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IAEA Safety Standards

for protecting people and the environment

A System for the Feedback of Experience from Events in Nuclear Installations

Safety Guide

No. NS-G-2.11

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IAEA SAFETY RELATED PUBLICATIONS

IAEA SAFETY STANDARDS

Under the terms of Article III of its Statute, the IAEA is authorized to establish or adopt standards of safety for protection of health and minimization of danger to life and property, and to provide for the application of these standards.

The publications by means of which the IAEA establishes standards are issued in the **IAEA Safety Standards Series**. This series covers nuclear safety, radiation safety, transport safety and waste safety, and also general safety (i.e. all these areas of safety). The publication categories in the series are **Safety Fundamentals, Safety Requirements** and **Safety Guides**.

Safety standards are coded according to their coverage: nuclear safety (NS), radiation safety (RS), transport safety (TS), waste safety (WS) and general safety (GS).

Information on the IAEA's safety standards programme is available at the IAEA Internet site

http://www-ns.iaea.org/standards/

The site provides the texts in English of published and draft safety standards. The texts of safety standards issued in Arabic, Chinese, French, Russian and Spanish, the IAEA Safety Glossary and a status report for safety standards under development are also available. For further information, please contact the IAEA at P.O. Box 100, A-1400 Vienna, Austria.

All users of IAEA safety standards are invited to inform the IAEA of experience in their use (e.g. as a basis for national regulations, for safety reviews and for training courses) for the purpose of ensuring that they continue to meet users' needs. Information may be provided via the IAEA Internet site or by post, as above, or by e-mail to Official.Mail@iaea.org.

OTHER SAFETY RELATED PUBLICATIONS

The IAEA provides for the application of the standards and, under the terms of Articles III and VIII.C of its Statute, makes available and fosters the exchange of information relating to peaceful nuclear activities and serves as an intermediary among its Member States for this purpose.

Reports on safety and protection in nuclear activities are issued in other publications series, in particular the **Safety Reports Series**. Safety Reports provide practical examples and detailed methods that can be used in support of the safety standards. Other IAEA series of safety related publications are the **Provision for the Application of Safety Standards Series**, the **Radiological Assessment Reports Series** and the International Nuclear Safety Group's **INSAG Series**. The IAEA also issues reports on radiological accidents and other special publications.

Safety related publications are also issued in the **Technical Reports Series**, the **IAEA-TECDOC Series**, the **Training Course Series** and the **IAEA Services Series**, and as **Practical Radiation Safety Manuals** and **Practical Radiation Technical Manuals**. Security related publications are issued in the **IAEA Nuclear Security Series**.

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A SYSTEM FOR THE FEEDBACK OF EXPERIENCE FROM EVENTS IN NUCLEAR INSTALLATIONS

Safety standards survey

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The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

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A SYSTEM FOR THE FEEDBACK OF EXPERIENCE FROM EVENTS IN NUCLEAR INSTALLATIONS

SAFETY GUIDE

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2006

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FOREWORD

by Mohamed ElBaradei
Director General

The IAEA's Statute authorizes the Agency to establish safety standards to protect health and minimize danger to life and property — standards which the IAEA must use in its own operations, and which a State can apply by means of its regulatory provisions for nuclear and radiation safety. A comprehensive body of safety standards under regular review, together with the IAEA's assistance in their application, has become a key element in a global safety regime.

In the mid-1990s, a major overhaul of the IAEA's safety standards programme was initiated, with a revised oversight committee structure and a systematic approach to updating the entire corpus of standards. The new standards that have resulted are of a high calibre and reflect best practices in Member States. With the assistance of the Commission on Safety Standards, the IAEA is working to promote the global acceptance and use of its safety standards.

Safety standards are only effective, however, if they are properly applied in practice. The IAEA's safety services — which range in scope from engineering safety, operational safety, and radiation, transport and waste safety to regulatory matters and safety culture in organizations — assist Member States in applying the standards and appraise their effectiveness. These safety services enable valuable insights to be shared and I continue to urge all Member States to make use of them.

Regulating nuclear and radiation safety is a national responsibility, and many Member States have decided to adopt the IAEA's safety standards for use in their national regulations. For the Contracting Parties to the various international safety conventions, IAEA standards provide a consistent, reliable means of ensuring the effective fulfilment of obligations under the conventions. The standards are also applied by designers, manufacturers and operators around the world to enhance nuclear and radiation safety in power generation, medicine, industry, agriculture, research and education.

The IAEA takes seriously the enduring challenge for users and regulators everywhere: that of ensuring a high level of safety in the use of nuclear materials and radiation sources around the world. Their continuing utilization for the benefit of humankind must be managed in a safe manner, and the IAEA safety standards are designed to facilitate the achievement of that goal.

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IAEA SAFETY STANDARDS

SAFETY THROUGH INTERNATIONAL STANDARDS

While safety is a national responsibility, international standards and approaches to safety promote consistency, help to provide assurance that nuclear and radiation related technologies are used safely, and facilitate international technical cooperation, commerce and trade.

The standards also provide support for States in meeting their international obligations. One general international obligation is that a State must not pursue activities that cause damage in another State. More specific obligations on Contracting States are set out in international safety related conventions. The internationally agreed IAEA safety standards provide the basis for States to demonstrate that they are meeting these obligations.

THE IAEA STANDARDS

The IAEA safety standards have a status derived from the IAEA's Statute, which authorizes the Agency to establish standards of safety for nuclear and radiation related facilities and activities and to provide for their application.

The safety standards reflect an international consensus on what constitutes a high level of safety for protecting people and the environment.

They are issued in the IAEA Safety Standards Series, which has three categories:

Safety Fundamentals

— Presenting the objectives, concepts and principles of protection and safety and providing the basis for the safety requirements.

Safety Requirements

— Establishing the requirements that must be met to ensure the protection of people and the environment, both now and in the future. The requirements, which are expressed as 'shall' statements, are governed by the objectives, concepts and principles of the Safety Fundamentals. If they are not met, measures must be taken to reach or restore the required level of safety. The Safety Requirements use regulatory language to enable them to be incorporated into national laws and regulations.

Safety Guides

— Providing recommendations and guidance on how to comply with the Safety Requirements. Recommendations in the Safety Guides are expressed as 'should' statements. It is recommended to take the measures stated or equivalent alternative measures. The Safety Guides present international good practices and increasingly they reflect best practices to

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help users striving to achieve high levels of safety. Each Safety Requirements publication is supplemented by a number of Safety Guides, which can be used in developing national regulatory guides.

The IAEA safety standards need to be complemented by industry standards and must be implemented within appropriate national regulatory infrastructures to be fully effective. The IAEA produces a wide range of technical publications to help States in developing these national standards and infrastructures.

MAIN USERS OF THE STANDARDS

As well as by regulatory bodies and governmental departments, authorities and agencies, the standards are used by authorities and operating organizations in the nuclear industry; by organizations that design, manufacture for and apply nuclear and radiation related technologies, including operating organizations of facilities of various types; by users and others involved with radiation and radioactive material in medicine, industry, agriculture, research and education; and by engineers, scientists, technicians and other specialists. The standards are used by the IAEA itself in its safety reviews and for developing education and training courses.

DEVELOPMENT PROCESS FOR THE STANDARDS

The preparation and review of safety standards involves the IAEA Secretariat and four safety standards committees for safety in the areas of nuclear safety (NUSSC), radiation safety (RASSC), the safety of radioactive waste (WASSC) and the safe transport of radioactive material (TRANSSC), and a Commission on Safety Standards (CSS), which oversees the entire safety standards programme. All IAEA Member States may nominate experts for the safety standards committees and may provide comments on draft standards. The membership of the CSS is appointed by the Director General and includes senior government officials having responsibility for establishing national standards.

For Safety Fundamentals and Safety Requirements, the drafts endorsed by the Commission are submitted to the IAEA Board of Governors for approval for publication. Safety Guides are published on the approval of the Director General.

Through this process the standards come to represent a consensus view of the IAEA's Member States. The findings of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the recommendations of international expert bodies, notably the International Commission on Radiological Protection (ICRP), are taken into account in developing the standards. Some standards are developed in cooperation with other bodies in the United Nations system or other specialized agencies, including the Food and Agriculture Organization of the United Nations, the International

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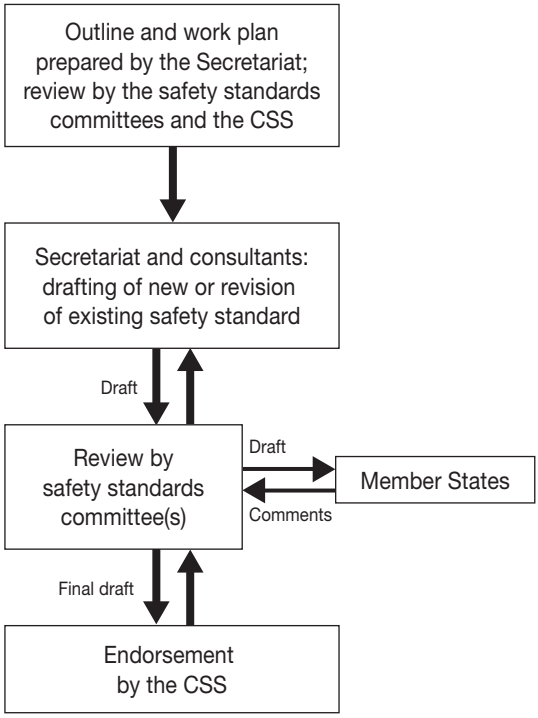

The process for developing a new safety standard or revising an existing one.

Labour Organization, the OECD Nuclear Energy Agency, the Pan American Health Organization and the World Health Organization.

The safety standards are kept up to date: five years after publication they are reviewed to determine whether revision is necessary.

APPLICATION AND SCOPE OF THE STANDARDS

The IAEA Statute makes the safety standards binding on the IAEA in relation to its own operations and on States in relation to operations assisted by the IAEA. Any State wishing to enter into an agreement with the IAEA concerning any form of Agency assistance is required to comply with the requirements of the safety standards that pertain to the activities covered by the agreement.

International conventions also contain similar requirements to those in the safety standards, and make them binding on contracting parties. The Safety Fundamentals were used as the basis for the development of the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. The Safety

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Requirements on Preparedness and Response for a Nuclear or Radiological Emergency reflect the obligations on States under the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

The safety standards, incorporated into national legislation and regulations and supplemented by international conventions and detailed national requirements, establish a basis for protecting people and the environment. However, there will also be special aspects of safety that need to be assessed case by case at the national level. For example, many of the safety standards, particularly those addressing planning or design aspects of safety, are intended to apply primarily to new facilities and activities. The requirements and recommendations specified in the IAEA safety standards might not be fully met at some facilities built to earlier standards. The way in which the safety standards are to be applied to such facilities is a decision for individual States.

INTERPRETATION OF THE TEXT

The safety standards use the form 'shall' in establishing international consensus requirements, responsibilities and obligations. Many requirements are not addressed to a specific party, the implication being that the appropriate party or parties should be responsible for fulfilling them. Recommendations are expressed as 'should' statements in the main text (body text and appendices), indicating an international consensus that it is necessary to take the measures recommended (or equivalent alternative measures) for complying with the requirements.

Safety related terms are to be interpreted as stated in the IAEA Safety Glossary (http://www-ns.iaea.org/standards/safety-glossary.htm). Otherwise, words are used with the spellings and meanings assigned to them in the latest edition of The Concise Oxford Dictionary. For Safety Guides, the English version of the text is the authoritative version.

The background and context of each standard within the Safety Standards Series and its objective, scope and structure are explained in Section 1, Introduction, of each publication.

Material for which there is no appropriate place in the body text (e.g. material that is subsidiary to or separate from the main text, is included in support of statements in the main text, or describes methods of calculation, experimental procedures or limits and conditions) may be presented in appendices or annexes.

An appendix, if included, is considered to form an integral part of the standard. Material in an appendix has the same status as the main text and the IAEA assumes authorship of it. Annexes and footnotes to the main text, if included, are used to provide practical examples or additional information or explanation. Annexes and footnotes are not integral parts of the main text. Annex material published by the IAEA is not necessarily issued under its authorship; material published in standards that is under other authorship may be presented in annexes. Extraneous material presented in annexes is excerpted and adapted as necessary to be generally useful.

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1. INTRODUCTION

BACKGROUND

1.1. Operating experience is a valuable source of information for learning about and improving the safety and reliability of nuclear installations.[1] It is essential to collect such information in a systematic way that conforms with agreed reporting thresholds for events occurring at nuclear installations during commissioning, operation, surveillance and maintenance activities and decommissioning, and on deviations from normal performance by systems and by personnel, which could be precursors of events.

1.2. In 1989 the IAEA issued a Safety Guide on A System for Reporting Unusual Events in Nuclear Power Plants (Safety Series No. 93). The Safety Guide presented a recommended scheme that was based on available national practice and was applicable to the management of safety related operational experience in nuclear power plants. The Safety Guide consisted of two parts: Part I, A National System, and Part II, the IAEA Incident Reporting System. The Incident Reporting System was developed in the early 1980s by the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD) and has been a single system jointly operated by the IAEA and OECD/NEA since 1998. The joint IAEA/NEA Incident Reporting System Guidelines have been published by the IAEA [1]; they supersede Part II of Safety Series No. 93.

1.3. The IAEA Safety Standards Series publications Safety of Nuclear Power Plants: Operation [2] and Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety [3] set out safety requirements for the feedback of operating experience. In the Nuclear Safety Convention, which entered into force in July 1996, the importance of the feedback of operational experience is fully recognized in Article 19 as a tool of great importance for the safety of the operation of a nuclear power plant and its further enhancement.

[1] A nuclear installation is a nuclear fuel fabrication plant, nuclear reactor (including subcritical and critical assemblies), research reactor, nuclear power plant, spent fuel storage facility, enrichment plant or reprocessing facility.

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1.4. This Safety Guide provides recommendations and guidance on meeting these requirements as established in Refs [2, 3] and constitutes an update and an extension of Part I, A National System, of the Safety Guide on A System for Reporting Unusual Events in Nuclear Power Plants (IAEA Safety Series No. 93).

OBJECTIVE

1.5. The objective of this Safety Guide is to provide guidance for the establishment of an operational experience feedback system for managing operational experience on a national basis. It brings together common elements that typically constitute an effective system at the national level. It should be noted that the process of feedback of operational experience is undertaken by many different organizations throughout the world (licensees, regulators, designers, international organizations) which, by cooperating, can help to ensure that the overall process of gathering operational experience for feedback is efficient and effective. This Safety Guide identifies the various organizations within a State and their roles and responsibilities, and gives guidance on the timing of their involvement in the overall process.

SCOPE

1.6. This Safety Guide provides recommendations on all the main components of systems for the feedback of operational experience for gathering relevant information on events and abnormal conditions that have occurred at nuclear installations throughout the world. It focuses on the interaction between the different systems for using feedback on operational experience. The publication provides guidance for all the organizations that are professionally involved in the nuclear industry, such as regulatory bodies, technical support organizations, operating organizations with ongoing or planned nuclear programmes, vendor companies (designers, engineering contractors, manufacturers, etc.), research establishments and technical universities with studies in the nuclear field.

1.7. Operational experience feedback systems are based on systems of plant operators. Relevant guidance is provided, for example, in Safety Guide No. NS-G-2.4 on The Operating Organization for Nuclear Power Plants [4]. Such systems make use of experience from the recurrent testing and maintenance of safety related equipment and the collection of plant specific

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reliability information and data on performance indicators of system or human performance.

1.8. This Safety Guide does not deal with the special reporting procedures covered by the Convention on Early Notification of a Nuclear Accident or those that may be necessary under emergency conditions or that are covered by the International Nuclear Event Scale [5].

1.9. This Safety Guide is not intended to cover communications subsequent to an event at a nuclear installation that relate to decisions concerning the operation of the installation during an accident.

STRUCTURE

1.10. Section 2 covers the need for a national system for the feedback of operational experience. Sections 3–10 address the process that should be established for the feedback of operational experience, covering: screening of events (Section 3), investigation and analysis (Section 4), corrective actions (Section 5), trending and review (Section 6), utilization and dissemination of information (Section 7), reviewing of effectiveness (Section 8), quality assurance (Section 9) and reporting of safety related events (Section 10). Additional detailed guidance is provided in Appendices I–IV. Additional information is given in the annexes.

2. MAIN ELEMENTS OF A NATIONAL SYSTEM FOR THE FEEDBACK OF OPERATIONAL EXPERIENCE

GENERAL

2.1. IAEA Safety Requirements publication No. NS-R-2 on Safety of Nuclear Power Plants: Operation [2] establishes in Section 2 the requirements for setting out a system for the feedback of operational experience to report, investigate, evaluate, trend, correct and utilize information in relation to abnormal events occurring at nuclear power plants and to disseminate this information to the relevant governmental bodies, national and international organizations and the public. In addition, IAEA Safety Requirements

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publication No. GS-R-1 on Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety [3] sets out the authority of the regulatory body to make available to other governmental bodies, national and international organizations and the public, information on incidents and abnormal occurrences. It also states the regulatory body's responsibility to establish national regulations in the field of operating experience feedback and to ensure that operating experience is appropriately analysed, that lessons to be learned are disseminated, and that appropriate records relating to the safety of facilities and activities are retained and are retrievable.

2.2. The importance of the feedback of operational experience as a tool of great importance for the safety of the operation of nuclear power plants and the need for its further enhancement are fully recognized in the Convention on Nuclear Safety, which entered into force in July 1996. Article 19 of the Convention, concerning Operation, requires that "…each Contracting Party shall take the appropriate steps to ensure that (vi) incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body; (vii) programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies."

IMPORTANCE FOR SAFETY OF LEARNING FROM THE FEEDBACK OF OPERATIONAL EXPERIENCE

2.3. One general technical criterion of safety for nuclear installations is that the organizations concerned ensure that operational experience and the results of research relevant to safety are exchanged, reviewed and analysed, and that lessons are learned and acted on. The primary objectives of a system for the feedback of operational experience are that no safety related event remains undetected and that corrections are made to prevent the recurrence of safety related events by improving the design and/or the operation of the installation. This criterion reflects the notion that an accident of any severity would most probably have been marked by precursor events, and to this extent would have been predictable and, therefore, avoidable. Feedback of experience also increases knowledge of the operating characteristics of equipment and performance trends, and provides data for quantitative and qualitative safety analysis.

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2.4. The investigation and reporting of events contribute to improvements in nuclear safety and have the following objectives:

— To identify and quantify events and conditions that are precursors to significant degradation and that have the potential to cause accidents that can lead to plant damage or releases of radioactive material;
— To identify events that are important to safety and their associated safety concerns and root causes, and to determine the adequacy of corrective actions taken to address the safety concerns;
— To discover emerging trends or patterns of potential safety significance;
— To assess how situations could have developed;
— To assess the generic applicability of events;
— To prevent the recurrence of similar events.

2.5. The organization that operates a nuclear installation should maintain an effective system for the collection and analysis of operational experience and should promptly disseminate safety significant information among its own staff and to other relevant organizations. The causes of all safety significant events should be determined and analysed. Events that may be regarded as precursors of accidents should also be identified and actions should be taken to prevent their recurrence. Each organization should learn from the experience of other organizations. The sharing of operating data should be coordinated nationally and internationally. In identifying important precursors, accident sequence precursor (ASP) studies (also termed probabilistic safety assessment (PSA) event analysis) are useful. Further information on ASP studies is provided in Annex I, paras I–12 to I–15.

2.6. Plants are designed to be safe. A systematic analysis of many potential failure sequences under the assumption of certain criteria (e.g. the single failure criterion) has helped in achieving the present generally high level of safety. To address the possibility of a potential failure of any of the plant's safety features, the concept of defence in depth [6] has been applied to the plant design. Owing to their well engineered design and the application of the defence in depth concept, most of the unplanned events that occur in nuclear installations do not have major consequences.

2.7. Events in nuclear installations are indicators of a weakness in, or the failure of, one or more of the barriers providing defence in depth. The complete and systematic detection of all failures of barriers is impossible. In many cases events may also indicate a lack of adequate supervision or deficiencies in the management of safety at the nuclear installation. From this point of view an

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event[2] should be taken as an opportunity for learning. The comprehensiveness and trustworthiness of the information on events that is provided to the regulatory body is an indicator of the installation's safety culture.

MAIN ELEMENTS OF A NATIONAL SYSTEM FOR THE FEEDBACK OF OPERATIONAL EXPERIENCE

2.8. Although national systems vary from State to State, an effective system for the feedback of operational experience relating to safety should cover the following:

- Reporting of events at plants;
- Screening of events — primarily on the basis of safety significance;
- Investigation of events;
- In-depth analysis, including causal analysis, of safety significant events;
- Recommended actions resulting from the assessment, including approval, implementation, tracking and evaluation;
- Wider consideration of trends;
- Dissemination and exchange of information, including by the use of international systems;
- Continuous monitoring and improvement of programmes for the feedback of safety related operational experience;
- A storage, retrieval and documentation system for information on events.

2.9. The above elements describe generally the important components that should be considered in the development and implementation of a national programme for the feedback of operational experience. Annex II presents an example of the main elements of a system for the feedback of operating experience. There should be a commitment from the management in the various participating organizations involved in the national operational experience feedback programme to ensure that it is efficient and effective.

[2] An event may be either a plant transient with accompanying failures or the anomalous performance of a function, or it may refer to a particular condition or the discovery of shortfalls in the plant safety systems, without an actual initiating transient. However, the distinction should be maintained between a low level event (with no consequences) as contrasted with a reportable condition, which may have a high significance for risk even though it has no immediate consequences.

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2.10. A system utilizing the feedback of operating experience is a two way process, i.e. for both providing and receiving experience. Internal operating experience refers to the process whereby a nuclear installation learns from its own experience — including sharing that experience with others — while external operating experience refers to the receiving of information that relates to another nuclear installation, which may lead to the development of corrective or preventive actions to avoid the recurrence of an event.

INVOLVEMENT OF THE REGULATORY BODY, OPERATING ORGANIZATION AND OTHER ORGANIZATIONS

2.11. Information on events, anomalies, situations and conditions starts at the plant level and should be communicated within the operating organization and then, in accordance with the relevant requirements, to the regulatory body, to other operating organizations and to research organizations, designers, contractors and other relevant parties. As a minimum, if event information yields lessons to be learned for other States it should be sent to the relevant international bodies (the IAEA/NEA or the World Association of Nuclear Operators/Institute of Nuclear Power Operations (WANO/INPO) reporting systems or both) for distribution. The flow of information on operational experience can thus run its full course from one State to another via the international coordinating agencies. At each step in the process of the dissemination of information, a number of the aforementioned elements (see para. 2.8) should be involved. Screening and analysis are two important elements in the flow of information.

2.12. A detailed procedure should be developed by the operating organization on the basis of the requirements for a national system established by the regulatory body. This procedure should define the process for dealing with all internal and external information on events at nuclear installations. The procedure should precisely define the structure of the system for the feedback of operational experience, the types of information, the channels of communication, the responsibilities of the groups and organizations involved, and the purpose of the documentation produced. Organizations that have various roles within the national process for the feedback of operational experience usually include operating organizations, the regulatory body, plant designers and research organizations. The procedure should be made available for review or approval by the regulatory body, if so required.

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LINKS BETWEEN NATIONAL AND INTERNATIONAL REPORTING SYSTEMS

2.13. The effectiveness of national systems for the feedback of operational experience can be significantly strengthened by linking them with international systems. Links between national and international systems for operational experience feedback broaden the sources of information on safety significant events, on the related lessons learned, and on the corrective actions taken at the plant or national level. Participants in such international systems can mutually benefit by sharing experience, reducing the risk of duplication and optimizing the use of resources to run the programmes in the domain of operational experience feedback.

2.14. Participation in international systems for operational experience feedback necessitates the establishment and harmonization of relevant parts of national systems for the feedback of operational experience. National systems for operational experience feedback should have procedures in place to deal with international information from the moment that it is received until the time that it is disseminated. The standard format and contents of Incident Reporting System reports [1] may be considered for adoption into national systems for operational experience feedback in order to link national and international systems more efficiently.

2.15. Some form of ranking of events should be considered in view of the number of events likely to be of interest and the resources needed to evaluate them.

2.16. Reports initially screened at a nuclear installation for applicability should also be screened by the regulatory body. This screening should consist of evaluating the specific area of applicability and the possible effects on the nuclear installation, and of estimating the potential for the event to occur at that nuclear installation.

2.17. The IAEA and the OECD/NEA jointly operate an international reporting system for exchanging information on safety related events that have occurred in nuclear installations, for States to benefit from the experience in operational safety gained in other States with nuclear power programmes. The international Incident Reporting System is established as an efficient system for exchanging important lessons learned from operational experience gained in nuclear installations in IAEA Member States and NEA States. The Incident Reporting System functions on the basis of the voluntary commitment of the

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