

Radiation Protection

# **Experience from International Nuclear Emergency Exercises**

**The INEX 2 Series**

NUCLEAR ENERGY AGENCY  
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

## **ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT**

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- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

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## **NUCLEAR ENERGY AGENCY**

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full Member. NEA membership today consists of 27 OECD Member countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Republic of Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities also takes part in the work of the Agency.

The mission of the NEA is:

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

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

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## FOREWORD

Since the beginning of the 1990s the NEA has offered its Member countries a forum for improving efficiency and effectiveness in nuclear preparedness strategies and nuclear emergency response. Based on experience and lessons learned from the first international nuclear emergency exercise INEX 1, the NEA launched a series of more realistic exercises, INEX 2.

The INEX 2 exercises were planned as a series of regional, command-post exercises with the simultaneous, real-time participation of many countries (including non-NEA members from Eastern Europe and Asia) and international organisations. Between 1996 and 1999 four regional exercises, all having the same objectives, were carried out based on realistic scenarios at nuclear power plants in Switzerland, Finland, Hungary and Canada. Each exercise was prepared, conducted and evaluated by a programme committee consisting of the NEA Expert Group, representatives of the host country's organisation team and the co-ordinators of the participating countries and organisations. For each regional exercise, all participating countries produced Country Exercise Summary Reports and attended a Regional Exercise Summary Meeting, from which generic conclusions and recommendations were drawn. This formed the basis for the four Final Regional Exercise Reports produced.

After the completion of these exercises, an INEX 2 Summary Meeting was held in December 1999 to review the overall experience, and to recommend new areas to be addressed by the NEA in the future. The experience gained and lessons learned were summarised during the meeting according to four areas of interest:

- decision making based on limited information and on uncertain plant conditions;
- real-time exchange of information;
- public and media communications; and
- preparation and conduct of emergency exercises.

The summaries are presented herein along with a one-page overview of those lessons that have potential policy implications.



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## THE INEX 2 SERIES OF EXERCISES

### Background

As a result of interest by its Member countries in emergency planning and preparedness for nuclear accidents, the Nuclear Energy Agency (NEA) has been actively involved in this area since the accident at Three Mile Island, in the United States in 1979, but more particularly since the Chernobyl accident in the Ukraine in 1986 (see references for a complete list of related NEA publications). From the very beginning, the NEA's focus of work has been on the international aspects of emergency situations. Within this constraint, the objective of the NEA's work in this area is to improve the efficiency and effectiveness of international nuclear emergency planning, preparedness and management by:

- Identifying areas in emergency planning, preparedness and management which could usefully be improved.
- Developing and testing with interested countries innovative ideas, approaches and concepts to facilitate international and national emergency management.
- Developing follow-up strategies, through workshops and expert group meetings, to address identified issues and to formulate new approaches for international testing.
- Providing a forum for experts in emergency response, outside the context of the legal requirements of international notification and assistance conventions.
- Participating in the overall assessment and lessons learned analysis of such exercises.

The International Nuclear Emergency Exercise programme (including INEX 1 and INEX 2) is an outgrowth of these emergency planning and preparedness activities. The NEA work in emergency exercises began in 1991 with the organisation of the first international nuclear emergency exercise INEX 1, which took place in June 1993. The objective of this table-top exercise was to identify policy issues and areas where transboundary communication and co-ordination could be improved. An important issue here was the different intervention levels that had been adopted by various countries, and how the implementation of countermeasures was co-ordinated, particularly in border regions (NEA95b).

The INEX 1 exercise was very well appreciated internationally. In order to follow-up on identified issues, and to carry work further, the NEA created the Expert Group for Nuclear Emergency Matters in 1993 (see Annex 1). As follow-up to the INEX 1 exercise, this Expert Group organised three workshops, between 1994 and 1995, covering the following topics:

- The Implementation of Short-term Countermeasures after a Nuclear Accident (Stockholm – NEA95a).
- Agricultural Aspects of Nuclear and/or Radiological Emergency Situations (Paris – NEA96a).
- Nuclear Emergency Data Management (Zürich – NEA96b).

Based on the experience from INEX 1, and from these workshops, it was felt that a more realistic international nuclear emergency exercise should be launched.

### Exercise series overview

The INEX 2 exercise was thus planned as a series of regional, command-post exercises with the simultaneous real-time participation of many countries – including non-NEA members from Eastern Europe and Asia – and international organisations. Between 1996 and 1999 four regional exercises, all having the same objectives, were carried out based on realistic scenarios at nuclear power plants in Switzerland (November 1996, NEA98), Finland (April 1997, NEA00b), Hungary (November 1998, NEA01a) and Canada (April 1999, NEA01b).

The INEX 2 series was based on and combined with previously planned regional or bilateral exercises which had their own specific objectives. Based on these Regional Exercises, the objectives to be tested in the international INEX 2 exercise were then added to the national-level command-post exercise. This required some compromises for the international exercises and their objectives and scenarios. The advantage of this approach, however, was that the main exercise organisation was handled by the host countries and that the NEA could concentrate on the international aspects.

Participating countries activated their own emergency command posts and utilised existing bilateral, multilateral and international notification and communication agreements to receive and transmit information. While in INEX 1 the participating countries simply described how they intended to handle notification, information exchange with other countries and co-ordination of counter-measures, INEX 2 was designed to put these intentions to a realistic test, using the real communication systems provided for emergency situations, and playing realistic scenarios. In the accident host country, this required the participation of all partners who would be involved in a real event, from the power plant emergency organisation over local and regional emergency staffs to national emergency staffs and operations centres. Official contact points were tested.

The four exercises involved the following nuclear power plants and accident scenarios:

Exercise	Date	Nuclear Power Plant	Scenario
<b>INEX-2 CH</b>	November 1996	Leibstadt (BWR), Switzerland	Explosion and fire in the turbine building, pipe-burst in bleed-steam line, release of radioactive steam through broken windows, reactor not affected
<b>INEX-2 FIN</b>	April 1997	Loviisa (PWR) Finland	Anticipated transient without scram (ATWS), initiated by power failure due to airplane crash, site emergency declaration.
<b>INEX-2 HUN</b>	November 1998	Paks (PWR), Hungary	Large primary to secondary circuit leak, activity release through an open safety valve.
<b>INEX-2 CAN</b>	April 1999	Darlington (CANDU) Canada	Loss-of-coolant accident (LOCA), containment dowsing, possible problem with emergency cooling, time of projected venting

The participating countries and international organisations in the four exercises are shown in Annex 2.

### **Exercise scope and objectives**

Under the heading, “Exercises are not for proving but for improving”, the aim of INEX 2 was by no means to show that everything was perfect, but to get a reliable picture of how concepts, agreements, teams, systems and other available means worked under realistic conditions, and to locate areas where improvement was needed. It was thus expected that problems would be detected and that mistakes would be made. Fault-free exercises would not be worth the effort and the costs.

Based on the experience of INEX 1 and the three follow-up workshops, the CRPPH Expert Group agreed on the following objectives for INEX 2 exercises (see Annex 3 for more details):

- decision making based on limited information and uncertain plant conditions;
- use of real time communications with the actual equipment and procedures;
- public information and interaction with media; and
- use of real weather for real time forecasts.

To these general objectives, each participating country and organisation could add its own specific objectives for each exercise. As many participants began to introduce modifications based on experiences and lessons from the first exercises of the series, testing such modifications became important specific objectives for the following exercises. Depending on the location of the respective regional exercise, many countries had the opportunity to play as neighbouring, near and far field countries.

Regarding the objective for decision making, scenarios with large-scale releases (e.g. INES level 6 or 7) would have involved more countries in decisions on early countermeasures. But the aim to use realistic scenarios and to avoid possible conflicts regarding motivation of the participating power plant staff and public perception of nuclear power plant safety, led in all four cases to the selection of small or moderate release scenarios (e.g. INES level 4 or 5), and events with no, or only short, pre-release phases.

### **Exercise evaluation and reporting**

Each INEX 2 exercise was prepared, conducted and evaluated by a programme committee consisting of the NEA Expert Group, representatives of the host country’s exercise direction and the co-ordinators of the participating countries and organisations. For each regional exercise, all participating countries produced country exercise summary reports and attended a regional exercise summary meeting, from which generic conclusions and recommendations were drawn. This formed the basis for the four final regional exercise reports produced (NEA98, NEA00b, NEA01a, and NEA01b). After the completion of these four regional exercises, an INEX 2 summary meeting was held, in December 1999, to review the experience to date, and to recommend new areas to be addressed by the NEA’s programme in the future.

In summarising the experience and lessons learned discussed during the workshop, four areas of interest were discussed:

- lessons learned for decision making based on limited information and on uncertain plant conditions;
- lessons learned on the real-time exchange of information;
- lessons learned in public and media communications; and
- lessons learned for the preparation of emergency exercises.

The lessons learned in these areas are summarised in this report. From these rather specific lessons, a more refined analysis has identified a series of policy-level lessons, which are also reported here.

### **Parallel follow-up activities**

Early during the Swiss and Finnish exercises, it became clear that in case of an emergency situation, the selection of information and the transmission of this information could be improved to assure that decisions and public information are based on appropriate and timely knowledge. Three NEA working groups were created to address these problems, resulting in a single, coherent strategy to:

- better identify key emergency data;
- improve emergency communication and information management;
- improve emergency monitoring strategies.

This strategy is laid out in the NEA report titled, *Monitoring and Data Management Strategies for Nuclear Emergencies* (NEA00a). Many NEA Member countries, the EC and the IAEA are implementing this strategy. Other countries and international organisations (WHO, WMO, UN-OCHA) are considering how best to adapt the strategy to their roles and needs.

## IMPLICATIONS OF THE INEX 2 SERIES

The four objectives of the INEX 2 series of Regional Exercises were focused on specific operational areas of nuclear emergency planning, preparedness and management at both national and international level. The synthesis of experience gained and lessons learned during INEX 2, however, revealed several key policy implications.

As has been shown on numerous occasions, **a nuclear accident anywhere is a nuclear accident everywhere**. Therefore, public and media interest in nuclear accidents, even those occurring in other countries and having no potential for direct impact, should trigger certain level of government interest and investigation in order to maintain public confidence in protection authorities. Suitable mechanisms have to be put in place, as quickly as possible, to monitor news events and to gather, co-ordinate and supply official information to be given to the public and the media. It should be recognised that sharing information and experience with other countries is as important as population protection and reassurance.

Nuclear emergency preparedness and management actions have to be co-ordinated and harmonised locally, nationally, regionally (with neighbouring countries) and internationally to avoid confrontation with the public and the media. Such co-operation, before, during and after nuclear accidents, will help to maintain and enhance public confidence in government, and will facilitate the implementation and effectiveness of public protection measures. Although much progress has been made in this area since the Chernobyl accident, more work is needed. For example, co-ordination of information within all relevant organisations could be more efficient.

The planning and implementation of countermeasures are among the most important areas for co-ordination and harmonisation. Although levels triggering urgent countermeasures (sheltering, evacuation and the use of stable iodine) have been largely harmonised internationally, variations in national habits may result in differing decisions on two sides of a border region. The reasons for these differences should be well understood and publicised. Harmonisation of food interdiction levels has been effectively accomplished at the regional and international level. However, further harmonisation could be achieved in areas such as advice to travellers, airline companies and businesses coming from or going to affected regions, advice to diplomatic and embassy staff, as well as communication with the public and the media.

Existing bilateral, multilateral and international agreements should be streamlined to optimise the use of resources. During nuclear emergency situations, these agreements often result in a large number of redundant messages sent and received. Such redundancy is at best a waste of resources, and at worst confusing and misleading.

The importance of a common language for communicating with other countries should also be recognised, and appropriate resources should be put towards the translation of messages to and from foreign countries, and the international organisations.



## EMERGENCY PLANNING, PREPAREDNESS AND MANAGEMENT

### General results

The INEX 2 exercise series offered for the first time the opportunity to exercise national and international concepts in emergency management under real time conditions, including testing of detailed arrangements, communications, teams and methods. Already during the first INEX 2 exercise in Switzerland, participating countries identified possible improvements in national emergency management and several countries took advantage of these identified improvements to change concepts and arrangements of their emergency organisations. The following INEX 2 exercises were then used to test these evolutions.

All participating countries and international organisations stated that they had profited greatly from these exercises that had enabled them to improve their emergency organisations, means and procedures.

Without political pressure, participating international organisations have begun to change and adapt their procedures and means following experience of the INEX 2 exercises and the recommendations made by NEA working groups and workshops.

The INEX 2 series was also open to non-NEA member countries. This partly initiated training and experience exchange programmes in the framework of regional assistance agreements, e.g. between Scandinavian countries and Baltic and other former Soviet States. After the Hungarian INEX-2 Exercise, Kazakhstan recognised the need to join the IAEA conventions on early notification and assistance.

The exercises revealed the importance of the national *contact point* as the **only** contact point for international communication in case of a nuclear emergency. These contact points must be operational around the clock, including national holidays, and must have an appropriate knowledge of English.

The emergency staff involved needs a clear understanding of their national and international partners as well as the tasks, concepts and obligations of those partners. Periodic training through repetition of the INEX 1 exercise, for example, could help to update such knowledge.

### Monitoring and data management strategies for nuclear emergencies

The need to improve emergency monitoring, communication and real time information exchange was identified during the NEA workshop on emergency data management held shortly after the INEX 1 exercise. The first two INEX 2 exercises, however, revealed in practice the extent and urgency of these problems so that the decision was taken not to wait until the end of the INEX 2 series but to launch three NEA working groups to propose new strategies to improve emergency monitoring, communication and real time information exchange. The results and recommendations of these three

groups were available at the end of the exercise series and were published by the NEA report *Monitoring and Data Management Strategies for Nuclear Emergencies* [NEA00a].

This report offers a coherent approach by focusing on the needs of the decision maker, particularly with respect to the different temporal and geographic phases of an accident, and including considerations of the nature of the sender and receiver of information and of the type of data being transmitted.

Developing, establishing and using **modern communication methods** will allow nuclear emergency response organisations to improve transmission and reception of data and information. The use of secure network-technology will help to reduce and optimise the volume of data which is currently transmitted by conventional means, such as fax, and at the same time improve the quality of information provided. The new strategy distinguishes between information which has to be actively sent (“push”) and information which could be made available via network-technology to be accessed if needed (“pull”). The official first notification of a nuclear or radiological emergency has to be actively sent to relevant receivers (“push”). This applies also to follow-up information, actively notifying relevant receivers of a change in the status of the accident. Additional information, such as background information on the accident plant, emergency response plans, monitoring and modelling results, weather forecast etc. could be made available on the web for easy access by emergency response organisations (“pull”).

In order to improve the data’s usefulness and to optimise resources, the report offers a selection of **key data** to be transmitted in case of a nuclear emergency. A matrix identifies data that is key as a function of the different pre-defined temporal phases of an accident, the various geographical zones and sender and receiver considerations. The matrix is coded according to the existing Convention Notification and Information System (CIS)<sup>1</sup> which provides an extensive, numerically keyed listing of important emergency data.

The report proposes, in addition, how to better define the **monitoring and modelling needs** to support decision making. A set of tables provides a matrix defining WHY emergency monitoring is performed (addressing the needs) identifying WHAT measurements are made (physical quantities), WHEN measurements are made (referring to the time phases of an accident) and WHERE measurements are made (with reference to the previously defined geographical zones). This facilitates optimisation of resources and assists countries wishing to check the adequacy of their monitoring concepts and organisation, or modernising parts of their systems.

### **Decision making based on limited information and uncertain plant conditions**

In general, decisions should be based on the most accurate assessment of the situation and a prognosis on the possible further development. However, in the event of a nuclear emergency, decisions on early or precautionary countermeasures, if taken early enough, could help reduce and/or avoid public exposure in case of a release of radioactivity. Thus decisions on first actions cannot wait until the situation is sufficiently understood, e.g. the source term or the activity to be released is available, but must be taken based on limited information and uncertain plant conditions. Criteria for such decisions need to be prepared beforehand in co-operation with plant operators and nuclear safety authorities, based on safety studies of design base accidents and even of severe accidents with a low likelihood of occurrence. It seems preferable to initiate timely countermeasures, based on the best

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1. Adopted in order to implement the IAEA Early Notification Convention and the European Union Council Decision on Early Notification (IAE 92).

estimate of the situation at the time, than to wait for a more detailed picture and to initiate countermeasures too late. Concepts and criteria for early countermeasures have been discussed and described at the NEA Workshop on short-term countermeasures in 1994 [NEA95a].

The decision not to take countermeasures is also an important action, which has to be justified and communicated to relevant partners, the public and the media.

Decision making on medium term countermeasures was outwith the scope of the INEX 2 exercises. However, experience during the exercises has shown that preparations for such decisions have to begin in the early phase of an accident, for example by the initiation of an extended monitoring programme. Decision makers and government agencies responsible for the medium or late phases of a nuclear emergency have to be informed during the early phase in order to give them enough time to start their preparations and initiate programmes.

Medium term countermeasures with an international impact, such as travel and trade, have to be co-ordinated as soon as reliable assessments of the qualitative and quantitative consequences in the affected regions are available. Decision makers in emergency response management have generally only limited knowledge of international trade relations, therefore early and close co-operation with relevant government agencies, customs, industry, trade and transports should be established before a nuclear emergency occurs.

Far field countries will not have to decide on early countermeasures on their own territories, but they may have to decide at an early phase on advice to travellers, on re-routing transport passing through the affected countries and on monitoring people and goods arriving from the accident region. An international common approach to such countermeasures in far-field countries should be developed. Far-field countries may also have to establish medium-term countermeasures, such as monitoring of airports and of imported goods.

In addition to the management of the emergency itself, decision makers must deal in parallel with information management, and integrate information with their event and intervention management. If the emergency managers lose the "information battle", they risk at least a partial failure of intervention management.

### **Real time information exchange**

At the beginning of an emergency the workload from information tasks on the emergency organisation will increase faster than the workload from emergency management. The inevitable time gap between the "exploding" requirements from media and public for information and the availability of sufficient and reliable knowledge of the event and its consequences must be filled by means of a well-planned and prepared information strategy with the aim of keeping the initiative in the hands of the emergency management organisation, not in those of the media. The experiences of some countries show that it may be wise to include local and national media as partners in the emergency management team.

The INEX 2 exercises have clearly shown the inadequacies and weaknesses of the present concepts and means of communication, both for notification of accidents and during an emergency. In accident host and neighbouring countries, and in distribution centres of the international organisations such as IAEA and EU (ECURIE), there is a recognised need to improve communication resources. The present communication systems (telephone, fax and telex) are not effective or efficient enough to exchange the information needed. Even high-speed and high-capacity fax systems were too slow or

became overloaded. The problems identified during the exercises are described in more detail in the aforementioned *Monitoring and Data Management Strategies for Nuclear Emergencies*.

Decision makers need more information more quickly to ensure that decisions and public information are based on appropriate knowledge. Delays caused by slow or overloaded communication systems, or by the need to copy or rewrite messages at distribution centres in order to make them readable, are not acceptable. Any relevant message should be made available to all interested parties in its original form simultaneously and without any unnecessary delay. National and international contact points also need “immediate” links at all times to a duty officer of the relevant national authority who is empowered to activate the emergency procedures without delay. Even far-field countries need quick information to establish recommendations to their citizens in affected areas, concerning travelling, transport and trade (e.g. long-distance transport, change of routes, control of imports).

The INEX 2 exercises showed that the accident country may be flooded by information requests immediately after an event has become known, and in a phase when national resources are desperately needed for solving the most urgent problems. In order to relieve pressure on the accident country, only direct neighbouring countries and relevant international organisations should establish and maintain direct contacts with the accident country. All other countries should get their orientation and information through the relevant international organisations.

The accident country needs additional resources, e.g. a special team to communicate with neighbouring countries and international organisations. This team should be assisted by a group of nuclear and related science field experts to answer additional questions. Although bilateral agreements are very useful for preparations, their requirements for mutual information bind the urgently needed resources of the accident country during an emergency. Once the international notification and orientation network is operational, bilateral special contacts should be reduced to those required operationally by the actual situation and are better handled by liaison officers.

The performance of international organisations, both for redistributing the initial notification and for providing meteorological services, was initially slow but improved markedly towards the end of the exercise series.

The use of diplomatic channels could be considered as an additional communication channel, e.g. with and between far-field countries, if normal communications are disturbed or overloaded.

Although English is the official language for international emergency communication, most countries will need to communicate in additional languages: their own national language(s) and major languages used by tourists, guest workers, minorities and neighbouring countries. This presents a number of severe problems of adequate and timely translation, which remain to be solved.

### **Public information and the media**

Public and media information was not addressed in the INEX 1 exercise but became a major objective for the INEX 2 series. The INEX 2 accident host countries tried to simulate, as far as possible, communication with national and international media.

The INEX 2 exercises showed clearly that informing the public and co-operation with the media remain major problems in emergency management. Frequent information failures during other types of unexpected and extraordinary events and emergencies prove that the lessons from such

previous experiences, including the large scale information failure after Chernobyl, have not been learned or taken into serious consideration. First attempts at possible concepts and solutions have been presented and tested during the exercises, but much work remains to be done, and this topic should be followed up in workshops, working groups and in future exercises, with larger involvement of media and public.

Public information and co-operation with the media is one of the first countermeasures in case of a nuclear emergency. The emergency management organisations have to deal in parallel with the event and its consequences and with information needs. Information mistakes at the beginning of an emergency may lead to early loss of confidence from the public which would be very difficult if not impossible to correct. The emergency management organisations must aim at a continuous presence in the news media, and to remain “**the**” source of verified, timely and comprehensive information on the event, its consequences and the response actions. Media should be considered as partners and treated as such, not as “enemies” or nuisances.

Even on a national level, information of the public cannot be undertaken by one institution or authority alone, as desirable as this might be. Local information needs must be satisfied by local authorities familiar with the particular circumstances. Each partner in the response organisation should be responsible for part of the information, based on the principle that information is only produced and given on matters relating to one’s own area of knowledge and responsibility, and that only facts are given, no speculations. This distribution of the information requires central co-ordination, a clear definition of the area of responsibility, and the mutual information of all partners – again well achievable with a web based application.

Information in an emergency has a greater chance of success if the emergency response organisation opens the dialogue with the media and public early in the preparation phase, before any accident happens, to built up a certain confidence. This process could include periodic information on the tasks of the emergency response organisation, on new developments and exercises, as well as the supply of verified information on incidents in other countries.

Language is an entirely unsolved and, at the international level, barely recognised problem, both relating to using correct and understandable terminology and to adequate translation into relevant languages. Contact point and emergency management staff often have no or insufficient knowledge of English, requiring translation services for all incoming information from international sources and for their own country’s input to international channels, with the inevitable delays and errors. The information given to the public in the accident country must, in many countries, be multilingual and may be complicated even more by unfamiliar languages of immigrants and guest workers. International organisations could offer assistance, for example by preparing dictionaries in nuclear and radiological terminology and by organising language training for contact point and emergency response staff. Countries not directly affected by the accident could assist affected countries in preparing information in other languages, for tourists, guest workers, neighbouring countries etc.

The International Nuclear Event Scale (INES) was originally developed to facilitate information of the media and public during an emergency, but its real application has developed in another direction, as a final qualification of an event based on nuclear safety criteria, and with contradictory criteria for in-plant and for off-site consequences. The INEX 2 exercises have shown the problems of the actual use of the INES scale, and the reluctance of affected installations and countries to assign a level early enough to be of any value for information purposes, due to fear that the level may have to be changed later. If INES is to be used at all during an emergency situation, it must be restored to its original purpose. It is suggested that a provisional INES level, relating only to expected off-site consequences, should be assigned at the time of the first decisions, indicating an upper level of

severity assumed by the decision makers in the accident country. Depending on the further development of the situation and on improved knowledge of the consequences, the INES level can be adjusted later.

The objectives of information in an emergency are to inform the public, to protect the public, to recommend actions to the public and to provide political justification of the emergency management. Another important objective should be to enable the public to help themselves, to make their own decisions based on sufficient knowledge of the situation and of the feasible protective actions (involvement of the so-called “stakeholders”). Therefore the advice should also contain information on what they are still allowed to do. This is achieved with the following types of public information:

- general information about the accident, its development and general actions;
- specific information and advice for people in emergency planning zones;
- specific information and advice for people directly affected;
- information for people who have relatives in the affected areas.

Information of the public must be based on three mutually dependent basic principles: honesty, trust, and regular information and communication. Nuclear emergency information is complex and has to be translated into everyday language. Lack of knowledge and information may lead to panic reactions; complacency on the other hand might lead to underestimating real danger. Both extremes of behaviour must be corrected by the right amount of information and knowledge.

Information must be characterised by its source and reliability. Rumours cannot be avoided, but they should be detected and corrected quickly. If at times information from unofficial sources has to be used, identify the source and indicate whether a verification has taken place or what degree of reliability is assigned to the source and the message. The basic principles are:

- Inform only on facts, not on speculation or fiction. Make this information transparent and do not try to hide anything. Explain if and why you are not able to give requested information.
- Inform only in your own area of competence and responsibility.
- Share your information with partners and contribute to keeping all information services at the same level of knowledge.

### **Role of international organisations**

The participating international organisations all stated that they had profited from the experiences during the INEX 2 exercise series. They started to review their emergency arrangements and introduced improvements to their services. In the sequence of the four exercises, it was clearly demonstrated that they had already begun to implement some of their lessons learned. However the exercises also proved that the roles, tasks and procedures of the various organisations must be scrutinised (reviewed), better defined and suitably modified. This would ensure that the services expected from them are both timely and of the required quality, without redundancies, duplication, overlaps or violations of national responsibilities. The participation in exercises should therefore lead to improved services in the case of real emergencies.

Co-ordination and co-operation among international organisations, and in organising international emergency exercises, is essential for successful emergency management. The United Nations (UN) have created the Interagency Committee on Response to Nuclear Accidents, IACRNA, where all interested UN organisations and other intergovernmental organisations such as NEA and EU are represented, in order to co-ordinate all activities in the field of emergency management, including the preparation and co-ordination of international emergency exercises.

The role of international organisations such as IAEA or WHO in assisting decision making in the accident country or in other affected countries needs to be clarified. National decision makers would welcome well-founded advice from these organisations. In no circumstances should international organisations issue or publish their own advice or recommendations without prior consultation with and the consent of the decision makers in the relevant country. Only the latter have the responsibility and authority to make such recommendations and also know the entire situation and the available resources and can thus judge whether a recommended action is suitable and practicable.



## **PREPARATION, CONDUCT AND EVALUATION OF EXERCISES**

After INEX 1, the launching of the more realistic INEX 2 series represented a first step towards an international nuclear emergency “exercise culture”.

Besides all lessons learned for emergency preparedness and management, the INEX 2 exercises offered the occasion to gain experiences in planning, preparing and performing exercises at an international level. In particular, the planning and preparation phase of the INEX 2 exercises offered the possibility to analyse, criticise and rearrange existing emergency arrangements in the accident host country, the other participating countries, and the international organisations involved. Accident host countries and possibly affected neighbouring countries profited most from the exercises, especially in the aforementioned preparation phase. The planning and organising of the INEX 2 exercises created useful experiences and should lead to the development of guidance for planning, preparing and executing exercises.

Many countries had difficulty in involving relevant governmental institutions or responsible individuals to participate in exercises. The international component of INEX 2 offered an important argument to motivate the relevant national organisations to participate and encourage emergency staffs to request more training.

Performing emergency exercises requires sufficient legal basis to ensure participation of relevant governmental organisations and agencies up to high level functions and to allow for a simulation of real emergency conditions, e.g. disregarding working hour regulations.

An important objective of all emergency exercises should be to explore the limits of existing concepts, means and procedures, and to test the ability to deal with unexpected situations. An important condition for developing such an exercise culture is to accept that mistakes are made in exercises and that weaknesses, gaps and insufficiencies are revealed. The results should then be evaluated in an atmosphere of constructive criticism with the aim to improve emergency preparedness, not to judge the performance of individuals.

The INEX 2 exercises have shown that the involvement of real media during the exercise could prepare media for real events and could help to foster mutual understanding and respect between media and emergency management personnel.

### **Planning, preparation and conduct**

The preparation of a major national or international exercise requires a planning period of about two years from the first brainstorming on objectives and possible scenarios to the day of the exercise. At this point, the entire documentation and guidance for players, exercise direction, simulators must be ready and distributed. Players must be instructed, all preparatory tests (e.g. of communications) and refinements of procedures must be successfully terminated.

International exercises such as INEX 2 have a number of common major objectives focusing on the international aspects of the exercise. In addition, INEX 2 exercises allowed each participating country or international organisation to add and perform specific objectives in the same exercise and could be combined with other national or regional exercises. For example, Switzerland, as the accident host country of INEX-2 CH, performed a monitoring field exercise prior to the INEX 2 exercise which served as a basis for the simulated monitoring data and a tabletop exercise to introduce some new concepts which would be tested in the INEX 2 exercise.

The most critical aspect of an international exercise is the arrangements for communications. It is essential that during the exercise the communication channels designated for real events are used, especially for international communication. This allows for testing of the actual co-ordinates of the relevant contact points (phone numbers, fax numbers, e-mail addresses).

The accident scenario has to be chosen in order to allow for an efficient evaluation of the exercise objectives. This includes the accident initiation, sequence of events and consequences such as activity releases. For an international exercise with decision making as a major objective, a large-scale release would be desirable in order to involve a larger number of countries which could then exercise their full range of decision making activities. Time jumps are problematic for planners and players and should be avoided. As nuclear accident scenarios generally develop rather slowly, it would be desirable to extend the duration of exercises to longer than one working day to include at least one shift change of the players.

As the INEX 2 exercises were based on previously planned regional exercises, the timing of INEX 2 had to follow national conditions. It transpired that the intervals between the individual exercises were too short. The lesson learned was that international command post exercises should not be held too close together so that improvements can be made, but still close enough that the same staff members can test these improvements in a second exercise. The time lapse between two international emergency exercises should be at least 18 months.

In preparing the exercise scenario, the choice between the use of real time weather versus “historical” weather depends on the objectives of the exercise. The use of real time weather, as in the INEX 2 series, offers realistic conditions for the participating weather services, associated forecast uncertainties and real-time plume dispersion calculations. The disadvantage of this choice is that unfavourable weather conditions would leave neighbouring countries unaffected and would not force them to simulate the introduction of countermeasures. The use of “historical” weather, on the other hand, allows to focus on the post-release phase of a nuclear emergency including the preparation of detailed monitoring data and the pre-selection of affected regions.

Simulation of realistic media and public pressure proves to be difficult and requires additional personnel and communication resources. The impact of media on decision makers in case of a real event is probably impossible to simulate.

From an accident host country’s viewpoint, the benefits for the preparation of an international nuclear emergency exercise such as INEX 2 could be summarised as follows:

- elevated attention and motivation to emergency preparedness;
- stimulation by the challenge;
- conscious and concise planning;
- exercise date as pressing deadline for implementation of improvements;

- attention to lessons learned from earlier exercises;
- attention directed to important issues;
- increased attention and assistance from international community;
- involvement of media offered the opportunity to promote co-operation;
- exchange of experiences; and
- gained capability to advise less experienced countries.

## **Evaluation**

Evaluation and follow-up of a major exercise are as important as the exercise itself. They should provide a detailed analysis of the lessons learned and a broad discussion and distribution of these. The lessons learned have then to be converted into improvements of concepts, procedures and means and the necessary training of emergency staff. The next major exercise should then be planned with a minimum time delay of 18 months to allow organisations and agencies to implement the identified improvements. Thus part of the objectives of a future exercise should always be to check the progress made since the last exercise.

The evaluation of the results of an exercise will usually require several months, especially for international exercises with longer delays.



## **FUTURE DEVELOPMENTS**

The NEA work programme on nuclear emergency matters has yielded much experience in the areas of transboundary co-ordination, short-term countermeasures, agricultural aspects, data management, and information and data input to decision making. The INEX 2 exercises have been successful at identifying areas where data and information management could be improved, and at testing possible mechanisms for this improvement.

In the short term, part of the experiences gained during the INEX 2 series will be tested during an exercise similar in scope to those of the INEX 2 series. This exercise, INEX 2000, will be conducted in May 2001.

Following INEX 2000, the NEA will continue to identify, through its Working Party on Nuclear Emergency Matters, innovative approaches to emergency planning, preparedness and management which could be usefully tested using the INEX 2 exercise model. Future exercises will be co-ordinated with other international organisations, such as the IAEA, the EC, the WHO, and the WMO, to ensure the most effective use of national and international resources.

In addition, it is recommended that other aspects of emergency planning, preparedness and management should be studied using exercise formats such as table-top or small-scale command-post exercises.

### **Short-term direction: The INEX 2000 Exercise**

INEX 2000, the next international nuclear emergency exercise is planned to be similar in scope to those of the INEX 2 series. An additional objective is to test the ability of modern data and information exchange technology via world wide web to improve the effectiveness and efficiency of exchanges, and to better serve the needs of decision makers, as defined in the report on "Monitoring and Data Management Strategies for Nuclear Emergencies". In addition, INEX 2000 will, for the first time, address questions regarding civil liability in the early phase after a nuclear emergency.

The INEX 2000 exercise objectives are:

- To test features of the "Monitoring and Data Management Strategies for Nuclear Emergencies" such as:
  - the effectiveness of the developed data matrix;
  - the effectiveness of proposed communication strategies employing new technologies.
- To test the co-ordination of media information between various participants.
- To test the mechanisms for the implementation of the Conventions on Third-Party Liability.
- To identify how participants incorporated the lessons learned from INEX 2 exercises.

The results from this exercise will most likely lead to short-term follow-up activities, such as the evaluation of experience with the practical implications regarding further optimisation of the communication strategy which has been developed, and/or third-party liability.

### Further development and next generation of international nuclear emergency exercises (INEX 3)

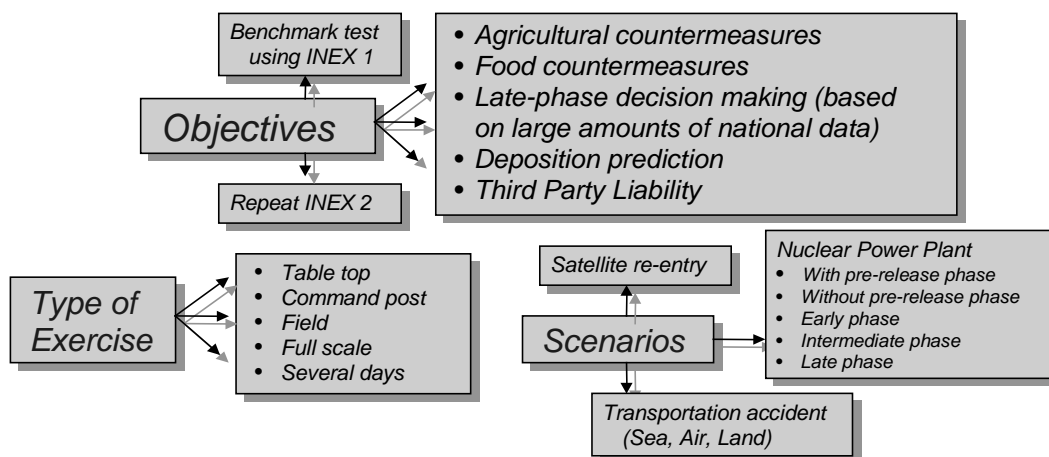
INEX 1, the INEX 2 series and INEX 2000 addressed mainly the pre-release, release and short-term post-release phase of a nuclear emergency. The next generation of international nuclear emergency exercises might focus on decision-making processes.

There are several questions pertaining to nuclear or radiological emergencies that have not yet been exercised on an international level. Several possible objectives for future international nuclear emergency exercises are under consideration by the NEA Working Party on Nuclear Emergency Matters. These are:

- exercise the policy and decision-making process, covering a spectrum of decisions and countermeasures before, during and after a nuclear accident;
- exercise to test agricultural and food countermeasures;
- exercise to test the management of contaminated territories during the intermediate phase of an accident (i.e. a few weeks after the release) and the ability to predict depositions;
- exercise to test the economic aspects of an accident, including countermeasure optimisation and selection, damage assessment, compensation, and third party liability;
- exercise to test late-phase decision making with large amounts of national data;
- re-examination of the INEX 1 exercise to “Benchmark” progress;
- repetition of INEX 2 regional type exercises periodically; and
- test information collection and decision making using web technology.

It is recognised that several of the above-mentioned objectives could be combined, focusing for example on the late phase of an emergency. Furthermore, by extending the exercise over several days and introducing time jumps, different phases of an emergency could be tested in one exercise, possibly in conjunction with other international organisations. Figure 1 shows the options and the variety of combinations.

Figure 1. Next generation of exercises INEX 3



Beyond these considerations, the Working Party on Nuclear Emergency Matters is discussing methodologies to address the psychological, societal and public information aspects of an accident.

### **List of topics for future action or discussion**

During the course of the INEX 2 exercise series, the following additional topics for future action and discussion were identified:

- Clarification of the roles and responsibilities of the international organisations.
- Co-ordinated action to analyse the implications of convention requirements, and to recommend an interpretation and implementation.
- Examination of the transition phase from “emergency management” during the early phase of an accident back to modified “normal” operation.
- Definition of a strategy for informing the media and public.
- To find or create efficient methods to monitor the effectiveness of public and media information.
- Definition of a strategy for public information of IAEA member states (communication strategy, information website, standard information text blocks, co-operation with media etc).
- Creation of an international data base for FAQ from real events and exercises.
- Study of the feasibility of an international advisory group (expert panel) to co-ordinate public and media information content, in order to provide internationally consistent information at the same time (incl. media monitoring and feedback).
- Definition of international standards for emergency data transmission.
- To make existing proven tools, software, procedures etc internationally available (electronic logs, monitoring data and information databases of the FAQ type etc), in order to avoid letting each country or organisation invent the wheel again and create a multitude of incompatible systems.
- Evaluation of other emergencies (earthquakes, floods, hurricanes, ...) for their relevance and lessons for nuclear emergency response and promotion of the exchange of experiences.
- Countermeasures for far-field countries – advisories for travellers, embassies, business and trade.



## CONCLUSIONS

With the launching of the INEX 1 exercise and the more realistic INEX 2 exercise series, the Nuclear Energy Agency initiated and established an international nuclear emergency “exercise culture”.

The INEX 2 exercise series offered for the first time the opportunity to exercise national and international concepts in emergency management under real time conditions, including testing of detailed arrangements, communications, teams and methods. All participating countries and international organisations stated that they had profited greatly from these exercises that had enabled them to improve their emergency organisations, means and procedures.

The INEX 2 series offered a wealth of lessons learned with respect to emergency planning and management, particularly in the areas of communication and information exchange, public and media information and decision making based on limited and uncertain information. The identified deficiencies in the area of communication and information exchange led to the elaboration and publication of the *Monitoring and Data Management Strategies for Nuclear Emergencies*.

In addition, these international exercises contributed to the experience gained in organising, performing and evaluating an international nuclear emergency exercise.

The NEA will continue to identify, through its Working Party on Nuclear Emergency Matters, innovative approaches to emergency planning, preparedness and management. In addition, the NEA will study and identify exercise objectives, scenarios and formats to usefully exercise the identified innovative approaches internationally.



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## LIST OF ABBREVIATIONS

<b>ConvEX</b>	Convention Exercise, IAEA test of convention procedures
<b>CRPPH</b>	NEA Committee on Radiological Protection and Public Health
<b>EC</b>	European Commission
<b>ENAC</b>	Emergency Notification and Assistance Convention (IAEA)
<b>EU</b>	European Union
<b>FAO</b>	Food and Agriculture Organization of the UN
<b>IACRNA</b>	Inter-Agency Committee on Response to Nuclear Accidents
<b>IAEA</b>	International Atomic Energy Agency
<b>NATO</b>	North Atlantic Treaty Organization
<b>NEA</b>	Nuclear Energy Agency of the OECD
<b>OCHA</b>	UN Office for the Coordination of Humanitarian Affairs
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>PAHO</b>	Pan-American Health Organisation (WHO)
<b>PfP</b>	Partnership for Peace (NATO)
<b>REMPAN</b>	Radiation Emergency Medical Preparedness and Assistance Network (WHO)
<b>RSMC</b>	Regional Specialized Meteorological Center (WMO)
<b>WHO</b>	World Health Organization
<b>WMO</b>	World Meteorological Organization



*Annex I*

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*Annex 2*

**COUNTRIES PARTICIPATING IN THE REGIONAL INEX 2 EXERCISES**

	<b>Swiss Exercise</b>	<b>Finnish Exercise</b>	<b>Hungarian Exercise</b>	<b>Canadian Exercise</b>
1	Austria	Austria	Austria	Austria
2	Belarus			Belarus
3	Belgium			
4			Brazil	Brazil
5	Bulgaria	Bulgaria	Bulgaria	Bulgaria
6	Canada			Canada
7	Chinese Taipei			Chinese Taipei
8	Czech Republic		Czech Republic	
9	Denmark	Denmark	Denmark	Denmark
10			Egypt	
11	Estonia	Estonia	Estonia	Estonia
12	Finland	Finland	Finland	Finland
13	France	France	France	France
14	Germany	Germany	Germany	
15		Greece	Greece	Greece
16	Hungary	Hungary	Hungary	Hungary
17		Iceland	Iceland	Iceland
18	Ireland	Ireland	Ireland	Ireland
19	Italy	Italy		
20	Japan	Japan	Japan	Japan
21			Kazakhstan	Kazakhstan
22	Korea	Korea	Korea	
23		Latvia	Latvia	Latvia
24	Lithuania	Lithuania	Lithuania	Lithuania
25	Luxembourg		Luxembourg	
26				Mexico
27	Netherlands	Netherlands	Netherlands	Netherlands
28	Norway	Norway	Norway	Norway
29			P. R. of China	P. R. of China
30		Poland	Poland	Poland
31	Portugal	Portugal	Portugal	
32	Romania	Romania	Romania	Romania
33		Russia		
34	Slovak Republic	Slovak Republic	Slovak Republic	Slovak Republic
35	Slovenia	Slovenia	Slovenia	Slovenia
36	Spain	Spain	Spain	Spain
37	Sweden	Sweden	Sweden	Sweden
38	Switzerland	Switzerland	Switzerland	Switzerland
39			Ukraine	
40	United Kingdom	United Kingdom		United Kingdom
41	United States		United States	United States
<b>Σ</b>	<b>30</b>	<b>28</b>	<b>33</b>	<b>31</b>

**International Organisations participating in the Regional INEX 2 Exercises**

	<b>Swiss Exercise</b>	<b>Finnish Exercise</b>	<b>Hungarian Exercise</b>	<b>Canadian Exercise</b>
1	EC	EC	EC	EC
2	IAEA	IAEA	IAEA	IAEA
3		WHO		WHO
4	WMO	WMO	WMO	WMO
5		UNDHA		



### *Annex 3*

#### **DETAILED INEX 2 EXERCISE OBJECTIVES**

The following three objectives were developed by the Working Party on Nuclear Emergency Matters, and were applied to all four of the INEX 2 Regional Exercises.

- **The real time exchange of information:** in order to exercise under conditions as close as possible to those of an actual emergency situation, each participant's actual communications hardware, software and procedures will be used to send and receive information from other countries and international organisations, and this will be done in real time. This will involve the use of all standing early notification conventions, notably those of the IAEA and the EC, as well as all appropriate bilateral and multilateral agreements that participating countries may have with other participating countries. The advantage of such an exercise is that programmatic and procedural aspects requiring further development can be highlighted, and at the same time personnel can receive valuable training and experience.
- **Public information:** many aspects of public information were not well exercised in INEX 1, and subsequently some participants felt that the exercise was not as realistic as it could have been. In view of this, INEX 2 will add such public information components as press releases, public briefings, media interactions and pressures, co-ordination of public information, etc. This will include areas such as:
  - Providing information to the public on what action to take – or not to take – based on the recommendations of government officials.
  - Questioning of various public officials and utility representatives by the media, at least by telephone, regarding the situation, actions taken or expected to be taken, and the reasons for not taking certain actions.
  - Conducting one or more press briefings in which media representatives have the opportunity to ask questions of government officials and utility representatives.
  - Providing information feedback to the players in the form of production of simulated news or radio programmes based on the information collected by the media simulators.
- **Decision making based on limited information and uncertain plant conditions:** in order to exercise the decision-making process in each participating country, the pre-release and immediate post-release phases of an accident will be simulated in INEX 2. The use of realistic data (in quantity, quality, and flow rate) will exercise participants' programmes and procedures for making decisions based on incomplete data, that is, preliminary and/or incomplete plant status and radionuclide release data, which is often limited in scope and certainly pre-dates any detailed information as to the scale, duration and effects of a release. In addition, the decision-making process immediately post-release will be exercised, thus providing information as to a programme's ability to adjust to rapidly evolving situations. Although rapid countermeasure decision making may be less essential for far-field countries, early decisions regarding travel, tourism and advice to embassies may well be necessary. In this same spirit, it is suggested that real weather conditions be utilised. The World Meteorological Organisation (WMO) will participate, as appropriate, in providing real-time information as to local, regional and global weather trends during the exercise.

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