IAEA
International Atomic Energy Agency

IAEA/NEA Fuel Incident Notification and Analysis System (FINAS) Guidelines

IAEA

AEN NEA

Vienna, September 2006

Services Series 14

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The originating Section of this publication in the IAEA was:

Research Reactor Safety Section
International Atomic Energy Agency
Wagramer Strasse 5
P.O. Box 100
A-1400 Vienna, Austria

IAEA/NEA FUEL INCIDENT NOTIFICATION AND ANALYSIS SYSTEM (FINAS)
GUIDELINES
IAEA, VIENNA, 2006
IAEA-SVS-14
ISSN 1816–9309

Printed by the IAEA in Austria
September 2006

FOREWORD

The Fuel Incident Notification and Analysis System (FINAS) is an international system jointly operated by the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency of the Organisation for Economic Cooperation and Development (OECD/NEA).

The fundamental objective of FINAS is to contribute to improving the safety of fuel cycle facilities, which are operated worldwide. This objective can be achieved by providing timely and detailed information on both technical and human factors related to events of safety significance, which occur at these facilities.

The purpose of these guidelines, which supersede the previous NEA FINAS guidelines is to describe the system and to give users the necessary background and guidance to enable them to produce FINAS reports meeting a high standard of quality while retaining the high efficiency of the system expected by all Member States operating FCFs. These guidelines have been jointly developed and approved by the NEA/IAEA.

CONTENTS

1. BACKGROUND OF FINAS

In September 1990, the OECD/NEA Committee on the Safety of Nuclear Installations (CSNI) Working Group on Fuel Cycle Safety proposed instituting a Fuel Cycle Incident Reporting System, similar to the Incident Reporting System (IRS) used for nuclear power plants. The Working Group noted the importance and effectiveness of having a data base system to share operating experience between Member States. A guideline document, [1] was developed and the Fuel Incident Notification and Analysis System (FINAS) was initiated in 1992. A first revision of the FINAS guidance criteria was made in 1995 [2].

Accidents in the past underlined two already known major lessons with respect to operating experience feedback:

- Precursors of serious accidents have to be identified in a systematic way from operating experience to draw the necessary lessons and take appropriate and timely corrective actions;
- Lessons from precursors of serious accidents are not necessarily limited to one country. Thus, international exchange of operating experience important for safety is highly desirable and should be intensified.

The 2001 IAEA International Conference on Topical Issues in Nuclear Safety stated: "The IAEA should continue its work of fostering the international exchange of information on regulatory and safety issues for fuel cycle facilities. It is recommended that the IAEA build on its long-standing activities on event information exchange and analysis for NPPs (IRS, NEWS, INES) to fulfill the same role for other installations of the fuel cycle and seek co-operation with the OECD/NEA on its FINAS database. Action should be taken to collect and disseminate to all interested Member States the experience and lessons learnt".

2. OBJECTIVES OF FINAS

FINAS is established as a simple and efficient system to exchange *important lessons learned from operating experience* gained in FCFs of the IAEA and NEA Member States. The main objective of FINAS is to assure proper feedback on events of safety significance on a worldwide basis *to help prevent occurrence or recurrence of serious incidents or accidents*.

Events reported to FINAS should be of *safety significance for the international community in terms of causes and lessons learned*. For example, events may present potential serious consequences in terms of safety as precursors for more serious events.

FINAS is a system based on the voluntary commitment of the participating countries, which obviously benefit from the exchange of information. FINAS relies upon Member States, which are responsible for selecting events to be reported to FINAS.

The information should be provided to FINAS in a timely manner; indeed, early information on significant events in a country can assist in avoiding the same problem in other countries; this is the main objective of the system.

As there are differences in design, construction, and operation of FCFs, FINAS has to provide sufficient detail to highlight the relevance of the event to the recipient. Therefore, a FINAS report should provide detailed technical and human factors information on root causes, safety significance, lessons learned, and corrective actions.

Since FINAS focuses on significant events important for the international community, it should neither be viewed as a source for statistical studies nor for component reliability studies. In addition, the system is designed for specialists of the nuclear community as a source of detailed information on analysis and lessons learned from the events, as opposed to a simple description aimed at the public. (Note: the International Nuclear Event Scale (INES) information service is designed for the media and public information.)

The report should not contain any technical detail or diagram that may disclose security or non-proliferation features.

3. TYPES OF FACILITIES

The types of facilities included in FINAS are defined as any type of installation dealing with the nuclear fuel cycle other than nuclear power plants and research reactors or waste disposal repositories. Associated activities related to these facilities such as radioactive waste management and decommissioning, are included. These include such facilities as, but not limited to:

- Uranium and thorium mines and milling
- Refining facilities
- Conversion facilities
- Enrichment facilities
- Fuel fabrication facilities
- Radioisotope production facilities
- Waste freatment and fonditioning facilities
- Fuel handling and intermediate ftorage facilities
- Reprocessing facilities
- FCF research and development laboratories.

Fuel transportation aspects are currently not considered a part of the reporting system (although individual member States may make their own determination to report on specific cases).

FINAS does not address incidents or events related to fuel that occur at nuclear power plants, since these are taken into account by the IAEA/NEA IRS.

4. USE OF FINAS

FINAS is for official use, within each participating country, by organizations professionally involved in the nuclear industry, such as:

- Regulators
- Technical support organizations
- Operating organizations of FCFs
- Vendor companies (design firms, engineering contractors, manufacturers, etc.)
- Research establishments working in the fuel cycle field.

FINAS focuses on important safety related events with potential for lessons to be learned internationally, in particular precursors, events with potentiality for a facility serious accident. The reports communicate to experts of other countries the results of the analysis carried out and the lessons to be drawn. Thus, FINAS provides a pre-processed set of data, easily transferable to situations in other countries, allowing an efficient feedback process. In addition, the potential exists to include both licensee and regulator assessments of events.

FINAS relies upon national reporting systems and complements them by providing an international perspective. The need for FINAS and its justification can be found in its specific characteristics, its efficiency and the fact that recipients may benefit from FINAS in different ways.

FINAS is an important source of information for regulators and their technical support organizations providing insights on important international operational experience for fuel cycle facilities oversight and licensing purposes.

Operating organizations receive additional information with different perspectives, supplementing their own national and international reporting systems. Design and supplier companies should be able to improve their process design and manufacture of structures, systems and components by incorporating lessons learned. Research establishments should receive additional guidance for establishing research goals and programmes.

Dissemination of event information should also benefit the originating body by the increased opportunity for receiving feedback from other organizations. In this way dissemination will lead to a more broadly based effort to improve safety by using operating experience from FCFs. It may constitute an input to decision-making and to government programmes for assuring the public on the safe operation of the facilities.

5. DISTRIBUTION OF FINAS INFORMATION

FINAS information is disseminated by the Secretariat to FINAS national coordinators who are responsible for further dissemination to their national organizations.

Due to legal requirements in some countries participating in FINAS system, reports are generally classified as “Restricted” in order to encourage open and timely exchange of information. The restriction applied to the distribution of FINAS reports is justified by the detailed technical character of the information, which is provided by participating countries for official use by the international nuclear community. This was accepted when the system was established and remains valid.

The term “Restricted” means that once an FINAS report is transmitted to FINAS national coordinators, it is their responsibility to decide on its further distribution for official use within their country.

Official use means that FINAS reports are intended for representatives of regulatory bodies and technical support organizations, operating organizations, manufacturers and researchers of fuel cycle industry. They are not to be used by the recipients for further distribution, in particular for public information. This is the role of the INES information service.

Whenever the originator wishes to place additional restrictions on the distribution of a FINAS report, the report shall be annotated as "Confidential". In that case, the report distribution is limited to those organizations and persons specifically named by the originator.

The classification given by the originator shall be mentioned on all reports and on the cover of all the material produced for dissemination.

Restrictions placed on the distribution of information shall not be removed without the consent of its originating country.

6. REPORTING

6.1. EVENTS TO BE REPORTED[1]

To meet the objective of FINAS, events to be reported to FINAS should be selected according to the following general principles:

(i) The event itself is serious or *important* in terms of safety due to an actual or potential significant reduction in the facility's defence in depth; or
(ii) The event reveals *important lessons learned* that will help the international nuclear community to *prevent its recurrence* as a safety significant event under aggravated conditions or to *avoid the occurrence* of a serious or important event in terms of safety; or
(iii) The event is a repetition of a similar event previously reported to FINAS, but *highlights new important lessons learned* for the international community.

6.2. REPORTING CATEGORIES

In order to decide on the events to be reported, the following categories should be considered:

(1) Unanticipated or unexpected releases of radioactive or hazardous chemical material or exposure to radiation
(2) Degradation of safety functions
(3) Deficiencies in design, construction, operation (including maintenance and surveillance), quality assurance or safety evaluation
(4) Generic problems of safety interest
(5) Consequential actions
(6) Events of potential safety significance
(7) Effects of unusual external events of either man-made or natural origin
(8) Events which attract public interest.

A detailed explanation of these categories is given in Appendix B.

[1] An event does not mean only a single occurrence; an event may include a series of events, lessons or findings important for the international community.

6.3. CONTENT, REPORTING TIME AND FORMAT OF THE REPORTS

FINAS is intended to be not too formal in order to promote (easy) reporting and encourage open contacts among people responsible for operating experience feedback in participating countries.

The reporting should provide the international community with:

- A narrative description of the event (including the plant specific technical data necessary to understand all its consequences),
- A safety assessment,
- A cause analysis (explaining the root causes),
- The lessons learned and corrective actions taken.

Detailed guidance is given in Appendix A.

The lessons learned and actions taken should be clear and understandable to the international community to facilitate the assessment of the applicability to the situation in other countries.

The reporting shall also include a cover sheet with standardized information and an abstract giving the essential characteristics of the event, as well as codes facilitating event retrieval (see Appendix C).

The report should be provided in a *timely* manner, i.e. as soon as all the necessary information is available.

For events of high safety significance, a *preliminary* report may be submitted consisting of a brief description of the event and all relevant preliminary findings. The preliminary report should be submitted as soon as practicable. This preliminary report should be followed by a full report.

The format recommended for the preparation of FINAS reports should be used to the extent practicable. However, *flexibility* should be maintained for practical reasons, such as specific types of reports or different national requirements.

FINAS is operated in English. Whilst one of the other official languages of the Agencies may be used, Member States should submit FINAS reports in English in order to avoid undue delays.

7. FINAS OPERATION AND MANAGEMENT

7.1. PARTIES INVOLVED IN THE FINAS OPERATION AND MANAGEMENT

This section describes the role and relationship of the respective parties involved in the operation and management of the system. These are the participating countries, the Joint IAEA/NEA Technical Committee of FINAS national coordinators, NEA Committee of the Safety of Nuclear Installation (CSNI), the Joint IAEA/NEA FINAS Secretariat and the Joint IAEA/NEA FINAS Advisory Committee (Figure 1).

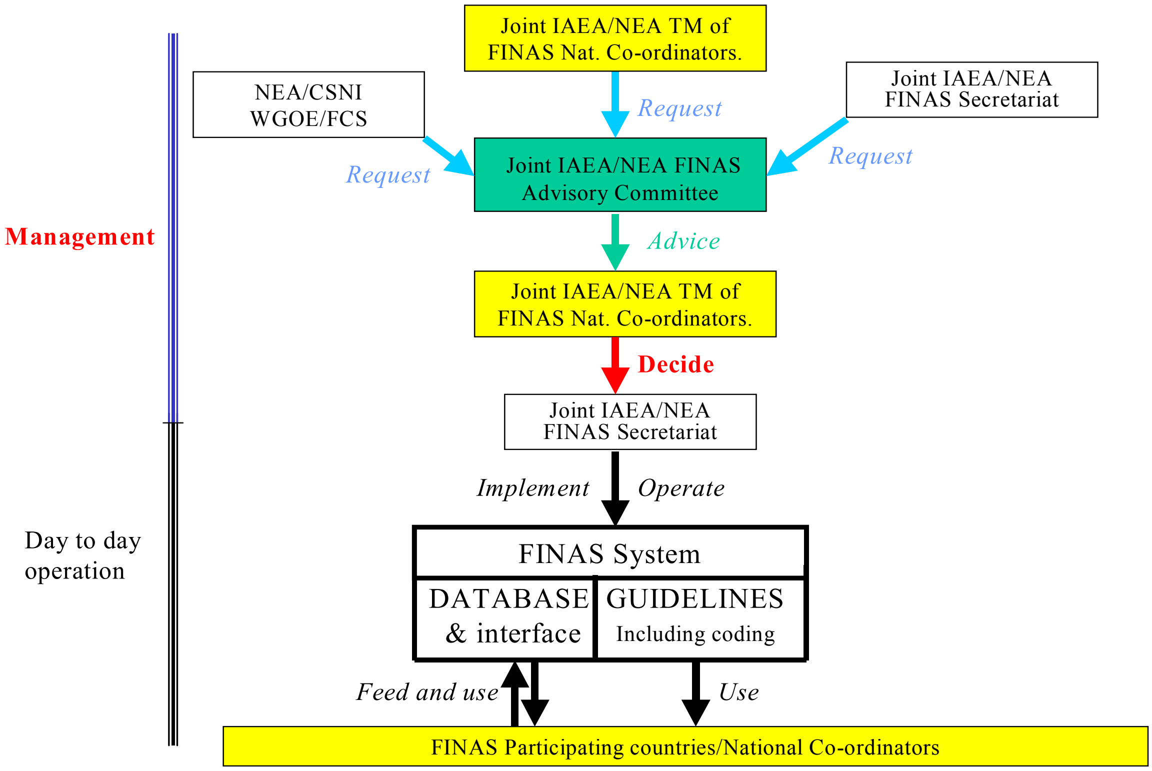

FIG. 1. FINAS operation and management chart.

7.2. ROLE OF PARTICIPATING COUNTRIES

While the viability of FINAS rests on the voluntary commitment of the participating countries to feed back appropriate information on significant events, its efficiency depends on the quality of the event selection and of the information exchanged among countries. Therefore, the primary role of participating countries is to ensure that all events with important lessons in terms of safety to be learned by the international community are effectively reported in a timely manner.

Effectiveness of FINAS also largely depends on its use. Therefore, the participants should promote, in their respective country, the use of FINAS. Participants should also collect feedback within their country, with the aim of contributing to improving and updating the FINAS system.

Participating countries shall designate a FINAS national coordinator to be responsible for receipt and distribution of information received from FINAS and for the transmission of information to FINAS. The reports and the associated attachments should be sent in English and in electronic format.

FINAS participating countries should keep full control over it. In particular, they have to agree at the Joint IAEA/NEA Technical Meeting of FINAS national coordinators on its objectives, decide on improvements and modifications in terms of content and format of the reports, management of the database and on related activities to be performed by the Joint IAEA/NEA FINAS secretariat. These agreements will be based on proposal to the Technical Meeting prepared by the Joint IAEA/NEA FINAS Advisory Committee.

The network of FINAS national coordinators can, via direct contacts, supplement the exchange of information.

Participating countries should allocate sufficient resources to take full advantage of the FINAS system as well as to contribute to it.

National coordinators have the responsibility to ensure the requirements defined in the last paragraph of Section 2 are met.

7.3. ROLE OF THE AGENCIES

7.3.1. Overall Role of the Agencies

The IAEA and NEA provide the framework, the infrastructure and the technical support to operate FINAS.

7.3.2. Role of the Joint IAEA/NEA Technical Committee of FINAS national coordinators and NEA/CSNI

The Joint IAEA/NEA Technical Committee of FINAS national coordinators and the OECD/NEA/CSNI regularly review the status of FINAS operation and management and provide recommendations to respectively the Joint IAEA/NEA FINAS Secretariat and NEA/CSNI. As described in the 2nd paragraph of Section 7.4, both meetings may request advice on FINAS matters to the joint IAEA/NEA FINAS Advisory Committee.

The Joint IAEA/NEA Technical Committee of FINAS national coordinators issues directions, through recommendations to the Joint IEAE/NEA FINAS secretariat, on actions to be taken to correct problems if necessary and implement any action agreed by the groups.

Any change in FINAS requires approval by both IAEA and OECD/NEA.

7.3.3. Role of the Joint IAEA/NEA FINAS Secretariat

The primary role of the Joint IAEA/NEA FINAS Secretariat is to operate FINAS, i.e. to act as central coordinators and provide technical support to participating countries for efficient operation and management of the system. In particular, the secretariats serve to:

- Compile, collate and disseminate all information related to events reported to the system by participating countries;
- Translate FINAS reports from official languages to English on an exceptional basis;
- Perform quality control of the reports and check their consistency;
- Request follow-up information as required;
- Make sure that all information received is periodically distributed in the manner requested by participating countries (normally CD ROM).

When defining the Joint IAEA/NEA FINAS secretariat, the IAEA and OECD/NEA secretariats coordinate their efforts so as to make sure that activities sponsored by both Agencies are not duplicated but rather complementary and meet the expectations of participating countries. These expectations are, namely, to have an efficient and useful system at hand, good management and quality control, and timely collection and distribution of FINAS information.

Whenever appropriate, the Joint IAEA/NEA FINAS secretariat play an active role in requesting participating countries to report.

7.4. ROLE OF THE JOINT IAEA/NEA FINAS ADVISORY COMMITTEE

The mandate of the Joint IAEA/NEA FINAS Advisory Committee is to assist participating countries and the two Agencies in making the best use of FINAS and to assure its high efficiency and performance. It supports the countries in keeping effective control over the system and assists the secretariats in providing effective technical support.

The Joint IAEA/NEA FINAS Advisory Committee plays an active role in providing guidance and advice on the IAEA/NEA FINAS guidelines, operation and management of the system, and in giving its views on specific FINAS matters as requested by the Agencies, participating countries as well as the Technical Committee of FINAS national coordinators and the NEA/CSNI. The Advisory Committee is clearly neither intended to take decisions regarding the operation of FINAS, nor to carry out technical analysis.

Usually the Joint IAEA/NEA FINAS Advisory Committee forwards its advice and recommendations with regard to FINAS operation and management to the Joint IAEA/NEA Technical Committee of FINAS national coordinators for their review and proposals. In case of a specific request, the Joint IAEA/NEA FINAS Advisory Committee will give its view and advice to an agency or member country.

Appendix A

PROCEDURE FOR PREPARATION OF FINAS REPORTS

1. INTRODUCTION

This appendix provides indications to the user in order to prepare a FINAS report on an event so that *important lessons learned are most efficiently transferred* to the international nuclear community. This procedure focuses on the content of the information to be provided in the report rather than on its format.

For events where human performance is dominant to draw lessons, more detailed guidance on the specific information that should be supplied is spelled out in the present procedure. This guidance differs somewhat from that for the provision of technical information, and takes into account that the engineering world is usually less familiar with human behavioural analysis than with technical analysis.

In order to facilitate the use of the present procedure, the basic process it describes has been summarized in the flowchart (see Figure 2).

2. EVENT SELECTION FOR REPORTING

A. The first step is to determine whether the event has actual or potential safety significance.
   Safety significant event categories are described in Appendix B, which sets out general definitions, cases and examples of such events.
   Typically, events that significantly affect defence in depth, and accordingly degrade safety functions, are safety significant events.
   Events affecting non-safety components, but that could occur similarly in safety systems or affect them, might also be considered as safety significant.
B. The second step is to determine whether important lessons can be learned by the international community in order to prevent the occurrence or recurrence of a serious event in terms of safety.
   Events which are the repetition of similar events reported to FINAS may still convey new lessons learned to the international community.
   The lessons to be learned from the event are to be evaluated in terms of applicability by the international community.
C. If the event satisfies both criteria (A) and (B), it should be reported to FINAS.

3. TYPE OF REPORT

Depending on the significance of the event, a *preliminary report* may be useful, otherwise a *full report* should be sent.

As soon as the necessary information is available, a full report shall supplement the preliminary report.

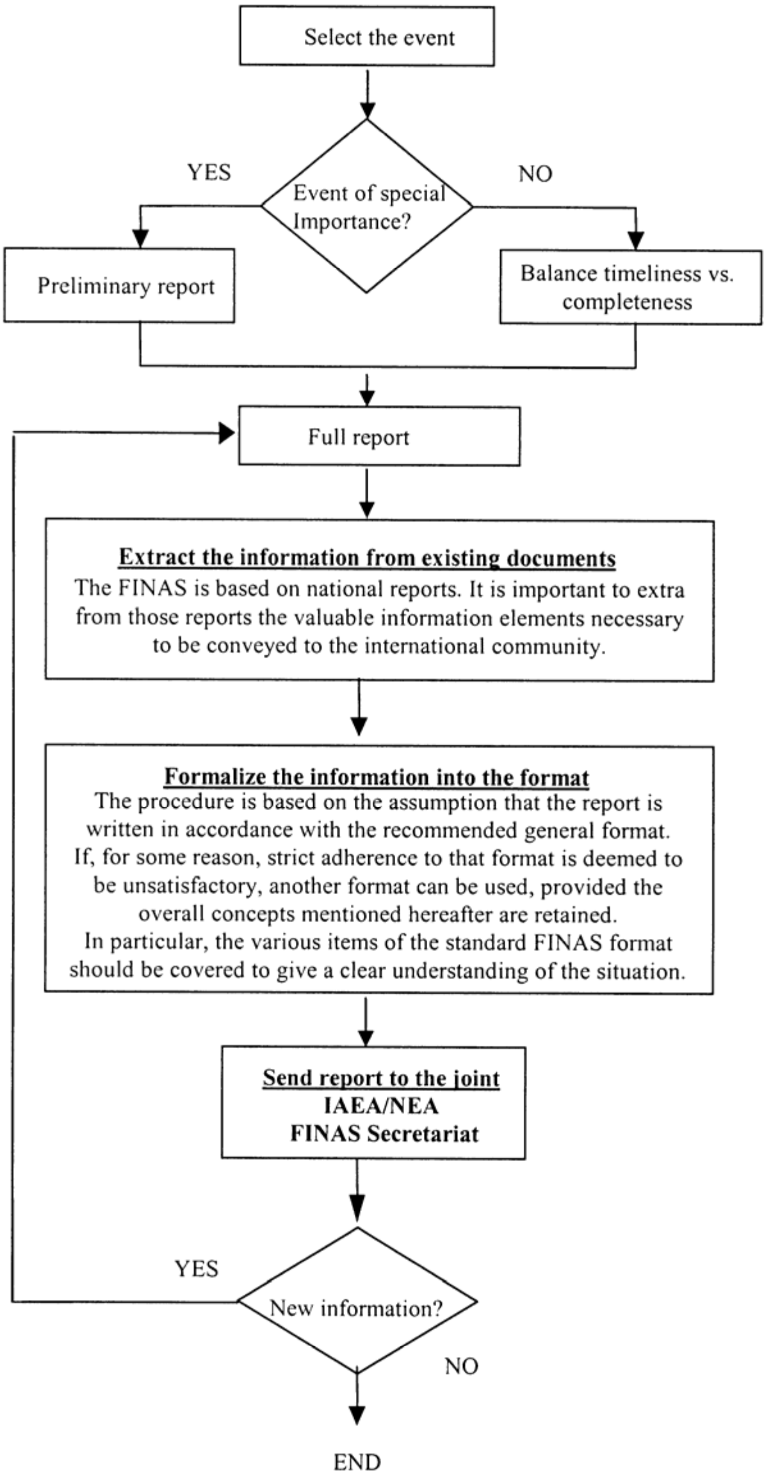

Fig. 2. Process flow chart.

There are two types of full reports:

(1) A *standard full report*, associated with a single event;
(2) A *generic full report*, associated with a set of events related to each other, and produced to focus on common lessons learned from those events.

If, after the publication of a full report, new relevant information becomes available, an update of the previous full report should be prepared (follow-up report, follow-up generic report).

Do not wait until exhaustive information on the event is available in order to prepare and send a full report. Do it whenever sufficient material is available. Judgement should be exercised to balance completeness of information and timeliness of reporting.

Consider that, if new elements become available later, you still have the opportunity to send a follow-up report.

4. PRELIMINARY REPORT

The preliminary report should summarize the information available at the time the report is prepared with emphasis on the safety significance for the international community and include a short description of the event, the preliminary safety evaluation and the short-term actions taken.

5. FULL REPORT

5.1. IDENTIFICATION OF THE NECESSARY INFORMATION

From the available national documents on the event, extract and sort the following items (if available):

A. General data, such as facility/workshop name and date/time of the event.
B. Facility conditions before the event and methods of event discovery (in case of a deficiency).
C. The factual event sequence as observed, possibly including the observed degradations or malfunctions of systems and on line reasoning or reaction of people, with their impact on the event sequence. Identify clearly the observed cause/consequence relationships.
D. A consequence analysis, in order to determine whether or not some aspects of the event are indicators of indirect problems, which could lead to a safety significant or a serious accident.
E. A safety analysis of the event, identifying all the observed and root deficiencies, as well as the investigation and corrective actions taken.
F. The causes and corrective actions should address technical as well as human aspects; an indication of how each given deficiency has been corrected is advisable.
G. Assessment by the regulatory body, to the extent possible.
H. If the event description and/or analysis require some knowledge unfamiliar to international readers in order to provide a good understanding, collect the necessary information on facility/workshop features.

5.2. FORMALIZATION OF THE COLLECTED INFORMATION INTO THE REPORT

In order to follow the recommended general format for FINAS reports, the following process should be applied.[2]

[2] A Member State may submit an existing document as an FINAS report if it contains all the appropriate elements. In this case, in addition, a cover page, abstract and codes should be prepared. The existing document can then be put into the narrative section of FINAS database.

5.2.1. Prepare the narrative description

Facility features

Provide the technical and organizational data necessary to understand the event. Fuel cycle terminology is not universal. It may be helpful for other FINAS users to include a brief description of the systems, practices, procedures and/or organizational characteristics that influenced the incident, especially if these are known to be peculiar to the facility or country. For a better understanding, descriptive names for equipment should be used rather than internal identification codes.

Event sequence and personnel reactions

All *relevant information on what happened* during the event and on the general *context* of the event. The following should be provided:

A. Situational aspects

(a) Facility conditions prior to the event.
(b) Operating modes or testing conditions.
(c) Equipment status.

When human factor plays a significant role, the following information should be provided where available:

(d) Plant staff involvement (Appendix C, Section 5.2)[3].
(e) Type of activity at the time of the event (Appendix C, Sections 5.3).
(f) Characterization of the personnel work practices (Appendix C, Section 5.4.2).
(g) Characterization of the working conditions (Appendix C, Sections 5.4.4 and 5.4.5).
(h) All other related organizational aspects (Appendix C, Sections 5.4.3 and 5.4.6 to 5.4.9).

B. Chronological information

(a) Chronological information indicating relevant time-scales.
(b) Identification of failures and successes in technical behaviour, up to and including the recovery actions (Appendix C, Section 9).

When human factor plays a significant role, the following information should be provided where available:

(c) Identification of failures and successes in human behaviour, up to and including the recovery actions (Appendix C, Section 9).
Information on the nature and timing of recovery actions may provide additional insight into the complexity of the situation and the difficulties for the operators to detect and diagnose the problem at hand. Lessons may also be learned from the positive role of the plant personnel involved in the event.

For large reports, only the executive summary of the existing document, with a note stating that a complete hard copy of the document is available, can be put into the narrative section of FINAS database. A complete hard copy of the existing document should be provided, so that copies can be sent to each participating country.

3 Reference to the appropriate appendices is made to clarify the content of the information to be supplied.

If relevant, include a discussion of the recovery actions, providing information on how and when the recovery was achieved. Identify the persons involved in the recovery actions.

(d) Detection and diagnosis activities.
More specific information on the time delay needed for the detection of the human deficiencies and system failures, and for the diagnosis of the safety problem. Indicate, if applicable, any factor leading to a lengthy delay before a problem was detected or diagnosed.

(e) Human actions.

(f) Intra- and extra-team communication aspects.

This description should not focus too much on causes, in order not to duplicate the cause analysis.

Previously related events or precursors should be indicated.

If available, add figures, including layouts, photographs and/or drawings, in order to allow a better understanding of the environment in which the event occurred.

5.2.2. Prepare the safety assessment

Address here the actual and potential consequences of the observed problems. In particular, a discussion of the barriers, which were broken by the observed deficiencies and the effective barrier that terminated the event should be included.

When relevant, safety aspects related to human performance should be included.

If the assessments by the licensee and by the regulatory body are different, this should be indicated.

5.2.3. Prepare the cause analysis section

Indicate clearly here, when relevant, the “direct or observed causes” as well as the “root causes”.

The presentation and discussion of the "direct or observed causes" (i.e. the failures, actions, omissions or conditions which immediately produced the event) should answer the question *"how did it happen?"*, identifying the technical or human deficiencies. It should give, to the extent possible, the results of the analysis identifying the failure mode including the nature of failures or errors (Appendix C, Section 8).

When human factor plays a significant role, the following information should be provided where available: include the type of observed inadequate human actions (Appendix C, Section 5.1.8) which contributed to the initiation of the event or affected in a direct way the operator or system response to the event.

The report should also provide the identified “causal factors” relevant to the message to be conveyed. These causal factors are causes that, if corrected, would not by themselves have prevented the event, but are important enough to implement worthwhile corrective actions in order to improve the quality of the process or product.

A presentation and discussion of "root causes" should follow. These causes are fundamental causes that, if corrected, should prevent recurrence of the event or of its adverse environment. Both causal factors and root causes provide the answers to the question *"why did it happen?"*.

When human factor plays a significant role, the following information should be provided where available: the human performance related causal factors and root causes (Appendix C, Sections 5.4 and 5.5).

If possible, include an event and causal factor chart to illustrate the analysis results.

5.2.4. Prepare the lessons learned and corrective actions section

Describe the set of corrective actions taken by the operating organization to address the observed technical and human problems in the form of short term and long-term actions. The priority of the various corrective measures should also be provided, if it emphasizes the significance of the various causes. They may cover administrative measures as well as hardware modifications taken to lower the likelihood of both technical and human failures.

For events where human aspects play a significant role, include when available:

(a) Changes in attitudes or habits of persons or groups
(b) Changes to training; indicate what was lacking in terms of knowledge and know-how
(c) Changes to procedures
(d) Organizational changes
(e) Improvement in ergonomics
(f) Hardware modifications, which influence man-machine interaction.

Describe also any specific actions taken by the regulatory body in response to the event.

Indication of the generic character of the actions taken or of difficulties in designing or implementing the corrective actions may be useful.

The content and formulation of the lessons (cause analysis, corrective actions) should be practical and applicable to other FCFs, in accordance with the message to be conveyed.

5.2.5. Prepare the abstract

The objective of the abstract is to convey the main messages contained in the report, essential for the understanding of the relevance of the event or conditions. A good abstract should give, in a concise form (maximum 25 lines), a brief description of the event, its safety relevance, its causes, the lessons learned and the corrective actions taken.

5.2.6. Choose a title

The title should be a very short characterization of the event, emphasizing its most significant features.

5.2.7. Prepare the cover page and codes

5.2.7.1. Cover page

Fill in the cover page information to identify the event according to the following instructions:

ITEM	RESPONSIBILITY	DESCRIPTION
1. FINAS No	FINAS Secretariat	Sequential numbering to be provided upon receipt of report
2. Classification	National coordinator	“Restricted” or “Confidential”
3. Event title	National coordinator	Brief one line description or title of event
4. Notification date	FINAS Secretariat	Date received at the FINAS secretariat
5. Event date	National coordinator	Date of occurrence of the event
6. Country	National coordinator	Country where event occurred
7. Facility	National coordinator	Name of the facility and Licensee where event occurred
8. Type/capacity	National coordinator	Type and capacity of the facility
9. Condition	National coordinator	Status of the facility at time of event
10. Abstract	National coordinator	Concise summary of event including major aspects

Report type

Indicate the report type as described in Section 4.

Title

Fill in the title as determined in Section 6.2.6.

Facility name and IAEA code

Preliminary and standard full reports

The standard facility name and IAEA code shall be indicated.[4]

Generic and follow-up generic reports

In the case of generic and follow-up generic reports, the fields of facility/workshop need not be supplied.

However, in the case of follow-up generic reports submitted in response to a single initial event, it may be convenient to use the specific IAEA plant code of that initial event so as to facilitate linking of the related reports.

Date of and time incident

Standard full reports

The date of incident should be in the form YYYY/MM/DD if a specific date can be defined. The time of incident should be recorded (standard time of the country).

[4] IAEA fuel Cycle Facility coding is to be defined.

Generic and follow-up generic reports

In the case of generic reports, the year of the first event or the year of investigation should be provided in the form YYYY.

However, in the case of follow-up generic reports submitted in response to a single initial event, it may be convenient to use the specific date of the initial event so as to facilitate linking of the related reports.

5.2.7.2. Event coding

As the codes are provided for retrieval purposes, they must reflect the event conditions, the observed phenomena and the problems encountered.

More than one code can be selected under each category. Naturally, the more detailed the code, the better. However, if a detailed code is selected, its parent codes should not be selected.

Refer to Appendix C, Sections 1 to 9 for the definitions and usage of the available codes.

Appendix B

FINAS REPORTING CATEGORIES

INTRODUCTION

This appendix discusses the categories of events to be reported. It provides background information on the reasons for their selection as well as a general description and examples of relevant events. As stated in the main text, the categories are intended to provide a basis for identifying safety related events to be reported to FINAS. It is important to note that a report may be prepared not only because an event has occurred, but also because a significant lesson learned has been identified. The examples given here are intended to illustrate typical events to be reported to FINAS under each category. It should also be noted that complex events may fall into more than one category. The examples are not exhaustive, i.e. many other events or situations which are relevant for reporting to FINAS might not be covered by these categories.

The categories are:

1. Unanticipated or unexpected releases of radioactive or hazardous chemical material, or exposure to radiation
    - 1.1. Unanticipated or unexpected releases of radioactive or hazardous chemical material
    - 1.2. Exposure to radiation that exceeds prescribed dose limits for member of the public
    - 1.3. Unanticipated or unexpected exposure to radiation for site personnel
2. Degradation of safety functions
    - 2.1. Degradation of confinement
        - 2.1.1. Static barriers
        - 2.1.2. Ventilation hierarchy
    - 2.2. Degradation of criticality control
    - 2.3. Degradation of the control of chemical reactivity
    - 2.4. Degradation of cooling
    - 2.5. Degradation of support functions
        - 2.4.1. Radiation protection/hazardous chemicals monitoring system
        - 2.4.2. Process monitoring, incl. supervision & communication systems
        - 2.4.3. Electrical power supply
        - 2.4 4. Controls systems
        - 2.4.5. Vacuum, fluids and gases
        - 2.4.6. Measurement systems incl. analytical laboratories
        - 2.4.7. Reagents
        - 2.4.8. Fire protection
3. Deficiencies in design, construction, operation (including maintenance and surveillance), quality assurance or safety evaluation
    - 3.1. Deficiencies in design
    - 3.2. Deficiencies in construction
    - 3.3. Deficiencies in operation (including maintenance and surveillance)
    - 3.4. Deficiencies in quality assurance
    - 3.5. Deficiencies in safety evaluation

4. Generic problems of safety interest
5. Consequential actions
6. Events of potential safety significance
7. Effects of unusual external events of either man-made or natural origin
8. Events which attract public interest

The order of such categories is not linked with a classification based on event importance.

1. CATEGORY 1: UNANTICIPATED OR UNEXPECTED RELEASES OF RADIOACTIVE OR HAZARDOUS CHEMICAL MATERIAL OR EXPOSURE TO RADIATION

Releases of radioactive or hazardous chemical material from the site directly impact the environment. Exposure of personnel directly affects the plant staff. The design and operation of a FCF incorporates features which prevent undue releases and exposures. Due to weaknesses in operational controls, design, etc., unanticipated releases or exposures may occur. This category is intended to report events addressing actual or potential serious weaknesses in the provisions implemented, even if the prescribed limits have not been exceeded.

1.1. UNANTICIPATED OR UNEXPECTED RELEASES OF RADIOACTIVE OR HAZARDOUS CHEMICAL MATERIAL

This category comprises unanticipated or unexpected releases to the environment or within the site, not exceeding the authorization limits. Unanticipated releases confined to the site may pose problems to safety of personnel or render access to on-site areas difficult, resulting in items important to safety that cannot be adequately controlled, tested or maintained.

Examples:

(a) Routine airborne activity monitoring of a ventilation discharge stack indicated a significant increase in alpha activity. The increased discharge continued into the next day before falling back to slightly above normal levels. No on-site personnel were affected and the potential dose to the most highly exposed member of the general public was assessed as less than 1 micro Sievert.
An investigation revealed the origin of the activity as a redundant building being decommissioned. No single cause was identified but it is clear that the ventilation system was partly unfiltered and did not meet modern standards. This had been recognized by the Licensee who, as part of the decommissioning operations, was in the process of installing a new filtered ventilation system. The programme for this work was brought forward and a temporary filtered extract system was made available for connection should the need arise.

Note: This example also requires further classifications in reference to the observed causes and failed equipment and safety functions (2.1 and 3.1 and/or 3.2).

(b) Significant quantities of iodine-129 were released over a 2-week period from a chimney which ventilates the cells within a chemical reprocessing plant. The amounts released were less than 10% of the authorised discharge. The analysis for the bulked daily samples is done weekly and the result was not available until 4 days after the end of the second week, thus causing a delay in reporting the event. No on-site personnel were affected and the potential dose to the most highly exposed member of the general public was assessed as less than 1 micro Sievert.

An investigation determined that during a routine planned change to operating conditions in the plant dissolver, iodine, which is normally retained in the early parts of the system, passed into subsequent down stream stages and volatilised, escaping via the cell ventilation system.

Note: This example also requires further classifications in reference to the observed causes and failed equipment and safety functions (2.1 and 3.3) as the process conditions are part of the iodine containment.

(c) During commissioning of a new plant for the treatment of waste solvents, it was noticed that a valve on a line carrying 13M nitric acid was leaking and required replacement of the internal parts. Before the repairs could begin, a double isolation of the line was specified including one isolation in a building under the control of a different plant manager. Because of inadequate arrangements for the control of cross boundary isolations, inadequate training of the people involved and inadequate verification before work began, the wrong line was isolated. The second isolation also failed because the valve had been incorrectly assembled, allowing nitric acid to pass when the valve was nominally in the closed position. About 7 cubic metres of nitric acid was released to the plant operating area when the bonnet of the faulty valve was lifted. The maintenance personnel involved suffered minor acid burns and a member of the emergency response team was affected by NOX fumes. Prompt action by the site fire brigade to neutralise the acid and cover surface drains prevented any significant release of acid to the environment.

1.2. EXPOSURE TO RADIATION THAT EXCEEDS PRESCRIBED DOSES LIMITS FOR MEMBER TO THE PUBLIC

An event resulting in exposure to radiation that exceeds prescribed dose limits for members of the public is the consequence of a serious breakdown of the barriers protecting the public. Therefore, all such events should be reported to FINAS.[5]

1.3. UNANTICIPATED OR UNEXPECTED EXPOSURE TO RADIATION FOR SITE PERSONNEL

The protection of facility personnel is a major safety objective for facility operation. Therefore, events dealing with unanticipated exposure of staff are usually due to degradation of protection equipment and/or efficiency of operational controls. This category comprises events addressing serious weaknesses (actual or potential) in the provisions implemented leading to external irradiation or internal contamination through airborne dispersion.

Examples:

(a) A MOX fuel pin was blocked in the loading machine. The automatic sequence failed to interrupt and the fuel pin was chopped. This resulted in the dispersion of an estimated amount of 1g MOX in the form of a fine powder and grains. The ventilation air exhausted from the affected hall passed trough an adjacent hall for the fabrication of uranium pallets and mounting into pins. As a consequence Pu contamination was spread

[5] Unanticipated or unexpected exposure to the public which does not exceed the limits is categorized in 1.1.

into both halls. Monitoring and decontamination started immediately after installing a triple entrance lock to the contaminated zone and an additional ventilation system. The internal contamination of eight workers involved in the incident was monitored by analysis of faeces and urine. All doses were below the prescribed limits.

(b) An apparently empty shipping container was sent to the decontamination area, where decontamination personnel established that the dose rate from the container had been underestimated. Their personal dosimeters alarmed, indicating higher than expected radiation fields. It was discovered that a small piece of metallic wire, probably from a neutron flux detector assembly, having a contact dose rate in excess of 10 Sv/h, was responsible for the unexpectedly high activity from the container. The event draws attention to inadequacies of administrative controls.

2. CATEGORY 2: DEGRADATION OF SAFETY FUNCTIONS

Safe operation of FCFs is assured by maintaining the three basic safety functions. They are:

(1) Confinement of the radioactive or chemically hazardous material (static/dynamic);
(2) Control of reactivity, i.e. avoidance of criticality or hazardous chemical reactions;
(3) Adequate cooling of the radioactive material.

Each of these safety functions is in turn assured by safety systems which are usually provided with redundancy and diversity, the availability of which is ensured by extensive surveillance programmes as specified in the technical specifications for a given FCF. This category is intended to include events where actual or potential serious degradation has occurred in the systems that are designed to maintain the availability of any of the above safety functions.

2.1. DEGRADATION OF CONFINEMENT

The confinement represents a system of multiple barriers that prevent the escape of radioactivity to the environment and limit the radiation exposure of the work force and the public. Confinement structures must withstand pressure and temperatures resulting from design basis accidents without exceeding the design intends. They include passive structures and components (e.g. a steel pressure vessel, leak tight containment penetrations, pressure suppression systems) as well as active components (e.g. containment isolation valves, and cooling systems, ventilation systems). In shutdown conditions confinement integrity may be required too, when performing handling operations in the building or when cooling of the radioactive material could be threatened.

During the normal operation of FCF, the potential exists for leaks to develop in process vessels and cells and associated equipment, despite the care with which they are fabricated and operated. Limited anticipated leaks that do not prevent continued operation of the plant are in themselves not reportable. However, breaches of confinement caused by unexpected factors and other unexpected failure mechanisms should be reported, especially when generic implications ensue. Reportable confinement failures are not limited to operation of FCF systems. Incidents which occur during ancilliary operations (e.g. waste posting and flasking/casking operations), which can result in actual or potential loss of confinement integrity and can give rise to important lessons learned, are also to be included in this category.

Examples:

In the course of a fuel shearing operation, monitoring showed a variation in the fuel dissolution parameters. Shearing was halted. After investigating, the operator found that the a fuel element nozzle had damaged the channelling system which diverts fuel elements to an acid decontamination vat and sheared sections to the dissolver. Sheared sections, containing fissile material, had consequently been directed to a nozzle decontamination vat instead of to the dissolver. An estimated 1060 kg of fuel vas sent to the decontamination vat. The incident had no radiological consequences for staff or the environment. Improvements were subsequently introduced to ensure early detection of similar incidents.

Note: For such an event, the degradation of reactivity control category (item 2.3) is also to be considered if the vat is not geometrically safe.

2.2. DEGRADATION OF CRITICALITY CONTROL

Various systems are provided for reactivity control. They include control of geometry, mass and amount of moderator. Reactivity control may be affected by failing administrative and operational controls (e.g. undetected changes in geometry and mass balance, removal of neutron absorbing material, changes in chemical conditions which may lead to phase changes, changes in the amount and disposition of the moderator). Degradation of such systems and controls may lead to reactivity excursions, high radiation levels accompanied by release of fission products. Observed degradation or failures of such systems and controls may have generic implications and should be reported if important lessons are to be learned.

Example:

A failure occurred in a pipe connected to a plutonium evaporation system in a reprocessing plant resulting in a leak of plutonium nitrate into the secondary containment cell and an accumulation of material at the base of the evaporator. The accumulation remained sub-critical. On discovering the leak, the Licensee shut down the reprocessing plant. The Licensee has subsequently modified the plant to prevent similar occurrences and has made improvements to the systems for leak detection. In addition operating procedures have been reviewed and strengthened. There was no unauthorized discharge of radioactivity to the environment during the incident or as a result of any of the remedial actions. There was no additional radiation exposure to workers on site at the time of the incident.

Note: This example is also relevant to Category 2.1.

2.3. DEGRADATION OF THE CONTROL OF CHEMICAL REACTIVITY

Here are considered unexpected chemical reactions like explosions, exothermal reactions due to non-compatible substances or unstable reagents or compounds, uncontrolled kinetics, auto catalytic reactions. Radiolysis and hydrogen generation can induced such events.

Example:

An uncontrolled exothermic reaction occurred during a routine operation to dissolve uranium/zirconium alloy swarf, which is produced during the manufacture of nuclear fuel, in a mixture of hydrofluoric and nitric acids. This heat generating reaction resulted in the burning of a small quantity of fuel alloy swarf. The swarf fire quickly extinguished itself but the heat given off was sufficient to cause a secondary fire by igniting plastic components within the plant. This secondary fire was in turn quickly extinguished by the on-site fire brigade. No on-site personnel were affected by the incident Although the fire resulted in a higher than normal discharge from a ventilation extraction stack on the day of the incident, this was significantly below levels requiring notification to the Regulatory Body and the overall monthly discharge was consistent with that which would have been expected from routine operations alone. An investigation identified the cause to be a modification to the plant which allowed undiluted acid to drip directly onto exposed swarf resulting in the uncontrolled exothermic reaction. The modification was carried out to overcome a conventional hazard found during the commissioning of a new acid feed system fitted to the plant, and was categorised as having only a minor, if any, nuclear safety significance. The incident demonstrated that there was a weakness in the safety categorisation system used by the Licensee.

Note: This event also could be relevant to the support function category (2.5) depending on the fire detection, fire brigades and extinction systems reactions.

2.4. DEGRADATION OF COOLING

Systems are provided which assure in normal and transient FCF operation sufficient means to remove heat. Failure to remove the heat may result in uncontrolled temperature excursions that can put containment integrity at risk.

In many cases, failure in cooling systems can degrade neutron moderators or absorbers. This is also true for chemical reactivity as most of the hazardous reactions are activated by temperature increase.

Actual failures of cooling systems or the existence of significant potential latent failures, e.g. due to shortcomings in inspection and testing programmes, may be of concern to the whole nuclear community and should be reported under this reporting category.

Degradation of related systems, structures and components resulting in actual or potential loss of this safety function are covered by this reporting category.

Example:

A spent fuel flask containing a magazine with 3 blocked channels was transported from the reprocessing plant to a fuel handling plant in order to free the blocked channels. On receipt at the handling plant it was discovered that the magazine within the flask did not contain water, in contravention of an operating rule which states that if a magazine contains irradiated uranium fuel, the flask may only be transported if there is sufficient water in the magazine to submerge the fuel, or alternatively, if special precautions are invoked prior to and during the transport of the flask, it is permissible to move the flask without water. The operating rule is a safeguard against the possibility of a fuel fire which could occur in certain unlikely circumstances.

Action taken to prevent a recurrence includes provision of additional engineered safeguards within the reprocessing plant to ensure that the flask cannot be lifted unless there is a sufficient level of water in the magazine within it. Other measures are concerned with enhancing the reliability of the magazine water monitoring system associated with the flask and rail wagon and improvements to procedures and instructions

Note: This example could have been relevant to Category 2.2 if the neutron moderation ratio taken into account in the sub-criticality justification have been based on the presence of water in the cask.

2.5. DEGRADATION OF SUPPORT FUNCTIONS

Many support functions contribute to maintain the safety of the facilities as their failure can lead to damages to the facility or personals. Typical examples of these support functions to be considered in this category are:

— Radiation protection/hazardous chemicals monitoring system
— Process monitoring, incl. supervision & communication systems
— Electrical power supply
— Controls systems
— Vacuum, fluids and gases
— Measurement systems incl. analytical laboratories
— Reagents
— Fire protection.

Degradations of such support systems may be of generic interest and should be reported, if important lessons can be learned.

Examples:

(a) A loss of electrical supplies resulted in non-availability of the air extraction systems in the high activity cells and the effluent treatment station and of the radiation protection measurement and monitoring systems for a period of six minutes. This incident also caused the onset of flooding in the low and intermediate activity laboratories. The cause of this incident was that all circuit breakers in the electrical circuits of these systems opened when a technician attempted to open a single circuit breaker during a maintenance operation. This malfunction caused by an installation design fault was familiar to the operator since it had given rise to a similar incident a year earlier. Moreover, no formal procedure existed for the particular task to be carried out. In accordance with the operating instructions, the personnel evacuated the areas affected by the shutdown of the veneration system. The flooding of the area was due to poor design of the liquid effluent collection system in the installations; a valve in this system remained open following the loss of electrical supplies.

Note: This example is relevant to this category as the root cause of the incident is a power supply failure. The incident also involves flooding and extraction system interruptions, which are relevant to the Category 2.1. It is also relevant to the categories 3.3 for the initial procedural deficiency and 3.1 for the open valve issue, which is due to insufficient failure consequences analysis.

(b) A liquid stream with a plutonium concentration significantly above the flowsheet value was produced in the Product Finishing Line of a reprocessing plant. The increase in concentration was not detected by the on-line monitoring system. The monitored liquid passed into one of two holding tanks where there is an operating rule that limits the plutonium concentration of the liquid which may be transferred from the tanks. The operating rule is supported by an operating instruction, neither of which was contravened. An investigation determined that the production of the over-concentrated liquid, and the failure of the safety mechanism to detect this, was due to a number of coincident deficiencies in operating procedures. These resulted from incorrect calibration of the safety mechanism to failure to check the results of daily samples taken from a point upstream of the holding tanks.

3. CATEGORY 3: DEFICIENCIES IN DESIGN, CONSTRUCTION, OPERATION (INCLUDING MAINTENANCE AND SURVEILLANCE), QUALITY ASSURANCE OR SAFETY EVALUATION

High standards in design and construction complemented by in depth safety evaluation assure the overall safety of FCFs. The most important means to maintain this safety level during the lifetime of a plant are good operational practices to prevent failures, quality assurance to verify the achievement of the design and operational intent as well as a comprehensive surveillance programme to detect and correct degradations or failures in time. Deficiencies related to these key elements of plant safety highlighting important lessons should be reported in this category.

3.1. DEFICIENCIES IN DESIGN

The main objective of plant and equipment design is to ensure overall facility safety with sufficient margins. Deficiencies in the design could result in loss of a safety function, loss of safety system or unexpected event sequences. Further, design deficiencies may cause common mode failures that affect the facility safety. All such cases including material compatibility, the degradation due to environmental or operating condition, computational errors, etc. should be reported under this category.

Example:

Reactivity calculations for a spent fuel pool were performed using different computer codes showed wide deviations in results. The cause of the potential errors in these calculations were approximations used in the calculations that were not appropriate in the presence of a highly absorbing material. The facilities evaluated spent fuel storage rack design changes, additional criticality analyses, and changes to the plant technical specifications in order to allow use of their fuel storage racks. The safety consequence of this event is a potential uncontrolled criticality event in the spent fuel pools.

3.2. DEFICIENCIES IN CONSTRUCTION

Deficiencies in construction and installation may cause significant deviations from the desired facility status. These deficiencies can occur during initial installation of the facility and during back fitting of equipment. If construction deficiencies cannot be detected by testing or maintenance they may cause latent failures that degrade facility safety. Events should be reported if these deficiencies affect facility safety and show significant lessons to be learned.

Example:

> In a uranium enrichment plant, a 140 litres of acidic liquid with a total radioactivity of 2.3 E^8 Bq uranium leaked from a collecting tank into a sealed concrete pit. The tank, made of ferritic steel with an inner plastic coating, had corroded in the area of the welding seam of the outgoing connection allowing acidic rinsing liquid to come into direct contact with the tank material. Routine inspection of the interior of the tank had not detected the damage and partial detachment of the inner coating had not been recognized. Four further tanks of similar construction were exchanged for tanks made of acid-resistant steel.

Note: Such incidents could be relevant to the Categories 3.1, 3.2 or 3.3 and have to be carefully assessed as the leakage can be related to:

- The design (error in material selection or inappropriate analysis: process conditions including degraded modes, overheating, etc.)
- The construction as in the example; the defect analysis revealed an inadequate assembly during construction.
- The operation conditions such as, insufficient analysis of corrective maintenance conditions (specific reagents, etc.) or insufficient periodic monitoring.

3.3. DEFICIENCIES IN OPERATION (INCLUDING MAINTENANCE AND SURVEILLANCE)

Safe operation and effective maintenance (including inspection and surveillance activities) are the result of qualified and well-trained facility staff, adequate procedures and tools, and good management. Deficiencies in human performance by licensed operators, other facility personnel or contractor personnel may degrade the defence in depth. They may result in the degradation or loss of safety systems or loss of operational control.

Example:

> A plant operator observed that a small amount of plutonium-bearing solvent liquor had leaked from a sample cabinet onto the floor beneath it.
>
> An investigation indicated that the initial cause was a restriction in the overflow line from an instrument feed tank located within the sample cabinet which serves as the secondary containment. The restriction led to the liquor overflowing into the base of the cabinet, and then feeding back, as it was supposed to, to a process vessel via a drain line. However, a small quantity leaked out through a defective cabinet seal.

Note: The following example is relevant to this Category 3.3 as the incident was due to insufficient monitoring of process equipment. Detection of the reagent flow disturbance or of the leakage in the cabinet should have avoided the liquid to reach the cabinet seal. This incident is of course fully relevant to the Category 2.1.

3.4. DEFICIENCIES IN QUALITY ASSURANCE

The quality assurance (QA) programme should ensure that the facility is constructed and operated within the licensed conditions. QA affects various areas including management, supervision, design and construction, operation and maintenance. Deficiencies in quality assurance may occur in the QA programme as well as in specific QA measures. Event reports in this category should highlight the deficiencies revealed which have impact on facility safety.

Example:

> During super-compaction of a steel drum containing low active waste in a mobile super-compactor, a detonation occurred which started a fire in the compaction cell. The pressure wave blew the Perspex windows between the cell and control room out of its fitting and control room was filled with black smoke. While hurrying out of the control room the operator slightly injured his leg. The fire was extinguished immediately by a nearby operator before the arrival of the fire brigade, which was immediately alerted. Except for the window, the damage to the installation was only minor. No contamination was detected outside the compaction cell and on the air exhaust filters of the building. The incident caused no internal contamination. The root cause of the event was determined to be violation of the specification for the waste form due to human error.

3.5. DEFICIENCIES IN SAFETY EVALUATION

The safety evaluation should cover the analysis of postulated operating conditions, design basis events and the related safety measures. This category addresses deficiencies in the safety evaluation of systems, event sequences and operating conditions considered in the design analysis, as well as deficiencies in the original scope of the safety evaluation (i.e. event sequences or conditions not identified or analysed). Due to these deficiencies, unexpected situations may occur which significantly compromise facility safety. Related event reports should provide information about the deficiencies identified and the responses of facility operators to control the event, and lessons learned to prevent recurrence. Typical examples in this category are environmental conditions not adequately taken into account, unforeseen system interactions, non-conservative calculations, and deficiencies in the safety evaluation of maintenance procedures.

Example:

> Several beta in air monitors alarmed resulting in the building being evacuated. The cause was traced to a flask containing swarf from the decanning of fuel elements. Pressurization within the flask had led to activity being released into the building. A small amount of activity was released to atmosphere before the building ventilation system was shut down. The release did not breach any authorized discharge limits.
>
> The Licensee has produced a revised safety case covering swarf flask transfers and introduced additional measures to monitor swarf behaviour within the flask, in particular the evolution of potentially explosive or flammable gases.

4. CATEGORY 4: GENERIC PROBLEMS OF SAFETY INTEREST

Events that reveal deficiencies, which affect or might affect several facility systems or components, or might have implications for other facilities, may be reported in this category. Reoccurrences of events, which indicate the existence of generic problems of safety significance should also be reported under this category. These generic problems might not have been adequately addressed by operation experience feedback, research and regulation.

The purpose of reporting such events is to draw attention to such problems and enable initiation of corrective action to prevent events with serious consequences.

Example:

> A vehicle carrying 12 Type A transport packages was involved in a collision with a car resulting in a fire. The outer wooden packaging burned away and the inner metal packaging was damaged. There was no release of radioactive material. The reduction in the effectiveness of the packaging included extensive damage to the gaskets and pressure relief valves of nearly all of the metal inners and deformation of the metal inner containers.

5. CATEGORY 5: CONSEQUENTIAL ACTIONS

This category is intended to include significant consequential actions taken by the regulatory body and resulting from lessons learned of reported events. Such actions would be changes to regulatory requirements related to the licensing process, the design or operation of FCFs. They include important modifications to the design basis, changes to design assessment requirements, changes to fault trees considered in probabilistic safety analysis, important changes to the requirements for construction, commissioning, surveillance and decommissioning of plant systems, changes to requirements on facility staff, changes to off-site emergency planning, etc. Reports on consequential actions identify important lessons learned related to the regulatory process dealing with significant problems or events.

Example:

> A criticality accident took place at the conversion building of the JCO in Tokai village when producing 18.8% enriched, 380 gU/l, uranium-liquid nitric acid from an uranium powder. The government of Japan required the operators to mix powdered uranium compound in a safe mixing tank. Instead, they dissolved powdered uranium compound in a 10-liter stainless steel bucket and poured seven batches of uranyl nitrate solution about 16.6 kgU, into the precipitation tank at one time. The licensed correct procedure required that no more than one batch of solution (work unit: 2.4 kgU) be put into the tank at any one time.
>
> As a consequence of these actions, the uranyl nitrate solution in the precipitation tank reached a critical accident at around 10:35 a.m. on September 30, the total number of produced nuclear fission is estimated at 2.5 × 1018.
>
> The radiation doses for three JCO operators, who were engaging the dissolution, were estimated over from 16 to 20 gray equivalent (GyEq), from 6.0 to 10 GyEq and approximately from 1 to 4.5 GyEq, respectively. Two of them died.
>
> Japanese government took several measures. such as the “Law for the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors” was revised to include periodic inspections, introducing a system to check licensees’ compliance with their safety preservation rules, the assignment of “Administration of the Nuclear Safety Inspectors” to the major sites, stipulation of licensees’ duty to train their employees, and the establishment of allegation system. “Special Law on Emergency Preparedness for Nuclear Disaster” was legislated. The Nuclear Safety Commission established the

"Safety Examination Guide for the Specific Uranium Fabrication Facilities" for the facilities that process the uranium enriched to 5% to 20%.

6. CATEGORY 6: EVENTS OF POTENTIAL SAFETY SIGNIFICANCE

This category is intended to include events which did not have any actual significant safety consequences, but which nonetheless are of potential safety significance. It covers events where protective systems were actuated to mitigate consequences of an event or where these systems had been challenged unnecessarily. It includes especially near-miss situations that may also be precursors to more serious events. It may include events that lead to potential loss of a safety function.

Example:

> The failure of spent fuel supply conveyer in a reprocessing plant causing the shearing operation of spent fuel to be suspended due to lack of spent fuel transfers from the storage pond to the shearing cell. Detailed investigation revealed that the drive shaft for the supply conveyer had detached from the joint of the driving shaft and drive motor unit. The setscrew of the driving shaft had loosened and had not acted as expected. As a countermeasure, spot welding of the setscrew for fixing the drive shaft position was improved. A new drive shaft and insert-shaft were assembled and inserted into the shearing cell. As a result of the event the soundness of the connection at the drive shaft will be subject to future periodical inspection.

7. CATEGORY 7: EFFECTS OF UNUSUAL EXTERNAL EVENTS OF EITHER MAN-MADE OR NATURAL ORIGIN

This category is intended to include those events caused by an external act or condition which might challenge the ability of the facility to continue to operate, or to shut down, or to maintain shutdown conditions in a safe manner. The category includes internal and external hazards such as natural events (e.g. high winds, earthquake, flood, ice formation, pollution of river water or sea water, lightning strikes, heavy rain or snow fall), external man-made events (e.g. explosion, fire, industrial transportation accident affecting the facility, aircraft crash), internal events (e.g. explosion, fire, flooding, toxic gas release, turbine missiles), and external as well as internal malicious acts.

Example:

> For a few days in the year, the river providing cooling water to the facility is strongly polluted with leaves and wood. Due to personnel error, the cleaning of the intake sieve drums was not carried out, resulting in their clogging. As a result, a bypass flap opened and dirty water entered the facility cooling water circuit. The control room operators reacted immediately after detecting the rise of the intermediate cooling water temperature. Lessons learned showed that the water intake is highly sensitive to operational failures when the river water is full of leaves and wood.

8. CATEGORY 8: EVENTS WHICH ATTRACT PUBLIC INTEREST

This category covers events that do not fall naturally into any of the previous Categories 1 to 7. It includes events, which attract significant public interest even though the safety significance of the event is limited and the event is not reportable according to the technically defined categories.

Example:

> Channel A of the Local Area Network between local instruments and the central control room in a uranium enrichment plant failed at around 1041 AM, followed by the failure of Channel B. 8 seconds after Channel B failed the Channel A line was restored and data transmission was resumed making possible the monitoring of process parameters. However, for a time the equipment controlled by sequence controllers were not monitored and operated in the central control room because the system sequence controllers remained unavailable. The plant was shut down to allow recovery. There was no release of radioactive materials.

Appendix C

FINAS CODING

DICTIONARY OF CODES

COUNTRY CODES

ISO codes shall be used.

FACILITY TYPE

Uranium/thorium mining and milling
Refining facilities
Conversion facilities
Uranium enrichment facilities (gaseous diffusion and centrifuge facilities)
Fuel Fabrication facilities (uranium oxide, MOX)
Radioisotope Production Facilities
Fuel handling and intermediate spent fuel storage facilities
Reprocessing facilities
Waste treatment and conditioning facilities (incl. interim waste storage)
FCF Research & development laboratories
Other

EVENT CODING

1. Reporting categories
2. Facility/workshop status prior to the event
3. Failed/affected systems
4. Failed/affected components
5. Cause of the event
6. Effects on operation
7. Characteristics of the incident
8. Nature of failure or error
9. Nature of recovery actions

1. REPORTING CATEGORIES

1.1. Unanticipated or unexpected releases of radioactive material or exposure to radiation

1.1.1. Unanticipated or unexpected releases of radioactive material

1.1.2. Exposure to radiation for members of the public that exceeds prescribed dose limits

1.1.3. Unanticipated or unexpected exposure to radiation for site personnel

1.2. Degradation of safety functions

1.2.1. Degradation of containment

1.2.1.1. Static barriers

1.2.1.2. Ventilation hierarchy

1.2.2. Degradation of reactivity

1.2.2.1. Criticality control

1.2.2.2. Chemical reactivity

1.2.3. Degradation of cooling

1.2.4. Degradation of support functions

1.2.4.1. Radiological protection monitoring system

1.2.4.2. Process monitoring (e.g. chemical analysis)

1.2.4.3. Electrical power supply

1.2.4.4. Controls systems

1.2.4.5. Vacuum, fluids and gases

1.2.4.6. Measurement systems

1.2.4.7. Reagents

1.2.4.8. Fire protection

1.3. Deficiencies in design, construction, operation (including maintenance and surveillance), quality assurance or safety evaluation

1.3.1. Deficiencies in design

1.3.2. Deficiencies in construction

1.3.3. Deficiencies in operation (including maintenance and surveillance)

1.3.4. Deficiencies in quality assurance

1.3.5. Deficiencies in safety evaluation

1.4. Generic problems of safety interest

1.5. Consequential actions

1.6. Events of potential safety significance

1.7. Effects of unusual external events of either man-made or natural origin

1.8. Events which attract public interest

2. FACILITY/WORKSHOP STATUS PRIOR TO THE EVENT

2.0. Other

2.1. Commissioning

2.2. Operation

2.2.1. Normal operation

2.2.2. Stand-by or partial shutdown

2.2.3. Maintenance

2.2.4. Testing

2.2.5. Modifications

2.3. Shut down
- 2.3.1. Maintenance
- 2.3.2. Testing
- 2.3.3. Modifications

2.4. Decommissioning

3. FAILED/AFFECTED SYSTEMS

3.0. Other

3.1. Primary process systems
- 3.1.0. Other primary process system
- 3.1.1. Handling and transport system
- 3.1.2. Feed and delivery systems
- 3.1.3. Dissolving systems
- 3.1.4. Liquid/liquid or gas/liquid extraction systems
- 3.1.5. Calciner / fluidized bed / furnace system

3.2. Other process systems
- 3.2.0. Other
- 3.2.1. Off-gas treatment systems

3.3. Essential auxiliaries systems
- 3.3.0. Other
- 3.3.1. Criticality control
- 3.3.2. Chemical control (including sampling and analytical control)
- 3.3.3. Cooling systems
- 3.3.4. Reagents feed systems
- 3.3.5. Instrumentation and control systems
- 3.3.6. Electrical power supply

3.4. Other auxiliaries systems
- 3.4.0. Other
- 3.4.1. Fire protection systems
- 3.4.2. Service air, compressed gas

3.5. Structural systems
- 3.5.0. Other
- 3.5.1. Building

3.6. Containment and shielding systems
- 3.6.1. Static containment
  - 3.6.1.0. Other static containment
  - 3.6.1.1. Building containment
  - 3.6.1.2. Tailings ponds containments
- 3.6.2. Ventilation and air cleaning system
- 3.6.3. Shielding

3.7. Waste management systems
- 3.7.0. Other
- 3.7.1. Waste storage
- 3.7.2. Liquid treatment systems
- 3.7.3. Compaction systems
- 3.7.4. Incineration systems
- 3.7.5. Waste encapsulation

3.8. Transport systems

3.8.1. On-site
3.8.2. Off-site

4. FAILED/AFFECTED COMPONENTS

4.1. Instrumentation (e.g. gauges, transmitters, sensors, etc.)

4.1.0. Other
4.1.1. Pressure
4.1.2. Temperature
4.1.3. Level
4.1.4. Flow
4.1.5. Radiation
4.1.6. Contamination
4.1.7. Concentration including pH
4.1.8. Position
4.1.9. Humidity
4.1.10. Neutron flux (detectors, ion chambers and associated components)
4.1.11. Criticality monitors
4.1.12. Speed measuring
4.1.13. Fire detectors
4.1.14. Hydrogen detectors
4.1.15. Hazardous gas monitoring
4.1.16. Electrical (current, voltage, power,...)

4.2. Mechanical

4.2.0. Other
4.2.1. Racks
4.2.2. Tanks, vessels
4.2.3. Containers
4.2.4. Retention structures
4.2.5. Valves / Diverters
4.2.6. Tubes, pipes, ducts
4.2.7. Pumps
4.2.8. Compressors, fans
4.2.9. Turbines, engines
4.2.10. Heat exchangers
4.2.11. Evaporators
4.2.12. Condensers
4.2.13. Filters
4.2.14. Furnaces
4.2.15. Penetrations
4.2.16. Fittings, couplings, hangers, supports, bearings, thermal sleeves, snubbers
4.2.17. Ladders and scaffoldings
4.2.18. Protective shielding (e.g. containment)
4.2.19. Glove boxes

4.3. Electrical

4.3.0. Other
4.3.1. Switchyard equipment (switchgear, transformers, buses, etc)
4.3.2. Inverters, rectifiers, batteries, small power supplies, discharging device for static charge etc.

4.3.3. Circuit breakers or fuses
4.3.4. Motors
4.3.5. Emergency or standby generators
4.3.6. Relays, connectors, hand switches, pushbuttons, contacts, etc.
4.3.7. Wiring, logic circuitry, controllers, starters, cables, etc.
4.3.8. Alarms

4.4. Information technology

4.4.1. Hardware
4.4.2. Software

5. CAUSE OF THE EVENT

5.1. Cause

5.1.0. Unknown or other
5.1.1. Mechanical failure
5.1.1.0. Other
5.1.1.1. Corrosion, erosion, fouling
5.1.1.2. Wear, fretting, lubrication problem
5.1.1.3. Fatigue
5.1.1.4. Overloading (including mechanical stress and overspeed)
5.1.1.5. Vibration
5.1.1.6. Leak
5.1.1.7. Break, rupture, crack, weld failure
5.1.1.8. Blockage, restriction, obstruction, binding, foreign material
5.1.1.9. Deformation, distortion, displacement, spurious movement, loosening, loose parts
5.1.2. Electrical failure
5.1.2.0. Other
5.1.2.1. Short-circuit, arcing
5.1.2.2. Overheating
5.1.2.3. Overvoltage
5.1.2.4. Bad contact, disconnection
5.1.2.5. Circuit failure, open circuit
5.1.2.6. Ground fault
5.1.2.7. Undervoltage, voltage breakdown
5.1.2.8. Faulty insulation
5.1.2.9. Failure to change state
5.1.3. Chemical or physics failure
5.1.3.0. Other
5.1.3.1. Impurities in chemicals used
5.1.3.2. Fire burning, smoke, explosion
5.1.3.3. Uncontrolled chemical reaction
5.1.3.4. Inadequate chemical control
5.1.3.5. Blockage, fouling, corrosion caused by chemical reactions
5.1.4. Hydraulic failure
5.1.4.0. Other
5.1.4.1. Water hammer, abnormal pressure
5.1.4.2. Loss of fluid flow
5.1.4.3. Loss of pressure

5.1.4.4. Cavitation
5.1.4.5. Gas binding
5.1.5. Instrumentation and control failure
5.1.5.0. Other
5.1.5.1. False response, loss of signal, spurious signal
5.1.5.2. Set point drift, parameter drift
5.1.5.3. Computer hardware deficiency
5.1.5.4. Computer software deficiency
5.1.6. Environmental (abnormal conditions inside plant)
5.1.6.0. Other
5.1.6.1. Temperature
5.1.6.2. Pressure
5.1.6.3. Humidity
5.1.6.4. Flooding
5.1.6.5. Freezing
5.1.6.6. Irradiation, contamination, irradiation of parts
5.1.6.7. Dropped loads, missiles, high energy impacts
5.1.6.8. Fire, burning, smoke, explosion
5.1.7. Environmental (external to the plant)
5.1.7.0. Other
5.1.7.1. Lightning strikes
5.1.7.2. Flooding
5.1.7.3. Storm, wind loading
5.1.7.4. Earthquake
5.1.7.5. Freezing
5.1.7.6. Aircraft crash
5.1.7.7. Heavy rain or snow
5.1.8. Human inadequate actions
5.1.8.1. Slip or lapse
5.1.8.2. Mistake
5.1.8.3. Violation
5.1.9. Security, safeguards, sabotage, or tampering actions

5.2. Inadequate human action – plant staff involved

5.2.1. Maintenance
5.2.2. Operations
5.2.3. Technical and engineering
5.2.4. Management and administration

5.3. Inadequate human action – type of activity

5.3.0. Other activity
5.3.1. Not relevant
5.3.2. Normal operations
5.3.3. Shutdown operations
5.3.4. Equipment start-up
5.3.5. Planned/preventive maintenance
5.3.6. Isolating/de-isolating
5.3.7. Repair (unplanned/breakdown maintenance)
5.3.8. Routine testing with existing procedures/documents
5.3.9. Special testing with one-off special procedure
5.3.10. Post-modification testing

5.3.11. Post-maintenance testing
5.3.12. Fault finding
5.3.13. Commissioning (of new equipment)
5.3.14. Recommissioning (of existing equipment)
5.3.15. Decommissioning
5.3.16. Nuclear material handling
5.3.17. Inspection
5.3.18. Abnormal operation (due to external or internal constraints)
5.3.19. Engineering review
5.3.20. Modification implementation
5.3.21. Training
5.3.22. Actions taken under emergency conditions

5.4. Human performance related causal factors and root causes

5.4.0. Other
5.4.1. Verbal communications
5.4.2. Personnel work practices
5.4.2.0. Other
5.4.2.1. Control of task/independent verification
5.4.2.2. Complacency/lack of motivation/inappropriate habits
5.4.2.3. Use of improper tools and equipment
5.4.3. Personnel work scheduling
5.4.4. Environmental conditions
5.4.5. Man-machine interface
5.4.6. Training/qualification
5.4.7. Written procedures and documents
5.4.8. Supervisory methods
5.4.9. Work organization
5.4.9.0. Other
5.4.9.1. Shift/team size or composition
5.4.9.2. Planning/preparation of work
5.4.10. Personal factors
5.4.10.0. Other
5.4.10.1. Fatigue
5.4.10.2. Stress/perceived lack of time/boredom
5.4.10.3. Skill of the craft less than adequate/not familiar with job performance standards

5.5. Management related causal factors and root causes

5.5.0. Other
5.5.1. Management direction
5.5.2. Communication or coordination
5.5.3. Management monitoring and assessment
5.5.4. Decision process
5.5.5. Allocation of resources
5.5.6. Change management
5.5.7. Organizational/safety culture
5.5.8. Management of contingencies

5.6. Equipment related causal factors and root causes

5.6.0. Other
5.6.1. Design configuration and analysis

5.6.2. Equipment specification, manufacture and construction
5.6.3. Maintenance, testing or surveillance

6. EFFECTS ON OPERATION

6.0. Other
6.1. Load or capacity decrease / reduction
6.2. Activation of engineered safety features
6.3. Unplanned or significant radiation or toxic exposure
6.3.1. Public
6.3.2. Facility personnel
6.4. Significant injuries
6.4.1. Public
6.4.2. Facility personnel
6.5. Outage extension
6.6. Exceeding technical specification limits

7. CHARACTERISTICS OF THE INCIDENT

7.0. Others
7.1. Unexpected or potential criticality
7.2. Degraded containment
7.3. Loss or significant degradation of safety function
7.4. Loss of power
7.4.1. On-site
7.4.2. Off-site
7.5. Discovery of major condition not previously considered or analysed
7.6. Fuel handling incident
7.7. Radioactive waste incident
7.8. Radiation exposure
7.9. Release of radioactive materials
7.10. Significant injuries

8. NATURE OF FAILURE OR ERROR

8.0. Others
8.1. Single failure or single error
8.2. Multiple failure or multiple error
8.2.1. Independent multiple failures or errors
8.2.2. Dependent multiple failures or errors
8.2.3. Recurrent failure or error
8.3. Common cause failure
8.4. Significant or unforeseen interaction between systems

9. NATURE OF RECOVERY ACTIONS

9.0. Not relevant
9.1. Recovery by human action
9.1.1. Recovery by foreseen human action
9.1.2. Recovery by unforeseen human action
9.2. Recovery by automatic plant action or by design
9.3. No recovery

GLOSSARY

The terminology below is intended for use in the Incident Reporting System for Fuel Cycle Facilities (FINAS) activity and may not necessarily conform to terminology/definitions adopted elsewhere for international and national use.

The aim of this glossary is to provide an opportunity for minimizing the proliferation of different terms describing the same thing and for harmonizing terms used for the preparation of national reports on FCFs events, submitted to FINAS.

accident
Any unintended event, including operating errors, equipment failures or other mishaps, the consequences or potential consequences of which are not negligible from the point of view of protection or safety.

Sequence of events which result in radioactive release or associated chemical discharges beyond the authorised limits or which result in significant damage to the installation which will necessitate difficult repairs with radiological protection problems.

anticipated operational occurrence

An operational process deviating from normal operation which is expected to occur at least once during the operating lifetime of a facility but which, in view of appropriate design provisions, does not cause any significant damage to items important to safety or lead to accident conditions.

authorization
The granting by a regulatory body or other governmental body of written permission for an operator to perform specified activities.

authorized limit
A limit on a measurable quantity, established or formally accepted by a regulatory body.

calcination
Evaporation of a waste solution to dryness and heating the residue so as to convert the waste to the oxides of the metallic constituents.

causal factor
Causes that, if corrected, would not of themselves have prevented the event, but are important enough to be recognized as needing corrective action to improve the quality of the process or product.

commissioning
The process by means of which systems and components of facilities and activities, having been constructed, are made operational and verified to be in accordance with the design and to have met the required performance criteria.

common cause failure
Failure of two or more structures, systems or components due to a single specific event or cause.

conditioning
Those operations which transform the concentrates produced by treatment and other disperse wastes into forms suitable for transport and/or storage and/or disposal.

construction
The process of manufacturing and assembling the components of a facility, the carrying out of civil works, the installation of components and equipment and the performance of associated tests.

containment
Methods or physical structures designed to prevent the dispersion of radioactive substances.

confinement
Prevention or mitigation of releases of radioactive material to the environment in operational states or design basis accidents.

contamination
Radioactive substances on surfaces, or within solids, liquids or gases (including the human body), where their presence is unintended or undesirable, or the process giving rise to their presence in such places.

criticality
A condition in which a sufficient quantity of fissile material is assembled in the right arrangement for a self-sustaining chain reaction to take place.

decommissioning
Administrative and technical actions taken to allow the removal of some or all of the regulatory controls from a facility (except for a repository or for certain nuclear facilities used for the disposal of residues from the mining and processing of radioactive material, which are 'closed' and not 'decommissioned').

defence in depth
A hierarchical deployment of different levels of diverse equipment and procedures to prevent the escalation of anticipated operational occurrences and to maintain the effectiveness of physical barriers placed between a radiation source or radioactive materials and workers, members of the public or the environment, in operational states and, for some barriers, in accident conditions.

dependent failures
The following six types of dependent failures may be distinguished:

1. Shared equipment dependencies.
2. Functional dependencies.
3. Common cause initiators.
4. Physical interaction failures.
5. Human interaction.
6. Common cause failures.

design
The process and the result of developing a concept, detailed plans, supporting calculations and specifications for a facility and its parts.

direct/observed cause
Direct cause: The latent weakness that allows or causes the observed cause of an initiating event to happen, including the reasons for the latent weakness.

Observed cause: The failure, action, omission or condition that directly leads to an initiating event.

discharge (of radioactive or chemical products)
Planned and controlled release of (usually gaseous or liquid) radioactive material to the environment.

disposal
Emplacement of waste in an appropriate facility without the intention of retrieval.

diversity
The presence of two or more redundant systems or components to perform an identified function, where the different systems or components have different attributes so as to reduce the possibility of common cause failure.

dose
A measure of the energy deposited by radiation in a target.

The mean energy imparted by radiation per unit mass of matter; it is expressed numerically in Grays, symbol Gy, as the unit of radiation equal to the Joule per kilogram. 1 Gy = 1 J/kg = 100 rad.

dose equivalent
The product of the absorbed dose at a point in the tissue or organ and the appropriate quality factor for the type of radiation giving rise to the dose.

The amount of absorbed radiation per unit mass of matter, it is expressed numerically in Sieverts, symbol, Sv, as the unit of dose equivalent. 1 Sv = 100 rem.

dose equivalent limits
dose limit: The value of the effective dose or the equivalent dose to individuals from controlled practices that shall not be exceeded.
The radiation exposure limit recommended by the International Commission on Radiological Protection (ICRP).

event
In the context of the reporting and analysis of events, an event is any occurrence unintended by the operator, including operating error, equipment failure or other mishap, and deliberate action on the part of others, the consequences or potential consequences of which are not negligible from the point of view of protection or safety.

An event is a deviation, an incident or an accident.

facility
Civil structures and engineered features for carrying out and safeguarding safe and reliable operation of process. A facility may also be made up of several sub-facilities provided there is a close physical and operational relation.

facility management (or management)
The members of operating personnel who have been delegated responsibility and authority by the operating organisation from directing the operation of the fuel cycle facility.

failure
The failure of a system, component or part in such a way that one or more design requirements can no longer be fulfilled.

fuel cycle
The various stages involved in supplying fuel for nuclear power reactors and any subsequent treatment and disposal operations. It includes front-end operations such as: thorium and uranium mining and milling, refining and conversion, enrichment and fabrication of fuel elements and back-end (following reactor operation) operations such as: spent fuel storage, reprocessing and waste management and waste disposal.

human errors
Groups/families of attributes to characterize wrong human behaviour (understanding, intention and actions). Examples of such groups are: violation (the person has a good understanding, he develops an intention not in compliance with his understanding); mistake (the intention of the person is wrong because his understanding is not in compliance with the prescribed task); slip (the intention was good, the action is wrong).

human factor — human performance
Any attributes to characterize human activities for functioning technological systems, connected machine design (including man machine interface), operation organizational aspects, skills and learning abilities, and working conditions.

incident
Is a singular event with no important damage to the plant or persons (including unplanned shutdown, violation of Operational Limits and Conditions, radioactive release, personal contamination or irradiation) or a sequence of events the occurrence of which may prohibit the continuation of the operation of the facility or sub-facility.

licence/licensee
A legal document issued by the regulatory body granting authorization to perform specified activities related to a facility or activity.

- The holder of a current licence is termed a licensee. Other derivative terms should not be needed; a licence is a product of the authorization process (although the term licensing process is sometimes used), and a practice with a current licence is an authorized practice.
- The licensee is the organization having overall responsibility for a facility or activity (the responsible organization).

mixed oxide fuel (MOX)
Reactor fuel which contains more than one type of fissile nuclide, both being in the form of oxides. Most commonly referred to fuel containing both Uranium oxide and Plutonium oxide.

normal operation
Operation within specified operational limits and conditions.

nuclear safety
The achievement of proper operation conditions, prevention of accidents or mitigation of accident consequences, resulting in protection of site personnel, the public and the environment from undue radiation hazards.

operating personnel
Individual workers engaged in the operation of an authorized facility. This may be shortened to operator(s), but only if there is no danger of confusion with operator in the sense of operating organization.

operation[1]
All activities performed to achieve the purpose for which the fuel cycle facility was constructed, including maintenance, in-service inspection and other associated activities.

operational limits and conditions
A set of rules setting forth parameter limits, the functional capability and the performance levels of equipment and personnel approved by the regulatory body for safe operation of an authorized facility.

operational records
Documents, such as instrument charts, certificates, log books, computer print outs and magnetic tapes, made to keep an objective history of fuel cycle facility operation.

physical separation
Separation by geometry (distance, orientation, etc.), by appropriate barriers, or by a combination thereof.

precursor
An initiating event that could lead to accident conditions.

prescribed limit
A limit established or accepted by the regulatory body. The term authorized limit is preferred.

Authorized limit: A limit on a measurable quantity, established or formally accepted by a regulatory body.

protection system
A system, which monitors the operation of a FCF and which on sending an abnormal condition, automatically initiates actions to prevent an unsafe or potentially unsafe condition.

quality assurance
The function of a management system that provides confidence that specified requirements will be fulfilled.

radioactive waste
For legal and regulatory purposes, waste that contains, or is contaminated with, radionuclides at concentrations or activities greater than clearance levels as established by the regulatory body.

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[1] The terms siting, design, construction, commissioning, operation and decommissioning are normally used to delineate the six major stages of the lifetime of an authorized facility and of the associated licensing process. Several of the stages may coexist; for example, Construction and Commissioning, or Commissioning and Operation.

radioactivity
The phenomenon whereby atoms undergo spontaneous random disintegration, usually accompanied by the emission of radiation.

recovery actions
Activities to terminate the event and reach a safe state of the system.

redundancy
Provision of alternative (identical or diverse) structures, systems or components, so that any one can perform the required function regardless of the state of operation or failure of any other.

regulatory body
An authority or a system of authorities designated by the government of a State as having legal authority for conducting the regulatory process, including issuing authorizations, and thereby regulating nuclear, radiation, radioactive waste and transport safety.

releases (of radioactive or chemical products)
The discharge of radioactive or associated chemical products from the facility, which exceed the authorised annual release rate.

reprocessing
A process, the purpose of which is to extract for further use Uranium and Plutonium from spent fuel and safely confine radioactive waste for final disposal. This operation also results in the separation of radioactive waste products.

residual heat
The sum of the heat originating from radioactive decay or fission.

root cause
The fundamental cause of an initiating event which, if corrected, will prevent its recurrence, i.e. the failure to detect and correct the relevant latent weakness(es) and the reasons for that failure.

safety functions
A specific purpose that must be accomplished for safety. The 3 basic safety functions are (a) controlling the reactivity or the process conditions, (b) cooling of radioactive materials, (c) confining the radioactive material

safety limits
Limits upon process variables within which the operation of the fuel cycle facility has been shown to be safe.

safety system
Systems important to the safety of a facility or sub-facility designed to protect the operating personnel, the population in the vicinity and the environment against the hazards involved in the operation or activity or to limit the consequences of anticipated operational occurrences and accident conditions.

serious accident
An accident involving significant release of radioactive material and likely to require full implementation of planned countermeasures covered by local emergency plans to limit serious health effect.

site personnel
All persons working in the site area of an authorized facility, either permanently or temporarily.

site
The area containing the facility, defined by a boundary and under effective control of the facility management.

spent fuel (irradiated fuel)
Nuclear Fuel removed from a reactor following irradiation, which is no longer usable because of depletion of fissile material, poison build-up or radiation damage.

storage
The emplacement of materials with the intent and in such a manner that the material can be retrieved later (for process inputs, main process outputs or secondary one like waste).

treatment
Those operations, which lead to the concentration of radio nuclides in a smaller volume and to a corresponding reduction of the radioactivity in the remaining material, thereby enabling it to be further processed, discharged or recycled.

waste management
All administrative and operational activities involved in the handling, pretreatment, treatment, conditioning, transport, storage and disposal of radioactive waste.

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INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA
ISSN 1816–9309