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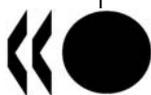
**NUCLEAR ENERGY AGENCY
COMMITTEE ON NUCLEAR REGULATORY ACTIVITIES**

Operating Experience Report: Investigating Trending Utilising the International Database

Working Group on Operating Experience (WGOE)

JT03297723

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In implementing its programme the Committee shall establish co-operative mechanisms with the Committee on the Safety of Nuclear Installations in order to work with that Committee on matters of common interest, avoiding unnecessary duplications. The Committee shall also co-operate with the Committee on Radiation Protection and Public Health and the Radioactive Waste Management Committee on matters of common interest.

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FOREWORD

The NEA Committee on Nuclear Regulatory Activities (CNRA) believes that sharing operating experience from the national operating experience feedback programmes are a major element in the industry's and regulatory body's efforts to ensure the continued safe operation of nuclear facilities. Considering the importance of these issues, the Committee on the Safety of Nuclear Installations (CSNI) established a working group, PWG #1 (Principle Working Group Number 1) to assess operating experience in the late 1970's, which was later renamed the Working Group on Operating Experience (WGOE). In 1978, the CSNI approved the establishment of a system to collect international operating experience data. The accident at Three Mile Island shortly after added impetus to this and led to the start of the Incident Reporting System (IRS). In 1983, the IRS database was moved to the International Agency for Atomic Energy (IAEA) to be operated as a joint database by IAEA and NEA for the benefit of all of the member countries of both organisations. In 2006, the WGOE was moved to be under the umbrella of the Committee on Nuclear Regulatory Activities (CNRA) in NEA. In 2009, the scope of the Incident Reporting System was expanded and re-named the International Reporting System for Operating Experience (although, the acronym remains the same).

The purpose of WGOE is to facilitate the exchange of information, experience, and lessons learnt related to operating experience between member countries. The working group continues its mission to identify trending and issues that should be addressed in specialty areas of CNRA and CSNI working groups.

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1. INTRODUCTION AND SCOPE OF THE TASK

On its 4th meeting in November 2008, the WGOE discussed the feasibility of developing international trending capabilities /1/. CNRA decided that the task should, in addition to the WGOE planned review of national event and safety performance indicator data, include a review of the quality of information held in the International Reporting System (IRS) database /2/. During the 5th meeting, taking place in May 2009, a first survey of a potential trending using the IRS was presented /3/.

Trending is part of operating experience (OPEX) analysis programmes. The IAEA guide NS-G-2.11 /4/ states:

Trending is a process used to identify conditions of degradation on the basis of the analysis of past events (precursors) at the plant. Plant operating organisations trend causal factors in events derived from analysis of apparent causes and/or root causes. The goal of any trending programme should be to identify an abnormal trend early enough that the operating organisation can initiate an investigation and take corrective actions to prevent a significant event. Corrective actions that are directed at weaknesses that have been identified should be specified and implemented through the corrective action programme. Industry experience indicates that trending of event information in this manner makes full use of information from investigations and can provide useful indications of the safety culture at the plant for line managers.

The purpose of an event trending process should be to determine the frequency of occurrence of certain conditions that have been gathered from reports on minor and major problems and event investigations. These data include information about equipment failures and shortfalls in human performance, and situational data that describe conditions at the times of the events.

Data from programmes other than problem and deficiency reports should also be trended to obtain a broader perspective of strengths and weaknesses at the plant. For example, trending of information from industrial safety reports, radiological contamination reports and records of maintenance work can provide useful insights.

Trending should be used to analyse the performance of various work groups, to identify those factors that result in either less than desired or better than expected performance. Follow-up investigations should be performed to gain a better understanding of why an abnormal trend is occurring so as to determine the causal and contributing factors.

A coding system should be applied that enables events to be characterized. Selected parameters or groups of parameters can then be trended to identify recurring themes (e.g. plant system, work group or cause of the activity). Examination of these parameters can permit the identification of adverse trends and the potential for events to recur.

Types of trending that provide useful information are those that identify:

- Recurring data derived from the events coded, preferably after detailed investigation;
- Abnormal trends relating to plant work groups;
- Abnormal trends in certain operating modes and during certain activities;
- Recurring failures of systems and components;
- The differences between trends during an outage in comparison with trends during non-outage periods;
- Those work groups that are performing well;
- Doses arising from different activities, as an input to ensuring that exposures to radiation are maintained as low as reasonably achievable.

The NEA-CNRA regulatory guidance booklet on challenges in using operating experience /5/, stresses that trending should be used for precursor events in the frame of accident sequence precursor programmes. By adding the sum of all conditional core damage probabilities (CCDP) for a year and comparing with the sum of yearly CCDPs for earlier years, one can deduce trends in the overall safety performance of the nuclear plants. Even if there are limitations in the probabilistic methodologies, some regulatory bodies find ASP (Accident Sequence Precursor) methods highly valuable for analysing operating experience for overall safety trends. Trending should not only be performed by the licensees but is also a task for the regulatory body. A regular review of trend information should be a part of the regulator's operating experience procedure.

The WGOE report "The Use of International Operating Experience Feedback for Improving Nuclear Safety" /6/ stated that – outside specific NEA database projects - international trending plays a minor role in determining the priorities and programmes of work in international organisations.

The purpose of this task group report is to show existing national trending tasks and to assess the possibilities in trending of internationally reported events. The report discusses the opportunities and limitations of international trending compared to the national works.

2. QUESTIONNAIRE ON NATIONAL TRENDING

On its 6th meeting WGOE discussed the first ideas of the trending task and received some presentations from the Member States. The use of trending in the regular OE feedback process showed a wide variation between the Member States. To harmonize the various topics related to trending and to ease the evaluation for this report, a short questionnaire was set up. The questions are:

1. What is the philosophy of operating experience for your RB framework?
2. What information is trended by your RB? (specific safety performance indicators, codings/event tags)
3. How is a trend determined by your RB? (mathematical, observation, as hoc, etc.)
4. What part of your RB performs the trending?
5. How is international data incorporated into your national trending programme?
6. How does your RB use the trending the information? Such as,
 - a. Reporting to other authorities, higher level government
 - b. Interactions with operator/ licensee
 - c. Input into inspection or other regulatory activities
7. Is your RB trending effort separate from the operator/ licensee?
8. Is the trending used to compare safety performance between plants?
9. What have been the results of the trending programme?

The evaluation of the answers to the questionnaire is given in the next chapters. Thereafter the answers of the different Member States to the questionnaire are given respectively. Next is a summary of the contributions to the 6th WGOE meeting.

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3. SUMMARY ON RESPONSES TO NATIONAL TRENDING EFFORTS

The evaluation of the different responses of the members states show for some questions a remarkable variety of answers. Some reactions to other questions revealed that there is a uniform approach for most of the member countries.

It is a common practice for most of the member countries to use safety performance indicators. These indicators are systematically evaluated with the goal to identify potential trends. Thus negative trends can be detected early. Corrective actions can subsequently be started to stop the adverse trends.

Trending by the regulatory body is done independently from the utilities. But, the results of regulatory trending and utility trending may be discussed in meetings of the regulator and the licensee.

Some regulatory bodies have developed their own set of indicators. These are either based on data that can be derived from direct indicators like scrams rate, safety system failures or forced outage rates. In some instances the regulatory body derives indicators during the regular authority supervision process. Some of these indicators may be based on the personal findings by a regulatory inspector. In other states, regulatory bodies and utilities use the same set of indicators.

Significant differences could be identified in the general approaches of the regulatory bodies in the use of the trending information. In some instances the authorities use the information mainly for their own purposes, that is, to be informed on the safety performance of the NPPs to be prepared in their discussions with the licensees. In some member countries the trends are regularly reported to the public. For a few authorities the safety performance indicators found a basis of their supervision programme. Thus trending has a direct influence on the plant supervision process.

Another remarkable difference can be seen in the use of international data for trending. Most of the countries use only domestic data for trending. But some regulatory bodies also look to international data especially of those reactor types that are operated in their own country. A systematic approach to a general trending of international data is not done by any authority.

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4. INTERNATIONAL TRENDING UTILISING THE IRS DATABASE

The use of the IRS database for trending is limited by the nature of the reporting /7/. There has never been a request to report specific events to IRS. The criteria for reporting could be considered to have too broad a range when deciding whether to report an event to the IRS or not. The database itself provides therefore no sufficient homogeneous basis for statistical analyses.

Taking these facts into account, international trending using the IRS and national trending differ significantly. Component or system failure rates as well as trends used for risk based decision making cannot be derived from the IRS.

On the other hand, IRS comprises more than 3000 event reports from the vast majority of all NPPs in the world. Besides the analysis of the reports for technical details, some very general trending should be possible. For the purpose of this report, two different trending methodologies were used:

- One for events of high safety significance
- A relative trending using specific codes of the IRS

The use of the first method is restricted to events that - with a high reliability - have been reported to IRS. For example, it can be expected that all important (like mid-size or 2A-LOCA) loss of coolant accidents have been reported to IRS. For this class, a frequency of occurrence could be derived from the IRS data. On the other hand, SCRAMs are not always reported to IRS. Thus, a SCRAM rate cannot be derived from the data.

The second method compares the reporting rate of certain event types for different years /3/. This method allows the trending of relative event occurrences in IRS. These trends may be an indication of increasing or decreasing frequencies in the respective types of events or a change of expert's interest in these types. Both can be used as a starting point for more in-depth evaluations.

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4.1 IRS BASED TRENDING OF EVENTS WITH HIGH SAFETY SIGNIFICANCE

The reporting to the IRS database is voluntary. Thus the safety significance of the reported events has an important variation. Nevertheless, it can be expected that beyond a certain level of safety significance all events have been reported. This level of significance is not defined.

The occurrence of a design basis accident would trigger an IRS report even if the event would be controlled in line with the emergency operating procedures. It is sure that such an event would initiate intensive regulatory responses and attracts the interest of foreign authorities. Thus an IRS report on such an event is to be expected.

These assumptions are the basis for the following two database searches for the reporting of design basis events in the IRS:

- Important LOCA
- Important steam generator tube leakage or rupture

Both searches were done with a guide word search. The LOCA events were identified with the following guide words:

- 1.2.2 Degradation of the primary coolant pressure boundary, main steam or feedwater line or other high energy systems AND
- 3.A Primary systems AND
- 4.2.6 Tubes, pipes, ducts AND
- 5.1.1.6 Leak OR 5.1.1.7 Break, rupture, crack, weld failure AND
- 6.4 Activation of engineered safety features AND
- 7.2 Degraded reactor coolant boundary

From the search result, three events were identified that described a Loss of Coolant Accident. Further events selected represented steam generator tube leakages that are discussed below. From the memory of the author, at least one event was missing. A name search identified this event that was not coded as such. Thus, in total four LOCA events were selected in this category.

The second search should identify real steam generator tube ruptures or important leakages. But minor leakages and cracks or crack indications should not be selected. These events are quite numerous, in some cases reported in generic reports, so that a complete list of events cannot be expected in the IRS

database. The distinction between an “important” leakage and a ”minor” had to be done by evaluating the reports. The decision was based on the leak propagation (only fast developing leaks were taken into account) and the leak rate (more than about 50gpm). The search string criteria that were used include the following:

- 1.2.2 Degradation of the primary coolant pressure boundary, main steam or feedwater line or other high energy systems AND
- 3.AH Steam generator, boiler steam drum AND
- 4.2.6 Tubes, pipes, ducts AND
- 5.1.1.7 Break, rupture, crack, weld failure AND
- 7.2 Degraded reactor coolant boundary

After the manual selection according to the criteria, described above, six events were identified that represent a steam generator tube rupture or an important tube leakage.

Figure 1 shows the trends of these two searches. The linear trend lines show no mathematically sound trending, although the trend for steam generator tube ruptures is a little bit declining. The LOCA line shows two events occurred in 1992 and 1994 respectively, whereas the STGR line indicates one incident of this nature in each year of 1982, 1987, 1989, 1993, 1994 and 2000.

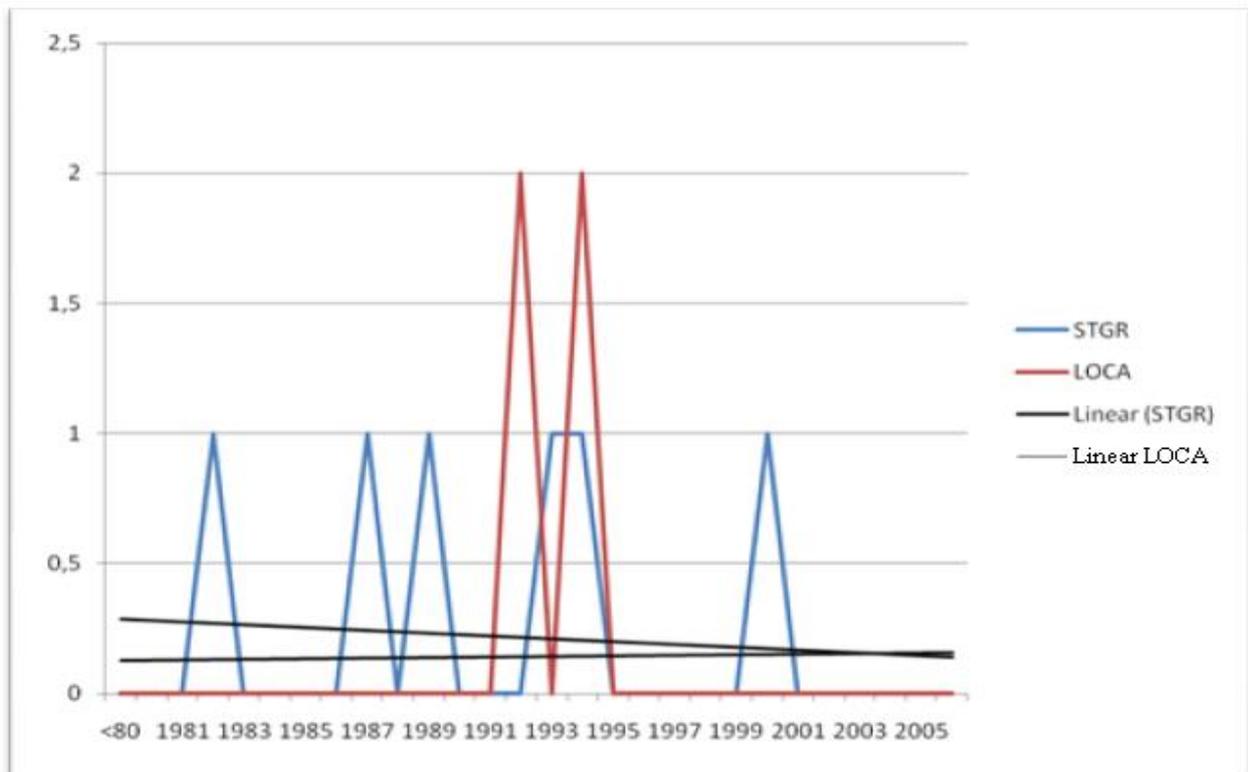


Fig. 1: LOCA and STGR events and their linear trends

4.2 RELATIVE TRENDING USING SPECIFIC CODES OF THE IRS

As discussed above, simple searches for frequent events in the IRS database cannot result in mathematically correct trending. Nevertheless, it may be useful information to know which event types have been reported over some years. These may indicate whether a problem has been solved or still causes events.

The following methodology was used for the trending. ‘Guide Words’ from the section “Characteristics of the event/issue” were chosen to capture the families of events. The resulting lists of events were manually analysed to remove double entries (e.g. preliminary and follow-up reports of the same event) and assess generic reports as far as possible. A further list was established with the number of all events that occurred in each year since 1980. Double entries were also deleted. There were no events considered after 2006, because there may be still events reported from 2007 to the present. The last years would then be systematically underestimated.

The relation between the reporting number related to one Guide Word and the total reporting number of events depending on the year is called in this report “relative reporting rate”. Trending analyses were performed only on the basis of these relative reporting rates.

The Guide Words that were chosen to perform the analyses are as follows:

- Degraded fuel (called “Fuel” in the figures)
- Degraded reactor containment (called “Containment” in the figures)
- Loss of safety function (called “Function” in the figures)
- Failure or significant degradation of the reactivity control (called “Reactivity” in the figures)
- Failure or significant degradation of plant control (called “Control” in the figures)
- Failure or significant degradation of heat removal capability (called “Heat” in the figures)
- Loss of off-site power (called “LOOP” in the figures)
- Loss of on-site power (called “LOIP” in the figures)
- Discovery of major condition not previously considered or analysed (called “Condition” in the figures)

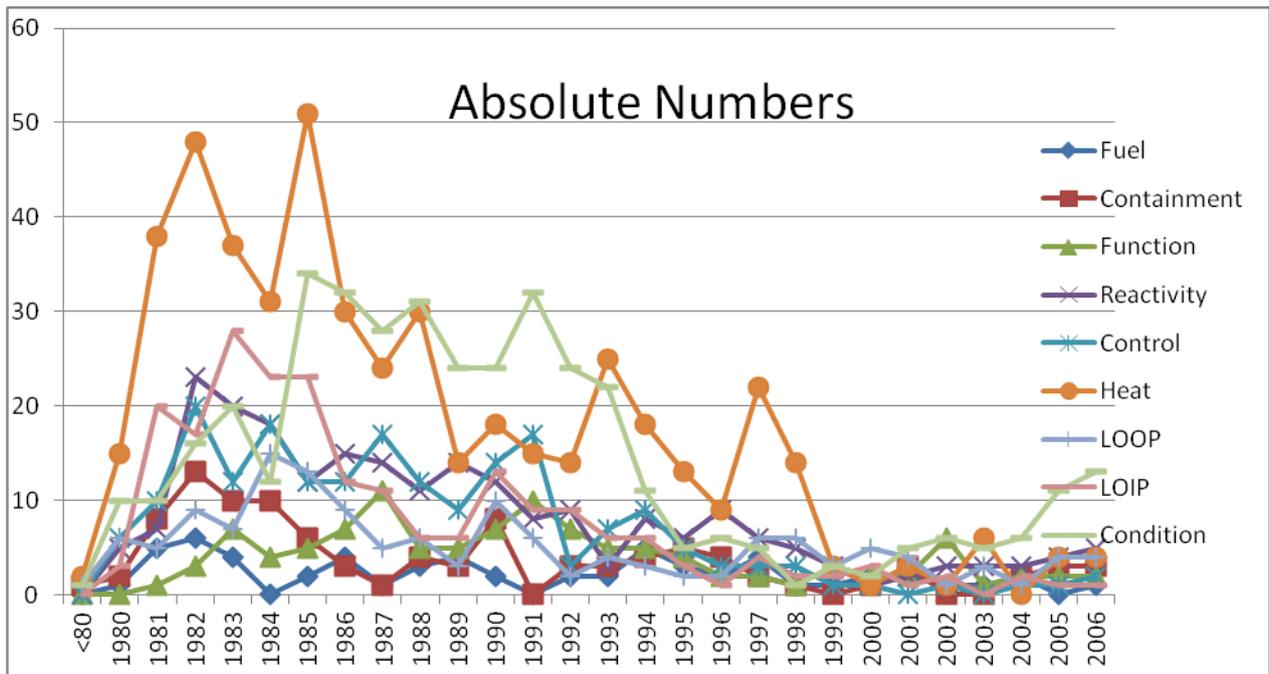


Fig. 2: Absolute number of events distinguished by the selected Guide Words

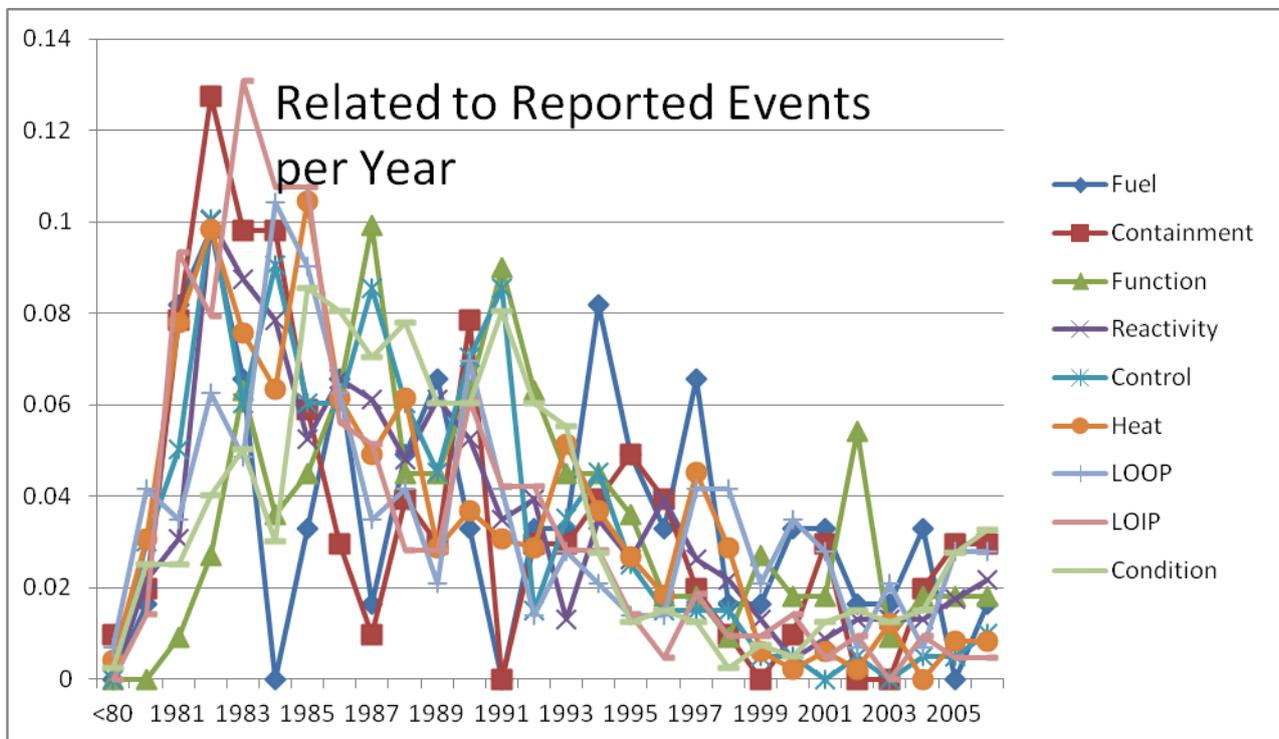


Fig. 3: Relative number of events distinguished by the selected Guide Words

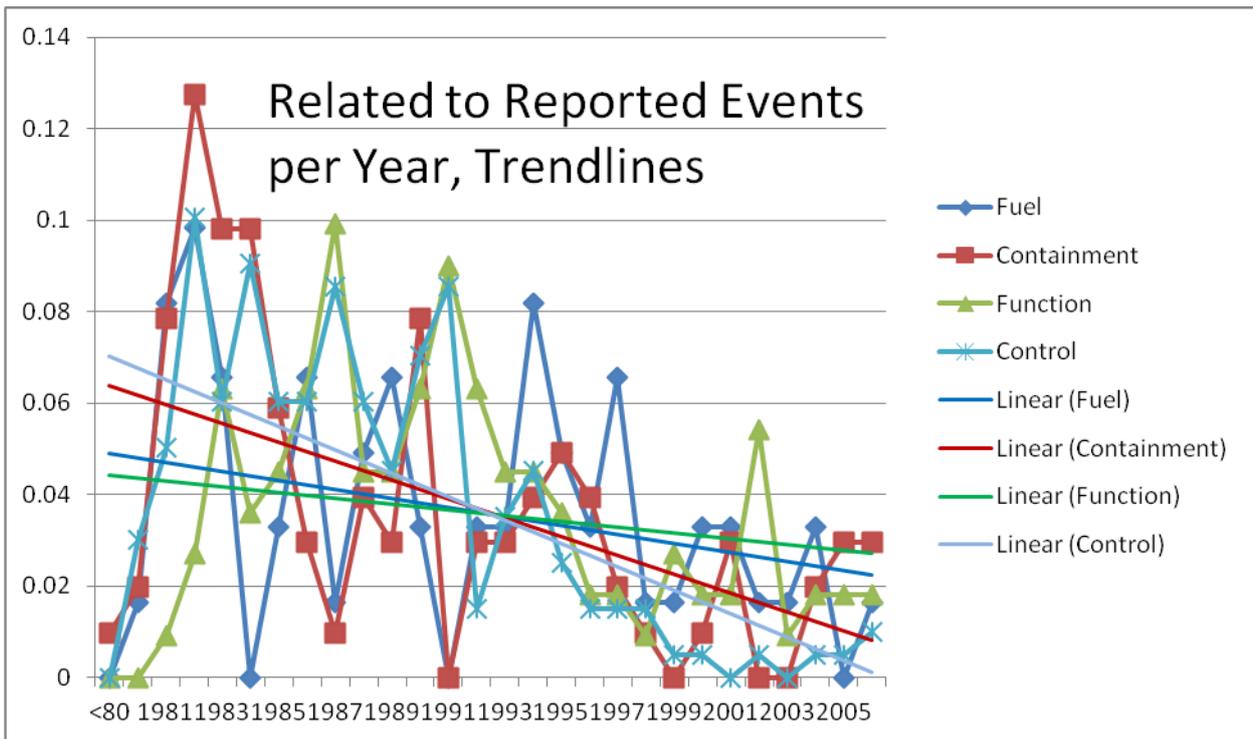


Fig 4: Relative trending for selected Guide Words (1)

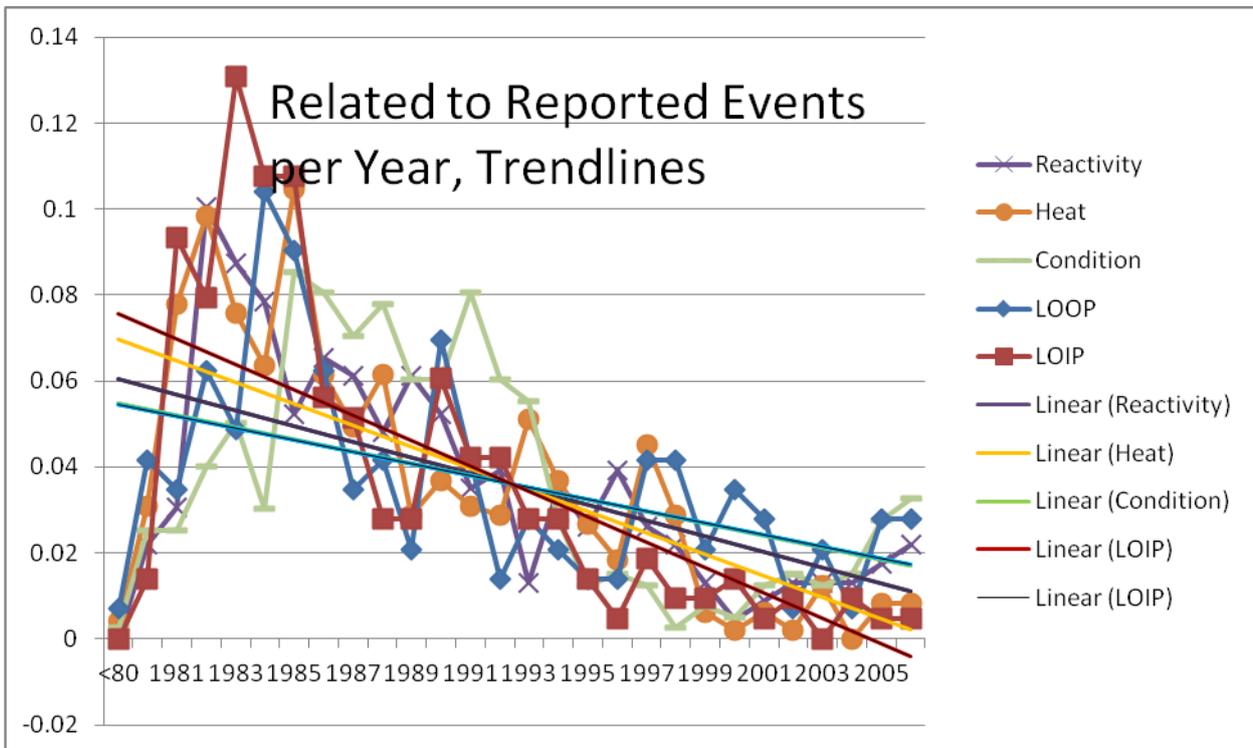


Fig 5: Relative trending for selected Guide Words (2)

Figures 2 to 5 show the results of the searches and the related trending for the Guide Words in the last 25 years. All trend lines are declining that would indicate a negative trend for all selected items. But, the further analysis reveals that the trending is massively impacted by the high number of IRS reports in the early 1980s.

Therefore, a second try was performed with respect to the last 10 years only (1997 – 2006). In these years the absolute reporting rate was quite uniform, i.e. about 100 events per year. Thus, a better comparability of the results is ensured.

The following figures (6-7) show the results of the relative trending of the last 10 years. The results reveal that for some Guide Words a positive linear trend line has developed. There are hints for an increasing trend for following Guide Words:

- Degraded reactor containment (called “Containment” in the figures)
- Loss of safety function (called “Function” in the figures)
- Discovery of major condition not previously considered or analysed (called “Condition” in the figures)

A mathematical statistical test, developed by GRS /8/, reveals that only the last issue has a real increasing trend. Interestingly, taking into account the last seven years only the events reported according to the Guide Word “Failure or significant degradation of the reactivity control” (called “Reactivity” in the figures) also show a statistically correct increasing trend.

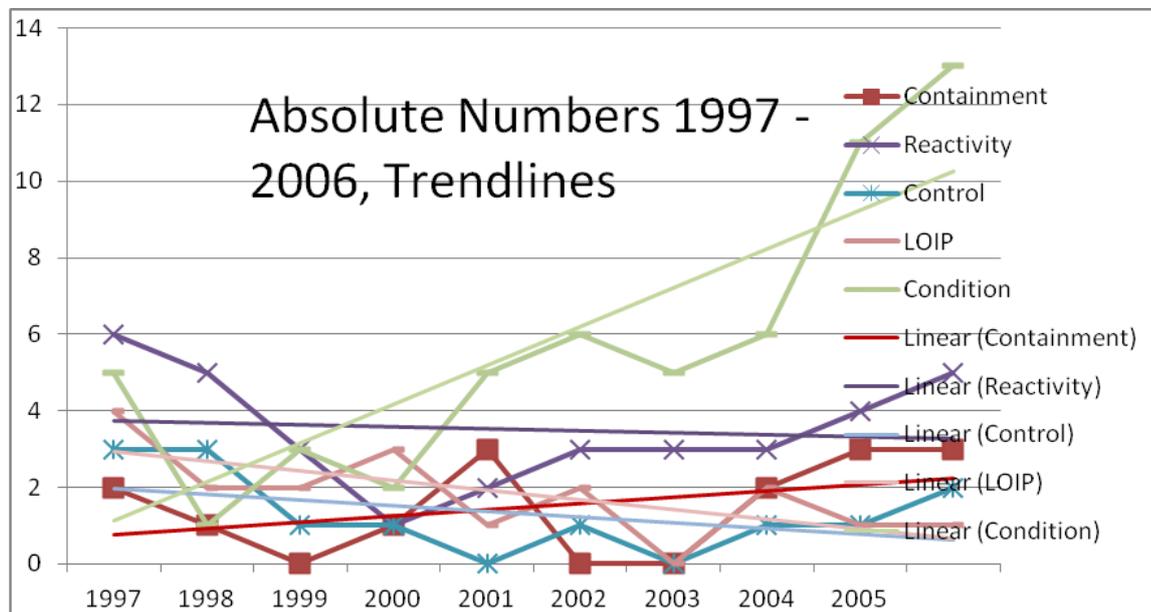


Fig 6: Relative trending for selected Guide Words for the last 10 years (1)

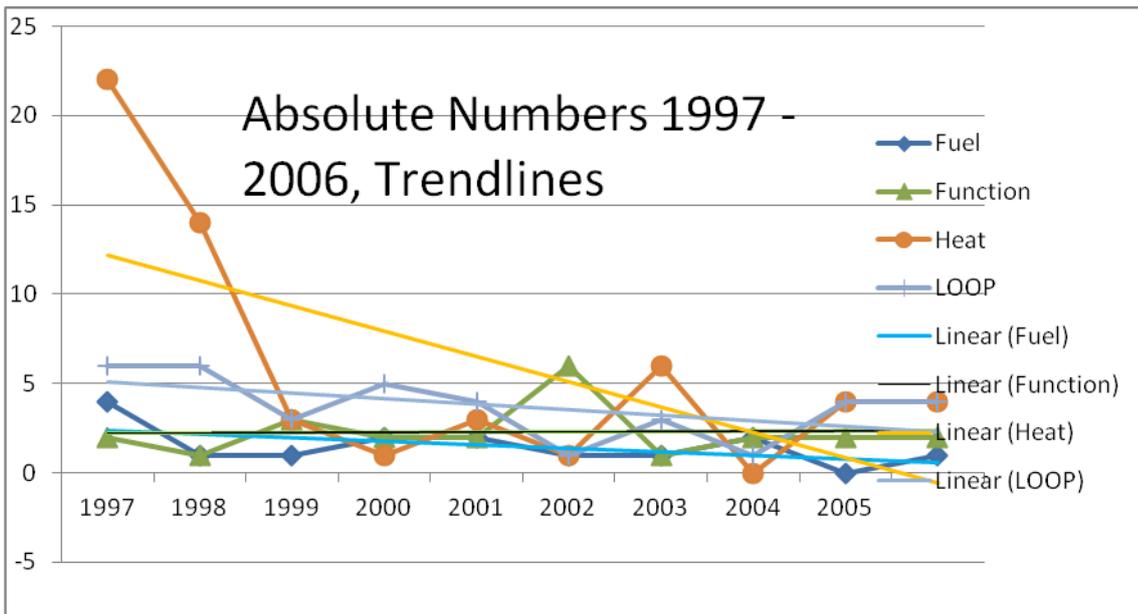


Fig 7: Relative trending for selected Guide Words for the last 10 years (2)

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5. CONCLUSIONS

The purpose of this task group report was to show existing national trending tasks and to assess the possibilities of trending internationally reported events retrieved from the IRS database. The opportunities and the limitations of international trending are compared to the national trending programmes. There are significant differences between the national and international trending efforts. Even though the national trending programmes show a great variety, international trending cannot meet the minimal level of the national programme.

Positive and negative trends trigger adequate regulatory actions. Positive trends show the development in the safety performance of the NPPs. Negative trends start regulatory actions with the goal to stop them.

In the international framework, the benefits of trending are much more limited. Useful trending can only be performed with safety significant events as design basis accidents. Taking into account that the recent operating experience reveals increased safety performance of the plants over the years (see fig. 8 overleaf).

Fig. 8: Worldwide nuclear operating experience /9/ with additive information by the author;

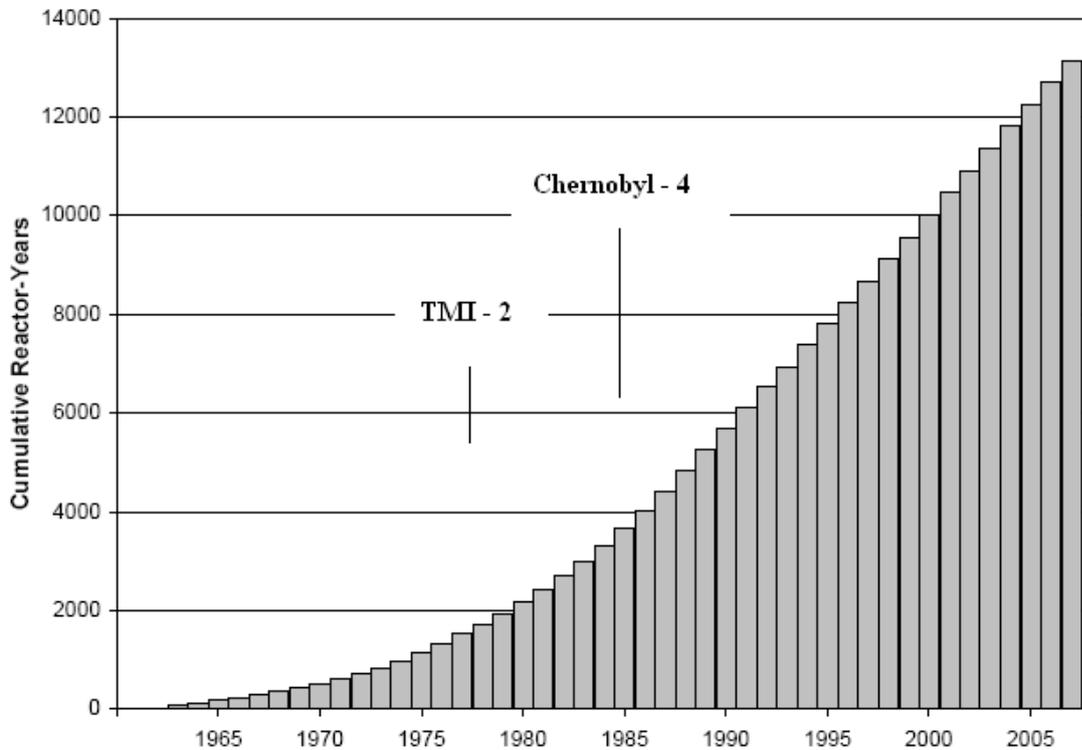


Figure 8 – Nuclear Power Reactors Operating Experience

After the Chernobyl accident, the cumulative reactor years have significantly increased them (up to 1986 about 4000 reactor years, after 1986 more than 9000 years). Such a long period without a core melt accident has not been experienced since the beginning of the nuclear era.

Nevertheless, the evaluation of the IRS database reveals that the two design basis accidents (LOCA and SGTR) taken as examples do not show clearly negative trends.

Trending provides a helpful tool in the framework of the regulatory national supervisory programmes. Negative trends may trigger regulatory actions systematically or on a case-by-case basis. On the international level, meaningful trending can only be performed on safety significant events that are to be expected to be reported completely in the IRS database. Positive international trends can underline the excellent overall operating experience worldwide. Negative international trends, including the relative trending performed in this task, should be taken as a starting point for further investigation by dedicated international working groups.

6. REFERENCES

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APPENDIX: MEMBER STATES RESPONSES TO THE QUESTIONNAIRE

A-1 Canada

Question 1: What is the philosophy of operating experience for your regulatory body (RB) framework?

The Canadian Nuclear Safety Commission (CNSC) requires all Canadian nuclear power plant (NPP) Licensees to operate operating experience (OPEX) programs. These programs generally include both Canadian and International generated OPEX and are periodically inspected by CNSC staff.

The CNSC does not yet have a systematic OPEX program although CNSC staff routinely conducts OPEX-related activities on an ad hoc basis. For example, National and International event reports (such as, in the International Reporting System for Operating Experience (IRS)) are reviewed by CNSC staff to evaluate the applicability of the information provided in the report. Follow-up with the licensee organization occurs to ensure any relevant information is capture in the OPEX program operated by the licensees.

The CNSC does operate two OPEX Databases; one is called the Central Event Reporting and Tracking System (CERTS) and the other one is called System of Performance Indices (SPIES).

CERTS is an electronic repository of all Canadian NPP events reported to the CNSC in accordance with Regulatory Document S-99. Each Canadian NPP event report is input into CERTS and coded according to the Characteristics of the event. The coding used is based on the codes used for the IAEA/NEA IRS with minor adaptations to fit the Canadian context and allow for trend analysis; in all there are approximately 300 codes available to characterize the event reports. CERTS also includes comment fields where CNSC staff can record observations or additional information about the event. The CNSC currently receives approximately 400 licensee event reports per year. All CNSC staff can access and search the CERTS data.

SPIES is an electronic repository of the Safety Performance Indicators which are reported to the CNSC in accordance with Regulatory Document S-99. The Safety Performance Indicators were developed by the CNSC in the mid-1990's and have been tabulated by the NPP licensee's and submitted to the CNSC on a quarterly basis since then. In all there are presently 15 Safety Performance Indicators with an additional 5 under development to cover the maintenance area.

All Safety Performance Indicators can be trended over time and they have been designed to allow comparison between stations. The Safety Performance Indicator Data is reported to the Public on an annual basis in the CNSC NPP Annual Report. All CNSC staff can access the SPIES data.

A complete listing of the event and performance indicator reporting criteria is provide in CNSC Regulatory Document S-99 available at:

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http://www.nuclearsafety.gc.ca/pubs_catalogue/uploads/S99en.pdf

It is important to note that a new version of Regulatory Document S-99 is expected to be approved later in 2010.

Additional information on the Canadian OPEX practices was provided to the CNRA in 2009. Please refer to the document entitled: "Current Status of the National Operating Experience Feedback Programs – NEA/CNRA/R(2009)".

Question 2: What information is trended by your RB (specific safety performance indicators, codings/event tags)?

The data contained in CERTS and in SPIES is trended on an Ad Hoc basis only. The CNSC does not presently have a systematic trending program in place.

Question #3: How is a trend determined by your RB (mathematical, observation, ad hoc, etc.)?

Trends are determined both mathematically and by observation depending on the data that is being trended. All CNSC trending activities are done on an Ad Hoc basis based on CNSC licensing and compliance activity needs.

Question #4: What part of your RB performs the trending?

Trending can be performed by any CNSC Division. The responsibility for maintaining and administering the CERTS and SPIES databases lies with the Compliance Monitoring Division of the Directorate of Power Reactor Regulation. The CNSC Information Technology Division is responsible to provide any IT Technical Support which may be required from time to time.

Question #5: How is international data incorporated into your national trending program?

International data is currently not incorporated into the CNSC trending activities.

Question #6: How does your RB use the trending information? Such as,

- *Reporting to other authorities, higher level government*
- *Interactions with operator/ licensee*
- *Input into inspection or other regulatory activities.*

The Safety Performance Indicator Data is reported to the Public on an annual basis in the CNSC NPP Annual Report. Some year-to-year trends are included in Section 3 of the report. A copy of the 2008 NPP Annual Report is available at:

http://www.nuclearsafety.gc.ca/pubs_catalogue/uploads/CNSC_Safety_Report_WEB_English_FINAL.pdf

Trending data is not usually reported to other authorities or government agencies.

Trending performed by CNSC Staff is usually done for a specific purpose to either confirm inspection findings and assessments or to determine whether the focus of future regulatory activities needs to be shifted or adjusted. Trending usually results from or impacts on interaction(s) with the licensee; for example, trend findings may trigger additional regulatory reviews, inspections, or investigations.

Question #7: Is your RB trending effort separate from the operator/ licensee?

Trending conducted by CNSC staff is done independently from any trending done by the licensees.

Question #8: Is the trending used to compare safety performance between plants.

The Safety Performance Indicators do allow comparison between NPPs; however they would only be one of the metrics used to compare safety performance. Trending of the Safety Performance Indicators can thus be useful in comparing safety performance between plants.

Question #9: What have been the results of the trending program?

The CNSC does not presently have a systematic trending program in place. Trending performed by CNSC Staff is usually done on an Ad Hoc basis for a specific purpose to either confirm inspection findings and assessments or to determine whether the focus of future regulatory activities needs to be shifted or adjusted.

Past Ad Hoc trending has had some impact on regulatory activities and at times provided some support for a regulatory position.

A-2 Czech Republic

What is the philosophy of operating experience for your RB framework?

- SÚJB philosophy of OpEx for our office is sufficiently described in the NOEF report prepared recently by WGOE.

What information is trended by your RB? (specific safety performance indicators, codings/event tags)

- SÚJB uses set of performance indicators developed based on the IAEA TEC-DOC-1141. The following indicators related to the EOF are trended:
 - Number of events
 - Number of safety relevant events
 - Number of safety relevant events where human factor was a cause
 - Number of OLCs violations
 - Number of OLCs forced actions

- Number of OLCs entries
- Summary of time when OLC were entered
- Forced power reductions and outages
- Unplanned automatic scram
- No. of demands on RPS/ESF systems actuations
- No. of hours a safety system is unavailable and various detailed system specific indicators
- No. of times a safety system is unavailable and various detailed system specific indicators
- No of failures of selected safety systems on demand
- No. of failures of selected safety systems during tests
- Fuel status – FRI factor
- Number of leaking fuel rods

How is a trend determined by your RB? (mathematical, observation, as hoc, etc.)

- For each above cited indicator, a graphical form is used to evaluate trends.

What part of your RB performs the trending?

- Dedicated employee (one) in cooperation with two resident inspectors. Resident inspectors are collecting data, filling spreadsheets, specialist is preparing summary report. Each of these SÚJB employees devotes the activities related to trending between 5 and 10 % of his working time.

How is international data incorporated into your national trending program?

- International data are not currently incorporated in our national trending programme.

How does your RB use the trending the information? Such as,

- Reporting to other authorities, higher level government
 - Yes – annually publicly available summary report is issued
- Interactions with operator/ licensee
 - Yes – trends are annually discussed with the licensee
- Input into inspection or other regulatory activities
 - Yes – if a negative trend is indicated, a higher attention is paid to the affected system, activity, etc... in the SÚJB supervision (review and inspection) activities.

Is your RB trending effort separate from the operator/ licensee?

- Our trending is separate; however, indicators used are nearly the same.

Is the trending used to compare safety performance between plants?

- Yes, it is

What have been the results of the trending program?

- It should be specified more precisely what results are questioned. One example – when trending the following indicators

- No. of hours a safety system is unavailable and various detailed system specific indicators
 - No. of times a safety system is unavailable and various detailed system specific indicators, it became evident that unavailability of some safety systems at Temelín NPP (NPP commissioned in 2004) is much higher than at Dukovany NPP (NPP commissioned in 1985). This fact was acceptable during NPP Temelín commissioning phase, but situation at Temelín NPP did not improve after several years of operation. Actions focused on achievement of higher availability were and still are being taken at both regulator and operator side.
- To answer this question in a reasonable way, each indicator should be evaluated separately. This activity is performed continuously/periodically and results are published annually in the above mentioned summary reports.

A-3 Finland

What is the philosophy of operating experience for your regulatory body's (RB) framework?

In the Finnish legislation are given the general requirements for utilisation of OE and for safety enhancement. Nuclear Energy Act (990/1987, amendment 7 a §, 23.5.2008/342) on Leading Principles for Nuclear Safety requires that: for further safety enhancement, actions shall be taken which can be regarded as justified considering operating experience and the results of safety research as well as the advancement of science and technology. According to the Nuclear Energy Decree (733/2008) operating experience from nuclear power plants shall be gathered and results of safety research shall be followed and these both shall be systematically assessed for further safety enhancement. Operating events both at the Finnish plants and abroad which have, or may have, specific safety-significance shall be analysed to resolve root causes and to determine appropriate corrective actions which shall be implemented for the removal of root cause to prevent occurrence or recurrence of an event and for the continuous improvement of safety.

STUK's regulation, called YVL Guides, provide guidance for operators for their processes for OEF and for implementing improvements at their plants. At the moment the separate guides addressing OEF arrangements and reporting on NPP events to STUK are going to be consolidated as one STUK-YVL Guide in accordance of on-going renewal project of STUK's regulatory guidance.

On present strategy period (2007-2011) international operating experience feedback has been taken as a special focus area at STUK: "International cooperation for learning lessons from experiences in nuclear power plant operation must be improved so that risks identified anywhere can be controlled efficiently everywhere. STUK actively participates in the development of a network and interaction between different countries and ensures on its own part that essential information is transmitted between nuclear power plants in Finland and other countries."

What information is trended by your RB? (specific safety performance indicators, codings/event tags.)

Collection of information on OE is the responsibility of the licensee and they must have processes and systems to systematically follow and analyse OE of their own and from foreign NPPs. Essential case-specific data about operational events are required to be recorded in such a way that, on the basis of the recorded data, summaries can be made to identify weaknesses and trends. Apart from the significance of a single event, licensees' attention is also paid to the event's rate and likeliness of recurrence (trending) - also low-level events and near misses. This analysis is supported by a failure and event register drawn up on the basis of previous events.

STUK controls the licence-holder's operational experience feedback arrangements as part of its inspection activities. This control includes a review of reports submitted instructions to STUK and on-site control that the instructions are complied with.

STUK does not perform coding or trending of operational events and their contributing or root causes but number of event reports in different categories: special reports, disturbance reports, and incident reports are followed by STUK's plant performance indicator system. STUK divides the direct causes of events roughly into technical failures and erroneous operational and maintenance actions (non-technical, human errors) which are also followed as indicators. Risk significance of operational events is followed by PSA based indicators as well.

The STUK indicator system consists of two main groups: 1) safety performance indicators for nuclear power plants and 2) indicators describing the efficiency of own activities. The indicator system divides nuclear safety into three sectors based on the concept of "Defence in Depth". The areas (layers) under consideration are 1) safety and quality culture, 2) operational events, and 3) structural integrity. These three sectors are divided into a total of 14 sub-areas to be interpreted. The first sector illustrates the condition of the plant and performance of different functional groups of the plant; as maintenance, operation, radiation protection, quality management, and attitudes to safety as well. Indicators in the second sector describe specially operation and the performance of operation unit through events, their risk-significance and direct causes of events. In the third safety performance indicator area, the integrity and leak tightness of multiple barriers (fuel, primary circuit, secondary circuit, containment) are monitored containing over 50 specific indicators.

Definitions and results of STUK's safety performance indicators are available in appendix 1 of STUK's annual report on "Regulatory control of nuclear safety in Finland", which is available on website: http://www.stuk.fi/julkaisut_maaraykset/tiivistelmat/b_sarja/en_GB.

How is a trend determined by your RB? (mathematical, observation, ad hoc, etc.)

STUK has not defined specific action or threshold limits for its SPIs. Rather, the aim is to recognise trends in the safety-significant functions of a nuclear power plant or of STUK as early as possible. The limit values set in the legislation, in STUK's regulation (YVL guides) and in the Technical Specifications (Tech Specs) of the plants, as well as the target values contained in the objectives of the department of Nuclear Reactor Regulation (NRR) of STUK, are applied where available. Trending of indicators is based on responsible persons' assessments. Safety performance indicators of STUK has been maintained since the mid of 90's; thus the conception on abnormal or normal results/level of each specific indicator have been formed. Variations from normal values are asessed and followed. STUK has written procedures to control this process in its process based Quality Manual "Calculation and use of safety performance indicators in STUK".

Regarding most of the indicators data is collected and indicators updated quarterly. Deviations and their reasons are tracked down immediately. The development trends of indicators and indicator areas are assessed in the beginning of following year in conjunction of other assessments and inspection observations to provide to an annual overall assessment of NPPs' safety.

Indicator information has been managed in STUK's INDI (INDicator DI스플레이) information system since 2006. INDI programme has characteristics applicable for trending. In addition, different kind of statistical trend analysis for each indicator was surveyed in a licentiate research, and found as well, but not applied yet and trending is based on expert's opinion.

What part of your RB performs the trending?

The nuclear power plant safety indicator system is maintained and coordinated by the office of operation and safety management (OKA) of Nuclear Reactor Regulation (NRR) department of STUK. The NRR has assigned persons that are responsible for the acquisition of the indicator data, their calculation, analyses and trending as follows:

- Resident inspectors of the office of operation and safety management (OKA) are responsible for indicators concerning failures and preventive maintenance of Tech Spec components and safety systems availability. The data on primary circuit leakages for the Olkiluoto nuclear power plant is also provided by the resident inspector.
- OKA is responsible for production losses due to failures and for the follow-up of documentation updating and investments indicators. The inspectors of OKA gathered and assessed indicators describing the quality of the maintenance activities at the Olkiluoto plant. OKA maintains an operational events follow-up table and is responsible for indicators based on operational events and reports.
- The office of risk assessment (RIS) assesses the risk-significance of the events.
- One inspector in the office of civil construction (VLT) is responsible for indicators describing the functioning of the fire alarm system.
- Two inspectors in the office of reactor and safety systems (REA) gather and calculate indicators describing the integrity of fuel and the primary circuit as well as containment leaktightness.
- The office of radiation protection (SÄT) gathers dose and release data and the corresponding indicators.

How is international data incorporated into your national trending program?

According to the Nuclear Energy Decree (733/2008) operating experience from the Finnish plants and abroad shall be analysed to resolve root causes and to determine appropriate corrective actions.

It is required that the licensees have established their OEF processes for analyzing events at their own plants as well as events reported from other plants. Finnish licensees have systematic procedures and guidance for management of any kind of observations and events of their own plants and abroad. Licensees' procedures for OEF Procedures and systems meet the best international practices described in IAEA Safety Standard NS-G-2.11 (2006) "A system for the feedback of experience from events in nuclear installations"

Both licensees have an OEF group having around 12 experts representing different areas of nuclear technology and meeting regularly and taking care of collection, screening, analysis of OE and entry into processing. Plants' OEF groups specially analyse and coordinate the utilisation of selected external OE and prepare an annual summary report on utilisation of OEF to STUK and the plant management. Plant personnel is informed on external events which are selected for further assessment in the plant's intranet. Feedback of actions decided on the bases of foreign events are used for personnel general training and simulator training as well as to PSA-studies

STUK oversees the functioning and results of licensees' OEF processes through its regulatory oversight processes of nuclear safety and as part of its periodic inspection program for operating NPP's. In that programme there is an inspection focused on utilisation of OEF from other plants and conducted once a year.

STUK has its own independent OEF processes for screening, review and assessment of operating experience information reported by Finnish NPPs or received through international channels. These processes are documented in STUK's Quality Manual. STUK has a group of ten experts who review and assess IRS reports received by WBIRS. The process is managed by an experienced expert working full time on IOEF. Other experts of the department contribute to the work if in-depth assessment and regulatory measures to address similar concerns in Finland are needed.

STUK has its own access-based IRS database, where every IRS report received through IAEA WBIRS is recorded. IOEF group expert writes a short event description (in Finnish) into database sheet and makes the categorisation of the IRS report: 0. No further actions; 1. Applicability on information / Particular issues need clarification; 2. Lessons learned need to be taken into account in certain activities; 3. Actions required in Finland; or 4. Good practice in Finland in the case the safety issue has already been addressed with precautionary measures at Finnish NPP's. Summary of actions needed or already performed at Finnish NPPs is written (in Finnish and in English) for each report categorized to class 1 or higher. Feedback reports are sent to the EU Clearinghouse database, which utilises safety issues concerned for trending. STUK follows the number of reports categorised to different classes annually.

Among the foreign events that have initiated a process leading to plant modifications at Finnish NPP's are the following: Partial core meltdown (TMI 1979); ECC recirculation filter blockage (Barsebäck 1992) and Disturbance in electrical power system (Forsmark 2006). Most of the corrective measures at Finnish NPP's based on inputs through international reports have been small improvements in management and operating practices, improvements in procedures, inspections and testing of equipment, additional analysis, and staff training, including simulator training. In addition, foreign operating experience has prompted some plant modifications and improvements on systems, structures, and components.

How does your RB use the trending of information? Such as,

The annual assessment of SPIs is attached to the annual report on regulatory control of nuclear safety as Appendix 1.

Reporting to other authorities, higher level government,

The annual report on regulatory control of nuclear safety is required to be submitted to the Ministry of Employment and the Economy, which is the highest authority within nuclear in Finland. The report is also delivered to the Ministry of Environment, the Finnish Environment Institute, and the regional environmental authorities of the localities in which nuclear facility is located.

The report is publicly available on STUK's website.

Interactions with operator/ licensee,

The results of annual assessment are discussed between STUK's and Licensees' management before publishing them.

Input into inspection or other regulatory activities,

Indicator results are used for focusing and optimising NRR's resources and for focusing safety reviews and inspections of NRR's Periodic Inspection Programme. Declining trends, if showing a degrading trend during two consecutive years, indicate a possible need to enhance the operation and organisational performance of the plant in question and STUK's regulatory efforts in those areas. If a declining trend of one or more indicators is detected the causes are clarified and need for focusing NRR's oversight activities are evaluated. The NRR's regulating action depends on the trend that has been violated and the margin to safety (Legislation; YVL-guides; Tech Spec; Plants' target values; STUK's annual goals. etc.). Increased inspection examines the effectiveness of the licensee's actions to correct the deficiency and also if STUK's own performance has contributed to the degradation.

Is your RB trending effort separate from the operator/ licensee?

STUK's safety performance indicator system is totally separate from the Licensees' indicator systems. The SPI system does not utilise indicators of plants own; only some WANO indicators (unavailability of safety systems) are included into STUK's system.

The project to develop a set of indicators for nuclear safety supervision was established by the NRR department in 1995. Documents published by IAEA were used to get familiarised with the concept of indicator systems. Phases of development and implementation took for few years. After monitoring potential areas initial data collection, data analysis and test calculations some indicators were dropped out and some new included. In the early stage of development project it was clear that two groups of indicators, one group describing safety performance of nuclear facilities and the other de-scribing regulatory activities would be needed and were determined. In 2003, the nuclear safety indicators were first connected to STUK's strategy and reported as part of the regulatory control of nuclear safety. Safety Performance Indicator system and individual indicators need to be reviewed on some years interval to confirm that they deliver their objectives.

Is the trending used to compare safety performance between plants?

STUK's safety performance indicators for NPPs are not used to compare safety performance between the nuclear power plants in Finland or abroad.

What have been the results of the trending program?

STUK's internal investigation team was assigned in the beginning of 2000 due to the in-creased number of deviations from the Tech.Specs in 1999 as compared to the previous years both at Loviisa and Olkiluoto nuclear power plants. Also the number of human-based common cause failures, analysed at Olkiluoto NPP, showed increasing trend during 1998 and 1999.

The number of reportable events (disturbances, Tech.Spec. deviations) was noticed to be in-creasing at Olkiluoto NPP within a short period in the fall 2003. The number of events rated INES Level 1 was also exceptionally high. Discussions with the licensee management were started immediately.

Quarterly results are reviewed and assessed at NRR within normal oversight and inspection activities. Causes behind degrading values and trends are cleared up immediately.

A-4 Germany

1. *What is the philosophy of operating experience for your RB framework?*

The systematic evaluation of operating experience including the investigation of events has been established by the Federal German regulatory authority (now BMU) at least in 1975 after issuing the national reporting criteria for events. At this time the first big German NPPs had started their commercial operation. From the beginning GRS performed the technical work on behalf of the competent federal authority. GRS has set up the German national event database for NPPs. This database is run since 1990 by the Federal Office for Radiation Protection (Bundesamt fuer Strahlenschutz –BfS). GRS still performs the in-depth evaluation of the events and develops the German Information Notices.

Thus operating experience feedback was ever in the focus of the regulatory authorities.

2. *What information is trended by your RB? (specific safety performance indicators, codings/event tags)*

In the frame of the BMU financed project SR 2368 the GRS has put together a hierarchically structured, detailed keyword directory with respect to technical and safety relevant plant and event characteristics, by using this directory encoded more than 1.100 reportable events at nuclear power plants operated in the Federal Republic of Germany during a time period of nine years and developed a database for the statistical evaluation of events under the ORACLE information management system. For the time period from 1994 to 2000 with more than 800 events plant exceeding statistical evaluations have been performed, which enable statements concerning plant technical safety weaknesses or safety relevant trends and can support the determination respectively the quantification of the plant's safety level.

Since a few years specific safety performance indicators are regularly used in the German State Baden-Wuerttemberg by the State supervision authority.

3. *How is a trend determined by your RB? (mathematical, observation, as hoc, etc.)*

Besides the systematic evaluation of operating experience described in the answer above, trending is performed if the evaluation of OE shows related indications. GRS has developed a mathematical tool for the evaluation of trends which is also used in this report.

4. *What part of your RB performs the trending?*

On the federal level, GRS performs the trending on behalf of BMU.

5. *How is international data incorporated into your national trending program?*

Generally, trending is performed with domestic data. But, if the evaluation of international OE indicates significant trends, this may be used as an impetus to start a related national investigation.

6. *How does your RB use the trending the information? Such as,*
- a. Reporting to other authorities, higher level government*
 - b. Interactions with operator/ licensee*
 - c. Input into inspection or other regulatory activities*

In general, BMU distributes the reports on OE to the State regulatory authorities, the NPPs, the Operating Organizations, the TSOs, vendors, and research facilities. BMU may ask the Reactor Safety Commission (RSK) to discuss the topic.

The State supervisory authorities may discuss the results of such trending tasks with the NPP operators on a voluntary basis.

The authority of Baden-Wuerttemberg uses the results of their trending (see above) on the basis of the evaluation of safety performance indicators in their discussions with the licensees. There are no direct consequences for the licensees based on the results of the trending.

7. *Is your RB trending effort separate from the operator/ licensee?*

The trending efforts of the GRS on behalf of the BMU are fully separate from related efforts by the licensees.

8. *Is the trending used to compare safety performance between plants?*

The authority of Baden-Wuerttemberg uses the results of their trending (see above) on the basis of the evaluation of safety performance indicators to identify indications potentially negative trends including deficiencies in the safety culture. The main goal of the trending is to be informed on the safety performance of a specific NPP. The comparison of the safety of different NPPs is not in the focus of the authorities.

9. *What have been the results of the trending program?*

There are two main purposes of the German trending program. The first task is the systematical analysis of the operating experience in order to inform the regulatory body about the safety performance of the NPPs. The second task is the triggering of regulatory actions in case of negative trends. In Germany these reactions are case related. If the regular analysis of operating experience reveals the increase in frequency of specific component failures, an in-depth evaluation of the related events is performed. This may result in the issue of a German Information Notice with recommendation for corrective actions. There are examples that show how the issue of such a German Information Notice ends a negative trend.

A-5 Japan

1. *What is the philosophy of operating experience for your RB framework?*

In Japan, 54 plants are in commercial power operation. All of plants now in operation are PWR and BWR. As the regulatory bodies, NISA and JNES always follow the operating status of those plants and take actions required to keep plants in safe operation. Trending would be useful to recognize the negative issues at the early stage and to assure the operating experience feedback for improving plant safety.

2. *What information is trended by your RB? (specific safety performance indicators, codings/event tags)*

(1) Basically they are from the event (incidents and accidents) reports reportable by laws.

(2) The items trended are the failures of the major equipments and systems important to plant operation. Those items are also trended plant by plant. The results are released in the Section XIV of the report, "Operational Status of Nuclear Facilities in Japan". It could be accessed through website (<http://www.jnes.go.jp/english/database/index2.html>).

(3) We implemented the new inspection scheme based on the plant performance indicators and the significance determination process. Those indicators are also to be trended from this year.

(4) As one of the activities of the Safety Information Review Meeting (NISA & JNES), we are discussing to do trend analysis more widely including minor events not reportable by laws. The information to be trended is the reports of the deviation from the LCO, the violation of the safety operation rule (Technical Specification), and the utilities press releases.

3. *How is a trend determined by your RB? (mathematical, observation, as hoc, etc.)*

Currently, the trending is done by observation unless otherwise it requires special evaluation process.

4. *What part of your RB performs the trending?*

JNES performs the trending analysis and issues the results in the annual report, "Operational Status of Nuclear Facilities in Japan". (Refer to item 2.)

5. *How is international data incorporated into your national trending program?*

Usually, trending analysis is done only with the domestic information.

International data are somewhat topical. So, they are reviewed when it is necessary or could be important for the trending analyses of domestic events.

JAEA uses the US LERs for the trending analyses of topics such as loss of decay heat removal during mid-loop operation at PWRs, PWSCC and setpoint drift in safety or safety/relief valves in order to reflect the insights obtained from US operating experience into inspection and/or maintenance activities in Japan.

6. *How does your RB use the trending the information? Such as,*
- *Reporting to other authorities, higher level government*
 - *Interactions with operator/ licensee*
 - *Input into inspection or other regulatory activities*

As above, the result of the trending is published in the annual report, “Operational Status of Nuclear Facilities in Japan,” to the public. So, any person can access to the trending.

If any topical trending analysis is done for the safety significant issue, the results would be reported to the Nuclear Safety Commission.

Also, the trending results are utilized to determine the contents and details of inspections.

7. *Is your RB trending effort separate from the operator/ licensee?*

The analysis is done by JNES and JAEA independent from the utilities.

The utilities may do their own trending by their related organization such as Japan Nuclear Technology Institutes (JANTI).

8. *Is the trending used to compare safety performance between plants?*

The trending is done only to review the operational status of individual plants and not to compare between the plants.

9. *What have been the results of the trending program?*

When we had found some topical trending issues, such as SG tube failures, BWR core shroud issue, SCC issues and so on, we had analysed the individual problem and fed the results back to all of the similar plants.

A-6 Netherlands

What is the philosophy of operating experience for your regulatory body's (RB) framework?

In the Netherlands we have a regulatory body that consists of two entities, a policy making entity (VROM/DGM/RB) and a nuclear inspectorate (VROM/VI/KFD) dealing with all aspects of nuclear safety, security and safeguards plus radiation protection.

- What information is trended by your RB? (specific safety performance indicators, codings/event tags.)

The information collected in the annual report to parliament (since 1980) is trended. This information contains statistics about facilities and abnormal occurrences but no performance indicators. In the last years a qualitative assessment has been added where appropriate.

- How is a trend determined by your RB? (mathematical, observation, ad hoc, etc.)

The only NPP operating in the Netherlands (Borssele NPP) has a trending programme based on WANO performance indicators. KFD receives this information and therefore has good insight in the NPP performance.

- What part of your RB performs the trending?

VROM/VI, the mother organisation of the KFD interacts very actively with all other inspectorates in the Netherlands. KFD interacts with the labour inspectorate, the aviation inspectorate, the transport inspectorate, the fire inspectorate and the health inspectorate. In the Netherlands there is a political tendency to combine all central government inspectorates. The KFD has multidisciplinary agreements with several foreign regulatory bodies, inspectorates and TSOs.

- How is international data incorporated into your national trending program?

International data from sources like IAEA, OECD, GRS, US NRC and recently EU is actively used to guide Borssele and the KFD inspection policy.

- How does your RB use the trending of information? Such as,

- *Reporting to other authorities, higher level government,*
- *Interactions with operator/ licensee,*
- *Input into inspection or other regulatory activities.*

- Is your RB trending effort separate from the operator/ licensee?

Both KFD and Borssele NPP have a multidisciplinary standing task force for operational event analysis. These groups work independent.

- *Is the trending used to compare safety performance between plants?*

Comparisons between plants in the Netherlands are not possible, since at present we only have one operating NPP.

- *What have been the results of the trending program?*

The results of our trending activities have been early interventions on several levels of the operating organisation of the NPP.

A-7 Slovenia

What is the philosophy of operating experience for your regulatory body's (RB) framework?

- Operating experiences play an important role as the first information about the operating conditions in the only Slovenian NPP. They are used to focus the RB's (and especially inspection's) attention to areas important for continued safe operation of the NPP. Many interesting insights arise also from foreign operating experiences (of interest have been, for instance, recent experiences on: temporary test configuration to prevent safety injection system recirculation mode, explosion endangerment due to use of hydrogen, false safety injection signal and reactor trip due to diode malfunction).

What information is trended by your RB? (specific safety performance indicators, codings/event tags.)

- Daily status includes short and to the point information about:
 - RCS leakage
 - RCS activity
 - list of non-operable components and relevant LCOs
 - corrective urgent work orders
 - planning activities (surveillance tests, on-line maintenance...)

The short daily status on day to day NPP operation is provided by the plant to the SNSA non-resident inspectors each day. The status is not trended.

- Specific safety indicators – monthly processing frequency:
 - PSA evaluation of planned and unplanned on-line maintenance
 - Number of corrective work orders and of repeatable corrective work orders
- Specific safety indicators – quarterly processing frequency:
 - Safety system demands

- Safety system failures
- LCO entries
- Number of plant events and reportable events
- Safety system function failures discovered by surveillance and maintenance
- Mitigation system performance index
- Specific safety indicators – annual processing frequency:
 - Unplanned power changes
 - Violations of Technical Specifications and Licensing requirements
 - Events due to human factor and due to procedure deficiencies
 - Number of performed analysis of foreign operating experiences and events
 - Temporary modifications
 - Damaged fuel elements
 - Containment and isolation valve leakage (performed only during outage)

How is a trend determined by your RB? (mathematical, observation, ad hoc, etc.)

- Each performance indicator has its graphical presentation. Some indicators are also supported with tabulated list of background information which enables easier evaluation. The SNSA activities are focused on performance indicators which exceed warning or alarm limits. The SNSA limits are for most of indicators above plant's limits. That approach gives time to the plant to improve the indicator value before SNSA intense activities came into force.

What part of your RB performs the trending?

- One dedicated employee in nuclear safety department is in charge of collection and presentation of data. If performance indicator exceeds warning or alarm limit, the employee who is in charge for problematic indicators performs detailed analysis. The indicators are via intranet available to SNSA employees to be used as needed.

How is international data incorporated into your national trending program?

- Foreign operating experiences (including already observed trends) are systematically screened, applicable information are reviewed. Selected information or questionnaires are sent to the plant for response. Conclusions are drawn and if necessary, actions taken. There is presently no formal way established to use international data in the trending program.

How does your RB use the trending of information? Such as,

- *Reporting to other authorities, higher level government,*
- Operating experiences (where trends are also presented) are included in the Annual report on the Radiation and Nuclear safety in the Republic of Slovenia and submitted to the Parliament for approval.
- *Interactions with operator/ licensee,*
- Operating experiences including unusual/unsafe trends are discussed within thematic inspections.
- *Input into inspection or other regulatory activities.*
- Yes, as described in above answers.

Is your RB trending effort separate from the operator/ licensee?

- Analyses are performed separately from the operator, although the performance indicators definitions are sometimes identical to the plants' definitions.

Is the trending used to compare safety performance between plants?

- No. Slovenia has only one NPP, while the trending is not compared to the foreign NPPs.

What have been the results of the trending program?

- It helped focus our attention to areas where safety related improvements in NPP operation are possible and desirable. For example, presently, due to a performance indicator's results ("red" finding), attention of the SNSA is focused on fuel elements as some were found damaged for the last four cycles.

A-8 Spain

Spanish Contribution to the 7^o meeting of the WGOE (13-15 April 2010)

TRENDING ANALYSIS

- *What is the philosophy of operating experience for your regulatory body's (RB) framework?*

To guarantee the safety performance of NPP and to avoid the recurrence of the incidents.

- *What information is trended by your RB? (Specific safety performance indicators, codings/event tags.)*

CSN uses for trending the Classical performance indicators, inspired in the old NRC indicator program previous to ROP and Indicators used by CSN's Integrated Method of Supervising NPP behavior

- Classical performance indicators
 1. Automatic scrams while reactor critical
 2. Safety system actuations
 3. Significant events
 4. Safety system failures
 5. Forced outage rate
 6. Forced outage rate for 1000 critical hours of critical commercial operation
 7. Radiation exposure to workers
 8. Cause codes for the incidents
- Administrative Control Problems:
 - Management and supervisory deficiencies including operations, maintenance, licensing, design, health physics, etc.
- Errors of Licensed Operator:
 - Errors of omission or commission during plant activities.
- Errors of Other personnel:
 - Non-licensed personnel errors involved in plant activities
- Maintenance Problems
- Problems in design/construction, installation, fabrication
- Miscellaneous:
 - Spurious or unique failures of electronic piece-parts and failures due to meteorological conditions, etc.
- Performance indicators used by the CSN's Integrated Method of Supervising NPP behavior (very similar to the ROP)
 - Initiating Event Cornerstone
 - Unplanned Scrams per 7000 Critical Hours
 - Unplanned Scrams with Loss of Normal Heat Removal
 - Unplanned Power Changes per 7000 Critical Hours
 - Mitigating Systems Cornerstone
 - Mitigating System Performance Index
 - Safety System Functional Failures

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- Barrier Integrity Cornerstone
 - Reactor Coolant System Specific Activity
 - Reactor Coolant System Leakage
- Emergency Preparedness Cornerstone
 - Response to Drills and Emergency Situations
 - Emergency Response Organization
 - Installations, equipments and resources used in emergency situations
- Occupational Radiation Safety Cornerstone
 - Occupational Exposure Control Effectiveness
- Public radiation Safety Cornerstone
 - Radiological Effluent Control

- *How is a trend determined by your RB? (Mathematical, observation, ad hoc, etc.)*

Basically the sources of information for performance indicators are:

- Event Reports
- Operating Monthly Reports
- Non - analysed Condition Reports
- Licensee Communications
- Surveillance Tests
- Maintenance Rule
- Logs of unavailability

Most of the performance indicators values are obtained directly through the information contained in Event Reports. In other cases the use of other sources of information and mathematical equations are required in order to obtain the value of some indicators.

- *What part of your RB performs the trending?*

Technical University in Madrid is under contract to CSN in order to carry out the calculations for Classical Performance Indicators. Based on those calculations, the Area of Operating Experience and Training performs the trending.

NPPs send to CSN headquarters the data to calculate the values of the Performance Indicators associated to the CSN Integrated Method of Supervising NPP Behavior.

In a CSN provider there is a computer application where the data is charged by the plant. CSN supervises periodically the results and makes inspections to the process every other year.

- *How is international data incorporated into your national trending program?*

CSN doesn't incorporate international data into its national trending program

- *How does your RB use the trending of information? Such as,*
- *Reporting to other authorities, higher level government,*
 - *Interactions with operator/ licensee,*
 - *Input into inspection or other regulatory activities*

The results of the Classical Performance Indicators are evaluated annually by the CSN in order to obtain the average industry trend and the trend by plant.

The values of the Performance Indicators used in the Supervision of NPP are evaluated quarterly by the CSN in order to decide about supplementary Inspections.

Each year the CSN sends a report to the Parliament with the main activities which were carried out, including a summary with the results of the performance indicators program

- *Is your RB trending effort separate from the operator/ licensee?*

CSN and the licensees combine their efforts to manage the same set of performance indicators associated to the CSN' Integrated Method of Supervising NPP Behavior

- *Is the trending used to compare safety performance between plants?*

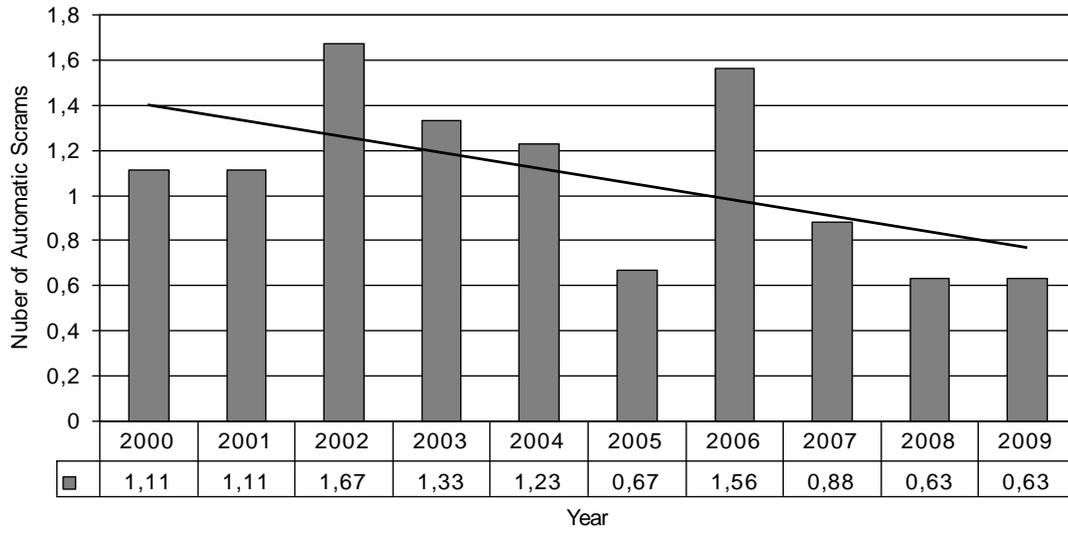
No. CSN' Integrated Method of Supervising NPP Behavior (SISC) is based on inspections as well as on indicators program. Both elements, and not only the results of the indicators program, are necessary to obtain a value about the safety performance of a plant.

- *What have been the results of the trending program?*

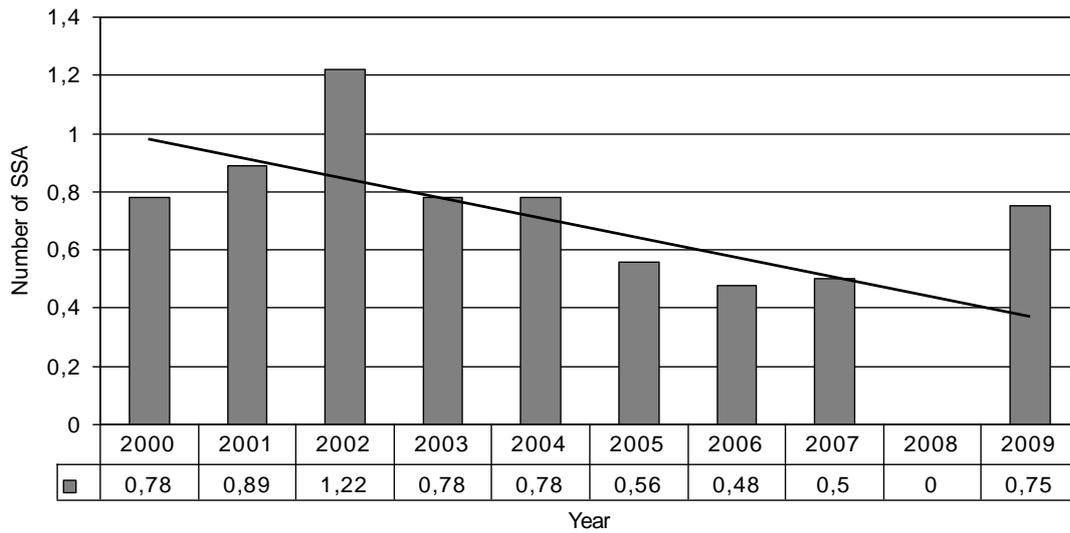
The following picture shows the average industry trend during the ten last years for the Classical Performance Indicators.

From the previous results it is worth considering the increase in the dose rates during the 2009 refuelling in Cofrentes NPP. CSN has requested additional actions from the plant to reduce doses with the aim of bringing Cofrentes NPP results closer to the outcome of NPP with the same technology and to try to fulfil the target of occupational exposures defined by INPO/WANO.

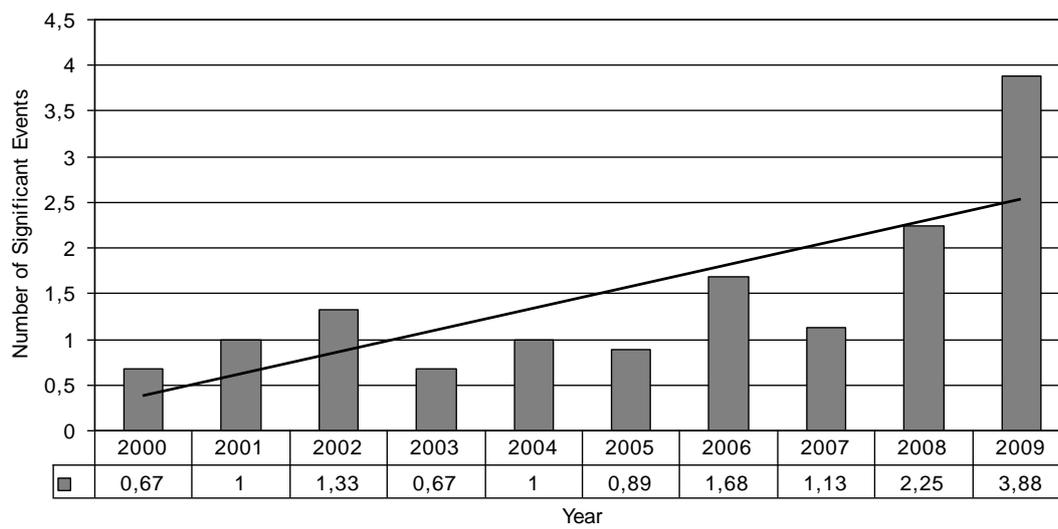
Average Automatic Scram while reactor critical



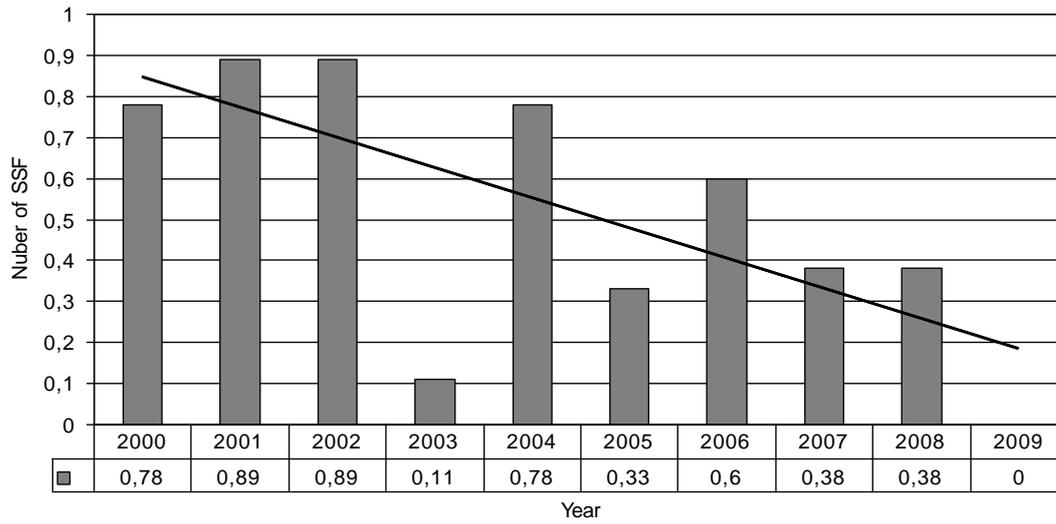
Average Safety System Actuations



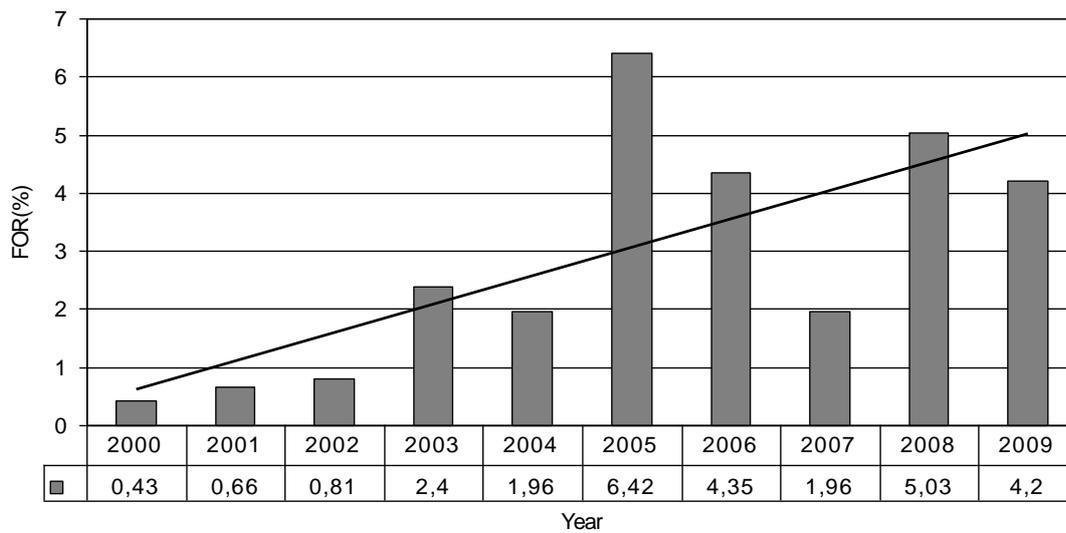
Average Significant Events



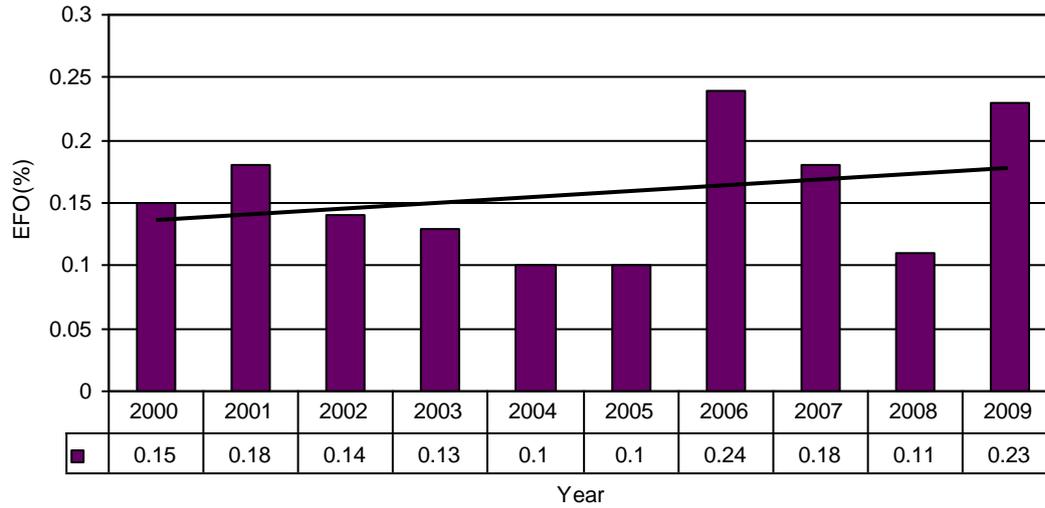
Average Safety System Failures



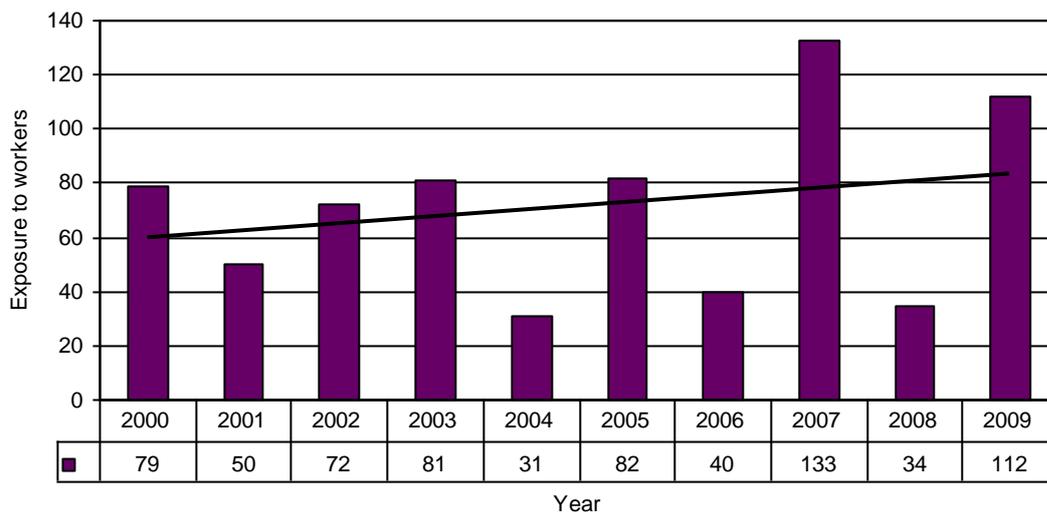
Average Forced Outage Rates



Average Forced Outage Rate for 1000 Critical Hours of Critical Commercial Operation



Average Radiation Exposure to Workers



A-9 USA

- *What is the philosophy of operating experience for your regulatory body's (RB) framework?*

Answer: It is the policy of the U.S. Nuclear Regulatory Commission to have an effectively coordinated program to systematically review operating experience (OpE) gained from the nuclear power industry and research and test reactors, to assess its significance, to provide timely and effective communication to stakeholders, and to apply the lessons learned to regulatory decisions and programs affecting nuclear reactors.

The objectives of the agency's Reactor OpE Program are as follows:

- To collect, evaluate, communicate, and apply OpE information in a systematic, timely, and coordinated manner to effectively support the agency's goal of ensuring safety. Application includes sharing significant OpE information with the nuclear industry in a timely manner so that the industry can ensure safety.
- To coordinate use of OpE information to improve the effectiveness, efficiency, and appropriateness of NRC decisions. Evaluations of OpE provide fundamental information necessary to improve safety assessments and help optimize NRC decisions. Lessons learned from OpE evaluations influence regulatory decisions to improve NRC regulatory programs, including licensing and inspection.
- To facilitate providing the public, Congress, and other external stakeholders with accurate, timely, and balanced OpE information, including actual or potential hazards to health and safety, thereby enhancing understanding of the performance of both the nuclear industry and licensed plants.

Operating experience implies that the NRC learns from operating experience and applies those lessons to its core regulatory programs. "Operating experience" is a broad term that has evolved to describe the evaluation and use of operational safety data by the NRC and its licensees. Operating experience includes a wide range of information regarding events and conditions at nuclear power plants, gathered from numerous sources. The NRC's systematic collection and evaluation of such information plays an important role in its mission to protect public health, safety, and the environment.

- *What information is trended by your RB? (specific safety performance indicators, codings/event tags.)*

Answer:

Within the U.S. NRC's Reactor Oversight Process, the following Performance Indicators are reported and trended at each operating commercial reactor plant. The performance indicator program and its associated trend results are publicly available.

- Unplanned Scrams
- Unplanned Scrams with Complications
- Unplanned Power Changes

- Emergency AC Power Systems
- High Pressure Injection System
- Heat Removal System
- Residual Heat Removal System
- Cooling Water Systems/Support Cooling Water Systems
- Safety System Functional Failures
- Reactor Coolant System Activity
- Reactor Coolant System Leakage
- Drill/Exercise Performance
- Emergency Response Organization Drill Participation
- Alert and Notification System Reliability
- Occupational Exposure Control Effectiveness
- Radiological Effluent Occurrences

Similarly, the NRC uses the Industry Trends Program (ITP) to collect industry-wide data to assess whether the nuclear industry is maintaining the safety performance of operating plants. The following data are collected and analysed for the ITP:

- Automatic Reactor Scrams While Critical
- Significant Events
- Safety System Actuations
- Safety System Failures
- Forced Outage Rate
- Equipment Forced Outage Rate/1000 Critical Hours
- Collective Radiation Exposure
- Accident Sequence Precursor
- Unplanned Power Changes
- Reactor Coolant System Specific Activity
- Reactor Coolant System Leakage
- Drill/Exercise Performance
- Emergency Response Organization Drill Participation
- Alert and Notification System Reliability
- Baseline Risk Index for Initiating Events

NRC's Accident Sequence Precursor (ASP) Program systematically reviews and evaluates operating experience to identify precursors to potential severe core damage sequences. The ASP Program documents precursors, categorizes them by plant-specific and generic implications, and provides a measure of trends in nuclear plant core damage risk.

As part of operating experience monitoring, the agency periodically encounters certain reactor systems or management areas it identifies as focus areas. The following are focus areas that the agency is reviewing or working to improve and upgrade:

- Control Room Habitability
- Davis-Besse Reactor Vessel Head Degradation
- Fire Protection

- Fitness-for-Duty Programs
- Access Authorization Programs
- Human Factors
- Operating Reactor Maintenance Effectiveness
- Multiple/Repetitive Degraded Cornerstone Column [Within the Reactor Oversight Program]
- PWR Sump Performance
- Reactor Pressure Boundary Integrity Issues for Pressurized Water Reactors
- Reactor Vessel Integrity
- Steam Generator Action Plan
- Groundwater Contamination (Tritium)
- Buried Piping Activities

Reactor Operational Experience Results and Databases used for Trending

The NRC periodically conducts risk studies, and has compiled results and databases for previously published studies on its [public website](#). Subject areas include:

1) Parameter Estimates

- a) Industry Average Parameter Estimates
- b) Common-Cause Failure Parameter Estimates
- c) Loss of Offsite Power

2) Trends and Insights

- a) Initiating Events
- b) System Studies
- c) Component Performance
- d) Common-Cause Failure Insights
- e) International Common-Cause Failures
- f) Fire Events

3) Supplemental Information

- a) Operating Time
- b) Industry Performance Data

4) Databases and Programs

- a) Common-Cause Failures (CCFDB)
- b) Reliability and Availability Data System (RADS)

c) RADS Calculator

- 5) **Events Assessment**
- 6) **Industry Trends**
- 7) **Operating Experience Smart Sample (OpESS) Program**
- 8) **Generic Issues**
- 9) **Inspection Findings**
- 10) **Emergency Preparedness and Response**

The NRC also has an agreement with INPO to view SEE-IN documents specifically Topical Reports to glean additional trends at an industry-wide level

- *How is a trend determined by your RB? (mathematical, observation, ad hoc, etc.)*

Answer: The NRC uses multiple methods to determine trends.

Mathematical Trending Programs:

Industry Trends Program - In the Industry Trends Program (ITP), NRC collects industry-wide data and uses it to assess whether the nuclear industry is maintaining the safety performance of operating plants. The ITP assesses the safety significance and overall effect of any statistically significant adverse trends, ensuring the NRC responds appropriately. The NRC formally reviews these indicators as part of the Agency Action Review Meeting (AARM) each year, and any statistically significant adverse trends are reported to Congress in the NRC's Performance and Accountability Report.

Performance Indicator - A performance indicator is a quantitative measure of a particular attribute of licensee performance that indicates how well a plant is performing when measured against established thresholds. Licensees submit this data quarterly, and the NRC regularly performs verification inspections of their submittals. The NRC uses its analysis of this data with its own inspection data for assessment of an individual plant's performance.

Accident Sequence Precursor (ASP) Program – The ASP Program systematically evaluates U.S. nuclear power plant operating experience to identify, document, and rank the operating events that are most likely to lead to inadequate core cooling and severe core damage (precursors), contributing to the likelihood of additional failures. To identify potential precursors, the NRC staff review plant events from licensee event reports, inspection reports, and special staff requests. ASP events are documented in the NUREG-4674 (series), "Precursors to Potential Severe Core Damage Accidents." The most recent status of the ASP program was reported to the Commission in SECY-08-0145, "Status of the Accident Sequence Precursor Program and the Development of Standardized Plant Analysis Risk Models."

Precursor Occurrence Rate (Initiating Events & Mitigating Systems) - The NRC's Industry Trends Program provides the basis for addressing the agency's safety-performance measure on the "number of statistically significant adverse trends in industry safety performance" (one measure associated with the

safety goal established in NRC's Strategic Plan). The mean occurrence rate of all precursors identified by the ASP Program is one indicator used by the Industry Trends Program to assess industry performance.

Baseline Risk Index for Initiating Events (BRIIE) - The NRC recently developed another tool in the Industry Trends Program (ITP) for assessing nuclear industry safety performance. The Baseline Risk Index for Initiating Events (BRIIE) monitors the first ("initiating") event in a series of unlikely failures that have the greatest potential to lead to damage of the reactor fuel. These initiating events are not common but do occur with some regularity over time. While plants are designed to have multiple means of stopping (mitigating) these series of events prior to damage to the reactor fuel, the NRC still wants to monitor their frequency. The NRC would take action if the frequency exceeded certain pre-determined levels. The BRIIE is intended to enhance and complement the ITP, and was implemented as part of the ITP starting in January 2008.

Observation/Ad Hoc Trending Programs

NRC's Operating Experience Program systematically collects, communicates, evaluates and applies operating experience data based on daily observation of plant events and interactions with the inspector and technical communities within the agency. Information collected by the operating experience clearinghouse is evaluated daily against the programs deterministic and risk-based criteria. Significant issues are communicated to pre-registered NRC staff members, and short-term studies are performed when certain screening criteria are met. These studies may result in various operating experience applications including generic communications, inspection program changes, or operating experience smart samples.

- *What part of your RB performs the trending?*

Answer: Office of Nuclear Regulatory Research, Office of Nuclear Reactor Regulation and Regional Offices (RI, RII, RIII & RIV)

- *How is international data incorporated into your national trending program?*

International events reported via the International Reporting System (IRS) are evaluated by the operating experience program using the same systematic process that is used for domestic events. Other data sources such as news releases or international working conferences are also considered.

Within the operating experience program, the NRC leverages expert level knowledge that resides in the technical staff through the Technical Review Group (TRG) process. TRG reviews focus on identifying potential significant OpE and pieces of different OpE with a common theme that may warrant further NRC review and application. Technical organizations are in the best position to do focused reviews in their areas of expertise and to identify issues that may supplement the normal OpE clearinghouse process. Staff experts in various disciplines, both at headquarters, and in the Regional Offices, serve as representatives of the NRC technical organizations, participating in 26 different TRGs. TRGs are led by a Nuclear Reactor Regulation or Nuclear Security & Incident Response technical group lead who is a subject matter expert. Periodic reviews conducted by these groups search the various OpE data streams, including international reports, as part of their operating experience review process.

- *How does your RB use the trending of information? Such as, reporting to other authorities, higher level government, Interactions with operator/ licensee, Input into inspection or other regulatory activities.*

Operating experience information trends are used in various applications and are used to influence agency programs such as:

- Rulemaking
- Regulatory Guides
- Standard Review Plan
- Technical Specifications
- Generic Communications
- Generic Safety Issues
- Inspections
- Enforcement Actions
- Research or Long Term Studies
- New Reactors
- Industry Voluntary Actions

- *Is your RB trending effort separate from the operator/ licensee?*

Yes

- *Is the trending used to compare safety performance between plants?*

Yes, via the use of Performance Indicator trends and their respective input to the NRC Action Matrix.

- *What have been the results of the trending program?*

Industry-Wide Assessment

Should any long term indicators show a statistically significant adverse trend, the NRC will evaluate them and take appropriate regulatory action using its existing processes for resolving generic issues and issuing generic communications. The NRC formally reviews these indicators as part of the Agency Action Review Meeting (AARM) each year, and any statistically significant adverse trends are reported to Congress in the NRC's Performance and Accountability Report.

No statistically significant adverse trends have been identified through the end of fiscal year (FY) 2009, based on the ITP indicators and the Accident Sequence Precursor (ASP) program.

Individual Plant Assessment

The Performance Indicator program results are used along with inspection data to assess individual plant performance and determine the necessary level of regulatory oversight required for public safety at the given facility.

A-10 Further Country Responses without Questionnaire

Belgium

Trending in Belgium

Please find hereunder a short description of the philosophy of operating experience for our RB framework. Trending of operating experience information is not part of our process.

For Bel V - subsidiary of the Belgian RB, the primary objectives of the Operational Experience Feedback process (REX) are

- to support the inspection of the licensees who are responsible for maintaining a properly working operational experience feedback process, with the pursued outcome that no safety significant events remain undetected by the licensee and that he takes actions to prevent their recurrence;
- to maintain and develop expertise in Bel V.

The specific objectives of the Bel V Operational Experience Feedback process are:

- to identify safety relevant lessons learned from events that occurred in Belgian and foreign NPPs and to assess their implications for the Belgian installations;
- to raise technical questions to be addressed by the Belgian licensees;
- to select and report domestic incidents to the IAEA database (IRS).

Secondary objectives are:

- confirmation of the adequacy of the existing installations; in the contrary, the advisability of modifications (for ex. Loss of shutdown cooling at mid-loop),
- reminder, for the training programs, of the potential for threatening events, (for ex. the Forsmark electrical transient),
- basis for a review of operating procedures,
- indication for the need to perform preventive inspections,
- enhanced capability to correctly diagnose the root cause of domestic abnormalities (e.g. knowledge of emerging Ageing Related Degradation Mechanisms),
- input for complementary safety analysis tools (PSA, PSAEA)

- Easier retrieval of all very significant events in NPPs since early use of nuclear energy (equivalent of at least INES 3).

France

- Safety performance indicators and trending
- Performance indicators started in 2000, indicators not too ambitious to be applicable of all plants, based on “hard” data
- IRSN develops the performance indicators (46 in 8 families) using different reports from the sites
- Comparisons between plants are possible; IRSN uses deviations just for starting point of further analysis
- Yearly evaluation, short (medium) and long term trending are performed
- Time for repair, HF, etc.
- EDF has similar task, comparison of methods will be made next year
- Used of trending just for internal use of IRSN
- Trending performed on single plants (sites)

Sweden

- Sweden is going to built up a database for trending use, high interest in other nations performance and approaches
- About 10000 events in Swedish event database (about 350 events per year; 10 reactors)
- Use as background information to be discussed in management meetings
- this year
 - New database with trending capability
 - Regulatory coding
 - System/components
 - INES
 - Reporting criteria,
 - Swedish regulatory code
 - Technical Specification
 - Etc.....
 - Still work to do

- Next year
 - Indicators from HF (?)
 - Some reports has been developed
 - Low level events and maintenance (?)
 - not started
 - New regulatory coding on events (?)
 - Not started
 - to be able to compare with others (IRS?)

- All events in the Swedish NPP that has been reported to the regularity body is registered in the DB
 - >10 000 events
 - From 1971
 - Approx 350 events each year

- Data is exported to Excel for trending