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NUCLEAR ENERGY AGENCY
COMMITTEE ON NUCLEAR REGULATORY ACTIVITIES

NEA/CNRA/R(2009)3
Unclassified

CNRA Summary Report on Operating Experience Feedback Related to Fire Events and Fire Protection Programmes

Safety Analysis of Fire Operating Events

English text only

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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NUCLEAR ENERGY AGENCY

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The mission of the NEA is:

- to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
- to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information.

The NEA Data Bank provides nuclear data and computer program services for participating countries. In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

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COMMITTEE ON NUCLEAR REGULATORY ACTIVITIES

The Committee on Nuclear Regulatory Activities (CNRA) of the OECD Nuclear Energy Agency (NEA) is an international committee made up primarily of senior nuclear regulators. It was set up in 1989 as a forum for the exchange of information and experience among regulatory organisations.

The committee is responsible for the programme of the NEA, concerning the regulation, licensing and inspection of nuclear installations with regard to safety. The committee's purpose is to promote cooperation among member countries to feedback the experience to safety improving measures, enhance efficiency and effectiveness in the regulatory process and to maintain adequate infrastructure and competence in the nuclear safety field. The CNRA's main tasks are to review developments which could affect regulatory requirements with the objective of providing members with an understanding of the motivation for new regulatory requirements under consideration and an opportunity to offer suggestions that might improve them or avoid disparities among member countries. In particular, the committee reviews current management strategies and safety management practices and operating experiences at nuclear facilities with a view to disseminating lessons learned.

The committee focuses primarily on existing power reactors and other nuclear installations; it may also consider the regulatory implications of new designs of power reactors and other types of nuclear installations.

In implementing its programme, the CNRA establishes cooperative mechanisms with the Committee on the Safety of Nuclear Installations (CSNI) responsible for the programme of the Agency concerning the technical aspects of the design, construction and operation of nuclear installations. The committee also co-operates with NEA's Committee on Radiation Protection and Public Health (CRPPH) and NEA's Radioactive Waste Management Committee (RWMC) on matters of common interest.

FOREWORD

Fire is one of many potential hazards within commercial nuclear power plants (NPPs) as it has the potential to result in damage to safety-significant structures, systems and components (SSCs). These can include the systems required to attain and maintain safe shutdown of the plant, the failure of which could lead to a release of radioactivity into the environment. One of the main conclusions from the Committee on Safety of Nuclear Regulations (CSNI) Working Group on Risk Assessment (WGRisk) 2005 workshop was that, depending on the design and operating characteristics of a NPP, fire can be a significant or even a dominant risk contributor. In addition, the WGRisk State-of-the-art report (SOAR) noted the significance of fire spreading and the impact of smoke and heat on instrumentation and control systems.

Some countries are introducing significant changes to their inspection process of fire protection programmes, specifically related to the use of risk-informed inspections in order to assess the impact of fire on safety significant SSCs. Operating Experience Feedback (OEF) within the area of fire protection provides relevant information which contributes to the identification of potential weaknesses in fire protection provision as well as providing valuable insight into areas where significant improvements in fire protection provision can be realised. This information can then be used to provide a basis for new inspection activity focus areas.

In 2006, the CNRA Working Group on Operating Experience (WGOE) began the task of examining national and international operating events databases in order to identify any potential safety issues related to NPP fires and fire protection systems. The purpose of this task was to provide the member countries with practical information that would be helpful in assessing and potentially improving their inspection and OEF programmes. This analysis and trending task was performed in conjunction with the Working Group on Inspection Practices (WGIP) task using inputs from OECD NEA Fire Project with the CNRA approval.

This report describes the outcomes from the task, including the background, the main conclusions, survey with analysis of results, and survey responses on the basis of national operating experience databases provided by regulatory organisations in the NEA countries.

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EXECUTIVE SUMMARY

Introduction

In April 2008, the CNRA Working Group on Operating Experience (WGOE) discussed the results of its study of national and international fire events databases. For national databases, participants found that fire events made up a very small percentage of the overall number of reportable events, so drawing meaningful conclusions and trends from these statistics was difficult. WGOE then performed an analysis of the Web-Based Incident Reporting System (IRS) database in order to determine any potential trends from the collective fire event reporting of all member countries. While the review of fire events in the IRS database noted several potential trends, the current database was not designed to facilitate detailed trending.

Following the April 2008 meeting, WGOE developed a set of survey questions for NEA countries related to their national fire event reporting methods in an attempt to learn more about how the different countries respond to fire events, and to determine the validity of the IRS database trends. Answers to the survey questions from all respondents are posted below. Many countries included considerable detail in their responses related to reporting practices for fire events, application of operating experience, required fire protection inspections, and the performance of root cause analysis following an event. Such information could be beneficial for countries looking for benchmarking information to help them develop their own fire protection inspection and/or reporting systems. This summary report provides the results of the survey and a consolidated list of each country's responses.

Background

1) The responses to the survey were received from regulatory organisations in the NEA countries. Therefore, the analysis is based on a regulatory viewpoint. Information is mainly based on national operating experience data bases. The IRS was reviewed but did not provide an adequate data base for providing useful information.

2) Additional questions were forwarded to other working groups as CNRA/WGIP, CSNI/WGHOF and WGRisk, and NEA Projects. As a result, the following inputs were received.

   a) WGIP noted the need to have further input on WGOE event findings prior to responding. (Note: The report on inspection of fire inspection programmes was prepared on a parallel path). Based on the WGIP findings and the results of the WGOE report there is need for the groups to continue exchanging information and for both groups to be vigilant in reviewing any new events.

   b) The OECD Fire Project (started in 2002 and now involving 12 Member Countries, the objective of which is to collect and analyse fire events according a detailed set of parameters) provided information that had been published but noted that the data itself was restricted.

3) Survey responses revealed differences in national practices in the use of varying types of guidance and criteria, which in turn made the use of international systems for trending difficult.

Main Conclusions

1. It is important to note that all the countries involved in this survey had limited operational experience relating to real fire events and the responses are based upon this limited amount of data, which makes it difficult to derive meaningful conclusions over the trending of fire events. However, the review has identified positive findings associated with a consistent approach to inspecting fire protection provision and a good understanding by licensees and regulators of the importance adequate fire protection provision has on safety at NPPs. This evidence is reflected in the fact there have been very few fire events at NPPs over a number of years across all NEA countries.

2. No new potentially significant nuclear safety issues were identified, as the review was based upon a very limited dataset (see (1) above). Significant resources would be required to acquire a complete data base and then perform an in-depth analysis. Any such task could be expanded to identify potential pre-cursors to fire events that would provide further operating experience relating to failures of structures, systems and components that act to terminate fires that do occur or prevent fire spread e.g. failure of active fire protection systems and breaches in nuclear significant fire barriers. This would involve countries analysing (using fire protection experts) both fire events and pre-cursors over a long period of time to establish whether there were any potential shortfalls in the provision of fire protection at NPPs.

3. A number of countries stated that plant age did not appear to have a detrimental effect on either the number or severity of fire-related events. However, based upon the low frequency of fire related events, it was not possible to draw any conclusion over whether plant age had a detrimental effect on either the number or severity of fire-related events.

4. Fire can represent a serious nuclear safety risk. However, this review has found that that licensees and regulators recognise the need to adequately address the provisions for fire protection and are appropriately managing them. Based on this, WGOE does not consider that additional overview is required at this time. It is recognised that, in order to determine whether there are specific issues for inspection, there is a need for WGIP to assess the responses to the survey.

5. As noted, based upon limited fire event data, no significant nuclear safety issues were identified. However, this should not be misinterpreted to mean that fire is not a significant contributor to risk on NPPs; it simply reflects the limited number of fire events that have occurred and, due to a range of fire protection features and management controls in place to prevent fires in the first instance, the number of events has been consistently low. These aspects of operating event feedback can have direct effects on licensing, such as: more focused inspections, changes in emergency procedures, plant modifications, etc.

6. Member countries performing or considering new builds have integrated the operating experiences in fire events into those in other events to use for the design and operation of these plants.

Survey and Analysis of Results

1. How do you identify the means by which to target and inform your inspection for fire?

    a. Fire inspections are a component included in most member countries normal inspection programmes. In addition to normal fire inspection programmes (ref. WGIP report) countries have the capability to perform reactive inspections.

2. What target areas would an Operating Experience data review be expected to highlight?

    a. Relevant information for target areas is not easily retrievable from international systems due to the ways information is reported (Note: It may be accessible from proprietary systems such as OECD Fire), therefore surveys of national systems are required to compile information such as this, although a more systematic response (e.g., US response) is needed to acquire consensus on specific target areas.

    b. Three common areas seem to be safety significance, root cause and trend analysis.

3. What guidance do you follow for the reporting of fire events?

    a. All countries provide guidance although the criterion used in NEA countries differs due to national requirements (based on national basis, IAEA standards /guides or WANO guides).

4. How are you informed of fire events?

    a. In general, oral reports (telephone) are provided, followed by detailed written reports.

5. What information is included within your event reporting e.g. human factors, maintenance, duration of fire etc?

    a. Generally, licensees are expected to perform a causal analysis, the detail of which is based on the safety significance of the event.

6. Have you considered failure or spurious actuation of fire protection systems within the data analysis?

    a. There is no clear consensus in this area. In some countries it would be considered under the reporting requirements and hence would be within the data analysis, while in others, it would only be considered within a fire hazard analysis.

7. Have you observed a correlation between plant age and the frequency of fires?

    a. A number of countries stated that plant age does not appear to have a detrimental effect on either the number or severity of fire-related events. However, based upon the low frequency of fire related events, it was not possible to draw any conclusion over whether plant age has a detrimental effect on either the number or severity of fire-related events.

8. Can you identify trends in fire events to ageing, life extension and plant modifications?

    a. Generally no trends have been observed in relation to ageing/life extension, but some have been observed due to the nature of plant modifications.

9. Have modifications to fire protection systems resulted in a reduction in frequency of fire?

   a. Responses vary based on the interpretation of the question and definition of fire. In general it appears that modifications have improved safety by limiting the growth or consequences of fires but not the frequency of them.

10. Have you made any changes in new build design or plant modifications based on operating experience for fire?

    a. Yes, there are many examples of plant modifications based on operating experience for fire and these are being taken into consideration for new build.

SURVEY RESPONSES

Question 1: How do you identify the means by which to target and inform your inspections for fire?

ANALYSIS	*Most countries have a normal fire inspection programme (ref. WGIP report)* • *There is a nuclear safety component, and* • *A conventional fire component.* *In addition to normal fire inspection programmes (ref. WGIP report) countries have the capability to perform reactive inspections.*

Belgium	Annual fire inspection in the following areas: • Check implementation of corrective actions from previous inspection. • Evaluated operating experience from the site and other nuclear installations as a means to target inspection areas. • Take into account any fire-protection issues identified by the resident inspectors during their systematic inspections. • Visit plant locations previous fire events, fire protection system failures, spurious actuations of fire protection equipment, and equipment modifications since the last inspection.
Canada	In Canada Canadian Nuclear Safety Commission (CNSC) establishes fire inspection frequencies based upon a corporate baseline compliance programme which takes into consideration the facilities risks, hazards, and historical operating performance. Internal risk assessments are usually performed by multi disciplinary teams to establish the baseline compliance activities and their frequency. The areas inspected are determined from the requirements in the operating license and the licensees programme and safety report with a focus on risk significant scenarios, credited mitigation safety systems and components (SSC) and areas of known weakness in operational performance or compliance.
Czech Republic	Systematic process. Fire protection is one of the inspection sub-areas, and fire inspections focus on status and operability of fire protection systems, their maintenance, and periodic testing. Unique to the Czech Republic is that another regulatory body, the Directorate of Fire Rescue Corps Czech Republic (separate from SÚBJ) reports to the ministry of the interior with primary responsibility for fire protection. SÚBJ fire protection inspections are based on equipment performance data, and operational history.

	Reactive inspections are performed in the case of fire, but none have been required in the past several years.
Finland	STUK has a thorough inspection plan of overall fire protection arrangements of NPP once a year. STUK prepares a detailed annual inspection plan and it is sent to the utility some weeks before the inspection. Before plant start-up after annual refuelling and maintenance outage of NPP, STUK will conduct thorough inspection of fire protection measures.
France	Fire inspections are one of ASN inspection priorities because it is related to safety and environmental issues. As a consequence, ASN carries out periodical control on fire. Every plant is submitted to at least one fire inspection per year. Following a fire related event, reactive inspections may be performed by ASN. Basis of an inspection are : • an ASN inspection guide related to fire inspection: • recent fires on the plant ; • implementation of corrective actions from previous inspections. Generally, a fire inspection focuses on: • sectorization ; • fire prevention ; • fire detection ; • fire control and fire fighting (organisation and equipment) ; • radioprotection issues while fighting fires. During inspection, ASN may also ask for and observe fire fighting exercises on a site, in order to check the efficiency of the operator's organisation and measures.
Germany	In Germany, yearly visual inspections of the overall fire safety are performed in nuclear power plants corresponding to requirements from the non-nuclear standards. In addition, according to the German nuclear fire protection standards KTA 2101.1, § 7 /KTA 00/ the fire protection tests and inspections have to be carried out for structural fire protection means as well as for active fire detection measures, in particular fire detection and extinguishing means but also ventilation systems. These tests and inspections cover tests prior to licensed construction, inspections accompanying the design and the regular inservice inspections. Details can be found in the following text taken from KTA 2101.1, § 7 /KTA 00/ **Tests and Inspections** **7.1** Tests Prior to Licensed Construction (1) The license applicant shall submit the following documents for review and examination before he may receive the respective license: a) fire protection concept, b) blueprints with details of the fire protection subdivision and lists with a room-by-room compilation of the existing fire loads and ignition sources, the latter insofar as required under Section 3, as well as safety-related evaluations of those plant components which could possibly be affected by fire,

	c) technical drawings of the areas monitored by automatic fire detection and alarm systems and the areas where fires can be suppressed by stationary fire extinguishing systems, d) description and. insofar as required. Proof of suitability of the fire protection related materials, structural elements and constructions, e) description of the ventilation systems with details on the schematics, technical drawings, controls concept and insofar as required ventilation rates, f) description of the heat and heat removal equipment as well as proof of their adequate design, g) description of the fire extinguishing systems as well as proof of their adequate design, h) description of the fire detection and alarm systems as well as proof of their adequate design, i) schematic of the areas for the fire brigade. (2) These documents shall be reviewed to ensure that they are complete, mutually compatible and that the designs they incorporate are suited to the respective functions. *N o t e: See also .Compilation of the Documents Required for the Testing of Nuclear Facilities by Construction Supervision Authorities of November 6, 1981 (GMBl. 1981, page 518).* **7.2** Accompanying Inspection (1) This includes: a) design review, b) construction supervision and assembly testing, c) acceptance and functional testing. (2) The required tests and inspections are specified in **Table 7-1**. Type and extent of the tests depend on the specific condition of the plant and shall be specified in each individual case. The test instructions shall be presented in good time before acceptance and functional testing. *N o t e: See also .Compilation of the Documents Required for the Testing of Nuclear Facilities by Construction Supervision Authorities of November 6, 1981 (GMBl. 1981, page 518).* **7.2.1** Design Review Design review tests shall be performed as specified in **Table 7-1**. **7.2.2** Construction Supervision and Assembly Testing (1) The construction materials and structural elements shall be checked in the course on construction and assembly. It shall also be checked that the plant components and equipment are manufactured and erected in accordance with the reviewed documents. (2) Insofar as the manufacture of the construction materials, structural elements and equipment were already subject to tests in the manufacturing plant, no further testing in this regard is necessary.

	7.2.3 Acceptance and Functional Testing (1) Acceptance and functional test shall be performed as specified in **Table 7-1.** (2) During acceptance testing, the completeness of the fire protection measures shall be checked. (3) After repairs and modifications, acceptance and functional testing of the respective structural elements, plants and equipment shall be repeated to the extent necessary. **KTA 2101.1** Page 11 **7.3** Inservice Inspections (1) The type of tests, the testing intervals and responsibilities regarding inservice inspections are specified in **Table 7-2**. The licensee shall ensure that the tests and inspections are performed properly. Insofar as suitability certificates require shorter testing intervals, these intervals shall be specified in each individual case. When specifying other testing intervals than the ones listed in **Table 7-2** the experience from inservice inspections as well as the special design characteristics and quality assurance measures required in nuclear power plants shall, in close coordination with the nuclear supervisory authority, be taken into consideration. (2) A prolongation of the testing interval is permissible, provided, for reasons of, e.g., accessibility, certain tests are possible only during refuelling or reactor shutdown. However, the proper authority must consent to the prolongation of operation then required. (3) In accordance with safety standard KTA 1202 testing instructions are required for individual test objects listed in **Table 7-2**. These shall, in particular, specify the pant-related and equipment-related individual testing steps. *N o t e: Test requirements are contained in the approvals and test certificates under construction supervision legislation and in the relevant standards and guidelines.* (4) The existing combustible materials shall be checked at least every three years regarding their correspondence with the licensed fire protection concept as specified under Section 3.1.2.2. Within the framework of the fire protection round after every major revision, it shall be checked that the additionally introduced fire loads have been properly removed. **7.4** Removal of Defects The licensee shall ensure that any defects determined during testing are removed. **7.5** Documentation (1) Test records shall be prepared as proof of the performance of the tests in accordance with Section 7.3 para.3. These test records shall, in particular, contain an evaluation of the test results, the detected defects, any necessary time limits for the removal of defects and the signature of the tester and the date of the test. *N o t e: Details are specified in safety standards KTA 1202 and KTA 1404.* (2) The test records of inservice inspections shall be stored by licensee." Inservice inspections are performed regularly by the licensees and their sub-contractors. On a regular basis, the inspections are accompanied/controlled/checked by independent

	experts (from TÜV and/or GL as TSOs) on behalf of the corresponding local state supervisory authority in charge. Testers and test objects regarding accompanying inspection can be taken from Table 7-1 and responsibilities and testing intervals regarding inservice inspections can be found in Table 7-2 of KTAAA 3101.1 /KTA 00/.
Hungary	12 different areas are systematically inspected every 3 years. One of these 12 areas is fire protection. The fire protection inspection focuses on status and operability of fire protection systems, maintenance and periodic testing and documentation. Following any fire-related event, causal inspections are performed.
Japan	Onsite fire protection system inspection has been done for each site by inspector of FMDA (Fire and Disaster Management Agency) every year based on the fire protection laws. And as one of the daily process inspection activities, onsite inspectors of NISA have been oversighting if the operators are following the fire protection rules of their safety operation programme. While, after the Kashiwazaki-earthquake, we reinforced fire prevention inspection issue. Some of the onsite inspectors of NISA are qualified to do fire protection inspection as one of the daily inspection items. The draft inspection manual is now being drafted and will become effective within this year.
Netherlands	The means are based on the license requirements: The plant must keep records of all fire events, all (inadvertent) actuations of fire protection systems and annual licensee inspection by a certified organization of all fire protection hardware like extinguishers and hoses. All modifications are reported to the regulator. The municipal fire department and regional fire departments of the Ministry of Interior Affairs are responsible for respectively direct control and training and education of the licensee fire brigade.
Russia	Fire safety regulation of NPPs is carried out by the Russian Ministry of Emergency Situations.
Slovak Republic	Fire inspections are built into the yearly inspection plan. Unplanned inspections may occur depending on the types of activities ongoing (i.e., fire hazards such as welding)
Slovenia	Fire inspections are part of annual inspection plan and are carried out once or twice per year. No systematic approach for targeting and informing the inspection for fire.
Spain	2 Inspection procedures for fire protection: • PT.IV.205 "Fire Protection – Resident Inspector" – looks at fire protection programmes, inspection basis and requirements, and makes verifications in selected areas. • PT.IV.204 "Fire Protection" – Biennial inspection. Focuses on design of fire protection systems, adequacy of procedures, equipment, fire barriers and other systems that ensure safe shutdown of the plant. Inspection team selects 3-5 risk significant areas and takes into consideration fire PRAs.
Sweden	This question seen from the licencees point of view. The means the licensees have are several, some of them are listed in the below. - direct call to the SSM, in the daily report, week report, LER, information the SSM inspector for a certain plant.

	This question seen from the SSM point of view. Reporting and analysis of fires (or any other initiating event or occurrence) is regulated in the Swedish regulation SKIFS 2004:1. Inspections and plant visits are curried out on a demand basis, at a fire situation, and then performed according to the procedures for inspection. Questions, topics in an inspection, a plant visit today are based on fears question built up or on actual matters to be better understood. There are now plans at SSM to establish a general “fire inspection guidance” with the following content (ideas of today) - General goals and defence-in-depth principles against fires - Basic design principles for fire protection - Fire Protection Systems, -alarm, -detection systems, ventilation, evacuation paths - Fire Safety Analysis, both deterministic and probabilistic studies, in which the normal operation as well as the shut-down risk is considered for level 1 and level-2. - Administrative control and maintenance - Organisation of the manual fire fighting principles o Guidance for emergency planning in nuclear power plants and organisation of manual activities In Sweden, major modernisation projects are at present curried out. Major design modifications are taken into consideration in the design of better resistance against impact of fire and dependencies. In the SSM review of these applications, both deterministic and probabilistic, lot of work is spent on the review of the design of “fire safety design”.
Switzerland	For the conventional fire components there is another regulatory body responsible, the fire protection body of the canton where the plant is located. The implementation is verified by HSK on a regular basis (HSK Guideline R-50), mainly by means of inspections.
United Kingdom	Licensees’ safety cases are the primary means for targeting and informing regulatory inspections for fire. Safety cases define nuclear safety significant structures, systems and components (SSCs) required for nuclear fire safety. These include fire barriers and fire detection and suppression systems and the systems for examination, maintenance, inspection and testing to ensure that the required reliability and availability requirements are met. Planned inspections as well as “reactive” inspection for fire are informed by operating experience, for example, findings from regulatory inspections, events reported by licensees, international events, etc.
United States	Has 2 inspection procedures related to fire protection: • IP 71111.05 AQ requires resident inspectors to perform quarterly walkdowns of plant areas to look at defence-in-depth measures, along with annual evaluations of the fire brigade during both announced and unannounced fire drills or in response to an actual fire. • IP 71111.05T is a Triennial inspection (every 3 years). A fire protection inspector, reactor operations inspector and an electrical systems inspector will conduct a design-based, risk-informed, onsite inspection of defence-in-depth elements used to mitigate the consequences of a fire, including the licensee’s identification and resolution of fire protection issues.

Question 2: What target areas would an Operating Experience data review be expected to highlight?

ANALYSIS	*Relevant information for target areas is not easily retrievable from international systems due to the ways information is reported (Note: It may be accessible from proprietary systems such as OECD Fire), therefore surveys of national systems is required to compile such as this, although a more systematic response (e.g., US response) to acquire consensus on specific target areas.* *Three common areas seem to be safety significance, root cause and trend analysis.*

Belgium	A fire OE data review would be expected to contribute to improvements to the fire protection programme in NPPs in the following areas: • Identify conditions (important fire loads, presence of ignition sources, etc) that have potential to cause fires leading to plant damage, radioactive release. • Identify root causes when fire events are reported. • Assess how the fire could have developed. • Assess generic applicability of a fire event. • Propose actions to be taken in the affected plant or at other plants to prevent recurrence of similar fire events, and determine the adequacy of those actions.
Canada	Operational compliance issues Events, i.e. fires, etc. Operational performance issues
Czech Republic	Target areas highlighted: • Root causes of fires • Human factors contribution • Fire protection systems aging • Distribution of root causes related to failed subsystem (i.e., power supply, I&C, pumps, etc.) • Contribution of design/manufacturing/maintenance/operation • Events analyses • Analysis techniques used (HPES, MORT, PSA techniques) • Usage of fire PSA (probabilistic safety assessment) • Was anything needed for analysis destroyed by the fire? • Effects of fire

	• To SSCs • To NPP staff • To public and media
Finland	All domestic INES classified events will be studied by ROOT CAUSE analysis and RISK FOLLOW-UP. Not classified events will be analysed case by case.
France	Fire events are screened in order to determine : • root causes ; • generic issues; • corrective measures: they must ensure installation compliance with the safety reference system, and prevent the reoccurrence of the event. Organisation and design modifications are assessed.
Germany	The following target areas could be expected to highlight: • Barriers, systems and components failures • Root causes of fires • Direct and indirect fire effects (smoke, soot, heat pressure, adverse effects from fire extinguishing, etc.) • Fire response time (rough estimates) • Fire detection performance • Fire extinguishing equipment performance • Fire brigade performance • Human factors contribution to the event initiation (to some extent) • Results from in-depth analyses/investigations of reportable fire events (such as failure due to equipment manufacturing, etc.
Hungary	Events analysis, root cause, other causes, human performance, maintenance, design, procedures and process. Safety consequences, effect of fire, potential consequences. Lessons learned and corrective actions. Applicability to other units.
Japan	Not only for the case of the fire incident, we always review past similar events both for the domestic and overseas experience when the incident is reported to the agency. At this time, we investigate if there exist any trend, understand the severity and the safety significance. And when the incident cause investigation is finished and the countermeasures are established, we issue regulatory letters to the related utilities to review their plants on the matter and take appropriate actions to prevent happening similar incidents. Then we prepare the check list of the incident experience feedback for all of the related units and follow it.

Netherlands	Inadvertent actuations, malfunctioning of specific fire dampers, actual fires experienced, records of exercises, fire plans for specific buildings, emergency plan of the NPP, communication with the local and regional fire departments, hardware and software.
Russia	NPP fire protection and safety upgrades as a result of analysis of fire operating experience review.
Slovak Republic	Target areas of the Operating Experience programme are: • Feedback system established (incorporates OEF policy, sources, procedures, etc) • Event reporting criteria • Event classification • Event analysis • Corrective action verification • OE system effectiveness monitoring
Slovenia	Operating Experience data review would highlight the malfunctions and/or proper performance of fire protection systems and annunciators.
Spain	Event Reporting Criteria, Root Cause Analysis, Assessment of Generic Applicability to Other Plants, Design Deficiencies (i.e., physical separation of safety system trains), Design and Maintenance of Passive Fire Protection Components (i.e., incomplete seals, seismic joints without homologated fire resistant barriers), Backfitting and fulfilment of updated standards.
Sweden	Sweden is a member of the international OECD FIRE project. In this project the member countries have agreed on a common FIRE Coding Guideline (CG) that gives the boundaries for how a good fire event record should be documented. The CG supports analysts on what and how to collect fire events and how to fill in a fire event record in the FIRE database. The data that is collected as fire events in Sweden, are all known and available fire reports. Basically the CG gives the quality aspects to be considered in a fire event record, regardless of the different regulations in member countries. A fire event record, in Sweden, can originate from several types of information sources, - **LER events** – according to the LER sheet. Plant name, date and time information, root causes, human factors performance, maintenance and design impact, risk significance and consequences, dependencies, repeating failures, improvement suggestions, lessons learnt, references to background sources, event descriptions. LER:s are used from trend analysis, input documentation to investigations, - research projects. - rescue services report - fire brigade report - evaluation reports of the licensees The aim with the different types of reporting wary a lot. Therefore also the qualitative information in those reports.

	Main targets in a LER "fire" should be - Affected Technical Specification chapter and function affected, systems and components affected, room area and or fire compartment affected - total downtime, repair time, outage time - Licensee name, date - actuation time of fire alarm, type of fire alarm, fire alarm performance - Start time for fire, end time for fire = extinguishing time - What is burning, where is the fire location, - Source of extinguishing source or type, extinguishing performance - reactor and operational consequences – reactor trip, shutdown performance - type of fire - Qualitative descriptions of the fire events in the text field in a Swedish LER - references to investigation reports
Switzerland	Target areas of Operating Experience programme are: - Feedback system established - Event reporting criteria - Event classification - Event analysis - Corrective action verification
United Kingdom	IAEA TECDOC 1134 "Use of Operational Experience in Fire Safety Assessments of NPPs." gives suggestions on target areas. Some key areas that a data review would be expected to cover are: • Where the fire occurred • How the fire started (causes) • How the fire was detected (manual or automatic) • How was the fire suppressed (manual or automatic) • Performance of the fire protection systems • Consequences • Generic applicability • Mode of plant operation • How has fire degraded nuclear safety systems, for example, potential contribution to core damage frequency for NPPs or significance to loss of containment for a chemical facility?
United States	The NRC's Operating Experience programme screens all fire related events in order to determine whether any regulatory follow up is required. Many of the reported events related to fire safety address vulnerabilities discovered during system walk downs by the

	resident inspectors. A vulnerability will be discovered that demonstrates a safe shutdown system's susceptibility to fire damage. The licensee must then either take compensatory actions, or make design changes to the fire protection system in order to address the vulnerability. Applicable target areas for an operating experience review of fire events include: • Risk significance • Loss of safety function • Complicated transients • Design, analysis, or equipment breakdown • Adverse trends and recurring events • Potential new or novel failure • Heightened public or media interest Following the issuance of a report titled "Nuclear Safety: NRC's Oversight of Fire Protection at U.S. Commercial Nuclear Reactor Units Could Be Strengthened," by the U.S. Government Accountability Office, the NRC staff compiled a detailed list of all fire events at U.S. commercial nuclear power plants. The list did not show any increasing trend in the overall number of fire events reported for the period of 1995 to 2007. In nearly half of the fire events included in this list, the ignition source was electrical in nature, whether it be an electrical arc, short, or fault of some sort. Other prevalent ignition sources were oil leaks and oil-soaked lagging. Transformer and switchyard fires were the most common fire locations, with transformer fires being caused by both electrical faults and oil leaks.

Question 3: What Guidance do you follow for the reporting of fire events?

ANALYSIS	*All countries provide guidance although the criterion used by NEA countries differs due to national requirement (based on national basis, IAEA standards /guides or WANO guides).*

Belgium	No specific guidance for the reporting of fire events Belgium uses WANO Guideline 2003-1 for the reporting of all significant events.
Canada	CNSC standard, S-99, *Reporting Requirements for Operating Nuclear Power Plants* is used. It is available on our website at: http://www.nuclearsafety.gc.ca/pubs_catalogue/uploads/S99en.pdf
Czech Republic	OEF system is based on IAEA and WANO guidelines. Reporting criteria are translated from IAEA NS-G-2.11. Basic reporting criteria include: Fires, failures and spurious initiations of fire protection and fire detection systems
Finland	STUK's guides for licensees' operation control state how licensees' should report fire events to STUK. All fire safety related non-conformances are reported by resident inspectors according to STUK's internal guide lines. STUK report all INES classified fire events to IAEA and to OECD FIRE according to corresponding guide lines. STUK's national reporting is in annual and quarter annual reports.
France	The operator made his own guidance which describes the reporting criteria of a fire event. According to this document, the operator has to sent a report within 15 days to the French regulatory body. The operator has to declare all fires on site which leads to one of the following situations : • call of the fire brigade ; • injuries ; • the fire occured in the nuclear island or one of the annex ; • the fire implied an equipment that is considered as important for safety.
Germany	In Germany, fire have to be reported to the supervisory authorities corresponding to the German "Reporting Criteria for Reportable Events in Installations for Fission of Nuclear Fuels (AtSMV, Anlage 1: "Meldekriterien für meldepflichtige Ereignisse in Anlagen zur Spaltung von Kernbrennstoffen") stating: *"Internal fire, explosion or flood **causing the unavailability** of a **safety sub-system** or a redundancy of a **system or component important to safety**." The system is similar to the 1985 version using event classes S, E, and N. However, the new structure is such that the safety significance defines sub-classes of the event type. E.g., there is the event type 3.2 "fire, explosion, or flood" which is subdivided into the classes S, E, N. (Note: The 1985 reporting criteria required the reporting of "**Any damage to systems and components** by plant internal fire, explosion or*

	flood ***that affects normal operation*** *(of the affected system or component)." There are three classes of events reflecting the significance in terms of safety. In contrast to the 1975 version most events show up in all three classes, depending on the systems affected and/or the severity of the event. The cited definition for fire events corresponds to the lowest level (N). A fire has to be reported as type E event, if systems or components important to safety are affected. There are no S class fires.)* In addition, fire events have to be reported to INES or IRS systems if the corresponding INES and/or IRS criteria are met. Finally, failures and spurious initiations of fire protection systems have also to be reported to the supervisory authorities, if the German reporting criteria mentioned above are met.
Hungary	Hungarian Nuclear Safety Codes contain detailed reporting criteria for fire events such as: • There were fires, explosions outside the unit(s) which made or can make the complete fulfilment of safety functions impossible • All kinds of fire occurring in an equipment or component room • Failure of a fire alarm or fire protection system which leaves a room unmonitored for 24 hours or makes extinguishing a fire impossible
Japan	The fire incident or accident is reported following the "Law for the Regulations of Nuclear Sources Material, Nuclear Fuel Material and Reactors", when the SSC important for safety is damaged and/or, the "Electric Utilities Industry Law" when the electric generating facility is damaged. However, we do not have any guidance to follow for the reporting
Netherlands	All fires are reported to the municipal fire department. Unavailability of fire detection or suppression capability is reported directly to the municipal fire department. All safety relevant fires are reported to the (nuclear) regulator. The (nuclear) regulator has quarterly information exchange meetings with the plant and the local and municipal fire departments.
Russia	Ministry Orders and Instructions provide the regulatory authority for requiring reports of fire events at any Russian Federation facilities, including NPPs. Fires are reported and registered in a central reporting system for tracking. Events are considered based on direct and indirect loss of materials as a result of the fire.
Slovak Republic	Fire events are reported to the Regional Fire Department, Slovak Power Company HQ, and the Nuclear Regulatory Authority.
Slovenia	National event reporting regulations require reports for: • Fire protection system malfunctions • Consequences of fires in the case of reactor shutdown, activation of safety systems, or other protective measurements required by technical specification
United Kingdom	Nuclear site licence condition 7, and licensees' arrangements for compliance with this

	condition, covers requirements for licensees to notify, record, investigate and report events. Relevant HSE/NII staff are alerted to licensee reports of significant events via a fast track initial information system. In addition, HSE/NII maintains a database of events reported by the licensee and disseminates information on significant issues or trends within the organisation to help inform regulatory interventions.
Spain	Fire events are reported per appropriate CSN Technical Instruction. 1-hour reporting criteria include: Non-compliance with a Technical Specification operating condition Actual fires lasting < 10 minutes that either affect or have the potential to affect safety systems/structures/components and/or trigger corresponding fire detection systems (or should trigger fire detection systems). 24-hour reporting criteria include: • Non-compliance with Tech Spec surveillance requirement • Spurious actuations of fire protection systems • Any discoveries of deficiencies (design, construction, operation, maintenance, human performance, etc) that could have prevented safety systems from performing their design functions.
Sweden	At licensees there are strict rules on how to keep the regulatory body informed about occurred incidents and events. In the Swedish regulation SKIFS 2004:1, fires affecting safety systems or –functions of the plant have to be reported to the SSM. All other fires, resulting in an alarm to the municipal fire department as well to the local fire department are documented, according to documented rules at the licensees.
Switzerland	According the HSK Guidelines R-15 until the end of 2008, B03 in 2009
United States	Regulatory requirements for fire event reporting and unanalyzed condition reporting are found in 10 CFR 50.72 and 50.73. The following thresholds determine whether a fire event is reported: • Deficiencies in design, safety system vulnerability, maintenance, etc. are reported as unanalyzed conditions. • Fires in the "protected area" of the plant lasting > 10-15 minutes result in declaration of an Unusual Event (lowest level of emergency classification). • Fires that affect operability of safe shutdown equipment may result in declaration of an Alert (second-lowest level of emergency classification).

Question 4: How are you informed of fire events?

ANALYSIS	*In general oral reports (telephone) are provided, followed by detailed written reports.*

Belgium	The Licensee informs the resident inspector, who in turn informs the fire protection specialist that an event has occurred. All events are discussed by the inspector during his systematic inspection reports. Later, the licensee will send the safety authority an event report or incident report that contains the description and his own analysis of the event.
Canada	CNSC is usually informed via the S-99 reports; however, the reporting criteria is not for fires but the activation of the emergency response team, which sets a higher threshold than we would prefer for reporting.
Czech Republic	Fire events are reported under the same system as other incidents and events. Specifically, fire reports are required to the regulator within 8 hours.
Finland	Shift supervisor of the NPP will inform to STUK's emergency preparedness officer by phone.
France	The operator has to provide a detailed written report within 15 days.
Germany	There is a standard reporting procedure as for all other events – see response to the question 3.
Hungary	Fire events are obligatory reports under the Nuclear Safety Code guidelines. The following criteria apply: • Person on Duty is notified by phone • INES is notified within 16 hours • Preliminary assessment is sent to the Authority within 24 hours, and describes the event, operational conditions, actions taken, and preliminary safety assessment
Japan	Following the above two laws, the fire events are reported to the Minister of METI by the letter as soon as possible. It is also reported to NISA (Regulatory Agency) head office and the onsite inspectors. The preliminary event report is to be provided with in 10 days.
Netherlands	By telephone (highest reporting category) and/or by written communication(s).
Russia	Prompt notification of a fire event is made to the plant shift supervisor. In addition, he regulatory body receives notification of any disturbances to NPP operation that meets the regulatory criteria (including fires). Fire information is submitted to the regulatory body as part of NPP's annual safety status reports as well as reports issued under the licensing process.

Slovakia	The Nuclear Regulatory Authority is notified of fire operating events in a similar fashion to other operational reports.
Slovenia	Fire events are reported through: • Daily plant status submitted each morning • Notification to the inspector on duty within 24 hours of the event • Plant written report within 30 days of an incident
Spain	If the fire event reaches the notification reporting threshold, we are notified by licensee event report. Otherwise, fire-related issues are passed on during daily conversations with the resident inspectors
Sweden	SSM is informed via the established ways of communication between the regulatory body and the licensees. In most of the cases the person in duty at SSM (commonly an inspector) is informed immediately. Later on in writing in the daily report and week report. Within 30 days a final LER have to subbmitted to the SSM. At demand, INES report is written. SSM is also an active member of the OECD FIRE group, and have access to all relevant fire reporting in the country. We have also very good contacts with the local Rescue Services organisations at the NPP communities.
Switzerland	There is a standard reporting procedure as for all other events- see response to 3.
United Kingdom	Nuclear site licence condition 7, and licensees' arrangements for compliance with this condition, covers requirements for licensees to notify, record, investigate and report events. Relevant HSE/NII staff are alerted to licensee reports of significant events via a fast track initial information system. In addition, HSE/NII maintains a database of events reported by the licensee and disseminates information on significant issues or trends within the organisation to help inform regulatory interventions.
United States	Fire events are reported by telephone and fax to the NRC Headquarters Operations Centre and entered into the events database. Requirements are as follows: • Within 1 hour if the fire results in declaration of an emergency • Within 8 hours if an unanalyzed condition is discovered Within 60 days if a Licensee Event Report is required.

Question 5: What information is included within your event reporting (e.g. human factors, maintenance, duration of fire, etc.)?

ANALYSIS	*Generally, licensees are expected to perform a casual analysis the detail of which is based on the safety significance of the event.*

Belgium	Main information included in an event report is: • Circumstances surrounding the fire • Event chronology • Licensee's analysis of root cause, fire growth, etc • Assessment on consequences on safety equipment • Lessons learned
Canada	It is up to the licensee to describe the event and its contributing factors. Sometimes we get an apparent cause or root cause analysis. CNSC often follows up with requests for additional information.
Czech Republic	Yes, our regulations require these criteria to be included in licensee event reports and subsequent analysis
Finland	Detailed event description in chronological order, e.g. fire attack, extinguishing, plant response, damages to structures, equipment and systems as well as fire after cleaning activities.
France	Event reports include : • general information: location of the unit concerned, status or operating regime of the unit, status of safety equipment and functions... ; • the sequence of events: detection, actions, staff evacuation conditions ; • analysis of the event: root causes, current and potential impact on safety, radiation protection, environment, analysis of consequences of inappropriate actions, efficiency of fire fighting measures ; • corrective measures: to ensure installation compliance with the safety reference system and to prevent the reoccurrence of the event, planned actions and corresponding schedules.
Germany	Based on the actual German reporting form, arrangement all the above mentioned may be included in the licensee event reports and their subsequent analysis as far as known.

Hungary	Within 30 days of a fire event, the licensee submits an event investigation report containing: • INES classification • Relevant Tech spec limits that were approached/exceeded • Event summary • Event chronology • Event evaluation (root cause, direct cause, safety consequences, safety significance, staff response, equipment operation or failures that contributed to or mitigated the event) • Corrective actions
Japan	Generally, in the fire event report as same with other incidents, the name of the facility, the system and/or equipment, event date, chronology, and the cause of the incident etc. Also reported are the facts if any peoples are wounded or if there were any radiological effects. The counter measures and the root cause analysis would be reported later if the fire incident is evaluated as of safety significance.
Netherlands	As much as possible and all of the above. The plant uses the WANO root cause HPES methodology and the WANO coding list.
Russia	When a fire event meets reporting criteria, all of the information mentioned in the question is reported.
Slovakia	Fire operating events are reported according to legislative rules. Reports include: • Facility name/date/time • Causes of the fire • Event investigation results • Corrective actions and prevention
Slovenia	Regulations do not proscribe any specific scope for the written report.
Spain	30-day report is submitted, as with any other reportable event. Report contains: • Applicable reporting criteria • Initial conditions • Applicable Operating experience • Safety assessment • Root causes • Human factors • Equipment failures • Corrective actions

Sweden	The reporting criteria for reporting LER:s to the SSM are established in the regulation SKIFS 2004:1. See answers in Q2. **Content of a Swedish LER events** – according to an established LER sheet format. A preliminary LER have to be written within 7 days. A final LER in 30 days. Plant name, date and time information, title, system and components affected, status, category of report, deviation from Tech.Spec. chapter, operation mode at discovery, operational consequence, consequence on system level, workorders, event description and operational consequences, description of the dafety impact, description of background causes, improvements, lessons learnt. In the text fields of a LER it is expected that the root cause, human factors performance, maintenance and design impact, risk significance and consequences, dependencies, repeating failures, improvement suggestions, references to background sources are described in detail. LER:s are used for trend analysis, input to questions at inspections and plant visits, input documentation to investigations, - research projects. Most of the historical fire event reports are basically technical to the nature. In very seldom fire events report one can see the impact of the fire on changes on the organisation or way of working, instruction improvements, description of the consequences an so on. There are lot of space for improvements in the reporting and documentation of the fire events. At least we believe that this is also the situation at all OECD FIRE member countries. The OECD FIRE Coding Guideline should be used and tested and further developed among affected organisation outside the FIRE group.
Switzerland	Based on the actual reporting form B03.
United Kingdom	On receipt of event reports from licensees, HSE/NII assigns coarse consequence and causal codes to events considered to be nuclear safety significant in accordance with a documented procedure (http://www.hse.gov.uk/foi/internalops/nsd/bmm/bmmannex8.htm). These codes are: • Consequence (actual / potential) • Inadvertent criticality • Radiation / contamination release • Loss of containment • Radiation exposure (internal / external) • Loss of operational / process control • Plant/ equipment failure • Plant/ equipment damage / defect • Challenge to safety case

	• Reduced safety margins / safety barriers • Breach of operating limits and conditions, licence conditions and other relevant regulations • Enforced plant shutdown – automatic / manual • None • Other (Specify) • *Cause(s) – Causal factors • Plant / equipment defect / degradation • Maintenance failure • Design deficiency • Modification deficiency • Operational process deviation / defect • Loss of services • External event - natural / man-made • Human performance • Training • Procedural • Intentional / misinformed / unintentional or lapse • Management system • In addition, licensee to have more detailed information on events.
United States	1 hour and 8 hour notifications made by the licensee under 10 CFR 50.72 will include whatever information is known by the licensee at the time of the event such as location of the fire, onsite and offsite response, whether the fire is out, and any safety related systems affected by the fire. Event reports include: • Facility name, date/time of event, date/time of report, other notifications made (i.e. state/local authorities) • Emergency classification • criteria for reportability • event summary • updates as available 60 day licensee event reports submitted under 10 CFR 50.73 generally include more detail and follow a more prescriptive format. Information includes: Brief event abstract

	Clear, specific narrative description including: plant operating conditions, status of any inoperable systems or equipment that may have contributed to the event, dates and times of occurrences, cause of each component/system failure or personnel error, failure mode/mechanism of each failed component, method of discovery of each failure, root cause discussion for each human performance related root cause, automatic and manual safety system, manufacturer/model number for each component that failed during the event. An assessment of the safety consequences and implications of the event Description of any planned corrective actions Reference to any previous similar events at the same plant that are known to the licensee Discussion of the root cause of the event (if the licensee performed a root cause determination).

Question 6: Have you considered failure or spurious actuation of fire protection systems within the data analysis?

ANALYSIS	*There is no clear consensus in this area. In some countries it would be considered under the reporting requirements and hence would be within the data analysis, while in others, it would only be considered within a fire hazard analysis.*

Belgium	Failures of fire protection systems are effectively considered in the fire events analysis. One major finding from 2007 had to do with the design of RCP fire detectors at Doel 3. The 16 detectors are divided into 2 loops of 8. In the span of 10 days, one detector in each loop failed. Per the design, a failed detector in a loop rendered the remaining detectors in that loop unavailable, so with the failures of these 2 detectors, all fire detection capability for RCPs was made unavailable.
Canada	These are required to be assessed under the fire hazard analysis and fire safe shutdown analysis. Unless there are significant safety issues related to an event involving their discharge, they are not reported.
Czech Republic	Per regulations, failure and spurious actuations are considered. Design requirements are such that fire detection and protection systems, in the case of failure or random start-up, will not lose their functional capability from the viewpoint of nuclear safety. Licensees are required to track any failures in their OEF database, but frequency has been low so there are no apparent trends.
Finland	These questions are considered mainly in flood and fire PRA. Technical Specification includes descriptions of fire protection systems and compensatory measures in case of non-conformances in system operability or fire compartment integrity.
France	There is no specific reporting criteria for spurious actuation of fire protection system, except if such an occurrence lead to make the fire extinguishing system inoperable, or if the fire extinguishing system is under maintenance.
Germany	Failures and spurious actuations of all active fire protection systems and equipment are considered, corresponding plant specific and reliability data are to some extent available, see also the recent German guidance document on PSA data /FAK 05a/.
Hungary	Our database contains only one event involving spurious actuation of a fire protection system.
Japan	We have done fire analysis for typical plants. We did not assume any spurious actuation of the fire protection system, since we do not have enough or adequate data of spurious actuation to apply for the fire hazard analysis

Netherlands	Yes, failure and spurious actuation of the fire protection system are considered in the analysis. Spurious actuations are a great nuisance to both plant personnel and the local and regional fire departments, especially when fire alarms are directly sent to the regional alarm control point.
Russia	Yes, this data are collected by the operators
Slovakia	Failures of fire protection systems are considered in our analysis. In addition, reliability of fire protection systems is monitored – with semi-annual and annual reports submitted. No failures or unanticipated actuations of fire protection systems have been observed. Reliability of non-active fire protection systems (alarm systems) has been high. Our database shows that only 0.05% of alarm indications have been false alarms.
Slovenia	Failure or spurious actuation of fire protection systems is considered in our data analysis.
Spain	Plants are beginning to consider, in their fire risk analysis, issues concerning fire-induced circuit failures, including multiple spurious actuations, along with operator manual actions. In general, Spanish plants need to satisfy the requirements of United States 10CFR Part 50 Appendix R. In addition, they are required to follow either the deterministic approach according to 10 CFR 50.48(a) and (b), Appendix R, and SRP section 9.5-1, or the Probabilistic approach outlined in NFPA 805 and 10CFR 50.48(c). In 2006-2007, CSN required all plants to execute, within 2 years, a fire risk analysis that requires plants to consider fire-induced circuit failures along with spurious actuations.
Sweden	This is a failure mode, discussed in lot of different safety analysis, as well as in lot of PSA:s. Spurious actuations of systems and components, due to short circuit, initiated by a fire is tricky failures to deal with and lot of research and development efforts are put on this question. For time being no specific reporting criteria is set for this particular failure mode. It is however, expected that the licensees have a discussion about this failure mode in the plant specific PSA, especially if the failure mode is not analysed in the PSA. Fire protections systems are however analysed in the domestic PSA:s.
Switzerland	The design is that a failure or spurious actuation of a fire protection must not threaten the safety of the plant.
United Kingdom	Yes, Licensee arrangements under their arrangements for compliance with Licence Condition 7 encompass failure or spurious actuation of fire protection systems within their data analysis.

United States	There is no specific reporting criteria for failure or spurious actuation of fire protection systems. Knowledge of such an occurrence would be included if it was part of an event resulting in an emergency declaration (due to toxic atmosphere, etc) or an unanalyzed condition due to system failure. From an analysis standpoint, spurious actuations or malfunctions of safety-related systems due to short circuits caused by fires are addressed by nuclear power plant licensees in their post-fire safe-shutdown analysis. Currently, licensees only account for such spurious actuations to occur one at a time or in isolation, but the NRC plans to address the issue of multiple spurious actuations in the near future. Such spurious operation issues are addressed in the significance determination process for inspection findings related to fire safety.

Question 7: Have you observed a correlation between plant age and the frequency of fires?

ANALYSIS	*There has been no correlation observed between plant age and frequency of fires.*

Belgium	Due to few fire related events having been reported at our NPPs, it is difficult to establish a correlation between plant age and frequency of fires. Upon a review of our OEF on fire events, no difference in the relative number of fire events was observed between our 2 oldest plants and our other operating units.
Canada	To date, we have not observed this. However, the CNSC is only beginning to assess fire frequency data.
Czech Republic	Fire event frequency is so low that no correlation with plant age can be observed. All relevant symptoms of aging are thoroughly monitored and reviewed, and appropriate steps are taken to cope with this phenomenon.
Finland	Dependencies due to the ageing have not been observed. Fire protection systems are modernised and maintained regularly.
France	No.
Hungary	No relevant trend has been observed
Japan	We have experienced not so much fire incidents and the number of the fire incidents are not enough to find out any correlation between plant age and the frequency of the fire.
Netherlands	Yes, slightly less fires as the plant becomes older. See also below.
Russia	We have observed about 1 minor fire event per every 3-4 years for the average NPP unit. No correlation with age has been observed.
Slovakia	We have collected reports on fire events since the beginning of our programme of operating NPPs. No relevant trends has been observed related to plant age.
Slovenia	Our NPP has had 6 fire events in its 10 years of operation, with numerous alarm actuations. The relative number of fire annunciator actuations is decreasing with time, and the plant age seems to be having no impact on the frequency of fires.
Spain	Of 2 main fire events (Vandellos I in 1989, Vandellos 2 in 2008) neither event was attributable to plant age. One thing the regulatory body has done is to encourage NPPs to have more of a safety culture when it comes to fire detection and prevention

Sweden	No, for the domestic data. Too few severe domestic fire events are stored e.g., in our own LER database an in the OECD FIRE database. Fire is an event that is taken into account in most of the plant and modernisation projects. When older plants are modernized the fire safety must be considered in the design concepts. On the other hand, insurance companies have also established very tuff demands on the plants for fulfilment of the fire safety aspects. All plant modifications and modernization projects performed so far, have made plants more resistant against unwanted events and incidents, so the fire frequency and the impact of the fires should be decreasing. However, the statistical evidence of that can be seen first when e.g., all events in the OECD FIRE database are analysed (ongoing now). The only quite accurate trend that can bee seen from our Swedish fire events are that they are concentrated to the turbine building and to oil impacts.
Switzerland	Until now, no relevant trend has been observed.
United Kingdom	HSE/NII does not have evidence to show a correlation between plant age and frequency of fires. Licensees maintain a safety case which demonstrates the safety of the plant and identifies conditions and limits necessary in the interest of safety. The licensees are expected to maintain the plant in full compliance with the requirements of the safety case throughout the lifetime of the plant. The licensee is also required to have arrangements for periodic and systematic review and reassessment of safety cases, which is particularly relevant as the plant ages.
United States	No correlation has been observed between plant age and the frequency of fires. Fires that are reported by commercial nuclear power plants result from a wide range of causes, and are relatively infrequent. There is not enough data available to make any accurate correlations between plant age and frequency of fires.

Question 8: Can you identify trends in fire events related to ageing, life extension, and plant modifications?

ANALYSIS	*Generally no trends have been observed in relation to ageing/life extension, but some have been observed due to the nature of plant modifications.*

Belgium	The event at Tihange 1 in 2003 could possibly be attributed to plant aging. The fire burned the polyvinyl chloride 6kV cables in a cable spreading room ignited. One of the root causes of the fire was the thermal aging of the cables due to exposure to high temperatures. Following the incident, the polyvinyl chloride 6kV cables in all NPPs were replaced.
Canada	There appear to be definite trends in terms of initiating events related to life extension and plant modifications. Aging issues have not been looked at yet.
Czech Republic	Aging phenomena are taken into account when reviewing fire protection status during periodic safety reviews. Results of periodic testing are used as a basis. If the testing reveals a potential trend towards reduced equipment reliability or aging, appropriate actions are taken to prevent its negative effects. One such action would be replacement or modification of a system or component. Due to this approach, no trends have been identified in Czech NPPs.
Finland	In spite of the ageing of electrical components and cables, no trend of increasing of fire ignition frequency is seen. Modification of electrical components and cables are done in the process of life extension of NPPs. This with the improved preventive maintenance practices are cutting the ageing effects and therefore no trend of increasing of fire ignition frequency is seen.
France	No relevant trends observed.
Germany	In general up to now only trends in fire events to plant modifications have been identified.
Hungary	No relevant trend observed
Japan	We have experienced not so much fire incident and the number of the fire incidents are not enough to identify any trends with aging, life extension and plant modifications.
Netherlands	Yes, fires during significant backfitting operations in the turbine hall. Spurious operations after major overhauls and backfitting of detection rings. Ageing sec has no negative influence since periodic backfitting usually improves the fire protection process as a whole.
Russia	No trends observed

Slovakia	No relevant trend of fire operating events has been observed related to these factors
Slovenia	No relevant trends observed
Spain	In some cases, the work being carried out in the plants during modifications have originated spurious actuation of fire protection systems. Other spurious actuations have occurred during swapover to digital detectors No actual fire events have occurred due to plant modifications
Sweden	No, for the domestic data. Too few severe domestic fire events are stored e.g., in our own LER database an in the OECD FIRE database. See previous answer.
Switzerland	One trend has been observed: when the plant modification uses a lot of fireworks (welding, grinding, …), the number of fire events has increased.
United Kingdom	The risk of fire events can potentially increase during outages or during plant modifications compared with normal operations, although the consequences may be less severe if the plant is shutdown because of the safer state of the plant. This increased fire risk can be due to increased numbers of hot work operations and the need on occasion to degrade the fire protection systems, i.e. isolating fire detection and suppression systems, breaking open fire barriers. HSE/NII expects licensees to put in place enhanced fire provisions during modifications and outages, for example, fire watches.
United States	No. There have not been enough fire-related events in U.S. commercial nuclear power plants to develop any accurate trends related to aging/life extension/plant modifications.

Question 9: Have modifications to fire protection systems resulted in a reduction in frequency of fires?

ANALYSIS	*Responses vary based on the interpretation of the question and definition of fire. In general it appears that modifications have improved safety by limiting the growth or consequences of fires but not the frequency of them.*

Belgium	Due to the low number of fire events, we cannot assess the effectiveness of fire protection modifications
Canada	In some cases we believe this to be the case, Our project under the OECD Fire Database Exchange is only beginning to provide us some insight. We expect that, as this project continues, it will yield more frequency / modification correlations.
Czech Republic	No trends observed, but it is evident that modernizations are reducing fire risk. Upgrades to our fire protection programme are still being implemented. In addition to fire PSR, the following activities are being performed: • Periodic revisions of fire analyses • Modernization of fire protection components (doors, fire flap valves, penetrations, MCP's, EDG fire detectors/extinguishers, etc) • Fire detection system upgrades • Modernization of piping
Finland	We have experiences only from small fires at NPP. The risk of fire spreading is reduced by new sensitive fire detection and effective automatic fire extinguishing systems.
France	The frequency of fire has been reduced due to the implementation of fire preventive measures and modifications, i.e. specific storage for flammable substances, training related to prevention of fire notably during shutdowns,…
Germany	To some extent, modifications and improvements in the fire protection features including number of equipment etc. have resulted in reduced fire frequency and CDF values.
Hungary	While no trends have been observed, several modifications have been prescribed in 2000-2007
Japan	We have experienced not so much fire incident and most of the fire incidents we have experienced are during the inspection and maintenance period. So, we do not have any data to identify the reduction of the fire after the modifications to fire protection systems.
Netherlands	Better detection systems will detect more. The number of false alerts increases sometimes.

	It seems that the frequency of fire has not changed much over the years, it is marginally lower, but statistically this is insignificant.
Russia	Yes, there has been an impact related to modernization efforts from 1990-2000. Complex fire-preventive measures were implemented, aimed at eliminating deviation from requirements in the regulations. Some important improvements include: • firewater monitors for cooling structural metal are mounted in the control rooms; • control rooms are equipped with deflectors for removal of hydrogen and smoke; • refractory quality of structural metal is increased (up to 0,75 hour) by covering it with flame retardants; • combustible insulant in the turbine hall roofing is substituted for fire-resistant one; • cable paths are treated with flame retardants; • extended evacuation corridors and cable tunnels are subdivided into fire compartments; • fire resistance limits of doors and cable space partitions are increased up to 1,5 hours; • fire-protective packing of cable penetrations and fire-protective belts are executed; • cast-iron isolation valves in automatic fire-extinguishing units are substituted for steel ones; • gas fire-extinguishing units in cable structures are substituted for water fire-extinguishing units; • automatic process control system (APCS) premises (including MCR, SCR and others) are equipped with automatic fire-extinguishing units; • modernization of fire-alarm is carried out; • additional fire cutoff valves of air discharge purification systems are installed; • in the premises of CR APCS space air overpressure systems are installed; • combustible plasticate on the escape routes and in the contamination control area is substituted for fireproof coating.
Slovakia	Yes modifications to fire protection systems have reduced the number of fire operating events.
Slovenia	While the frequency of fires is too low to measure effectiveness of modifications, the modifications are implemented in order to increase fire protection system availability and reliability and decrease overall CDF.
Spain	There is no statistical data, but there has been a reduction in fire frequency due to fire protection system modifications. Fire awareness has been increased due to the diligent work of resident inspectors and risk-informed inspections. These aspects are motivators that have also resulted in a reduction in fire frequency.

Sweden	No, for the domestic data. Too few severe domestic fire events are stored e.g., in our own LER database an in the OECD FIRE database. See previous answer.
Switzerland	No trend has been observed.
United Kingdom	Fire protection systems can affect the growth or consequence of a fire but not the frequency.
United States	Per 10 CFR 50.48, licensees may make changes to their fire protection programmes without NRC approval provided the changes do not result in a reduction in effectiveness in fire protection for the facility that could result in a radiological hazard. The NRC put together a matrix of reported fire events from 1995 through 2007. The data did not show any trends in the number of fire events reported per year. From 2000-2007, an average of 10 fire events were reported per year, with approximately 70% of the events resulting in an Emergency Action Level (EAL) declaration.

Question 10: Have you made any changes in new build design or plant modifications based on operating experience for fire?

ANALYSIS	*Yes, there are many examples of plant modifications based on operating experience for fire and these are being taken into consideration for new build.*

Belgium	In addition to the polyvinyl chloride 6 kV cable replacement described above, additional efforts to reduce the effects of thermal aging have included installation of new ventilation systems in cable spreading rooms to reduce ambient temperature. Oil collection trays are also now required on all main steam isolation valves as a result of an oil-soaked insulation fire at Tihange 2 in 2000.
Canada	Yes, OPEX has been incorporated into design changes, future modifications and is a requirement for new builds under regulatory document RD-337 *Design of New Nuclear Power Plants*. This document, which has been approved by the CNSC is awaiting final translation, but a draft can be found at: http://www.nuclearsafety.gc.ca/pubs_catalogue/uploads/RD-337_Draft2_e.pdf.
Czech Republic	No new build designing is underway in the Czech Republic currently.
Finland	STUK's regulatory guide is stating that passive fire protection is the first priority and active fire protection has secondary meaning in total fire safety. New NPPs are designed in accordance with fire hazard analysis, fire simulation and fire PRA. Following changes have been made in basic design phase of new NPP concepts compared to old NPPs. • Passive (structural) fire protection is in four divisions. • Flame Retardant Non-Corrosive (FNRC) cables are used.
France	Changes have been made on new build design, i.e. on the EPR : • specific storage zones for fire loads, which will be used during the unit outage, have been determined ; • separation of redundant safe-shutdown trains and separation of cabling have been taken into account ; • automatic fire extinguishing system in every room which contain radioactive material. Following the turbine hall fire in the Blayais plant in 2005, modifications have been implemented on every plants, in order to reinforce the fire prevention and the fire protection of turbine halls : • building sectorization ; • fire detection ;

	• fire extinguishing system ; • smoke extraction system (…).
Germany	There is no new build design in Germany, i.e. we cannot respond this part of question. Regarding modifications, there were made modifications / modernizations / replacements to some extent (e.g. more and different types of fire detectors, different extinguishing strategy, etc.) , these were based on the one hand on fire protection features performance and reliability data and on results from PSA performed in the frame of (periodic) Safety Reviews. /FAK 05/ Facharbeitskreis (FAK) Probabilistische Sicherheitsanalyse für Kernkraftwerke Methoden zur probabilistischen Sicherheitsanalyse für Kernkraftwerke, Stand: August 2005, BfS-SCHR-37/05, Wirtschaftsverlag NW / Verlag für neue Wissenschaft GmbH, Salzgitter ISSN 0937-4469, ISBN 3-86509-414-7, Oktober 2005 /KTA 00/Kerntechnischer Ausschuss (KTA) Sicherheitstechnische Regel des KTA: KTA 2101, Brandschutz in Kernkraftwerken, Teil 1-3, Fassung 12/00; Dezember 2000
Hungary	Some examples of modifications as a result of survey reports: • Modification of scheme display control software • The modification of the connection between the high-pressure ECCS pump and its tank. • Modification of ECCS pump pressure leg and other pipes in order of gassing • The use of the wires of reactor hall crane at twin-unit 1 mechanically not protected shall be unplugged and the use shall be prohibited. • With the aim to substitute them, the reconstruction of the referred wires of the reactor hall cranes at both of the twin-blocks shall be carried out. • Possibility of under voltage fire extinguishing shall be carried out independently on the install fire protection system • The elimination of differences of the Main Coolant Pump oil system pipes on the different units and carrying out a uniform solution.
Japan	We have experienced the fire of the house service transformer of Kashiwazaki-Kariwa NPS by the 2007 Niigataken Chuetsu-oki Earthquake. As operating experience feedback, our utilities have enhanced their fire protection systems for existing reactors, such as to: • organize insite fire fighting team with 10 employees and 24 hour on duty status, • facilitate onsite fire engines • Fire fighting water supply system. We are still investigating to enhancing fire protection systems considering the external events.
Netherlands	There has been systematic backfitting during the two major ten-yearly periodic safety re-evaluations that the plant has undergone.

	Some modifications: • Fire detection and suppression system for reactor main coolant pumps. • More automatic fire suppression systems in cable corridors and trenches. • Use of Inergen after Halons were prohibited. • Turbine hydraulic control system replaced by electric control system. • Spatial separation of all emergency feedwater pumps and all high and low pressure safety injection pumps.
Russia	Yes, for the new generation VVER 1200 (Leningrad NPP 2, Unit 1) the following fire protection improvements are being considered: Concept of defence in depth, realizing the principles of passive fire protection with limited use of active fire protection means Passive fire protection improvements include: • reduction of fire hazard level of all main buildings and constructions by introducing building and finishing materials as well as cables with reduced (in accordance with requirements of NPB114-02) fire hazard; • absence of technological systems of production, storage and use of gaseous hydrogen; • reduction of fire hazard level of technological equipment in the turbine building due to application of fire-resistant oil (OMTI) in turbine oiling system and disuse of hydrogen in the turbine cooling system; • reduction of fire hazard level of equipment in containment due to application of Reactor Coolant Pumps (RCP) with water-lubricated bearings; • Implementation of a passive way (special pallets) of extinguishing during spills of inflammable oils from equipment, situated in containment (including electric motors of RCPs and in the turbine building; • preliminary processing and fire-safe (in airtight packing) storage of inflammable solid radioactive waste, not requiring presence of gas fire-extinguishing systems, used in the depositaries of existing NPPs. in what concerns fire localization: • subdivision of main buildings and constructions into fire zones (building, part of the building) is carried out on the basis of calculated justification of actual refractory quality of their boundaries in the situation of free fire development (not taking into consideration extinguishing facilities impact); • for each fire zone an assembly of passive fire-protection elements (including active elements – fire floats), preventing in the situation of fire back-up trains of safety systems from failure , is regarded as safety system – a system of passive fire protection).

	Active system improvements include: • *absence of systems of active fire-extinguishing in containment due to the presence of passive fire-protection system;* • *increased number of automatic fire-extinguishing systems (equipment with such systems of all fire-hazardous locations within main buildings and in power unit constructions);* • *assignment to all elements of fire protection monitoring and control system in the main buildings and constructions of higher safety class (not less than class 3 according to OPB-88/97), which ensures their stability against internal and external (including earthquakes) impacts.*
Slovakia	During the modernization of NPP Bohunice, the following modifications were implemented: • Heat removal systems from main transformers with aim to protect main turbines building in case of fire (controlled from MCR, cameras, monitoring and extinguishing systems) • Extinguishing system of main TGs oil systems (oil tanks and pumps) • Extinguishing system of Main Feedwater System (oil tanks and pumps) • Main turbines building fire monitoring systems • Reactor Coolant Pumps fire monitoring and extinguishing system (extinguishing system based on carbon dioxide)
Slovenia	No modifications resulting from Operating experience.
Spain	New construction buildings in Spain have been built with accumulated state of the art Operating experience. The Vandellos I fire in 1989 revealed important design deficiencies such as physical separation between trains and buildings. Subsequently, CSN adopted 10 CFR Part 50 Appendix R and SRP 9.5-1 requirements from the U.S. As a result of the 2007 Japanese earthquake event, seismic systems were installed for the fire fighting water supply in areas containing safe shutdown equipment. Physical fitness requirements for members of the fire brigade are also being adopted.
Sweden	Yes. In year 2004 former SKI published the regulation concerning the design and construction of NPP:s in SKIFS 2004:2. This regulation demand the licensees to perform major plant modifications, so they can be operated according to modern construction demands. Most of the modernisations projects actual at this time in Sweden, have as one of their goals to build away the dependences a fire can result in. The consequence of occurred Swedish fires have resulted in design modifications at the plants, changes in instructions, changes in organising the fire fighting brigade, changes in training of Rescue Services personnel and own fire fighting personnel.

Switzerland	There is one example of plant modification based on a fire: installation of fire-protection valves at the turbine oil-tanks.
United Kingdom	HSE/NII expects licensees and new build Requesting Parties to take account of fire research and development and their own, other licensees and international operating experience in the safety cases they submit for new build or plant modifications.