"

24-26 June, 1997, Vienna, Austria

ABSTRACT

The State Scientific Centre (SSC) "Research Institute of Atomic Reactors" (RIAR) is situated 1000 km to the south-east from Moscow, in Dimitrovgrad, the Volga Region of the Russian Federation.

SSC RIAR is the largest centre of research reactors in Russia. At present there are 5 types of reactor facilities in operation, including two NPP.

One of the main tasks the Centre is the investigations on safety increase for power reactors.

Broad international connections are available at the Institute.

On the basis of the SSC RIAR during 3 years work has been done on the development of the branch training centre (TC) for the training of operation personnel of research and pilot reactors in Russia.

1. INTRODUCTION

Nuclear engineering and enterprises providing its functioning, in spite of different approaches to this branch of the public and governments, take one of the leading places in the world industry and energy programs of many states.

However, usage of this energy type is possible only at the high safety level of atomic power plants and during release of radiation wastes formed as the result of their operation.

This condition can be performed if the following will be provided: scientific tracking of the nuclear fuel life cycle, constant monitoring of the technologies and production, advancing research in those fields which determine the safety level.

It is accepted world-wide that one of the most important conditions of safe and reliable operation of the reactor facilities, NPP units along with providing the high quality of the project, construction, equipment and materials is high qualification of operation personnel. In the former USSR the scientific support in solution of the arising problems of safe operation of atomic power plants, development of principally new technologies and their introduction to atomic power engineering were performed in the scientific centres of Moscow, St.Petersburg, Volga Region, Ural and Siberia at research facilities and stands specially mounted for this purpose.

The largest centre of research reactors - SSC RIAR- is placed in Dimitrovgrad.

Research reactors have to be operated in rigorous agreement with safety requirements in order to fulfil the task of safety justification in atomic power engineering.

2. FEATURES OF RESEARCH REACTORS OPERATION

At present according to the official data of RF Gosatomnadzor there are 27 research reactors in account in Russia (see Tab. 1), the considerable part of which is placed in the State Scientific Centre (SSC) "Research Institute of Atomic Reactors" (RIAR). The SSC RIAR is situated 1000 km to the south-east from Moscow in Dimitrovgrad, in Volga Region of the Russian Federation.

This is one of the largest centres in the CIS in the field of experimental studies on fundamental issues of nuclear energy, development of designs and problems related to safe operation of nuclear power plants.

At present there are 5 types of reactor facilities in operation, including two pilot NPP which produce electrical energy and heating for local needs (see Tab.1)
- the SM-3 reactor, 100 MW (heat), high-flux, vessel type;
- the MIR reactor, up to 100 MW (heat), multiloop, test;
- 3 pool-type RBT reactors up to 10 MW (heat);
- pilot NPP VK-50, 50 MW (el.), with the boiling vessel-type reactor;
- pilot NPP BOR-60, 12 MW (el.), with the fast reactor and liquid-metallic sodium coolant.
- one research reactor ARBUS is under decommissioning.

The main experimental base of the SSC RIAR also includes: a complex of "hot" material science laboratories for post-radiation investigations of the power reactor fuel; a radiochemical complex; a pilot-experimental workshop for unconventional equipment production, the radioactive wastes utilisation facilities. This allows complex solution of the research programs on the Institute site. The Centre has its own social-cultural base.

Closed fuel cycle with mixed U-Pu fuel has been carried out and successfully operated for some years at the SSC RIAR on the basis of the pilot BOR-60 NPP and radiochemical complex with the facility for irradiated fuel reprocessing.

The whole activities of the SSC RIAR, incorporated into the Russia Minatom, are controlled by the Gosatomnadzor of Russia performing supervision of nuclear- and radiation-dangerous facilities and production lines operation, including supervision of the personnel training, qualification level and competence.

Unique experimental possibilities, space-saving facilities location (on the one site) allow to solve different tasks on safety improvement and further development of atomic power engineering not in Russia only but in other countries. Broad international connections to be available in the Institute are based on this fact. At present joint works with England, France, Germany, Japan and some other countries are conducted.

Personnel of research reactors operating in the SSC RIAR work for twenty-four hours fulfilling, apart from usual NPP personnel functions, some additional functions related to preparation and performance of experimental programs. This introduces certain features in operation. Let us consider them in more detail.

One of the main features of the research reactor (RR) operation is a criterion of estimating its operating efficiency as compared to the same criterion for NPP. An example of such a comparison is presented in Tab.2. In this event it means that in compliance with the General Safety Provision the main criterion is safety. From comparison in Tab.2 we can conclude that if for NPP the criterion of electric energy output in a general case remains unchanged, it is necessary to take into account the final results during experiments performance in the case with RR. From this viewpoint the basic difference can be stated as follows: for NPP it is energy production (electrical and/or thermal); for RR - "knowledge" production and only after that -products manufacture. The next distinguishing feature is the fact that during RR operation there can arise mutually excluding requirements for providing some or other conditions, operating parameters of various experimental devices located in the reactor. It is evident that fulfilling all the experiment conditions should be made with strict observation of the safety requirements. However, simultaneous observation of these requirements is a very complicated task.

Finally, it should be noted that simultaneous solution of several tasks in the reactor core during one campaign is also possible. The order of priority of these tasks can be changed even in one campaign. A list of such tasks solved simultaneously at the Institute reactor facilities is presented in Tab.3 as an example.

3. EVENTS INVESTIGATION IN RESEARCH REACTORS

Any research reactor has to inform the regulatory bodies about all accidents, incidents which cause reactor shutdown or power decrease and incident with fuel assemblies damage during their transportation with irradiated fuel in accordance with the requirements contained in Russian Safety Standards for Research Reactors.

Event are investigated by the commission. The commission staff is determined by Gosatomnadzor, Minatom or by the site director in accordance with the consequences effects. The results of commission work are presented in the report on faults where the following moments should be described:

- event description
- event consequences
- direct and root causes for event
- event assessment from the safety point of view
- deficiencies detected during investigation
- corrective actions.

It looks like that the methods applied for events investigation in the frame of

compare them using the example with research reactors.

We had only 1 event 2 level in INES during research reactors operation. All other events were 0 level or below scale.

The causes for recorded faults are distributed in such a way on the basis of analysis:

-failures of equipment	- 47%
- failures of personnel to perform as expected	- 28%
- failure of experimental equipment operation	- 21%
- failure of procedure	- 4%

Of course, there are some measures for described above causes elimination available in the Institute. For example, supervision on work and equipment replacement is under constant development. In order to decrease the number of personnel failures the Training Centre (TC) has been opened three years ago in SSC RIAR. The work of designers and manufacturers of experimental equipment is improved, the procedures are changed periodically.

Particularly the work of TC should be stressed. It solves the set task using rich international experience and by participating in international programs aimed at improvement of the personnel training systems..

In particular together with the Training Facilities of the German Nuclear Research Centre, Karlsruhe, and with the Training Centre of Siemens - KWU, Germany, are already carried out and planed in future works on development of technical training means and the relevant training-methodical provision on the basis of the Systematic Approach to Training (SAT). The basic aim of the performed works and those to be planned is organisation and establishment of the Training Centre for personnel training of research reactors on the SSC RIAR basis using modern training aids, that would meet the national and international standards and requirements, and in perspective could solve the tasks for personnel training not only in Russia, but in other countries as well.

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Table 1.

Summary of Russian Research and Experimental Reactors in 1996

№	Name	Location
1	F-1	Moscow
2	Gidra	Moscow
3	Gamma	Moscow
4	Argus	Moscow
5	IR-50	Moscow
6	IW-2M	Zarechny, Sverdlovsk region
7	IRT-M	Moscow
8	IRT-T	Tomsk
9	WR-M	Gatchina
10	WR-TS	Obninsk
11	RG-IM	Norilsk
12	AM	Obninsk
13	BR-IO	Obninsk
14	IBR-2	Dubna
15	IBR-30	Dubna
16	SM-3	Dimitrovgrad
17	RBT-6	Dimitrovgrad
18	RBT-10-I	Dimitrovgrad
19	RBT-10-2	Dimitrovgrad
20	MIR	Dimitrovgrad
21	VK-50	Dimitrovgrad
22	BOR-60	Dimitrovgrad
23	TIBR-IM	Moscow
24	BARS-2	Moscow
25	BARS-3M	Moscow
26	BARS-4M	Moscow
27	PIK (under construction)	Gatchina

Table 2

EFFECTIVE OPERATION CRITERION OF NPP AND RESEARCH REACTOR

Compared index	NPP	Research reactor
Output	Energy production	"Knowledge production" is more important
Unplanned reactor shutdown	Not desirable	Possible as consequence of the planned experiment
Efficiency of fuel usage	Main economic factor	Achieved experiment aim is more important
Multipurpose use of the core	Not desirable	Possible. This improves economics, provides solution of several problems at a time
Stability of operation parameters	Main requirement of safety assurance	Determined by the experiment conditions
Primary aim of operation personnel work	Keep the reactor steady	Perform experiments
Requirements for personnel	In compliance with the existing standard regulations	More severe requirements are possible

Table 3

Listing of the main research performed in the RIAR reactors

1. Radiation testing of different types of materials, fuel elements and fuel assemblies for service-life determination under controlled conditions.
2. Radiation testing of fuel (fuel rods, fuel assemblies) under project accident conditions.
3. Service-life testing of equipment (steam generators, pumps, etc.).
4. Testing of the core diagnostic systems.
5. Accumulation of isotope products.

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SLOVAK REPUBLIC

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Annual Workshop on ASSET experiences

Wienna 24. - 26. 6. 1997

Operational Experiences Feedback in BOHUNICE NPP

presented by

A. Beták, NPP Bohunice, Slovakia

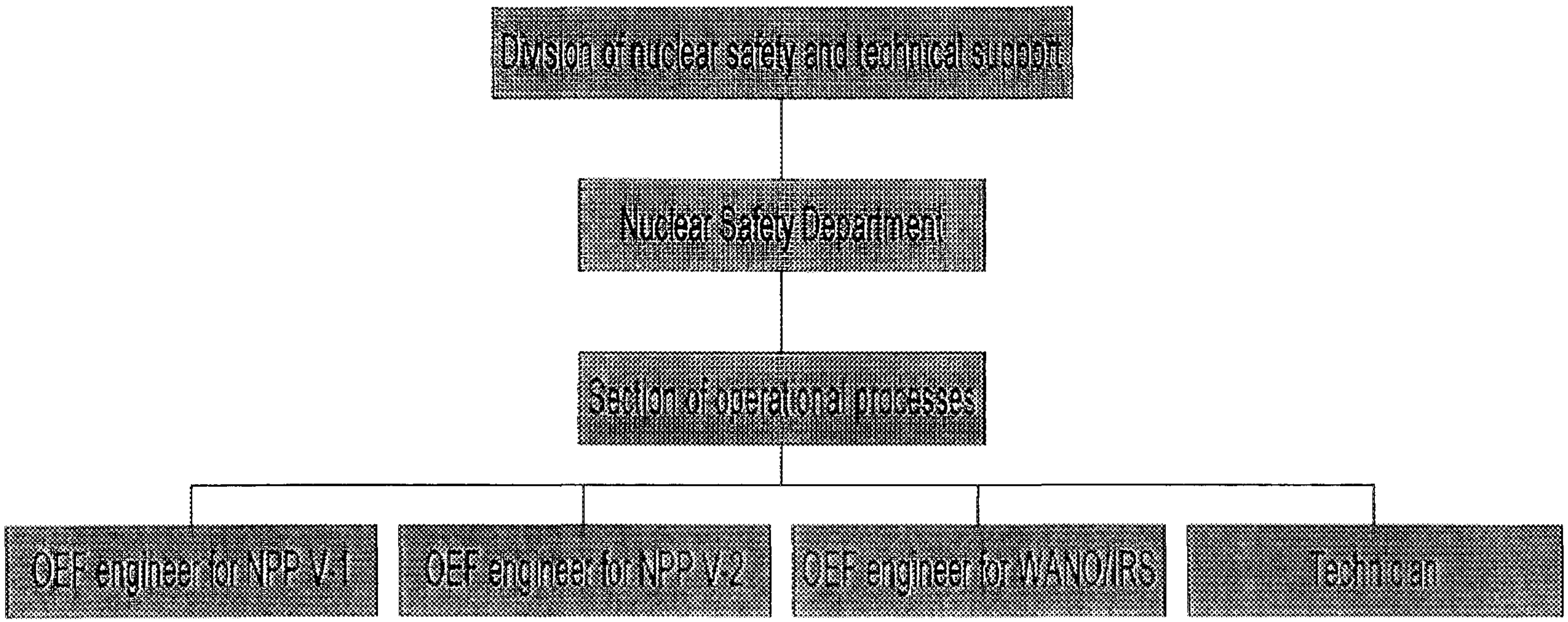
Operational Experiences Feedback in BOHUNICE NPP

Summary of presentation :

- OEF team in Bohunice NPP - structure
- training and qualification : ASSET seminars on Prevention of incidents - INES manual handling, NRA-NRC the training on event investigation methods, NU- the training on HPES
- legislation - documentation prepared in the frame of QA programme
- results of OEF team activities
- ASSET mission Dukovany - Experiences
- the perspective activities

Operational Experiences Feedback in BOHUNICE NPP

Structure of OEF management



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Operational Experiences Feedback in BOHUNICE NPP

Training & Qualification of OEF personnel

- training related to operation (experienced operators)
- IAEA seminars on Accident prevention and INES Manual handling
- NRC seminar on investigation techniques
- Nuclear electric - course on HPES methodology

Operational Experiences Feedback in BOHUNICE NPP

Legislation

Procedure for operational event investigation process:

- purpose of document
- responsibilities of NPP personnel
- event categorization
- event reporting / information flow
- event commitee members
- INES classification

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Operational Experiences Feedback in BOHUNICE NPP

Legislation (cont.)

Procedure for foreign operational experience handling:

- purpose of document
- responsibilities of NPP personnel
- WANO database updating
- information flow
- results implementing

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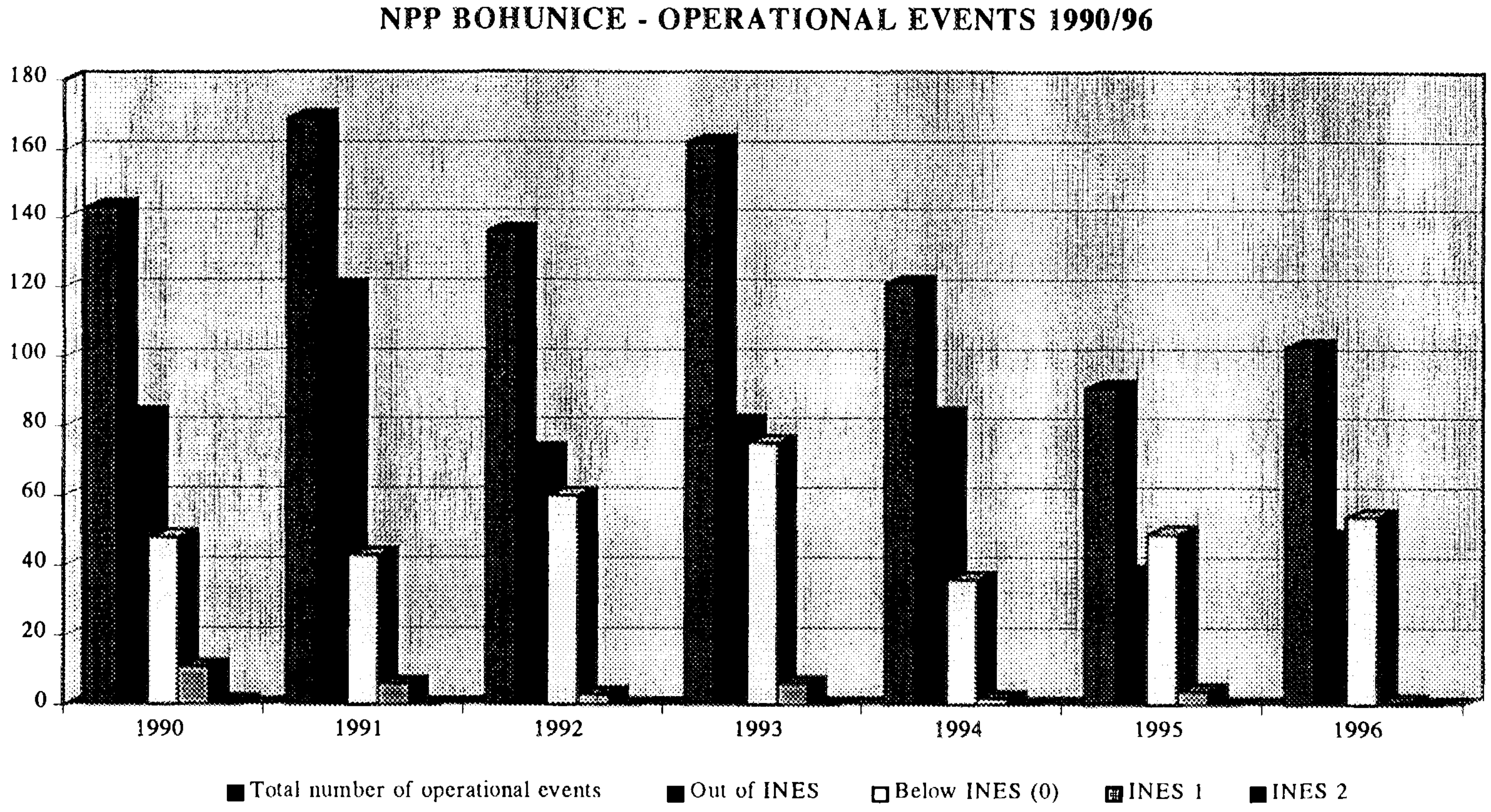
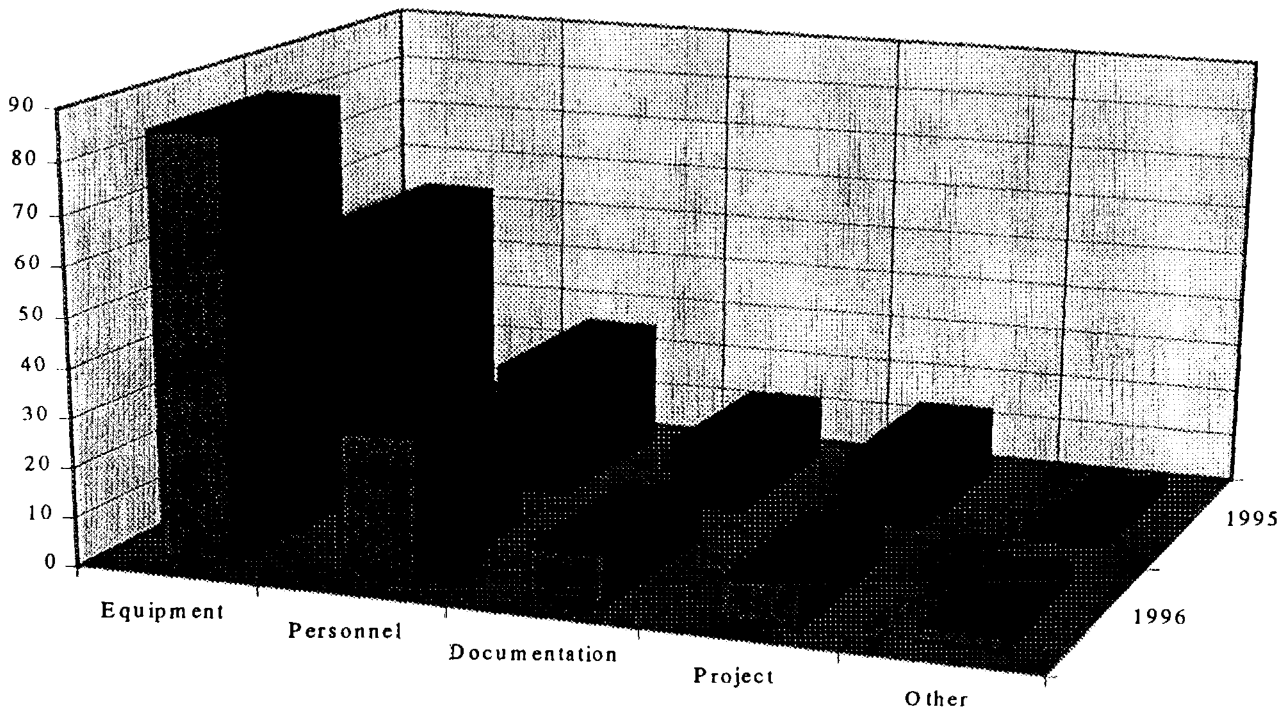
Operational Experiences Feedback in BOHUNICE NPP



Operational Experiences Feedback in BOHUNICE NPP

Identified causes of operational events - comparison 1996/95



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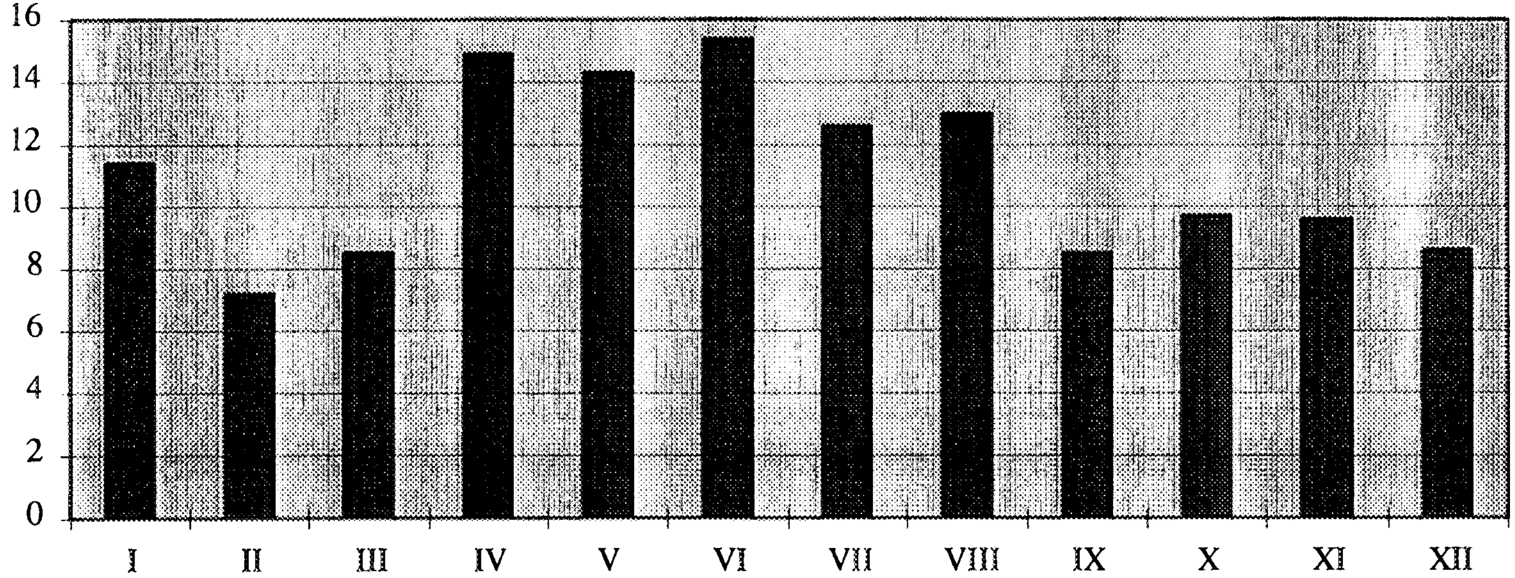
Operational Experiences Feedback in BOHUNICE NPP

Average distribution of events among the moths years 1990-96



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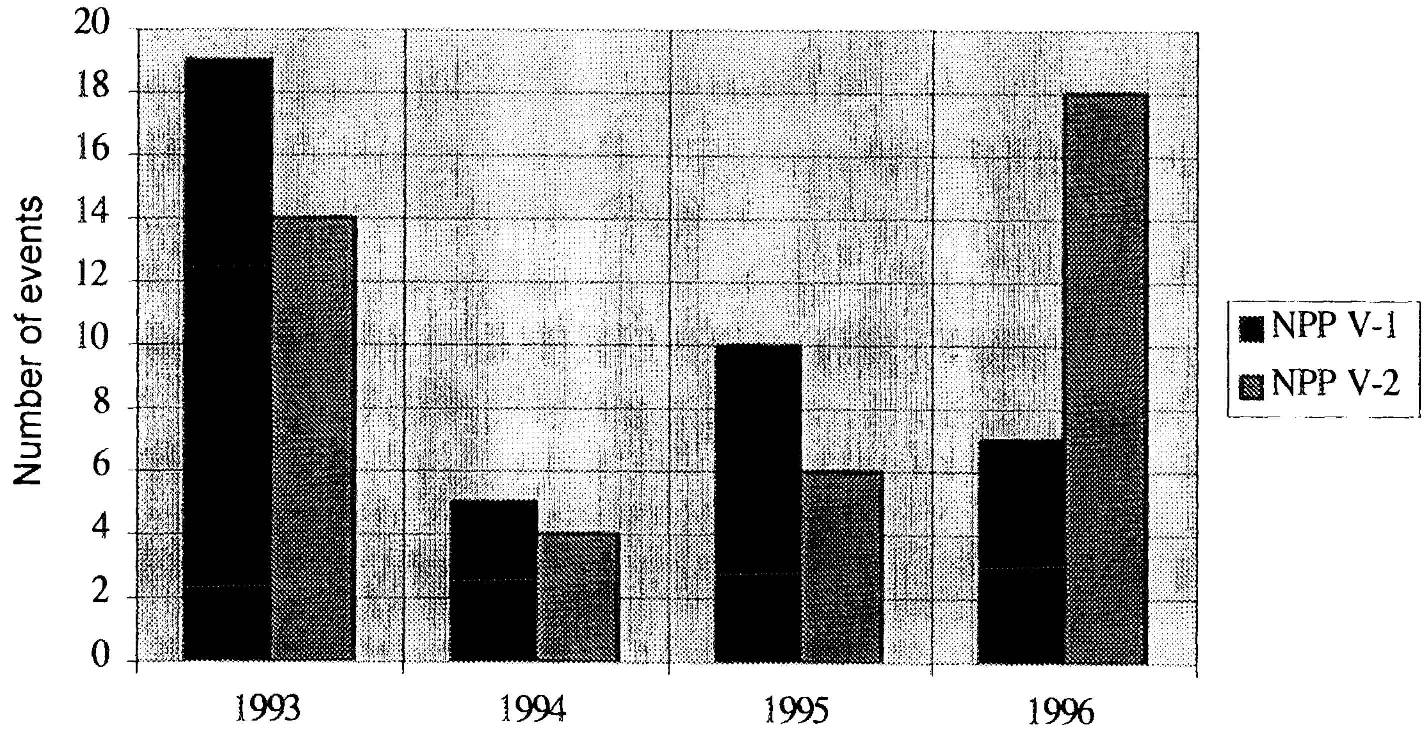
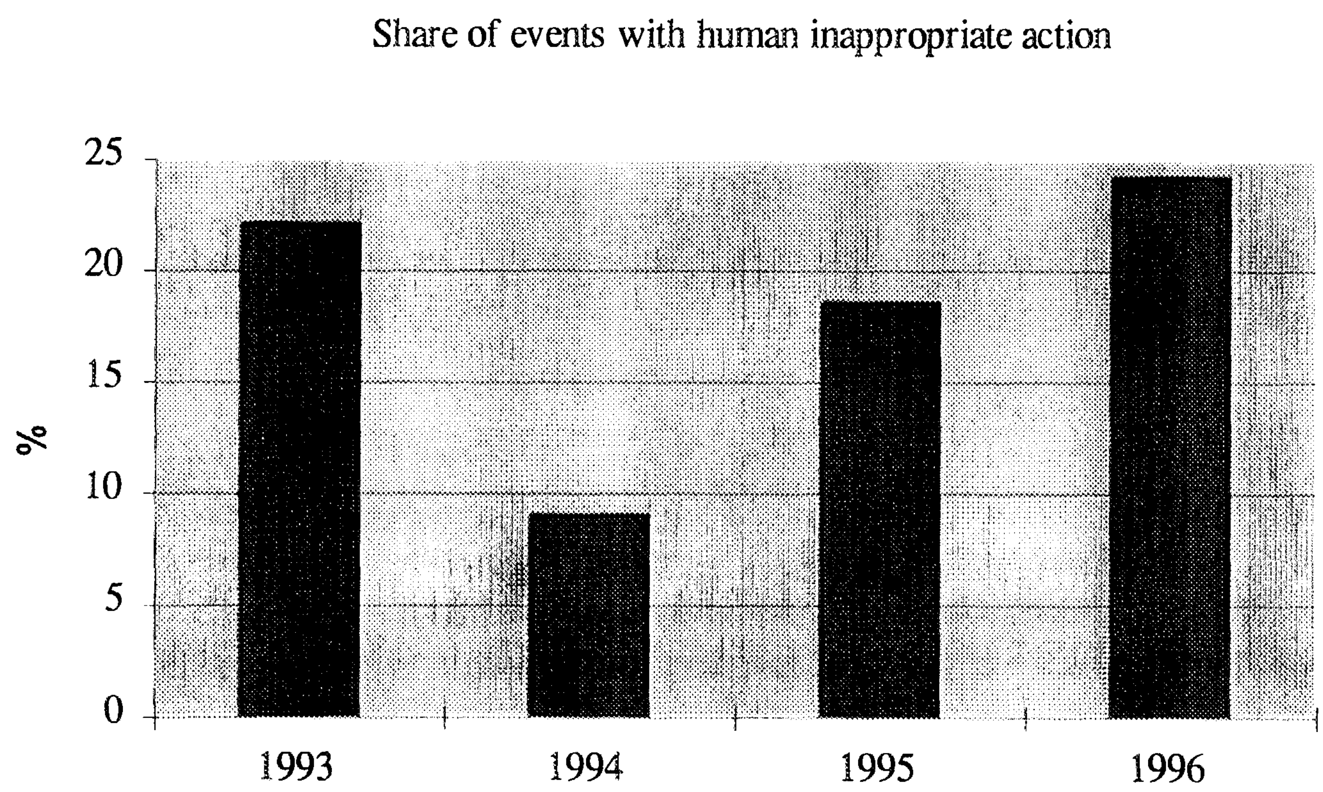
Operational Experiences Feedback in BOHUNICE NPP

The number of events caused by human inappropriate action



204

Operational Experiences Feedback in BOHUNICE NPP



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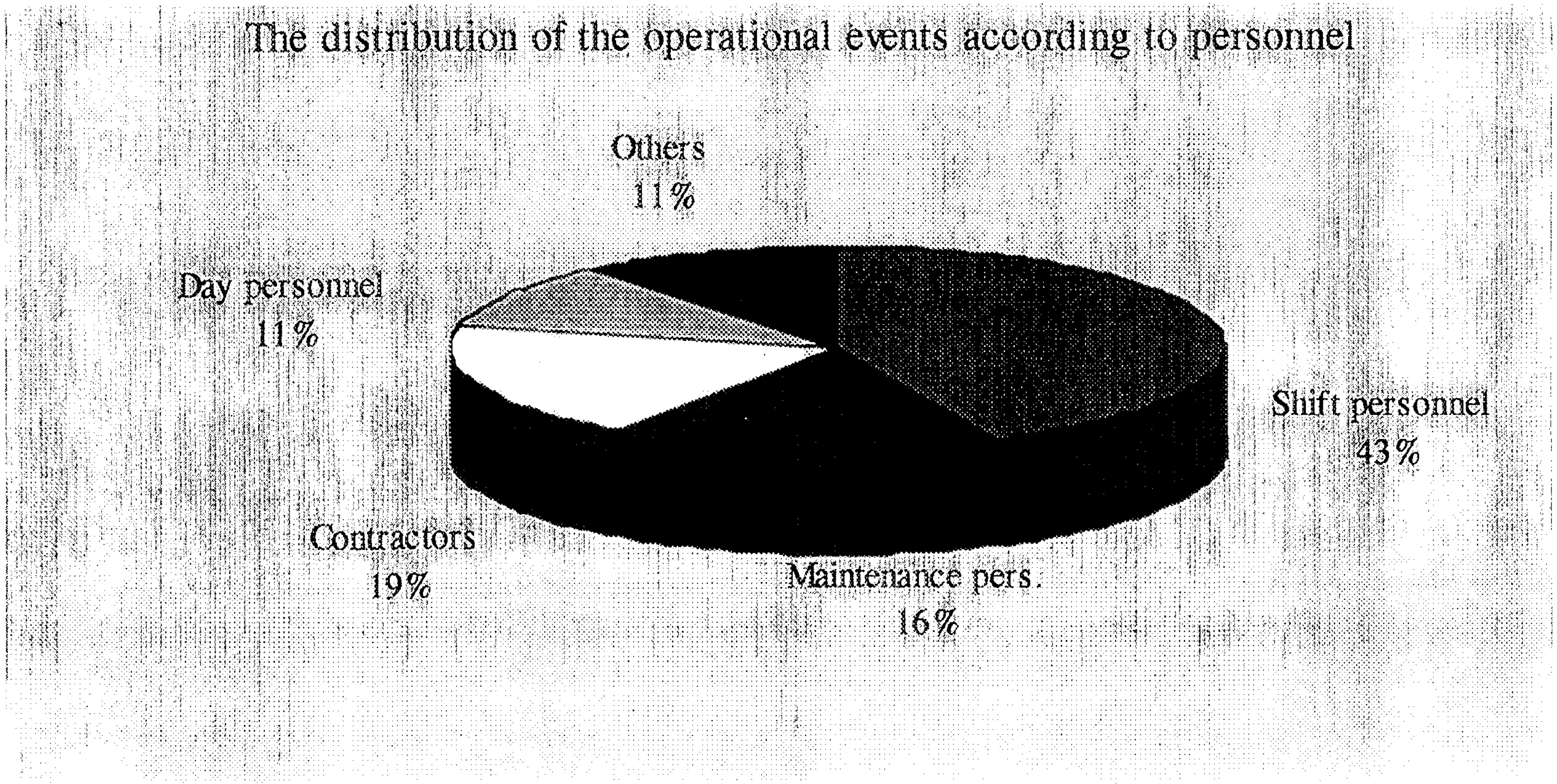
Operational Experiences Feedback in BOHUNICE NPP



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Operational Experiences Feedback in BOHUNICE NPP

Conclusion and planed actions :

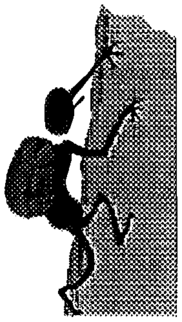
- OEF in Bohunice is relatively good organized, equiped and sufficiently supported by plant management
- tangible results are available from OEF staff (trends, attitudes, actions proposals)
- however, some gaps exists, which are the area for improvement :

  # software which is used for information processing doesn´t fully complies with today requirements and is planed to be modernized

  # more advertising of safety culture principles among the personnel of all levels

  # operational experiences handling

  # commitment of medium level technical personnel on correct event investigation



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SLOVENIA

21)

SLOVENIA

XA9745029

Experience with the ASSET service

Chronology:

- first ASSET mission in the world was conducted at NPP Krško - 1986

- ASSET seminar "Guidance for prevention of incidents" - July 1994

- ASSET seminar "Practical use of the ASSET analysis procedures on the plant operational events for self assessment" - January 1996

- ASSET peer review of plant self assessment of operational safety performance, 23-27 September 1996

With all these services the IAEA ASSET team personnel provided valuable support to NPP Krško and helped us to achieve high industry standards in the safe and reliable operation of plant. The close co-operation between plant professionals and the IAEA ASSET missions had established many personal contacts and a common basis for efficient past and future work. Throughout the missions, the ASSET team counterparts were open minded, co-operative and supportive in creating a productive atmosphere.

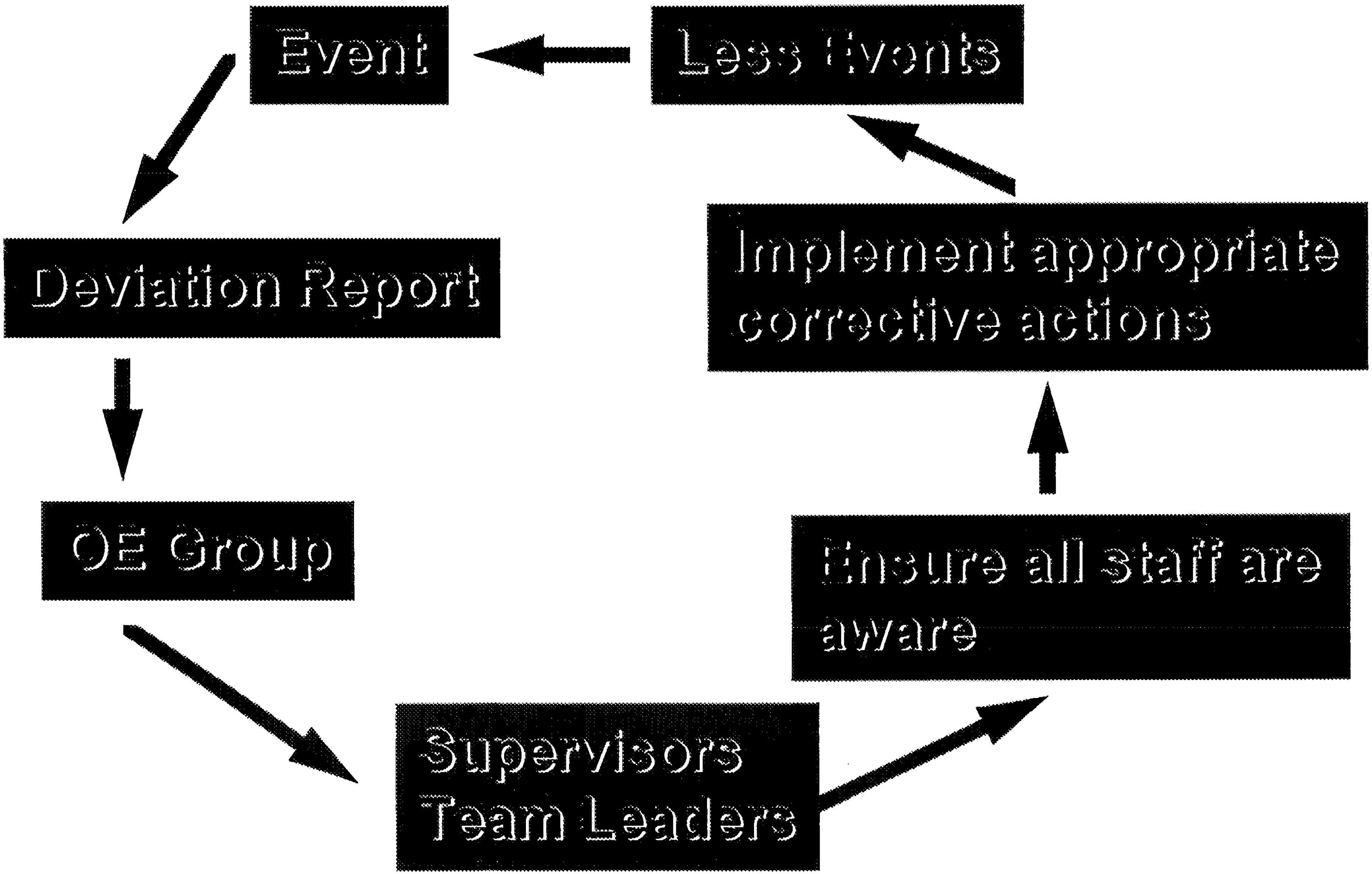
ASSET methodology

IAEA has developed universal root cause analysis methodology to support plant self assessment of operational safety performance.
The root cause methodology is easily available to all member states and has a degree of international recognition. It is developed to target organisational problems and to advise NPP management how to prevent operational events (assess latent weaknesses in management and associated root causes). The ASSET methodology is supported by IAEA training courses or seminars.

Suggestions:

- develop computerized program to assist the analysis of plant operational events,
- develop a preliminary set of root causes and corrective actions,
- improve human performance aspects so that they become more sophisticated.

OE PROCESS


Event
Less Events
Deviation Report
Implement appropriate corrective actions
OE Group
Ensure all staff are aware
Supervisors
Team Leaders

On-site event reporting

Abnormal occurrence

Reported to Management or OE Group via Deviation Report

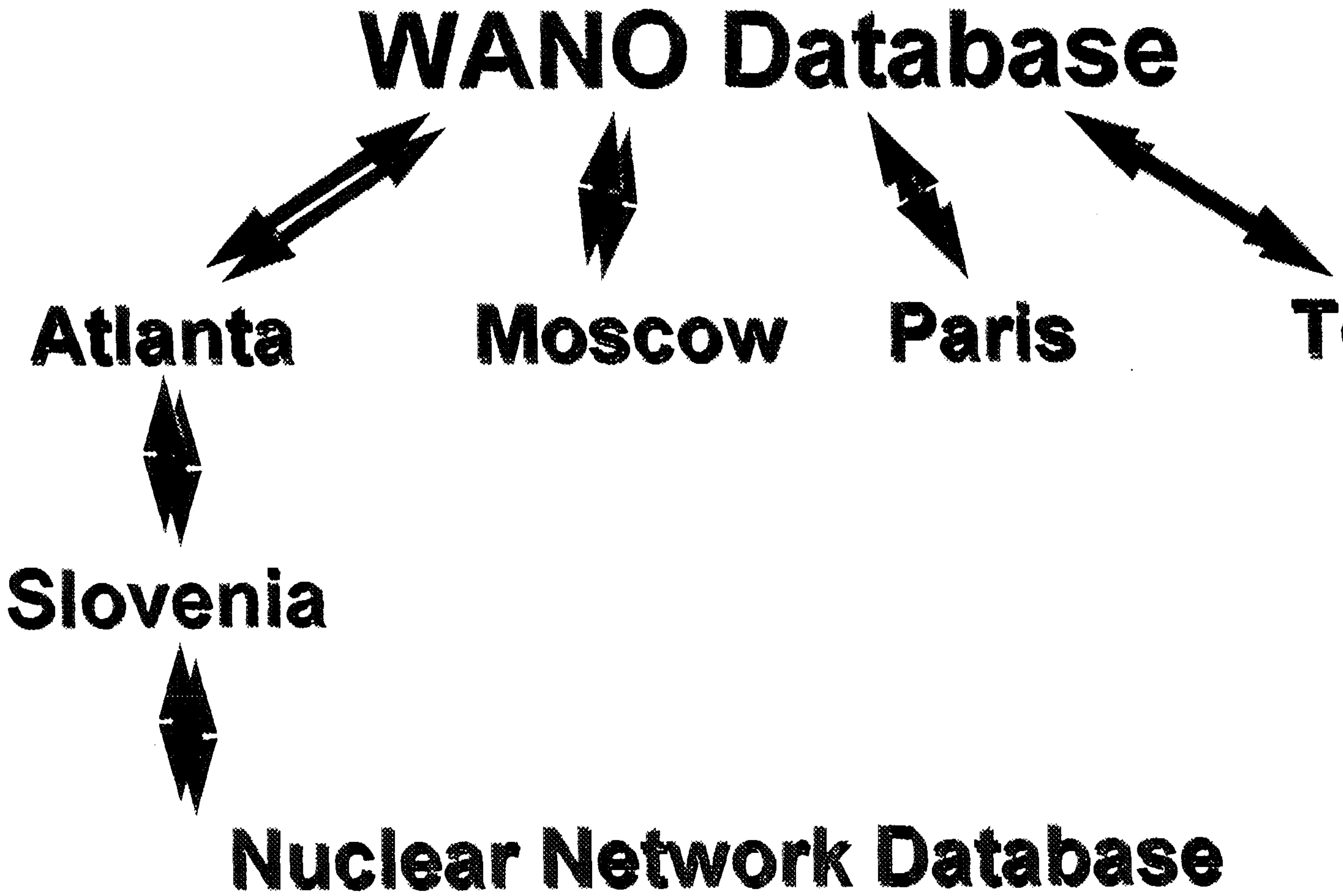
Copy to TO.PR, TO.VZ

Original to Operating Experience Feedback

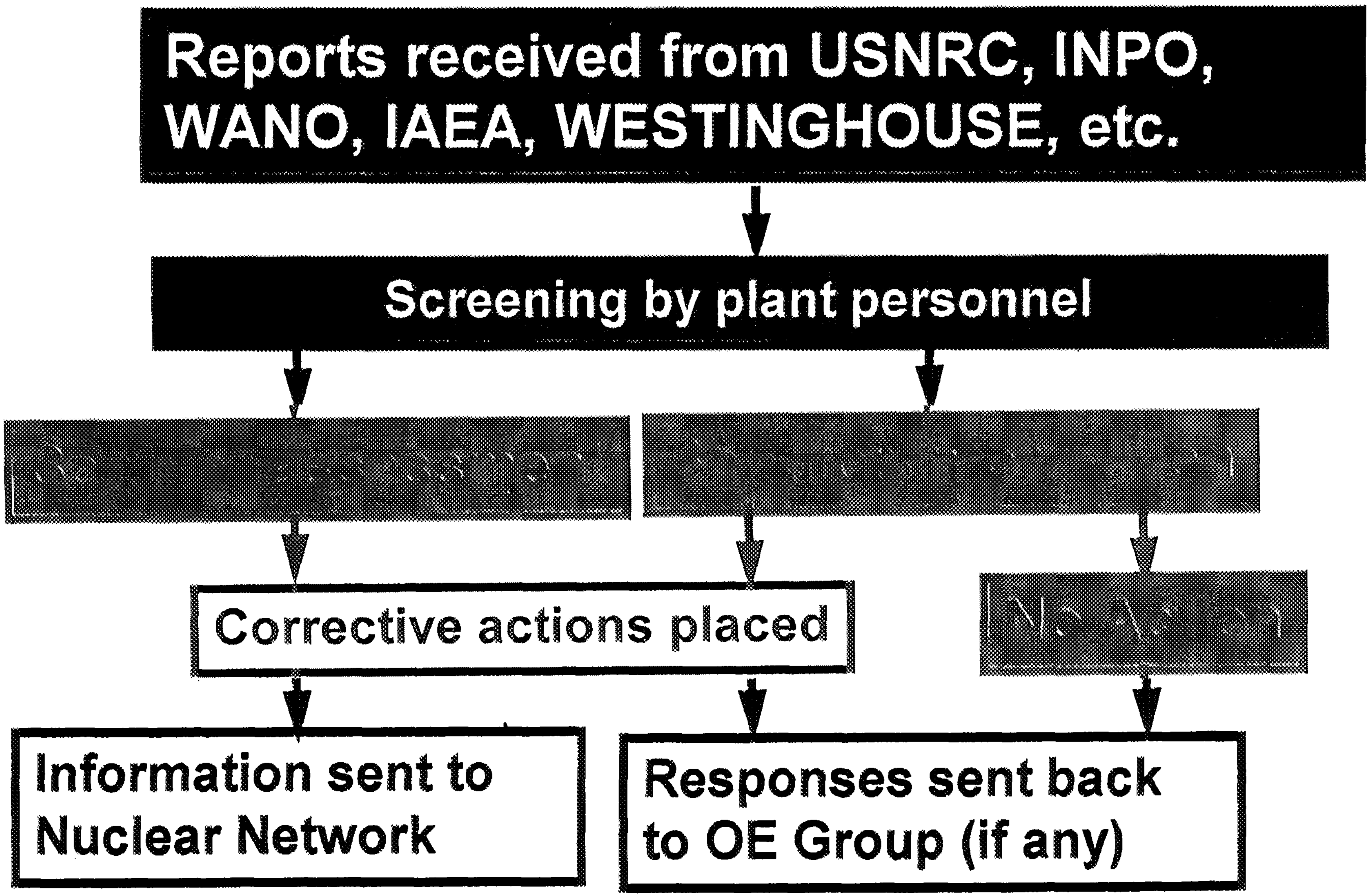
Event Reports approved by KOC

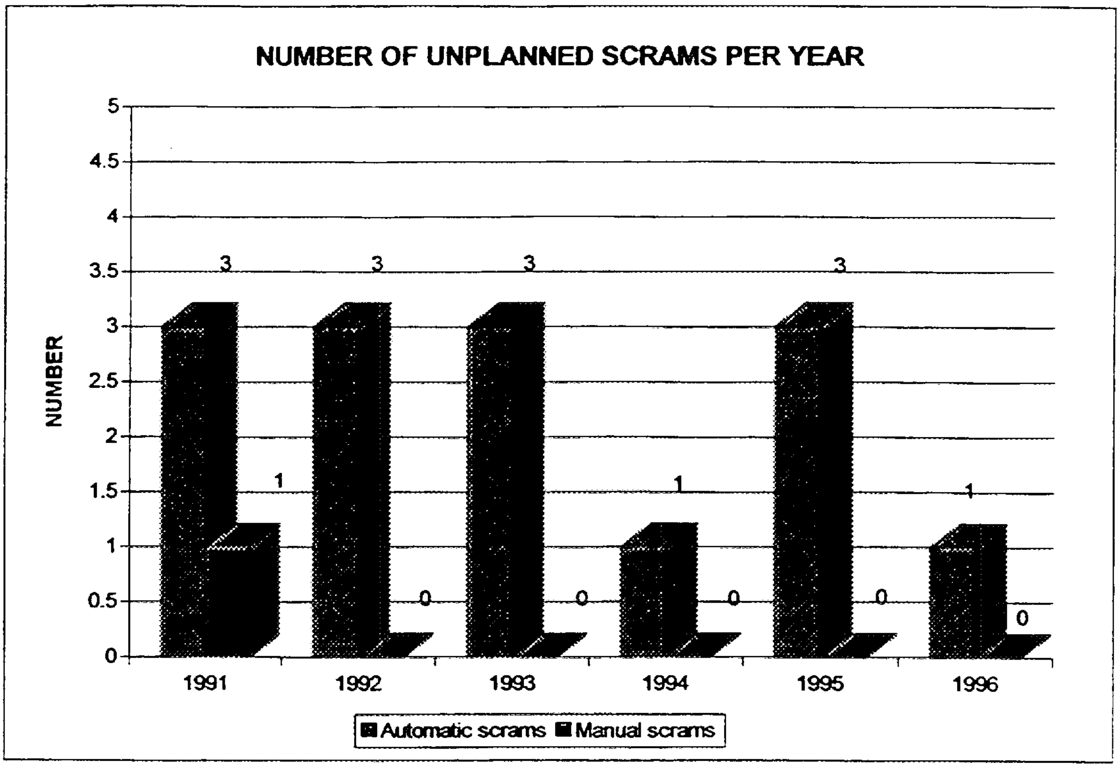
Corrective actions placed and tracked to completion

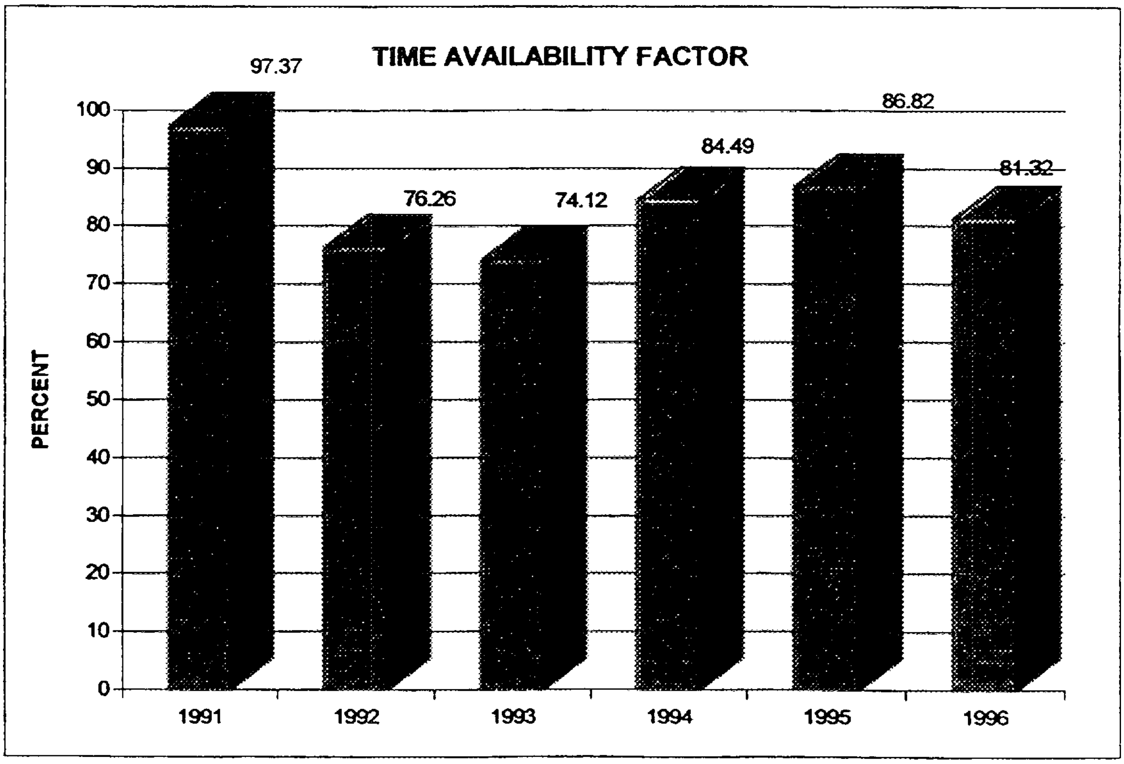
Operating Experience Feedback Information Sharing



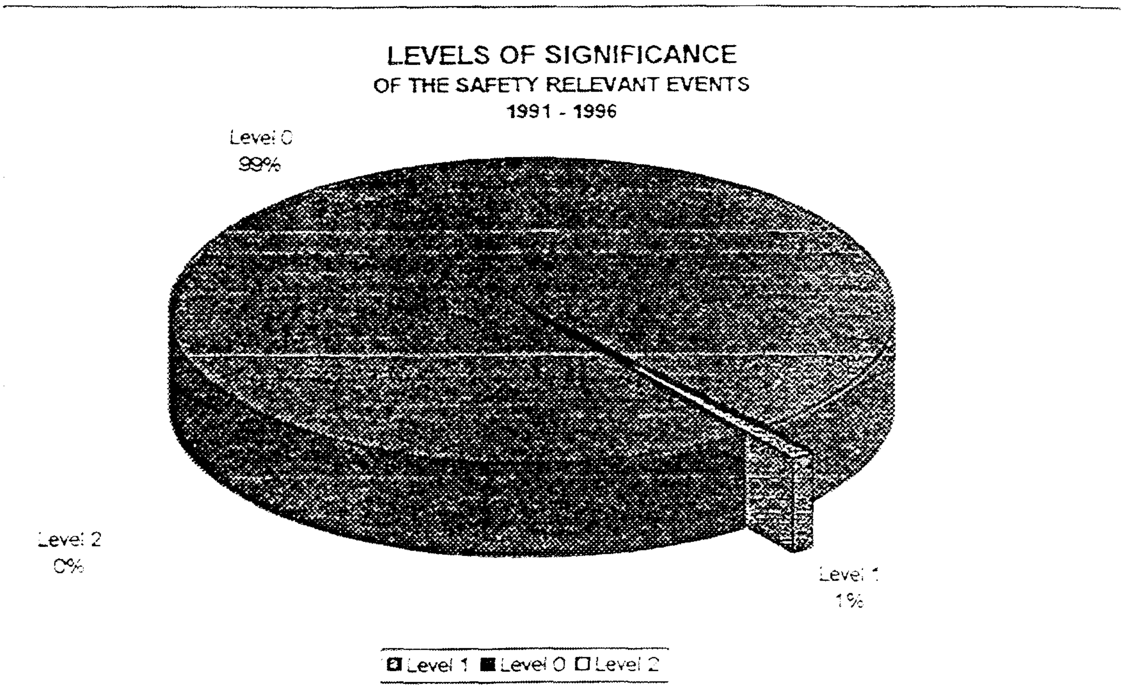
Assessment of Industry Experience



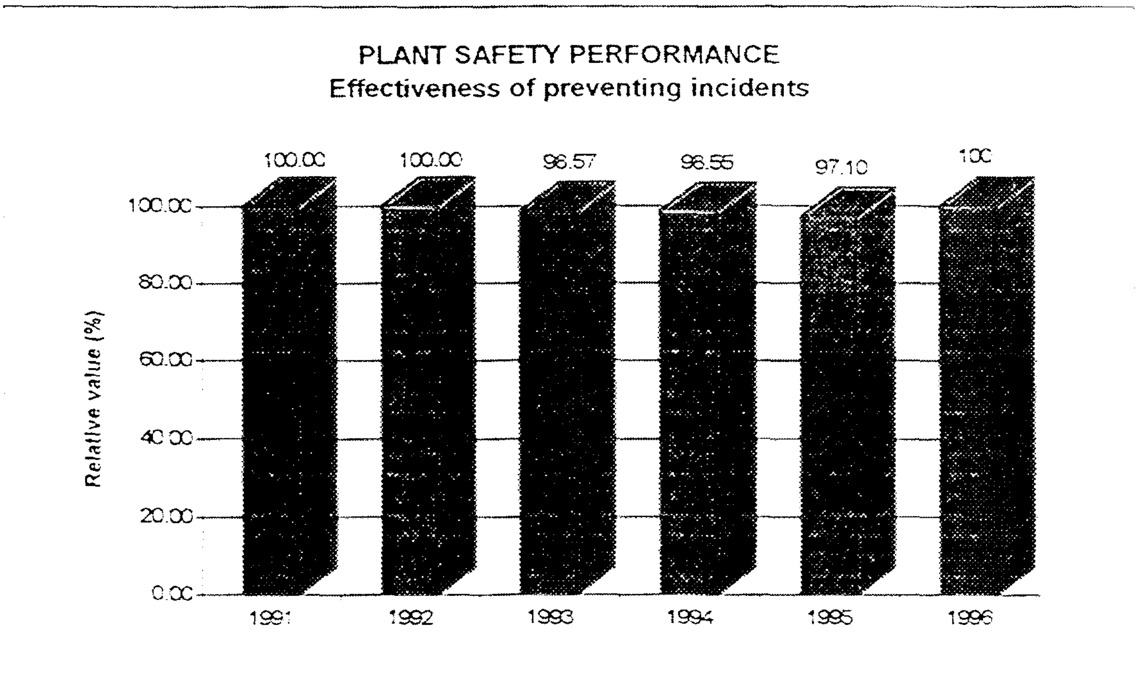

NUMBER OF UNPLANNED SCRAMS PER YEAR
NUMBER
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
3
1
3
0
3
0
1
0
3
0
1
0
1991
1992
1993
1994
1995
1996
Automatic scrams
Manual scrams


TIME AVAILABILITY FACTOR
PERCENT
100
90
80
70
60
50
40
30
20
10
0
97.37
76.26
74.12
84.49
86.82
81.32
1991
1992
1993
1994
1995
1996

217



LEVELS OF SIGNIFICANCE
OF THE SAFETY RELEVANT EVENTS
1991 - 1996
Level 0
99%
Level 2
0%
Level 1
1%
Level 1 Level 0 Level 2



PLANT SAFETY PERFORMANCE
Effectiveness of preventing incidents
100.00
100.00
98.57
98.55
97.10
100
100.00
80.00
60.00
40.00
20.00
0.00
Relative value (%)
1991
1992
1993
1994
1995
1996

21 f

SWEDEN

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Work at Forsmark since ASSET 1996

Gustaf Löwenhielm and Olle Andersson

Forsmark Kraftgrupp AB

presented at ASSET meeting, June 24-26

IAEA, Vienna, Austria

221

XA9745030

Peer Review follow-up

Must obtain a stringent follow-up of findings
Implemented in QA-list
i.e. followed up as other QA findings

FKA did not accept Peer Review finding concerning annual unit self assessments reviewed by safety department

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Work related to Peer review

- ✓ Forsmark 2 mini-ASSET
- ✓ Root-cause method implemented in MTO analysis
- ✓ Forsmark INES manual developed

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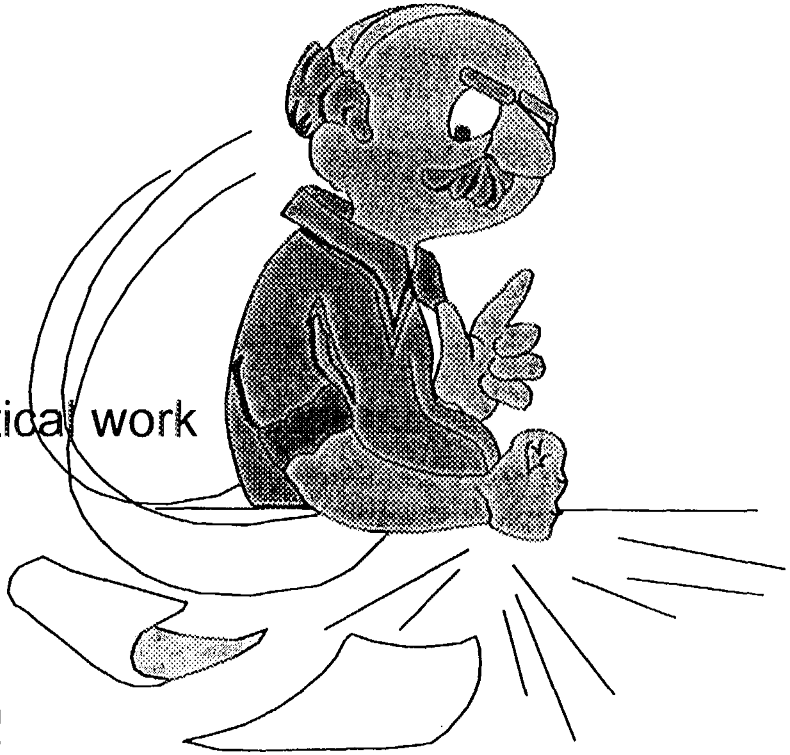
Forsmark 2 mini-ASSET

- **Too many incidents during outage period:**
- **Decision by Managers of Forsmark 2 and Safety Department to perform an analysis with ASSET method**
- **Screening of 28 incidents**
- **Root-cause analysis 9 incidents**
- **Common factors**
  - Application of existing rules
  - Planning and carrying through of safety critical work
    Lack of resources and time
  - Management of maintenace work
- **Conclusions**
  - Improve prioritization, learning and quality!!



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MTO

The MTO concept can be defined as an approach to safety which have the purpose to learn how Man interact with different Technologies and Organisational matters,

and,

based on this knowledge promote safety, recognising that Man have both physical, psychological as well as social pre-requisites.

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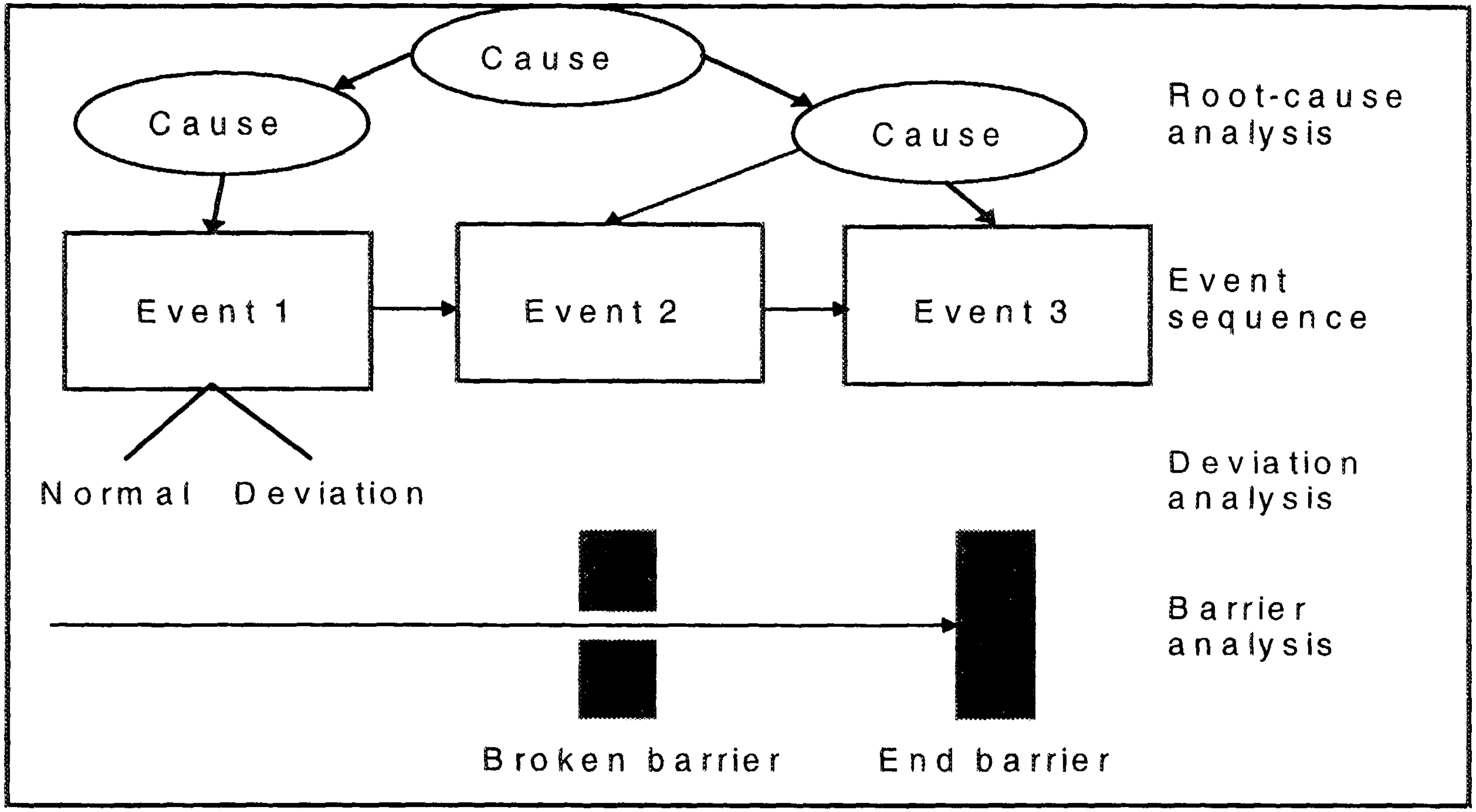
The MTO-analysis method:



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The MTO concept development

1988
- The MTO-concept was introduced
- The joint power plant MTO group was formed

  41 meetings. 36 MTO-analysis are performed

1990
- Identification of good praxis in the control room

199X
- MTO-seminars carried out at all three production units

1992
- Evaluation of the control room function during an outage
- Categorisation of LER:s begins

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The MTO concept development

1995 ◆ The ergonomic handbook is written

◆ Retrofit projects starts with identification of requirements and conditions for control room work

1996 ◆ A self-assessment ASSET is performed
IAEA Assessment of Safety Significant Events

1997 ◆ MTO and ASSET methodologies will be merged together

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The MTO Concept

Individual factors

- Training
- Skill
- Attitudes

Organisational factors

- Provisions for training
- Production of procedures
- Operability checks
- Norms and standards

Supporting factors

- Policy and strategies
- Root-cause analysis
- Experience feed-back

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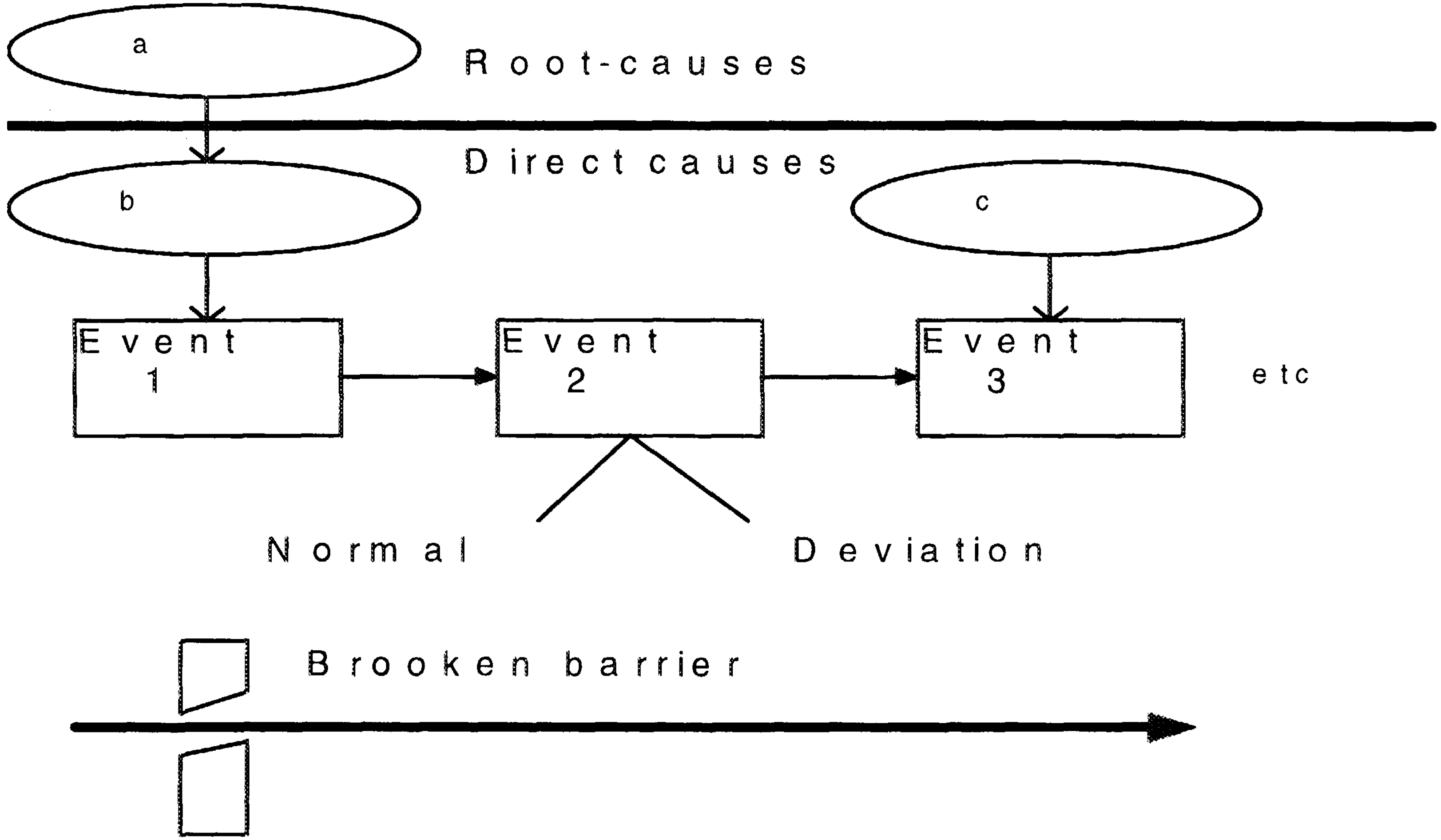
Combination of the MTO and ASSET Analysis methods



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Forsmark INES manual

- IAEA's INES Users manual too difficult!!
- Therefore translated to Swedish
- Excluded INES > 2
- Forsmark interpretation
- Short "how-to-read"
- Follow-up with training

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SWITZERLAND

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"Operational Experience Review and Methods to enhance Safety and Reliability in the NPP-Leibstadt (KKL)"

Rudolf Häusermann, Kernkraftwerk Leibstadt AG
CH-5325 Leibstadt Switzerland

XA9745031

1. Abstract

"Mankind can only learn by experience. Therefore the success in learning depends on the way to continiously communicate work-practices and results to the following generations."

Complex workpractices with a large participation of humans require a formulated written communication for full understanding of expected results on preset performance indicators. The NPP- and authority-control of results and their review is established. And still "avoidable" errors (seen in retroperspective) are repeatedly "made" in the well established industry.

Two key reasons shall be considered:
1st. Not every NPP has the same expectation on performance measured by Performance Indicators (PI).
2nd. Not every NPP performs the same indepths review/analysis of an event/incident nor do all apply the universal ROOT CAUSE-ANALYSIS e.g the ASSET method. (see Figure 1).
(Note: These statements apply also to authorities)

The root-cause-analysis was a significant contributor to reduce the amount of safety significant events worldwide - rated by the INES-Scale - based on the amount of energy produced.

In the nuclear community it became clear that an integrated feed-back system of operating experience must also include the un-successful results. (See Figure 2). The deviations, expected to achieved performance are analysed to the failure mode and its effect. Figure 3 depicts the interaction of people with the technical process executed by the machine. This interface is considered the focus point in this report.

In that context near miss reporting and analysis was recently introduced in the KKL process to continiously learn from internal and external unwanted events. This strategy allows to achieve a very high confidence level to minimise unwanted events to a tolerable level, far away from safety significance. KKL has in fact lowered the number of safety significant events since commercial operation started. The thoroughness of the review/ analysis of the events has increased with high priority set to human factor induced events in operation and maintenance.

Since the participation of the author in the ASSET-Mission in Smolensk in 1993, KKL introduced the ASSET-Root-Cause method and has supplemented it by the HPES (Human Performance Enhancement System).

2. Introduction and Goals

2.1 General observation

In the context of this paper the following definitions shall be considered:

--- the **NPP** is a complex network composed of **Components** and **Parts** located in bulidings to perform the heatproduction and conversion into electricity. (see Figure 3.)

--- the **Organisation** is a network of **Teams** and **Individuals** to keep the NPP safely and reliably running. (see Figure 3.)

Note: the learning network is the Organisation by proper surveillance of the results from the NPP.

In that context, it is evident that a continious surveillance on the plant parameters must be performed and compared the actual values with the permissible ones. The time dependant deviations have to be evaluated for their significance to plant operation. Intolerable deviations have to be corrected by calibration and/or maintenance measures and/or enhancements made to the appropriate procedures.

A NPP must make itself independant of the plant designer and ensure that the documentation at the NPP describes all the design basis completely. Modifications made later in the plant have to be reviewed against the basis. A statement was made in Ref. 4 by Mr. Johansson: "We suffer from lack of people who were involved in the design and construction of Ringhals-1 and can pass their knowledge on". A very important message! KKL is in the process to put together and supplement the design basis documentation and verifies that the Safety Analysis Report is completely in line with the design basis and is comprehensible to the next generation. (See Figure 6.)

The interaction of the NPP with the organisation is controled and the results expressed by performance indicators (PI`s) of technical and financial matters. E.g. the 10 WANO indicators and the production cost/kwh.

Learning elements from OSART-Reviews like Good Practices, suggestions and recommendation; ASSET-Missions to support NPP in the effort to enhance nuclear safety; strengths and areas for improvement, the results from WANO-Peer-Reviews, shall continuously be reviewed for applicability to enhance or maintain a high NPP safety standard.

All measures serve the same purpose to apply the NETWORKs for a safe and cost effective nuclear power production. A living interaction.

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All measures serve the same purpose to apply the NETWORKs for a safe and cost effective nuclear power production. A living interaction.

2.2 Detailed Goals of Operational Review and feedback

- To learn from the internal and external experience feedback such that the continuous review process leads to an operational strategy that unwanted events are, by a high probability, avoided and that the remaining events are of very low safety significance rated on the INES scale, below the scale.

- Maintain and verify that positive safety margins exist for all plant operating states,i.e. power operation and refuelling.

-to keep the power conversion system in a very high state of availability throughout a fuel cycle thereby lowering the probability to cause initiating events which challenge safety systems.

3. Methods

3.1 NPP-Controlling

In Figure 4, two sequences of feedback into a NPP is depicted.

Sequence 1 shows a fully automatic sequence governed by the plant controllers, which by measuring the actual plantparameters and comparing them with the permissible values as per the design objectives. The value, in the example, exceeded the permissible range and prompted an automatic action. Thus brought the plant into a safer status or started up redundant functions. The latter depends on the availability of redundant functions.

In the Sequence 2 the controlroom team perceived the ongoing transient in time and successfully controlled the plant manually and avoided the automatic action. The manual control is governed by written procedures and is within the Plant Technical Specification.

Once all the available power conversion systems (PCS) in the turbine hall are lost, the plant will be shut down to the residual heat level. For that plantstatus, ECCS system will be started.

3.1.1 Diagnostic Tools

KKL performs analysis for plant deviations far below the Alarm 1 Level (see Figure 4) to get knowledge on the condition of the plant.

The major ones are:

- On the functional level:
  - Vibration
  - Plant output Monitoring: A Diagnosic Tool for early recognition of Malfuntions in components and errors in measurements. Ref.[1]. The method decribed is supplemented by a sophisticated Datavalidation -Process, realised with the Software VALI II from BELSIM S.A.(A writeup in German language is available on request).
  - While performing periodic tests, important parameters of equipment are measured and reviewed.

- On the structural level:
  - Corrosion and erosion control
  - NDT in mechanical/electrical components
  - Building control

Thus to control the aging of the plant in order to plan actions to at all time warrant enough safety- and availability margin.

3.2 Experience Exchange

In Figure 5 the "Control loop for Experience Exchange" is depicted. By comparison to paragr. 3.1, a similitude can be recognised. The control action is also based on a Deviation:

IS =/= SHOULD

Here we have to emphasise **Control-loop**, which means that all work has to be performed by implemented procedures. Deviations discovered have to be treated in accordance to priorities:

- Safety (nuclear and conventional)
- Production

Figure 2 depicts two mainstreams of the feedback:

--- Hardware change
--- Software or procedural change

both as a result of internal and substituted by external experience.

3.2.1 Some examples

3.2.1 a. Internal Experience:(see Figure 5)

The personnel is instructed to report any perceived deviation from the normal plant status. KKL has also introduced the concept of reporting near-misses.

If KKL recognises an important deviation by any of the implemented methods, then the process to take countermeasures in defining adequate solutions takes place. The findings and measures taken are registered and documented. They are available as historical information on a permanent basis. Out of the collection of all data, plant specific reliability data and performance indicators are deduced. Those become necessary for the IPE (Individual Plant Evaluation) using the LPSA (Living Probabilistic Safety Assessment) model. The same data serves also as input to the **On-condition based maintenance** program.

3.2.1.b External experience:(see Figure 5)

Well defined "Information Sources" will be preanalysed by KKL-coordinators and searched for KKL-relevance. If the information is considered important, then it is passed to the specialist for detailed investigation. If no learn effect can be deduced from the information the specialist has to explain why not and return it to the coordinator who has to check the result. If however a learn effect is gained then it has to be implemented through standard plant procedures and inform the coordinator. The whole process is documented in a retrievable manner.

3.3 Training of the Organisation

3.3.1 On the specific Task level

A specialist must have a chance to demonstrate his special skills. On the level of hardware- and software tools substantial progress was made on a industry wide basis. This affects also the training- and retraining-program. KKL offers this training and creates a healthy environment of **"Ownership"** on the specialist level.

3.3.2 On the communication level

The Organisation was defined as a network (paragr. 2.1). Each individual (see paragr 3.3.1) is part of the network and works toward the plant goals (Parag.2.2). In order to promote and sensibilise **"the Corporate Identity"** without conflicting with the "Ownership", KKL has offered communication training for the plant staff at each hierarchical level. To take special consideration of the NPP needs, KKL has increased the effort in the area of **safety culture.** The OSART-Mission in KKL was a catalyst to increase the effort. Basis is (Ref.2) and supported with visible demonstrations and practices developped by KKL.

KKL is now in the process to further work on a solution to treat near miss situations. The definition: A provoked situation one step before the next step would cause an unintended incident.

Two types of principle categories exist.
....Detected by the person who performed the near miss
and
....Detected by another person.

Both types shall be reported and reviewed if the same situation could also happen in a generic matter to someone (in accordance to its work task requirements) else performing the same task. The theme is critical as it touches individuals closely. However in a work climate where a safety culture exists, a full recognition can be expected from top management in the prevention of real incidents as part of the operational experience review process in a living learning environment.

4. Conclusions

The internal and external experience review/exchange have a definite positive value in the ongoing and never ending learning process to operate and maintain a NPP in a safe and reliable manner.

Personnel which processes the internal exchange have the advantage that they have a lot of detailed descriptions (see Figure 6) and plant historical data available to perform an ongoing review of the plant- and equipment reliability.

In contrast personnel processing the external feedback, which fully depend on the reported information. This puts a big burden on the quality of the information such that even without the detailed information mentioned above, the event and its significance can be understood. WANO for that reason has set up rules on how a report shall be structured and codified for better understanding and retrievability. The last resort beeing the telefon nr. of the report-writer.

In the area of maintenance where more details are to be treated the difficulty is even larger. In Europe VGB and NUMEX(NUclear Maintenance EXperience) forums were formed where experience is exchanged at periodically hold workshops. KKL is a participant.

The NPP are well adviced when they participate in a well selected external experience feedback process. This is to complement the internal experience.

The methods so far implemented, proved to be effective. However some must still be refined, further developed and supplemented with more precise risk quantifing methods. The data collection for this purpose has to be expanded to get higher reliable data for the components- and human reliability and use LPSA as a supporting tool for the Living program for success. See Figure 3.

5. Outlook

In the Ref. 3 an excellent review and summary was published on the evolution of NPP-Operational Experience Exchange starting in 1950.
On the 26. April 1986 occured the one step two much to make of a near miss situation a real one. In Chernobyl the fatal sequence of an uncontrolled nuclear reactor disruption started with consequences that became visible worldwide and could not be overlooked.

The NPP-Operators then started to build up a world wide partnership-organisation. WANO (World Associaton of Nuclear Operators) was created. The close cooperation with IAEA and its programs to promote and enhance nuclear safety by OSART, ASSET etc. was a large support for the successfull and safe operation of the NPP worldwide. WANO has enlarged its program with the WANO-Peer-Review.
We, the shareholders of the nuclear business, have to support these institutions and continue to use them and open them to the next generation of the staff of nuclear operators. The largest enemy to nuclear is the low cost of fossile energy with it`s well known detrimental effects. What we contribute to the nuclear business is the safe and reliable production in a most costeffective manner.

References:

1.) Plant Outout Monitoring: A Diagnostic Tool for early Recognition of Malfunctions in Components and Errors in Measurements. R. Häusermann published in VGB Kraftwerkstechnik 70 (1990), Nummer 10.

2.) Safety Culture, Safety Series No.75-INSAG-4 IAEA, Vienna 1991

3.) Globale Sicherheitspartnerschaft bei der Kernenergie. Eine Zwischenbilanz. Von H.-D.Schilling VGB Kraftwerstechnik 77 (1997),Heft 2

4.) "Ringhals-1 Review aims to improve standards, pass on lore." Nucleonics Week- October 27,1994. For full text.

THE UNIVERSAL

ROOT CAUSE ANALYSIS

METHODOLOGY

I. WHAT IS THE PROBLEM ?

(Failure to perform as expected)

II. WHY DID IT HAPPEN ?

(Direct Cause)

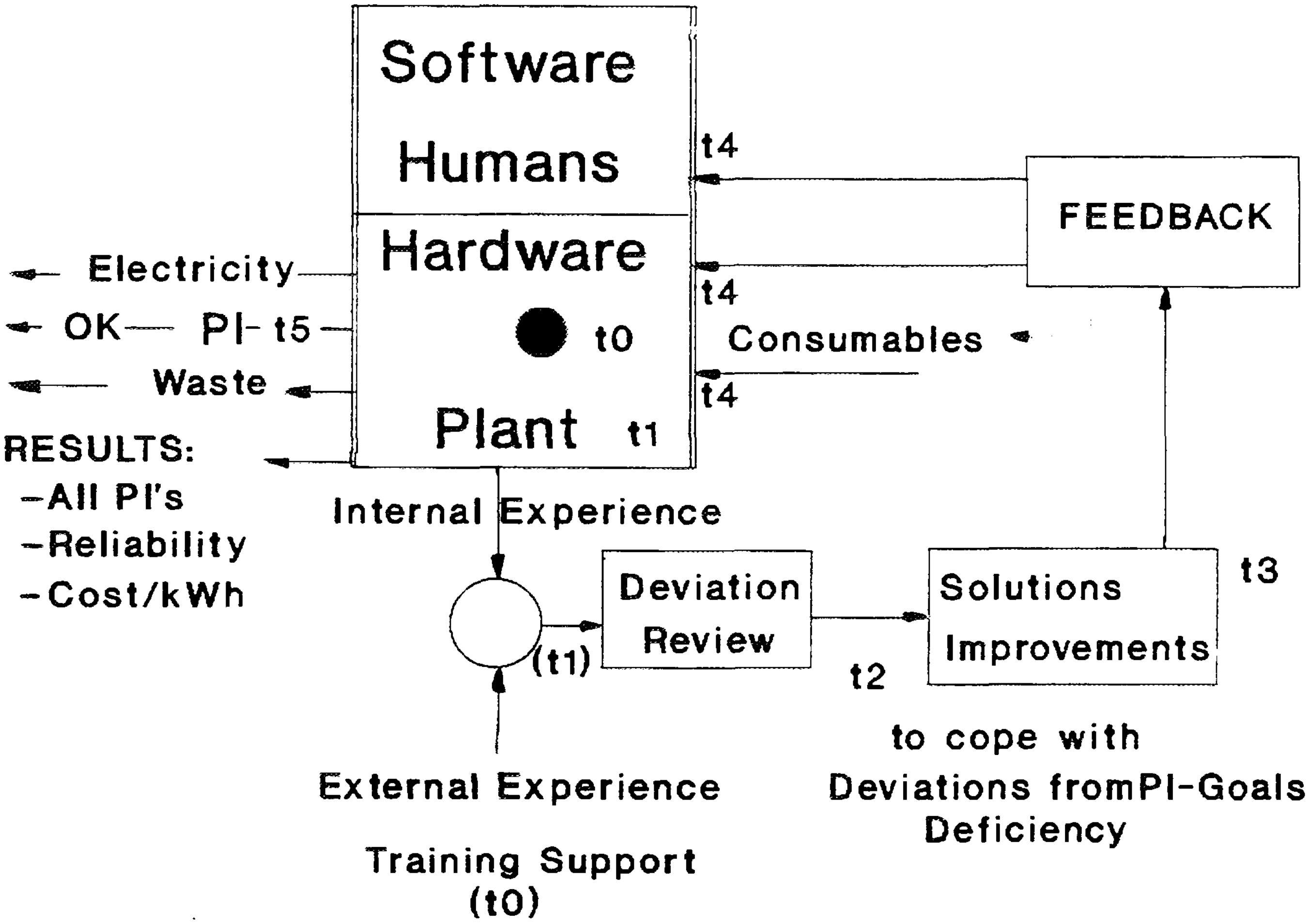
III. WHY WAS IT NOT PREVENTED ?

(Root Cause)

Figure 1

Control Loop For: Operationel Experience Review

Operational Feedback to enhance Safety Reliability to meet set PI-Goals



KEYS:

PI = Performance Indicator

t0 = event happened ( ) extern

t1 = discovered ( ) extern

t2 = Review of deviations completed

t3 = Solution accepted/approved

t4 = Solution implemented

t5 = PI Improvement made visible

● Focus Point

Performance-Indicators PI

Figure 2

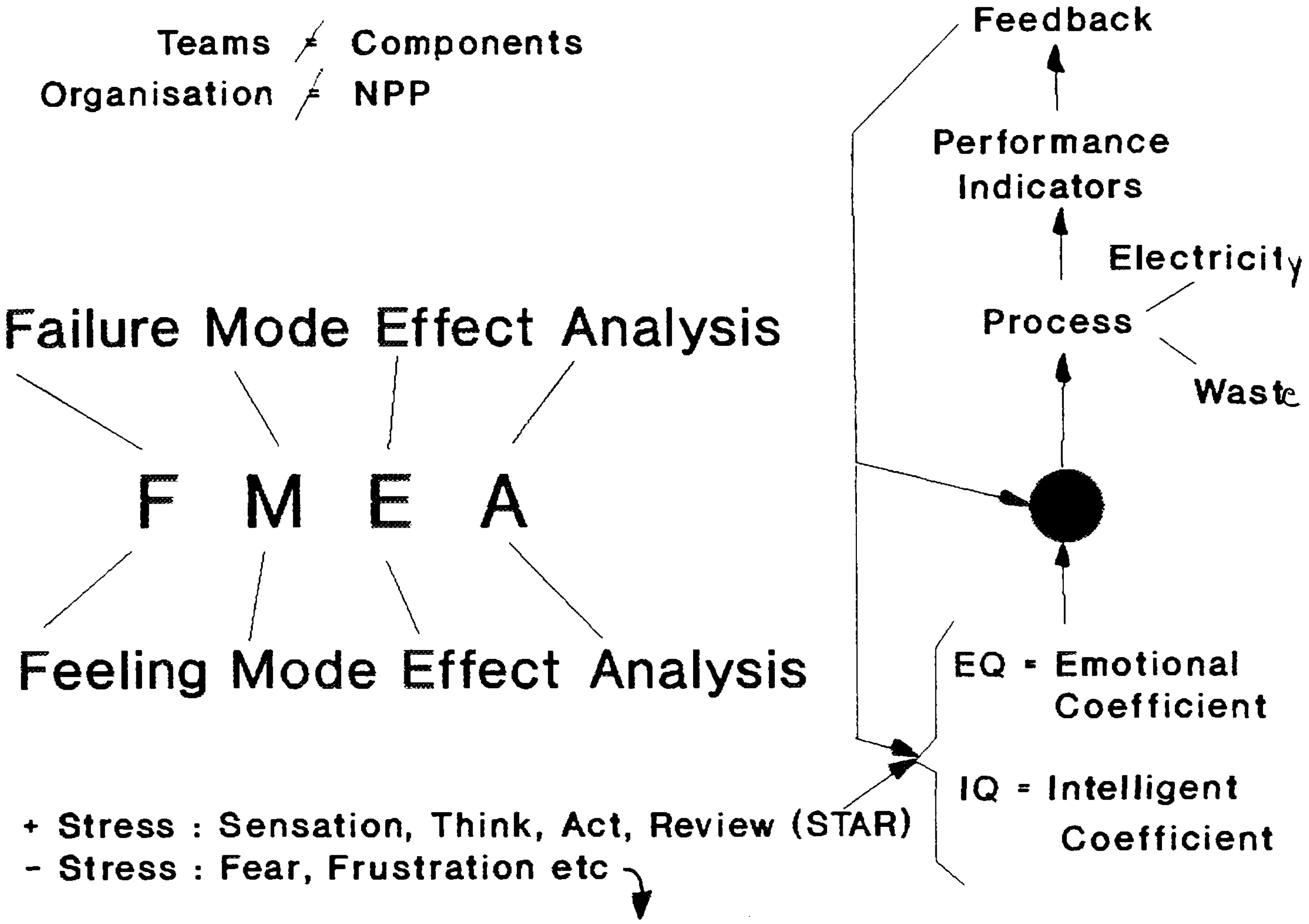
Interaction: Technical Process -- People

Individuals, Teams, Organisation

Individuals ≠ Parts

Teams ≠ Components

Organisation ≠ NPP

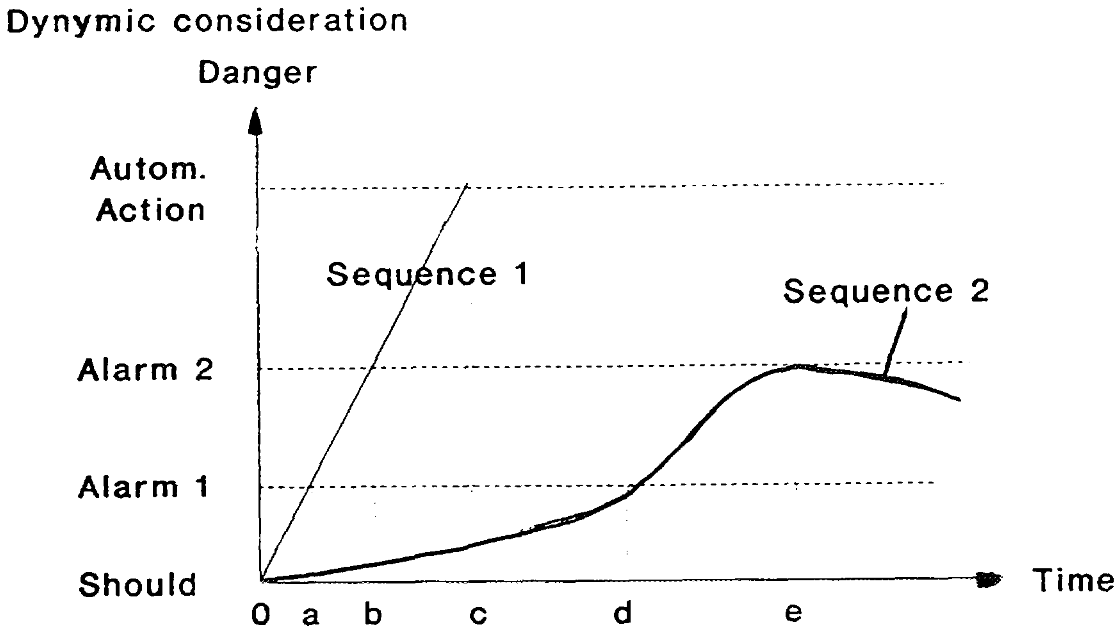


● Focus Point of Living interaction ≠ LPSA = supporting tool

= Living Program for Success !

Figure 3

Deviation of Plantparameters
Operator actions



Sequence 1:

at a 1st alarm	Perceived by team? No
at b 2nd alarm	Perceived by team? No
at c autom.action	Perceived by team? Yes

The team had no time to react. The autom. action terminated the transient. The success in termination is given by the design objective of the function and their reliability. (Proper calibration and MAINTENANCE)

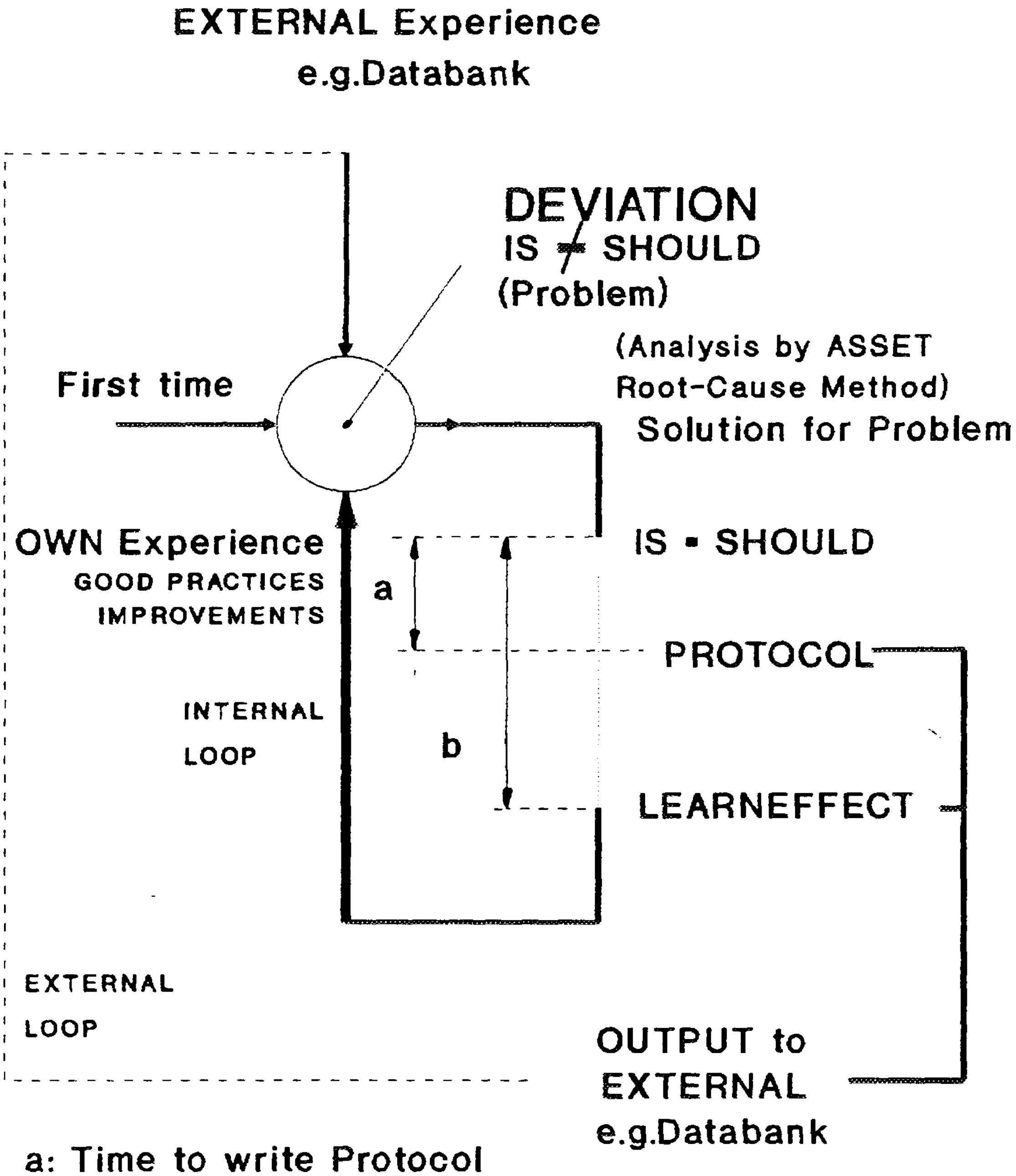
Sequence 2:

at d 1st alarm	Perceived by team? Yes. Initiation of countermeasures in accordance with procedures.
at e 2nd alarm	Perceived by team? Yes. Successfull termination of slow transient by team. Leaving the dangerzone.

The team had time to react. The transient was slow enough. The success depended on the reliability of the corrective action of the team, the design objective of the manual functions and their reliability. (Proper calibration and MAINTENANCE)

Figure 4

Control loop for Experience Exchange

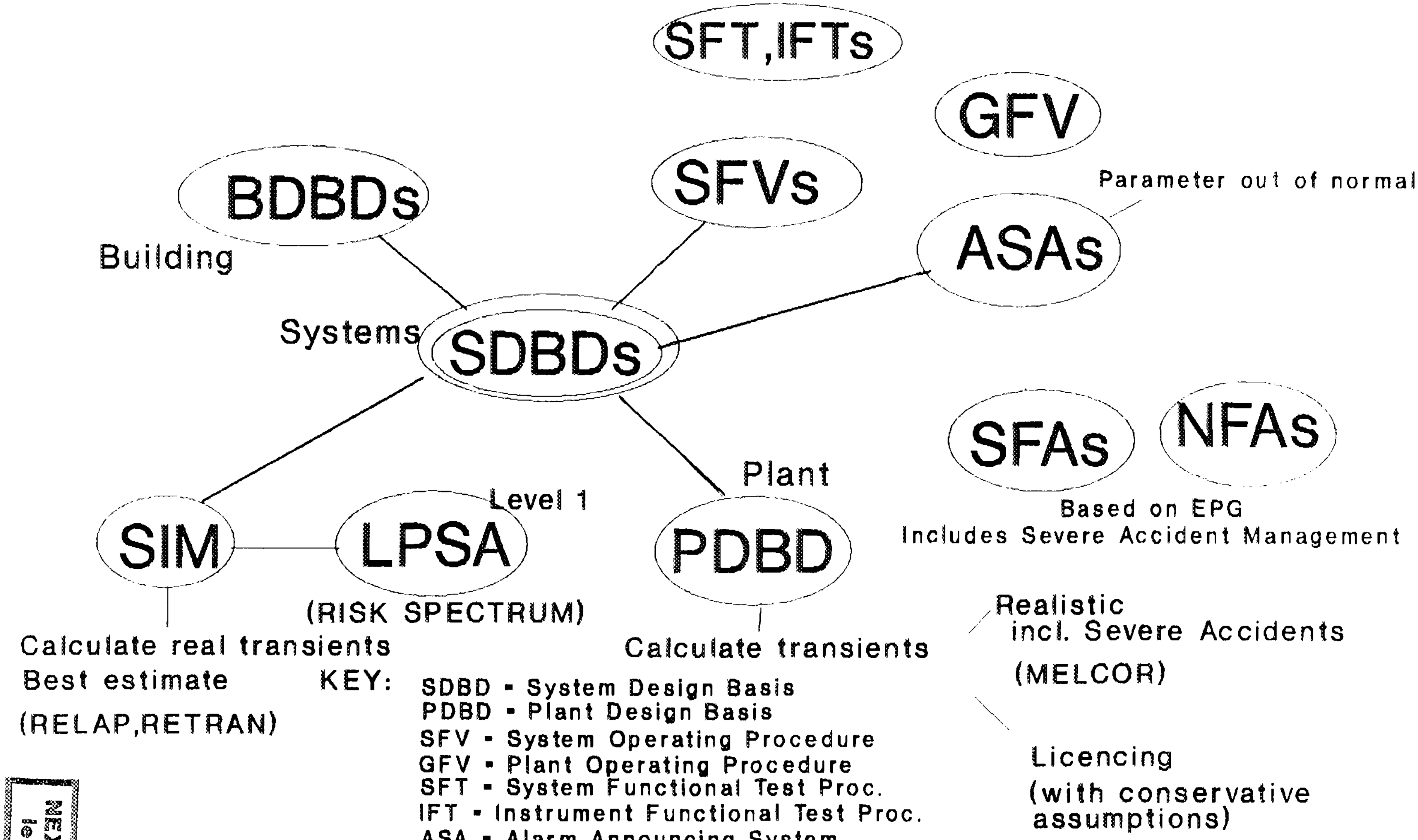


a: Time to write Protocol

b: Time to work out LEARNEFFECT

Figure 5

System DBD's
Dependency



KEY:

SDBD - System Design Basis
PDBD - Plant Design Basis
SFV - System Operating Procedure
GFV - Plant Operating Procedure
SFT - System Functional Test Proc.
IFT - Instrument Functional Test Proc.
ASA - Alarm Announcing System
SFA/NFA - Emergency Proc.
SIM - Plant Simulator
LPSA - Living PSA Workstation

Figure 6

2-4P

UKRAINE

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2-5 /

MINISTRY OF ENVIRONMENTAL PROTECTION AND NUCLEAR SAFETY OF UKRAINE

STATE SCIENTIFIC AND TECHNICAL CENTRE ON NUCLEAR AND RADIATION SAFETY

THE STATUS OF NUCLEAR SAFETY OF UKRAINIAN NPPS AND EVALUATIONS BY ASSET METHODOLOGY

Koltakov Vladimir

ASSET National Co-ordinator

Kyiv 1997

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1.2. Electricity production and operating personnel.

2. Status of nuclear safety at NPPs of Ukraine.

3. Operation of Ukrainian NPPs.

4. Violations of NPPs operation.

5. Short review of ASSET missions.

6. Experience of feedback process.

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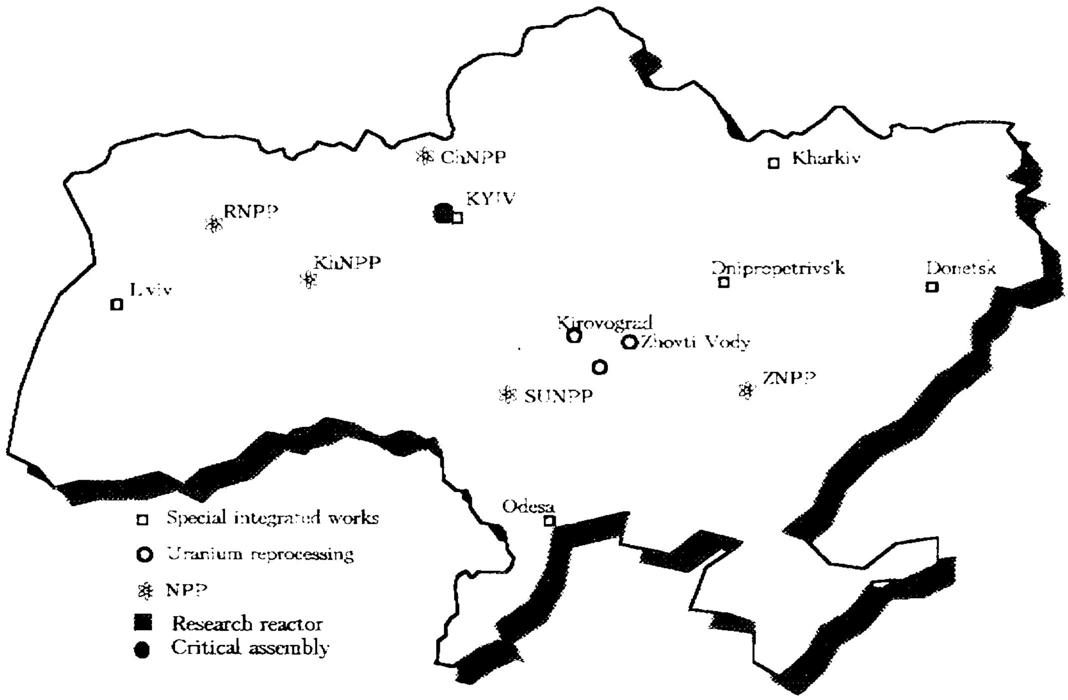
1. INTRODUCTION

Utilisation of nuclear energy in Ukraine occurs in all branches of national economy, in industry, medicine, agriculture, scientific researches and in everyday life. In 1996 43,9% of the whole electric power, consumed in Ukraine, was generated by nuclear power plants. Location of the enterprises of nuclear energy industry as well as radioactive waste plants on the territory of Ukraine is presented on the scheme below.



1.1. Nuclear power plants and research reactors.

In 1996 there were 15 nuclear units in operation on five NPP sites having the aggregate electrical power of 13,618 thousand MW and total electricity production of 79,6 billion kWh. Ukraine occupies the 8th place in the world and 5-th in Europe by reactor units quantity and their total capacity.

Ukrainian nuclear power industry based on pressurised water reactors of VVER-1000 type (11 units), as well as VVER-440 (2 pieces) and uranium - graphite channel reactors of RBMK-1000 type (3 units). Zaporizhzhia NPP following the commissioning of Unit 6 has became the most powerful nuclear plant in Europe. The second ChNPP unit, since 1996 is in lay-up (prolong storage) state, Unit 1 of this plant is shutdown finally in November of the fiscal year.

Four units with reactors of VVER-1000 type is under construction at Rivne and Khmelnitsky NPP sites at different stages of construction preparedness.

Though in year 1996 the total amount of 79 577 million kWh was generated by Ukrainian nuclear plants, and that is a record parameter among all years of existence of nuclear power industry in Ukraine, nevertheless from the point of view of safety the year 1996 is hardly to be recognised as satisfactory. In 1996 nuclear power industry operated in extremely difficult conditions of economic crisis, which has grasped the whole country. Sharp deficit of financial and material resources has not given an opportunity to execute scheduled repairs of equipment and to implement measures on increase of NPP safety in complete volume. For measures on operating safety upgrade the sum of 400 million Grn was planned and only 30 % of it was spent. First of all, it is a narrative fact, that nuclear plants staff have lost economic motivation of the electric power production for the recent years. In the conditions of non-payment for generated electric power the indeptedness of nuclear plants grows proportionally to amount of generated electric power, that results in non-payment of wages, makes impossible to purchase spare parts of the equipment, to implement safety upgrade measures and to improve the industrial conditions.

There are several research reactors located in Kyiv and Sevastopol, which were not in operation in 1996, but the continuation of their operation is scheduled for subsequent years.

1.2. Electricity production and operational personal

Since 1993, despite the complicated situation, under pressure of the bodies of State regulation and inspection, a plenty of technical improvements, aimed at safety upgrading and NPP reliability is realised on nuclear plants. In 1993 - 1995 the implementation of measures, directed on overcoming of the very dangerous phenomenon, namely, the stuck of means of control and protection of VVER-1000 (CPS rods), leads to positive results in 1996. Only the second unit of South-Ukrainian NPP was operated with CPS defects, the implementation of measures at other units has enabled 1,196 million kWh of additional electric power generation. Measures on vacuum improvement in turbine condensers at ZNPP Unit 2, 3 and SUNPP Unit 1 enabled 2,033 million kWh of additional production of the electric power.

From these examples one can see, that the increase of safety and reliability along with the achievement of general goal, namely, the safety assurance of the public, gives significant economic benefit at minimum costs.

Due to implementation of technical measures in previous years the total amount of safety related infringements, has decreased from 87 in 1995 down to 82 in 1996.

However, along with the reduction of infringements there is a very dangerous tend of infringements quantity increase related to human factor and with laps at NPP management. Such infringements can result in the heaviest consequences, and it is very difficult to predict them and to apply adjusting measures. For example, on KhNPP the consequence of such infringements was the infringement of safe operation conditions, contamination of reactor building premises. . The error of RNPP staff resulted in falling of extraneous technological part into reactor core during the scheduled maintenance and the reactor outage at about 26 days after that.

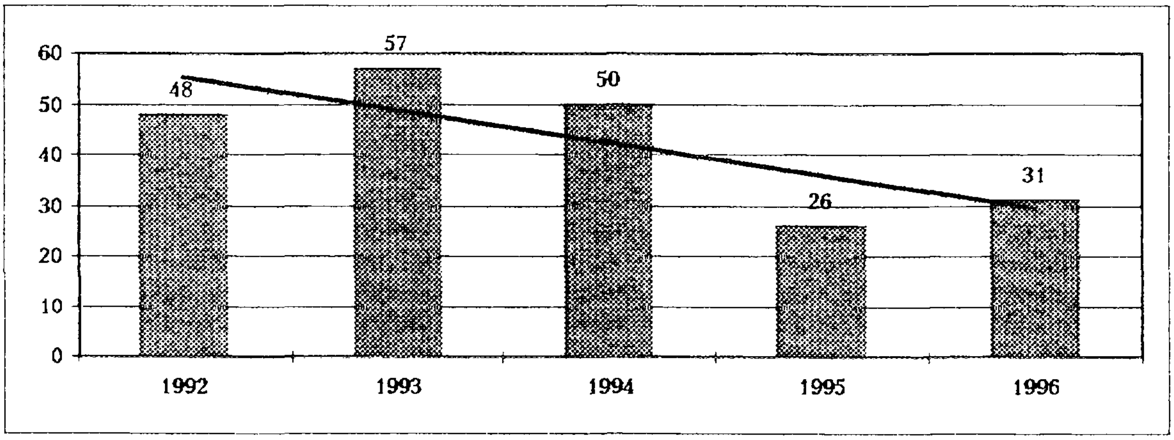


Fig. 1 Distribution of failures associated with "Human factor" for 1992-1996.

The reason for such infringements increasing in 1996 was the deepening of economic crisis in nuclear power branch, that resulted in loss of labour motivation, exacerbation of social tension in industrial collectives. All that point out the insufficient level of safety culture not so at the nuclear plants, but firstly at top-management level of nuclear industry.

The next negative tendency in nuclear power is pointed out by the analysis of work of branch in 1996. Losses of the electric power production owing to dispatching restrictions are of 616 million kWh., and that is also a peak value and is simptomic indicator of disbalances which have been developed in Energy production and supplying industry in Ukraine. The nuclear plants of Ukraine are designed for base load operation and by their constructive properties cannot work in regulating mode. Increase of aggregate capacity at NPP due to the commissioning of ZNPP Unit 6 with simultaneous reduction of the electric power production on thermal and hydropower plants, that is shown in Appendix A, has resulted in exhaustion of regulating capacities in energy system, and the dispatching service start using the nuclear units for regulation of frequency in the electric grid. From the safety point, the bodies of state regulation cannot allow such operational mode of nuclear plants. With new units on Rivne and Khmelnitsky NPP putting into operation the amount of unbalance in energy system has gone deep, and the situation can become non-controllable, that will result in necessity to use nuclear plants on non-complete capacity. The maintenance of regulating capacities in energy system of Ukraine becomes the important factor of safe operation of nuclear plants.

2. STATUS OF NUCLEAR SAFETY AT NPPS OF UKRAINE

Nuclear safety of the units of nuclear plants and research reactors under operation which have been erected in the former Soviet Union was carefully studied not only by national experts, but also by international ones. In 1996, at the nuclear plants of Ukraine four types of reactor facilities were in operation:

- reactor facility of RBMK type at the units 1 and 3 of Chornobyl NPP without containment, the design of which is similar to the reactor facility design of unit 4.
- two reactor facilities of VVER-440 type at the units 1 and 2 of Rivne NPP;
- two reactor facilities of VVER -1000 type at the units 1 i 2 of South-Ukraine NPP - reactors of "little series", which preceded the implantation of the serial reactors VVER-1000;
- nine serial reactor facility VVER-1000 at the units 1-6 of Zaporizhzhia NPP, the unit 3 of South-Ukraine NPP, the unit 3 of Rivne NPP and the unit 1 of Khmelnitsky NPP.

All 14 operational units of NPPs must obtain the license for permanent operation of the regulatory body prior to 2000 in compliance with article 89 of the Low of Ukraine "On nuclear power utilisation and radiation safety". Taking into account that comprehensive safety analysis was not implemented in the former Soviet Union for the units of NPPs, a necessary condition to obtain the license for permanent operation is the submission of safety analysis reports to the regulatory body. There are no doubts as to a need for implementing this task, and it has already started, despite of a lateness, at the some units of NPPs.

To obtain the license for permanent operation, a lot of safety-significant works are to be implemented simultaneously with implementing the work on safety assessment of the units of NPP. List of those works has been specified based on operating experience in the former USSR yet, and later it was reviewed and specified in more detail by Derzhkomatom and Derzhatomnagliad of Ukraine in 1994.

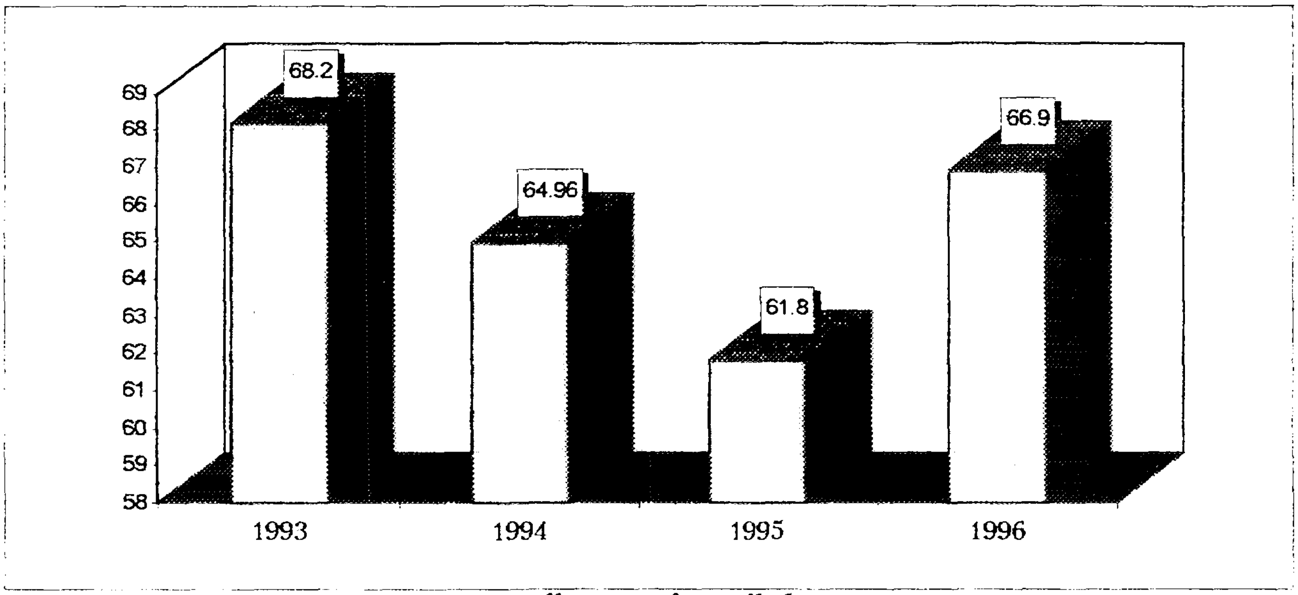
All the works of this list are included in the "Programme of safety improvement of the units with reactors VVER-1000, 440 under operation", priorities and terms of their implementation are established. An analysis performed has revealed that the work timing are disregarded, and the "Programme..." is implemented to no more than 10%.

3. OPERATION OF UKRAINIAN NPPs

Assessing the operating safety at the power units and determining the safety level of these facilities are implemented based on annual reports on current safety level and reports (which are received on regular basis) on failures of equipment and of NPP system operation as well as results of inspectional activity.

The nuclear and radiation safety level, reached in 1996 at the NPP units of Ukraine may be qualified as satisfactory one; there were no nuclear and radiation emergencies at the NPPs of Ukraine for the reported period.

Performance/economic indices of NPPs operation for 1996 in comparison with precedent years are given in Figs. 2, 3.



Usage coefficients of installed power.

Fig. 2

Raising availability factor in 1996 as opposed to 1994-1995 demonstrates a cessation of power production decrease at NPPs. The biggest factor in 1996 was at Chornobyl NPP (76.1 %), the least one - at Khmelnitsky NPP (54.5 %).

The quantity of electricity underproduction due to failures in NPPs operation and lay-up in 1996 has been increased as to factor 2.8 in comparison with indices of 1995. It was caused by increase of failures share, which is determined by time necessary for equipment repair.

In Fig. 3 the under-produced power value and idle time of the units because of the failures of systems and equipment operation for 1993-1996 is given.

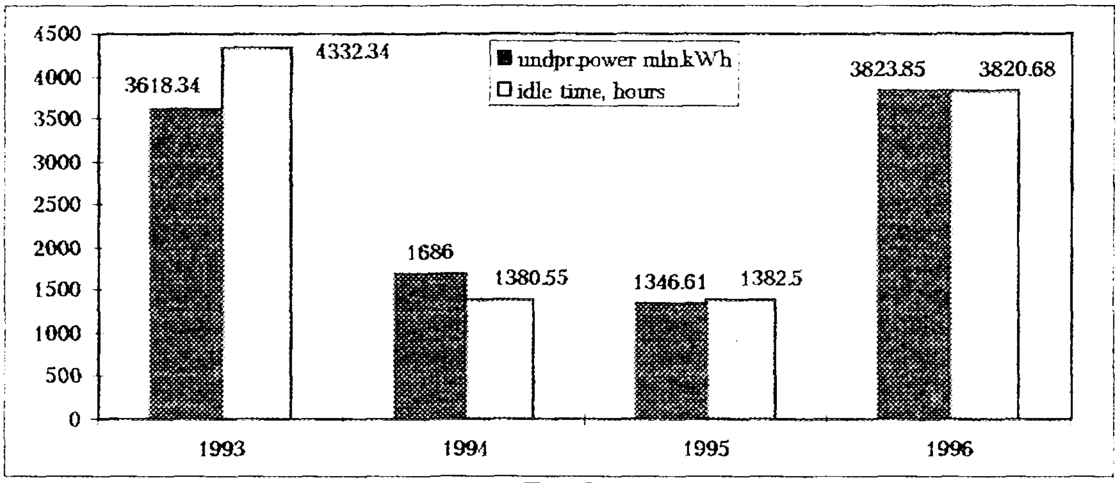


Fig. 3

Essential increase the quantity of electricity underproduction and of the idle time in 1996 as compared with 1995 was caused by:

- failure at the South-Ukraine NPP, associated with fault of the main unit transformer, which resulted in the idle time of the unit 2 during 39 days and raise of failure because of the degradation of quality of the secondary circuit cooling water;

- repeated failures at KhNPP, associated with damage of the steam generator blowing pipeline as a result of insufficient control of welding work quality as well as the failure at KhNPP resulted in damage of turbogenerator rotor on 21.01.96;
- failure, occurred at ZNPP on 15.11.96 because of the low quality of work implementation during steam generator upgrading in 1989. This failure has caused the unit idle time (approx. 12 days);
- failure, which occurred at unit 1 of RNPP on 18.04.96 because of the presence of foreign body in the reactor vessel associated with failure to follow the procedure requirement by the maintenance personnel, and has resulted in a need to suspend operations for PPR -96 (approx. 26 days).

Distribution of the electric power quantity produced in Ukraine for 1990-1996 is given in appendix A.

The information given in Fig. 3 and in appendix A demonstrates, that, despite the increase in underproduction of electricity because of failures at nuclear plants, the electricity produced in 1996 was higher than one in 1995 to 9054 millions kWh. This is caused by:
- commissioning and connection to the grid of ZNPP unit 6 at which 6798 millions. kWh has been produced in 1996;
- lowering the power loss due to defects of CPS CR by results of the measures on elimination the causes of CPS rods stuck, which allowed to produce additional 1196 millions. kWh in 1996;
- lowering the power loss owing to vacuum improvement in the turbine condensers as a result of introducing the ball clean-up at units 2, 3 of Zaporizhzhia NPP and unit 1 of South-Ukraine NPP, that allowed to produce additional 2033 millions. kWh in 1996.

4. VIOLATION OF NPPs OPERATION

Quantity of failures at NPP for 1996 in comparison with 1995 did not change in practice and accounts to 5.5 events in recalculation per one unit under operation, that corresponds to mean indices reached by leading nuclear countries of the world.

All events are investigated with the use of implemented ASSET methodology.

Distribution of quantity of failures at NPPs for 1993-1996.

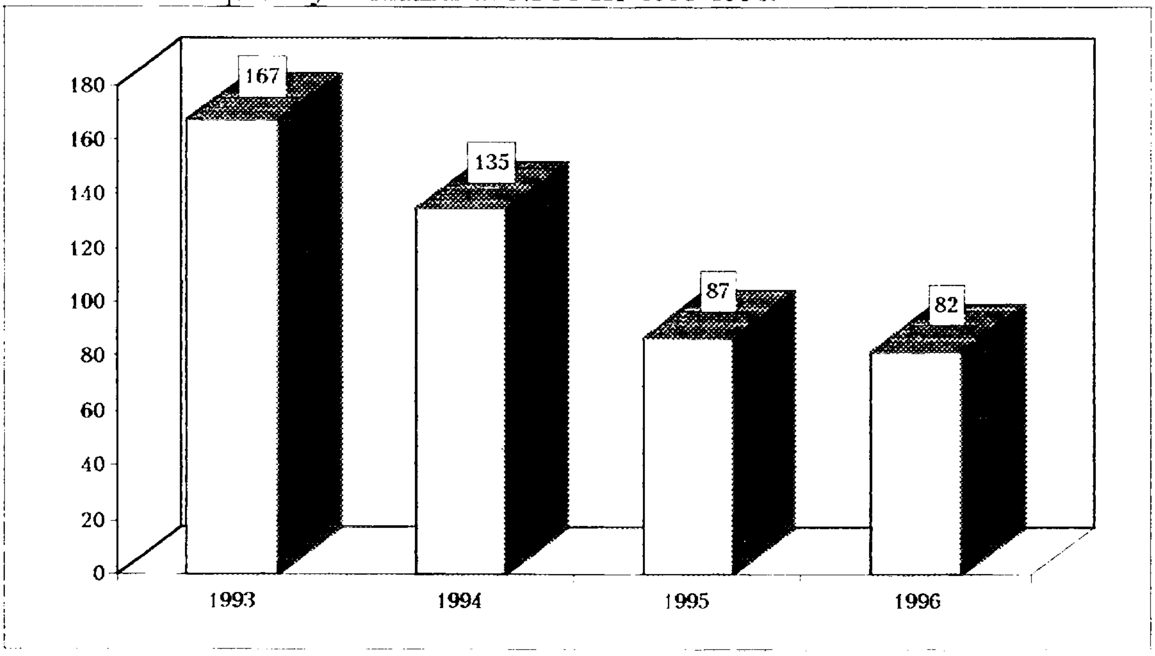


Fig. 4

Distribution of failures in operation of systems and equipment at NPPs of Ukraine for 1993- 1996 by the units is given in Appendix B.

It should be noted, that, according to the information given in this appendix, the total quantity of failures at Zaporizhzhia NPP has decreased. The quantity of failures in 1996 at the South-Ukraine NPP in comparison with the indices of 1995 did not change. Rise of the quantity of failures for the several units (unit 1 of KhNPP, units 2 and 3 of SUNPP, unit 2 of RNPP) in 1996 is essentially affected by equipment ageing, which results in raising the quantity of damaged systems and elements in the course of events. It should be noted that essential increase of failures at Chornobyl NPP is caused by the personnel erroneous actions and faults of I&C devices as well as electric equipment failures.

Changes of mean quantity of failures at NPPs for the latest 5 years are presented in Fig. 5.

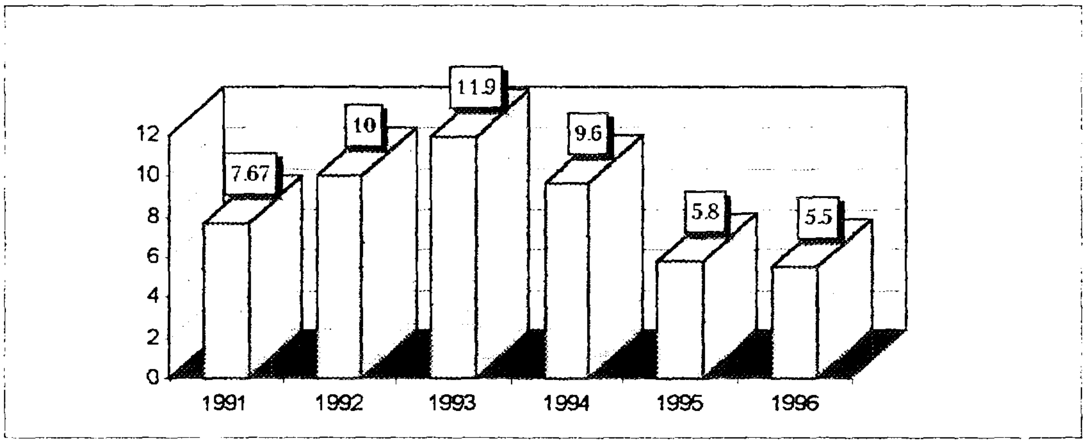


Fig. 5

Fig. 6 shows the distribution of failure quantity for 1993 - 1996 by reactor types of NPP Ukraine under operation.

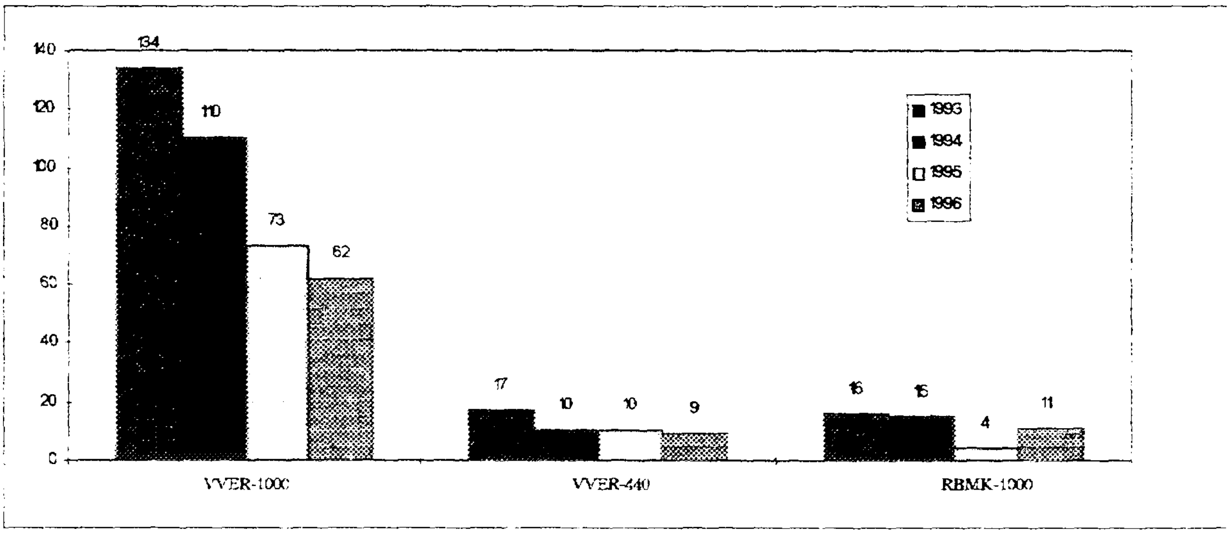


Fig. 6

It should be noted, that, according to the given information, quantity of failures at the power units with reactors of VVER-1000 type has been decreasing. The quantity of failures at the units with reactors of VVER-440 type does not change during the last 2 years. It should be noted significant increase of failures quantity in 1996 at reactors of RBMK-1000 type in comparison with the indices of 1995.

Zaporizhzhia NPP was the most reliable plant in 1996 based on the mean quantity of failures per unit.

Quantity distribution of reactor facility trips as a result of failures in NPPs operation for 1993-1996 is given in Fig. 7.

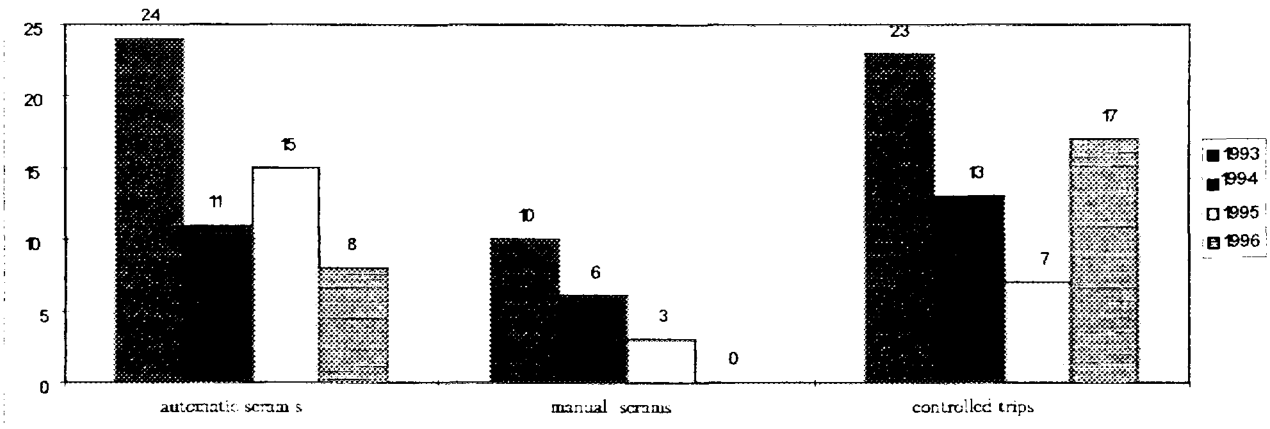


Fig. 7

Proceeding from the presented information it should be noted that the number of failures quantity at NPPs, which necessitate reactor scram in comparison with 1995 has almost twice decreased. A rise of controlled trips in 1996 p. is a consequence of more reliable operation of reactor facilities equipment, which operates during the failure in accordance with the predetermined requirements, that prevents occurrence of situations associated with work of automatic emergency protection. Lack of manual scrams demonstrates practically faultless work of the equipment and devices of control systems automatics and protection of reactor facilities.
Quantity of failures in operation of safety systems in 1996 in comparison with indices of 1995 has decreased in 1.7 time.

Distribution of failures in operation of safety systems, occurred during their testing for 1993-1996 is given in Fig. 8.

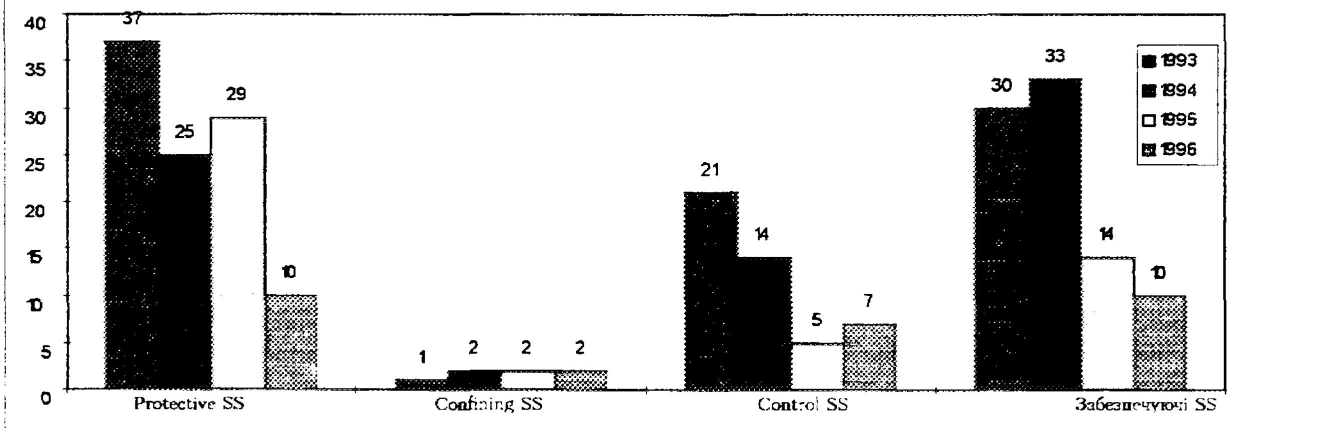


Fig. 8

Quantity of failures in protective SSs decreased almost 3 times, that demonstrates a quality improvement of their repair and maintenance. Quantity of failures in operation of localising SSs has remained almost unchanged.

An insignificant rise of failures in operation of control SSs resulted from faults of electric components because of their insufficient quality and untimely replacements of electronic blocks, service life of which is terminated.

It should be noted that in all cases of SS failures, safety of the units was provided by redundant and duplicating systems.

Distribution of failures in operation of NPPs of Ukraine for 1996 by the international scale of nuclear events INES is given in Table 3.1.1.

The comparative characteristics of indices for 1993 - 1996 by INES scale is given in Appendix B.

Table 3.1.1

Level by INES scale	NPP																				Total
	ZAP							KHM	SUK				CHR				RIV				
	1	2	3	4	5	6	NP	NP	1	2	3	NP	1	2	3	NP	1	2	3	NP	
2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
1	1	-	-	2	-	-	3	1	1	2	1	4	-	-	1	1	-	-	1	1	10
0	2	4	4	3	1	3	17	7	6	5	7	18	4	-	5	9	2	4	6	12	63
Out of scale	-	-	-	-	-	-	-	1	-	-	2	2	-	-	1	1	1	2	1	4	8
Total	3	4	4	5	1	3	20	10	7	7	10	24	4	-	7	11	3	6	8	17	82

The majority of failures in 1996 was rated at "0" (insignificantly for safety).
Level 1 covers events with deviations from the permissible operation mode, which were caused by equipment faults.

The event, which has been occurred at unit 1 of Khmelnitsky NPP on 30.04.1996, where conditions of safe operation on the main circulation circuit heating velocity were violated in the course of routine/preventive maintenance implementation (PPR-1996), was qualified by level 2 (significant violation of safe operation limits).

The list and short description of failures, attributed to level "1" and higher based on the international scale, are given in appendix D.

5. SHORT REVIEW OF THE ASSET MISSIONS.

The history of the ASSET missions at Ukraine began from 1992 after the fire at the Unit 2 Chernobyl NPP. Successful conduction of this mission laid down the beginning of introduction ASSET methodology at other NPPs of Ukraine. Here in Tables 1 and 2 the chronology of conduction training seminars and missions from 1992 up to 1997 is pointed out.

ASSET seminars type S conducted at Ukrainian NPP, 1992 - 1995.

Table 5.1.

NPP Name	Number, type of Units	Date of mission
Khmelnitskaya	1 VVER - 1000	7-11 September 1992
Rivnenskaya	1 VVER - 1000, 2 VVER - 440	28 May - 2 June 1993
Zaporizhskaya	6 (5) VVER - 1000	7-11 February 1994
South Ukrainian	3 VVER - 1000	21-25 March 1994
Chornobylskaya	3 (2) RBMK - 1000	3-5 October 1995
Khmelnitskaya	1 VVER - 1000	11-15 December 1995
Kiev	SSTC NRS Minekobezpeky	3-5 September 1996
Rivnenskaya	1 VVER - 1000, 2 VVER - 440	11-13 March 1997

ASSET mission type R conducted at Ukrainian NPP, 1993 - 1995.

Table 5.2.

NPP Name	Number, type of Units	Date of mission
Chornobylskaya	3 (2) RBMK - 1000	21-26 June 1992 (A-type)
Khmelnitskaya	1 VVER - 1000	8-19 March 1993
Rivnenskaya	1 VVER - 1000, 2 VVER - 440	22 Nov. - 3 Dec. 1993
Chornobylskaya	3 (2) RBMK - 1000	11-22 April 1994
Zaporizhskaya	6 (5) VVER - 1000	13-24 June 1994
South Ukrainian	3 VVER - 1000	16-27 January 1995

Results of these seminars and missions were first of all the knowledge obtained by operating personnel and personnel of the regulatory body on the ASSET methodology application.

Seminar on prevention incident at Chernobyl NPP in October 1995 helped for safety self-assessment RBMK reactors.

Seminar on plant self-assessment to further enhance prevention of incidents that was held at Kiev in September 1996 gave an essential help for the group at SSTC NRS on analysis and assessment events important for the safety.

It is necessary to add that after conduction of the seminar at Rivne NPP in March 1997 the quality of commission work on investigation of violations was greatly improved.

The main objective of these important working sessions was to present the methodology which has been disseminated worldwide over the ten past years by the ASSET service to support self-assessment of plant safety performance and to demonstrate its practical use on operational events that have valuable impact on the safety performance of Ukrainian nuclear power plants.

6. OPERATING EXPERIENCE FEEDBACK PROCESS.

The first steps on organisation of the operating experience feedback process when investigating violations in operation of Ukrainian NPPs were made after approval in the Regulatory Body of Ukraine in the August of 1993 the regulating document: "Regulations on Information System of Violations in operation of nuclear power plants of Ukraine (ISV of Ukraine)".

A rather clear understanding of this process was evidenced after conduction a series of the ASSET missions at Ukrainian NPPs said above.

From 11 to 15 November, 1996, on invitation of the Government of Ukraine in the SSTC NRS the Peer Review Mission of national safety experience feedback process was conducted by the IAEA experts as a result of which was developed a report pointing out deficiencies of existed operational experience feedback system.

At present a new regulations is developed in which all the pointed out recommendations and advices of experts will be taken into account.

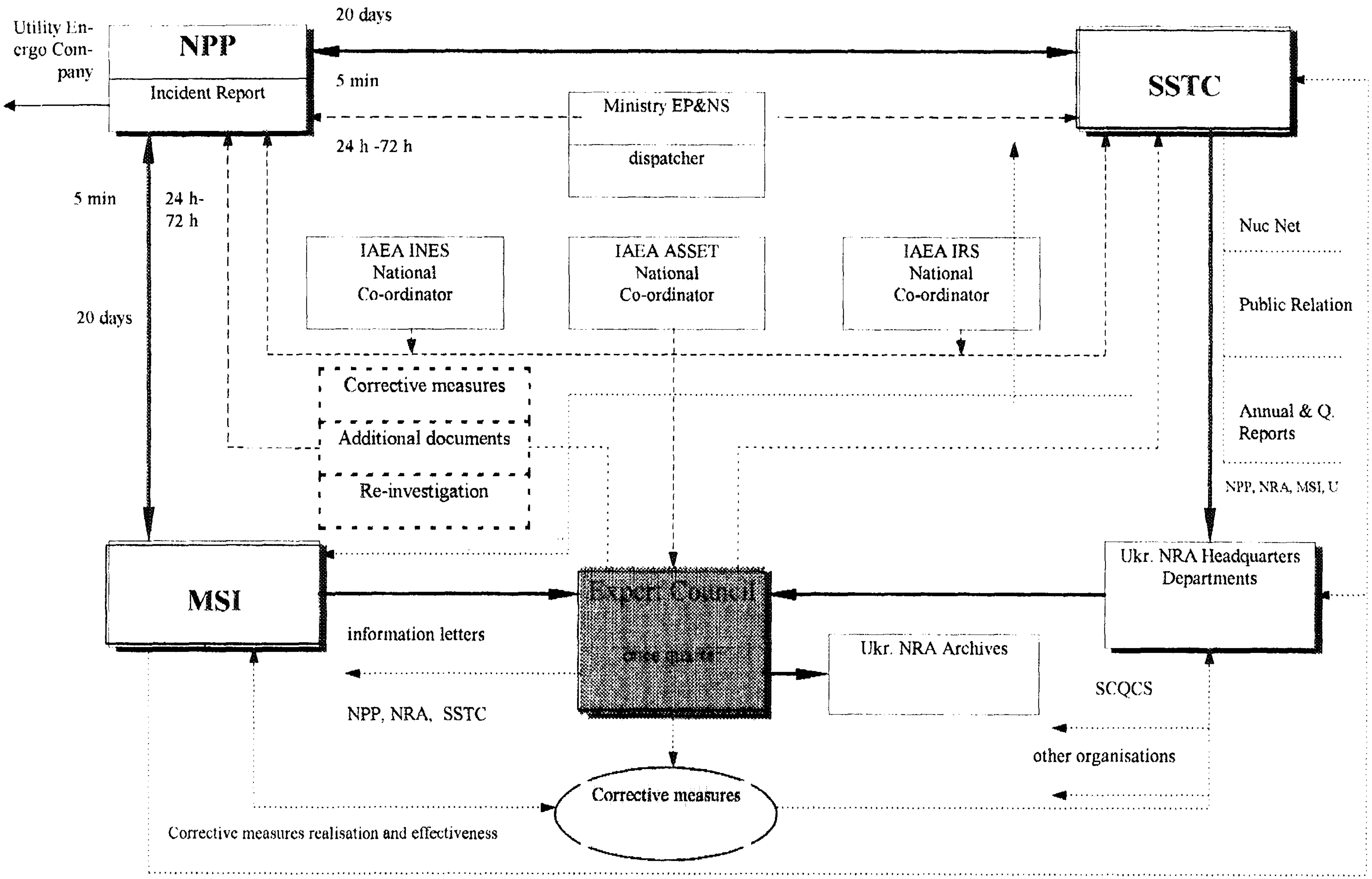
At fig 9 project of a functioning structure of the process is depicted. The following scheme is supposed to be introduced.

Reports on violations prepared by commissions at NPPs are directed to the Utility EnergoCompany, to the Main State Inspection and the SSTC NRS. After fulfilment the necessary expertise and analysis the SSTC NRS and the Utility EnergoCompany develop the Quarterly Reports that include generalised analysis of causes of violations and corrective actions. The Quarterly Reports are directed to NPP operating Utilities and other involved organisations. After studying of the Quarterly Reports approximately 0.5 month lately the Expert Council is gathered one time quarterly in which the representatives of the regulatory body and Operating Utilities take part.

Results of discussions are formulated in the protocol and are directed to the Chairman for approval, then they are distributed to all of the involved organisations.

Now it is important to mark the following: South Ukrainian NPP after discussion of this scheme every quarter submits to the SST NRS the schedule of corrective measures.
It is possible to hope that this scheme will be workable.

Fig. 9 Experience feedback in Ukrainian Regulatory Body



7. CONCLUSIONS.

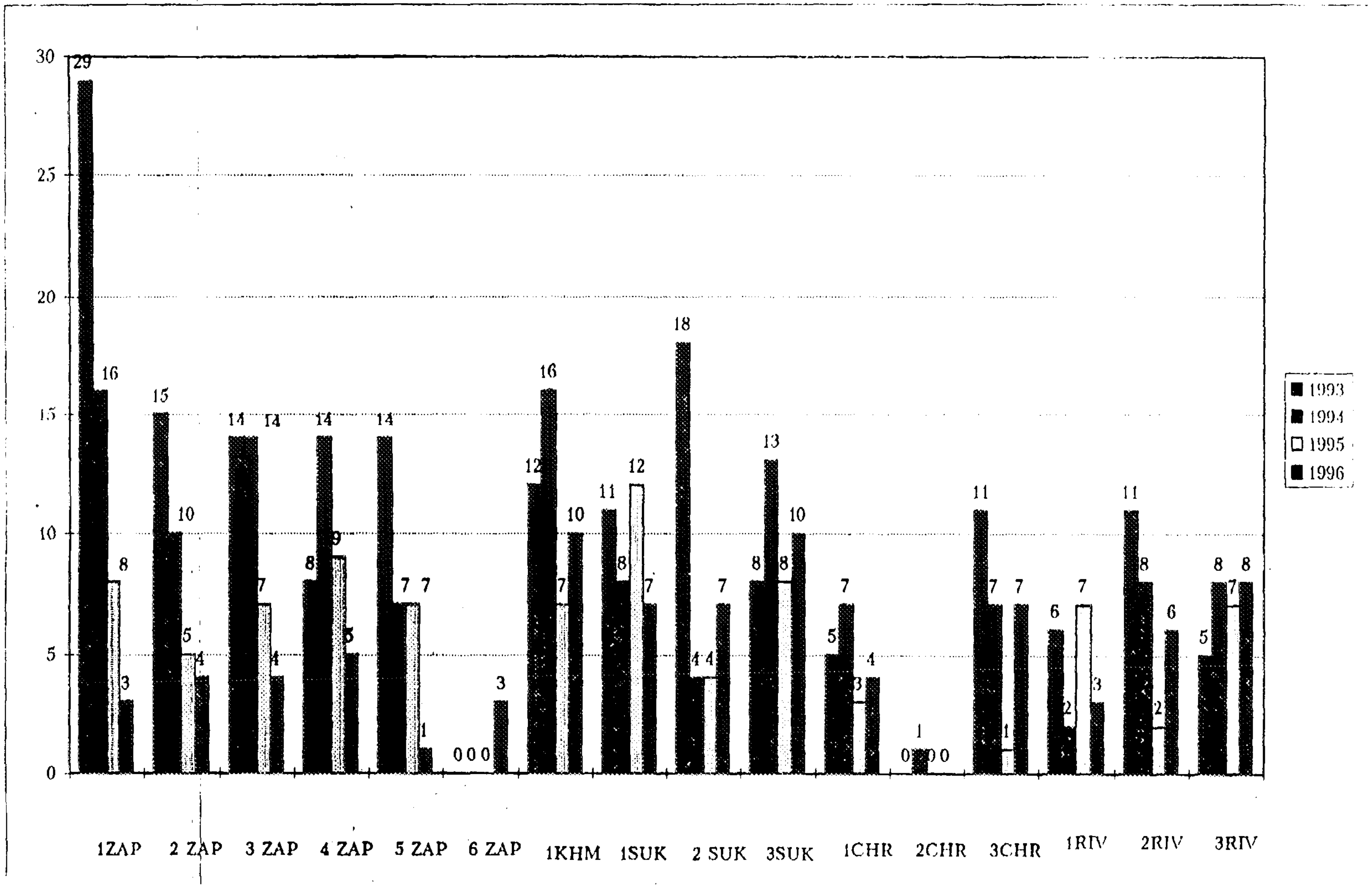
1. In 1996 the Regulatory Body of Ukraine assessed the operation of Ukrainian NPPs from the safety point of view as satisfactory.

2. It is important to mark the positive input of the IAEA ASSET Teem into safety improvement of Ukrainian NPPs. Delivering of experience on safety self-assessment is a stimulus for development of operating safety culture of Ukrainian NPPs.

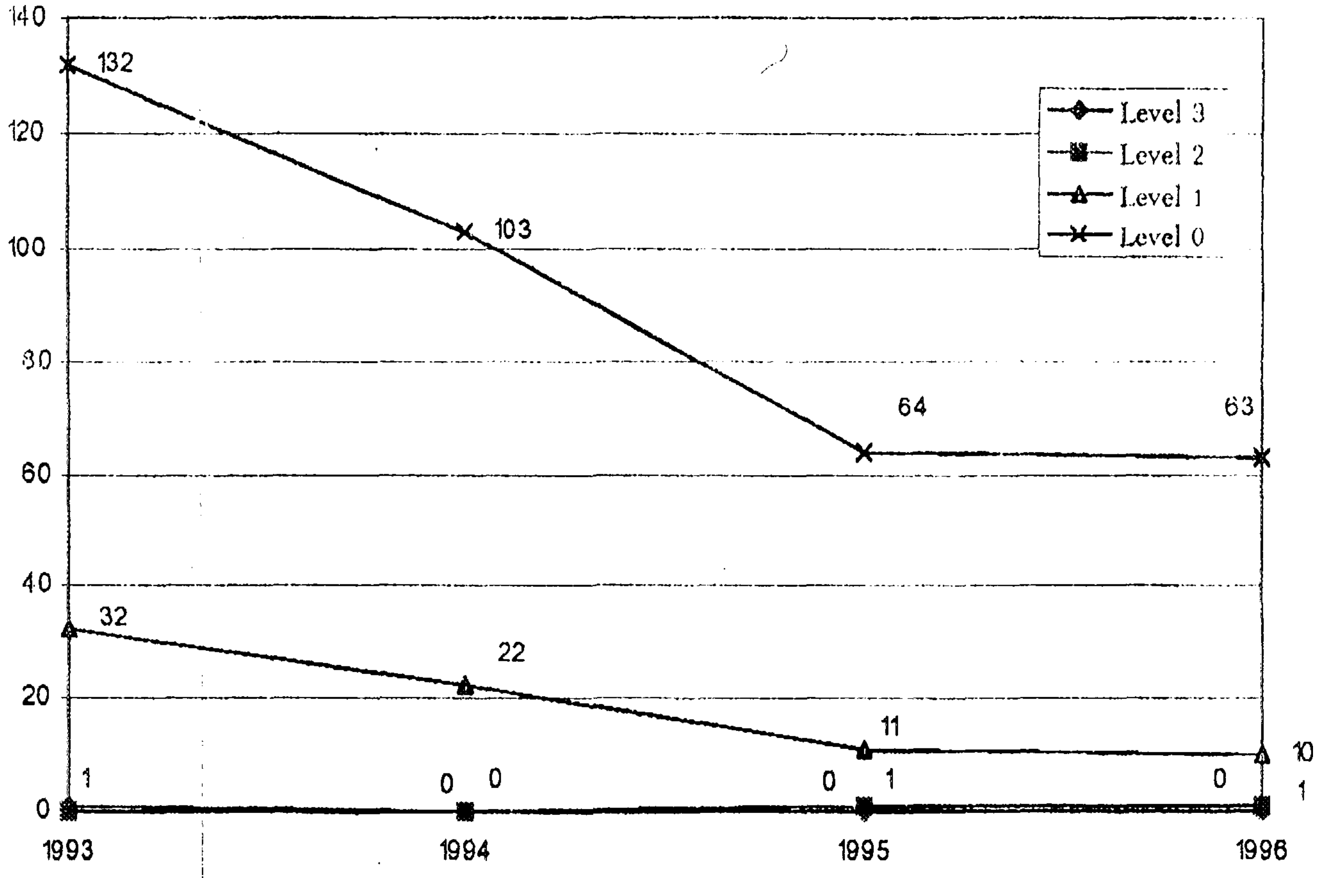
3. Seminars and missions on self-assessments have to be conducted at all of the Ukrainian NPPs.

4. After development of regulations on operating safety experience feedback process it is necessary to conduct Peer Review Mission of national operating safety experience feedback process with help of the IAEA ASSET.

Disrtibution of system/equipment failures at NPPs of Ukraine for 1993 - 1996 per units



Comparative characteristics of the indices for 1993 - 1996 according to INES scale.



Item No	Failure date. NPP.	Level according to INES	Sort event description
			Zaporizhzhia NPP
1	03.01.94. 2 unit ZNPP	1	Spurious actuation of the protection of II PVT limit group B.
2	11.01.94 4 unit ZNPP	1	Contamination with radioactive media of the compressed air line and room C-117 of the sprcial building higher the design-specified levels for normal operation.
3	16.03.94. 1 unit ZNPP	1	Loss of reliable information on CPS CR 05-36, 10-37, 13-30, 11-22 without immediate reactor unloading by the shift personnel.
4	01.05.94 1 unit ZNPP	1	Switching to repair of pump TQ22D01 when 1SS was switched to repair.
5	11.07.94 1 unit ZNPP	1	Ingress of boron solution from the delay pond to the distributing сильфон and main joint stud of the containment.
6	14.07.94 3 unit ZNPP	1	Failure to connct to the reliable power supply section (RPS) and sudden switching off the diesel generator (DG-3) at the regular tests during the unit maintenance.
7	05.08.94 2 unit ZNPP	1	Breakage of reserve impulse tube at unsevering section of the flowrate-metering spacer RL41F01.
8	09.08.94 1 unit ZNPP	1	Tripping the power unit due to leakage by the branch pipe flange joint of the upper reactor block.
9	05.10.94 2 unit ZNPP	1	Withdrawal from duty operation of the pump of emergency and regular cooling down pump of the second channel of safety system TQ22D01 due to 3d bearing temperature elevation at 1 SS under maintenance.
10	10.02.95 3 unit ZNPP	1	Failure to switch on of the spray system pump and SG emergency feeding pump of the safety systems second channel during implementation of complex inspection.
11	20.04.95 1 unit ZNPP	1	Failure of main relief valve YP23S01 to close in the course of testing by direct pressure elevation in the primary circuit.
12	29.04.95 3 unit ZNPP	1	Exceeding the time of several CPS CR drop more than the standard one in the course of testing implementation
13	28.08.95 1 unit ZNPP	1	Failure of diesel generator 1RDES3 to start-up during regular testing of SS channel III in course of switching to repair of SS channel II.
14	01.01.96. 4 unit ZNPP	1	Actuation of the emergency protection "Switching off three of four operated MCPs at the reactor facility neutron power more than 5%" following a false closing the fast sealing MCP water discharge valve.
15	29.09.96 4 unit ZNPP	1	Disengagement of CPS CR with the refuelling machine pole during transportation/process work implementation
16	10.07.96 1 unit ZNPP	1	Switching to repair of pump TQ22D01 due to a false reading of bearing 4 temperature at the safety system channel 1, switched to repair. Safe operation conditions are violated
			South-Ukraine NPP
17	06.04.94 1 unit SUNPP	1	Non-long-term elevation of the indices of secondary drive of level meter PG-3, which generate signal of emergency protection AZ-1 by water level decrease in steam generator PG-3.
18	25.05.94 1 unit SUNPP	1	Studs damage of main joint G33.
19	15.06.94 2 unit SUNPP	1	Water-chemical regime violation in the spray system tanks and ECCS tanks.
20	01.09.94 1 unit SUNPP	1	RF tripping by emergency protection AZ-1 action in response to incorrect actions of the shift personnel.
21	03.07.95 1 unit SUNPP	1	Actuation of AZ-1 in response to switching off MCP due to incorrect actions of the shift personnel.
22	03.10.95 3 unit SUNPP	1	Increase of drop time of five CPS CR over the designed value, revealed during the regular inspection implementation.
23	28.10.95 3 unit SUNPP	1	Damage of motors of emergency/regular cooling down RF pump TQ32D01 and service water pump QF31D02.
24	01.12.95	1	Piping damage during the still residual transferring from SWP of

Item No	Failure date. NPP.	Level according to INES	Sort event description
	unit SUNPP		2nd phase into tanks of the [illegible] waste processing workshop of 1st phase.
25	12.02.96 2 unit SUNPP	1	Unloading the unit due to switching off MCP GTsN-2,4 followed by switching off turbine generator TG-2 and actuation of AZ-1.
26	10.04.96. 1 unit SUNPP	1	Outdoor wall contamination of the special building of SUNPP 1st phase and concrete bridge adjacent to it over the permissible levels.
27	12.05.96. 2 unit SUNPP	1	Increase of drop time of eight CPS CR over the designed value, revealed during the regular inspection implementation.
28	30.07.96 3 unit SUNPP	1	Violation of safe operation conditions in implementing maintenance of pump TQ33D01 of the emergency boron injection system
29	14.08.96 3 unit SUNPP	1	Tripping TG-1 by action on a vacuum decrease in the condenser followed by actuation of AZ-1 in response to switching off MCP
Chornobyl NPP			
30	18.04.94. 3 unit ChNPP	1	The unit trip by protection AZ-5 in response to the signal "Decreasing the level in ECCS tanks" of subsystem II as result of unauthorised opening the fast-action valve P.1.5221.
31	19.04.94. 1 unit ChNPP	1	Damage of transportation packing container with ten fresh FAs.
32	17.10.94 3 unit ChPP	1	The unit trip by key of EP AZ-5 due to the crack availability in basic metal of rack channel N 41-13 .
33	29.01.95 3 unit ChNPP	1	Actuation of protection AZ-5 by the false level decrease signal in ECCS tanks.
34	27.11.95 1 unit ChNPP	3	Contamination of the strict monitoring zone premises.
35	24.04.96 3 unit ChNPP	1	Contamination of the unit premises exceeding the permissible level as result of violating the requirements of the instruction on work organisation and applying the unified assignment/permission system by the personnel.
Khmelnitsky NPP			
36	04.05.94 1 unit KhNPP	1	False actuation of the ECCS protection of safety channel III.
37	18.08.94 1 unit KhNPP	1	Actuation of the safety system in mode which is not associated with a safety function provision.
38	16.11.94 1 unit KhNPP	1	Actuation of emergency protection due to a loss of generator cooling.
39	18.11.94 1 unit KhNPP	1	Disconnection of the unit from the grid due to failure of the level regulator operation failure in steam generator PG-3.
40	20.03.95 1 unit KhNPP	1	Disconnection from the grid caused by damage of HPC rotor of turbine N1.
41	30.04.96 1 unit KhNPP	2	The main circulation circuit heating velocity has been exceeded as a result of breach.
42	27.07.96 1 unit KhPP	1	Damage of the pressure compensation system piping.
Rivne NPP			
43	21.06.94 3 unit RNPP	1	Drop time increase of 20 CPS CRs. revealed in the course of RPW
44	04.10.94 3 unit RNPP	1	Tripping the turbogenerator TG-5 by the personnel at loss of process parameters readings of the turbine division followed by consequent actuation of the reactor emergency protection and actuation of the safety system gears caused by the steam generator level decrease.
45	28.02.95 1 unit RNPP	1	Exceeding the primary circuit cooling down rate in the course of testing the relief valve 1PG 4 caused by its seizing in an open position.
46	25. 07.96 3 unit RNPP	1	Increase of the CPS CR drop designed time

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UNITED KINGDOM

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PRESENTED BY

R.C.M. Nichols

Central Feedback Unit - Objectives

- Maintain Compliance with Site Licence Condition 7
- Minimise events to enhance Company profit

MK3477-1

Nuclear Electric

Central Feedback Unit - Targets

- Minimise unplanned trip rate. Currently AGR's 3/year, World Ave. 1/year
- Minimise Op rule/IOI compliance events
- Minimise unauthorised discharge events
- Enhance NEL performance by sharing good practices

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MK347794

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Site Licence Condition 7

- The licensee shall make adequate arrangements for the **notification, investigation and reporting of incidents** occurring on site
  - Following an event on site **or on similar plant or operations elsewhere,** appropriate actions shall be taken to minimise the probability of recurrence of the event.

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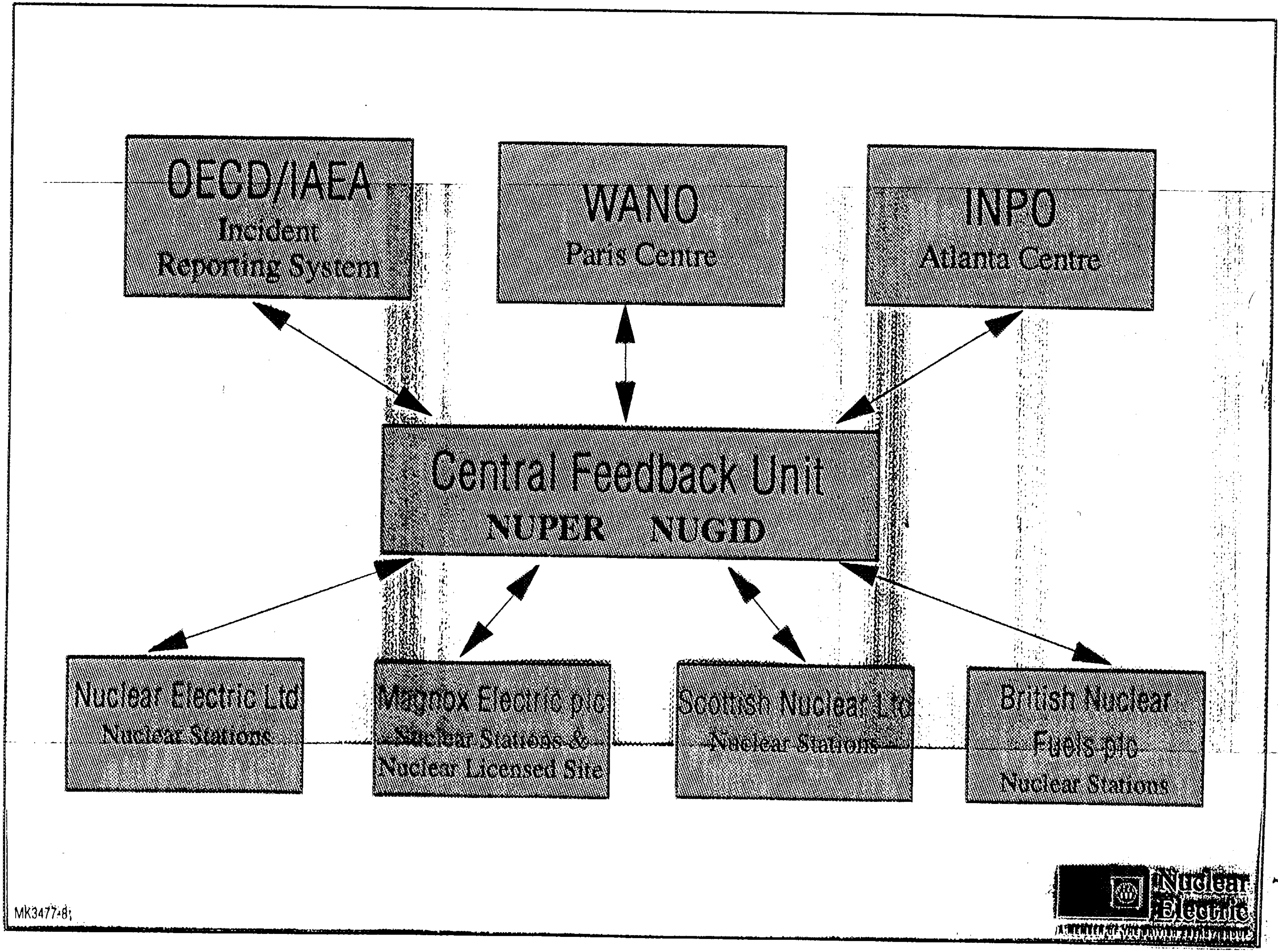
OECD/IAEA
Incident
Reporting System
WANO
Paris Centre
INPO
Atlanta Centre
Central Feedback Unit
NUPER NUGID
Nuclear Electric Ltd
Nuclear Stations
Magnox Electric plc
Nuclear Stations &
Nuclear Licensed Site
Scottish Nuclear Ltd
Nuclear Stations
British Nuclear
Fuels plc
Nuclear Stations
Nuclear
Electric
MK3477-8

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Operational Experience - Feedback

- Feedback Databases:
  - NUPER
    Nuclear Plant Event Reports. Contains details of all UK plant event reports and selected reports from other utilities.
  - NUGID
    Good Practices. Contains information on good practices which may be of use to UK nuclear stations.

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MK347758

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Operational Experience - Feedback

- **Customers:**

Coal Face	-	(Operators /Engineers) Station
Specialist	-	Station / HQ
Management	-	Station / HQ

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MK3477-5

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Operational Experience - Feedback

- **Coal Face**
  - Training Videos / Newsletters / Face to Face presentations (there's no substitute)
  - NOT numerous event reports
- **Specialist**
  - Detailed Event Information
- **Management**
  - Generic Issues / Potential Solutions / Justifications for spending money on solutions

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MK3477-7

NUPER Classification Of Root Cause

#Root

1. Human performance related
2. Equipment related

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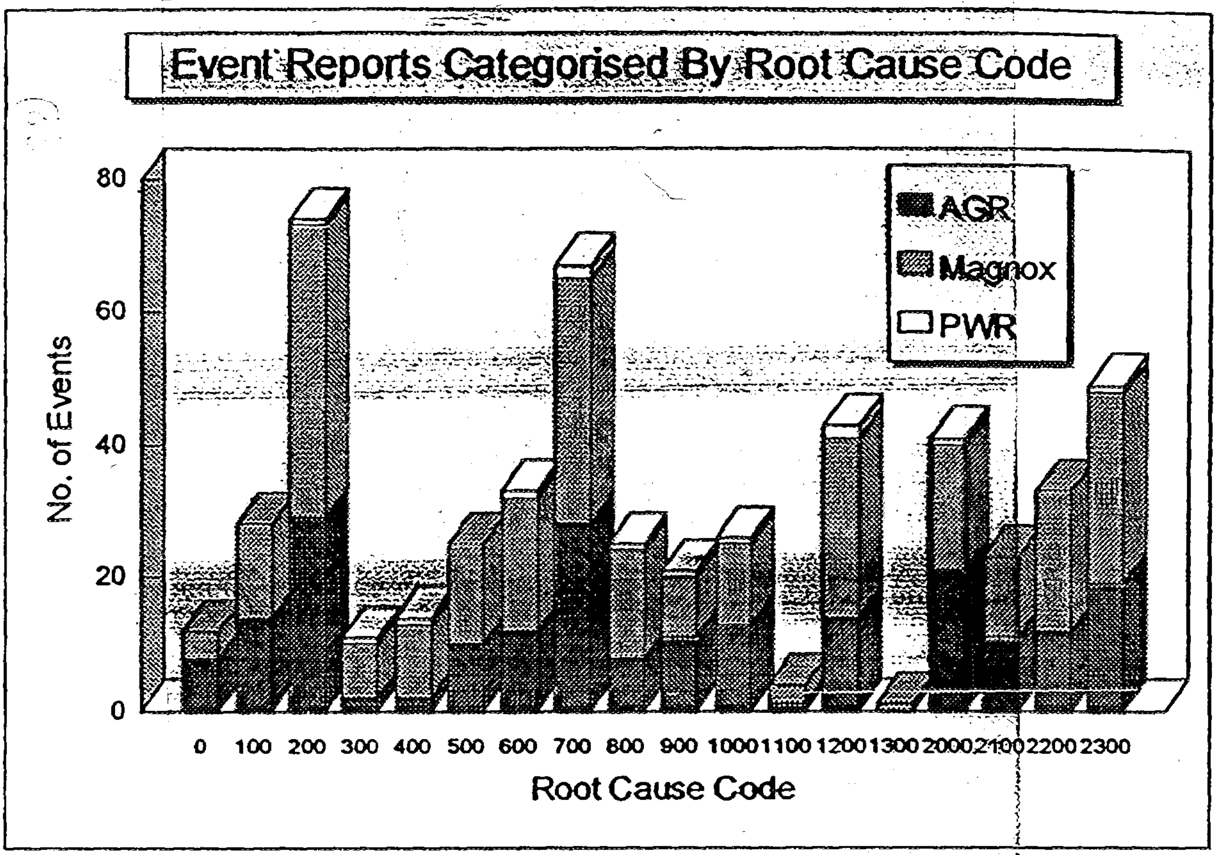

KEY TO ROOT CAUSE CODES

0 Others

Human Performance Related		**Equipment Related**	
100	Verbal Communications	2000	Design Configuration and Analysis
200	Personnel Work Practices	2100	Equipment Specification Manufacture and Construction
300	Work Schedule	2200	Maintenance, Testing and Surveillance
400	Environmental Conditions	2300	Equipment Operations and Documents
500	Man-Machine Interface		
600	Training/Qualification		
700	Written Procedures		
800	Supervisory Methods		
900	Change Management		
1000	Work Organisation		
1100	Resource Management		
1200	Management Methods		
1300	Personal Factors		

NB SOME EVENTS HAVE MORE THAN ONE ROOT CAUSE CODE

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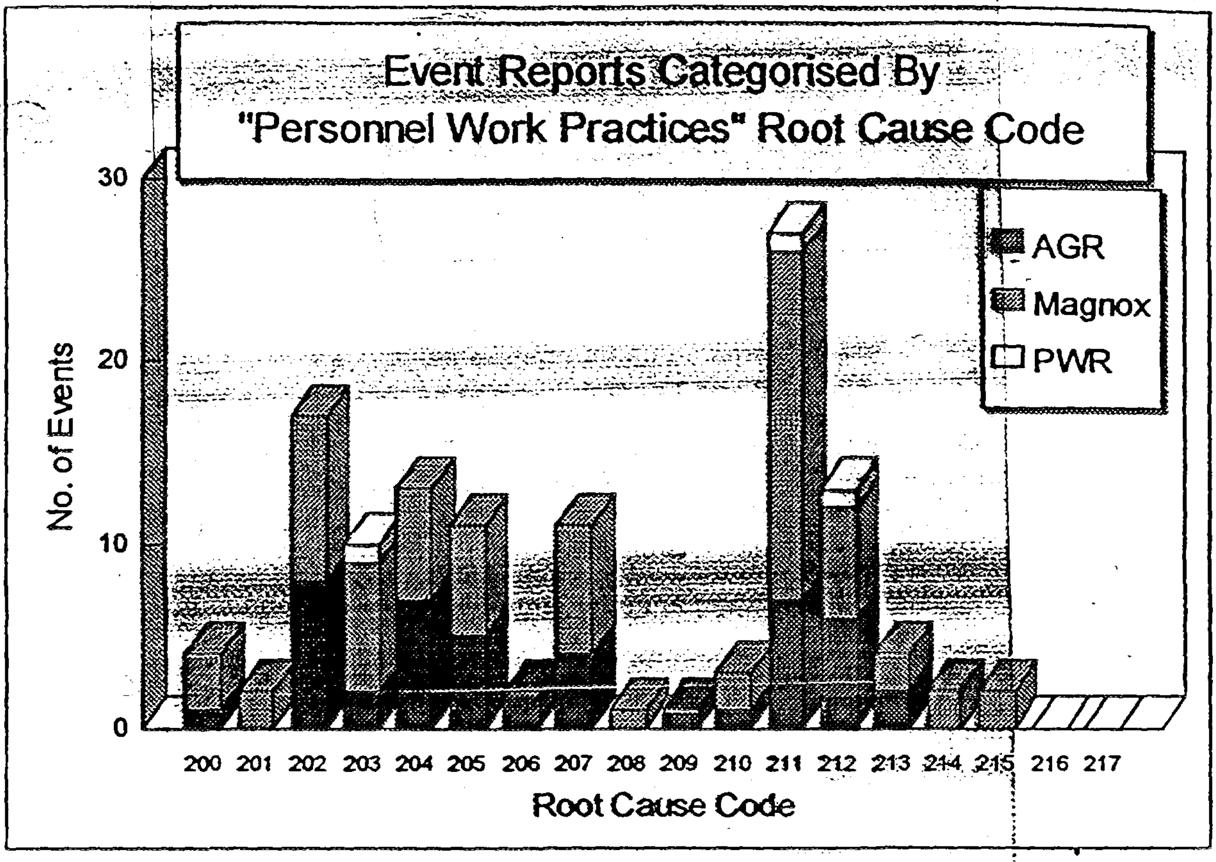

KEY TO 'PERSONNEL WORK PRACTICES' ROOT CAUSE CODES

200	Other
201	Unidentifiable
202	Self Checking not used or ineffectively applied
203	System alignment/isolation not verified
204	Required procedures, drawings or other references not used
205	Administrative controls circumvented or intentionally not performed
206	Conditions not verified prior to work
207	Task not adequately researched prior to start
208	Unauthorised material substitution
209	Inadvertent bumping, stepping on, or other damage to equipment
210	Radiological/ALARA work practices not followed
211	Inattention to detail
212	Independent checking not used
213	Unsafe working practices applied
214	Personal Protective Equipment not used/worn
215	Improper tools/equipment

NB SOME EVENTS HAVE MORE THAN ONE CAUSE CODE

NUPER Classification Of Human Performance Root Cause

1. Verbal communication
2. Personnel work practices
3. Work schedule
4. Environmental conditions
5. Man-machine interface
6. Training/qualification
7. Written procedures and documents
8. Supervisory methods
9. Change management
10. Work organisation
11. Resource management
12. Management methods
13. Personal factors (mental and physical characteristics of the individual)

NUPER Classification Of Equipment Root Cause

1. Design configuration and analysis
2. Equipment specification, manufacture and construction
3. Maintenance/testing/ surveillance
4. Equipment operations

C. Phipps

Technical Committee Meeting
Annual Workshop on ASSET Experience and Feedback
24-26 June 1997

Experience

The UK has been involved and supported the development of the ASSET Self Assessment Peer Review type mission since its "birth" at the 1994 ASSET workshop.

The UK has provided support to numerous ASSET missions in the past and have participated in the recent Forsmark, Krsko and Dukovany self assessment missions as well as supporting workshop and consultancy meetings.

All UK nuclear power plants now have experience feedback sections in place and they have developed procedures, accepted by the regulator, to select and analyse events to establish the root cause. The regulatory site inspector reviews the event register as part of the normal safety inspection as part of its 'core inspection'.

In the UK we are in a stable position regarding operation of our nuclear power plants, however, continued pressure for economic efficiency is providing a challenge to the operator and regulator. A number of the gas reactors have been granted permission to operate for a period of three years between shutting down for maintenance. As a high proportion of events are part maintenance related it will be interesting to see if this change increases or decreases maintenance related events.

The UK also has a number of plants that are being de-commissioned, events happen at these plants and they must still be considered in the overall database of events.

The UK has hosted ASSET training seminars and OSART inspections but to date has not hosted an ASSET mission. I hope that in 1998/99 my plant, Oldbury, will request such a mission.

Observations

I have participated in the Forsmark and Krsko NPP self assessment ASSET missions. Difficulties arose during both missions that require addressing by ourselves, this ASSET workshop, to advise the IAEA. These are:

1. The programme at site (and in hotel)
2. The team composition, training and secretarial support
3. An understanding of the plant's assessment methodology
4. Integration of the regulator and operator in the ASSET mission
5. Guidance provided for the mission and to the ASSET team by the IAEA.

I understand that some changes to the ASSET mission have been implemented since my participation in the Forsmark and Krsko missions and I believe it would be useful if a member of the IAEA staff could provide us with information on these changes prior to us splitting into groups to review the completed self-assessment missions.

Mr. Nichols, the Chairman, I believe has further comments from an operational standpoint.

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ATTACHMENT 5

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Department of Nuclear Safety
Division of Nuclear Installation Safety

Final Issue
1997-06-26

INTERNATIONAL ATOMIC ENERGY AGENCY

NOTIFICATION OF AN AGENCY SPONSORED MEETING

Title of the meeting:	*TCM: Annual Workshop on ASSET Experience and Feedback*	
Date of the meeting:	*24-26 June 1997* *(starting 9:30 a.m.)*	***Scientific Secretary:*** *P. Bliselius* *B0869, x-26082* *e-mail: P. Bliselius@iaea.org*
Place of the meeting:	***C07 V***, *x -21351* *C0751 & C0753 (for WGs)*	***Secretary:*** *R. Kim* *B0871 x-22521*
Meeting number:	*712-J8-TCM-871.5*	

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