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Strategy for Developing and Conducting Nuclear Emergency Exercises

NEA No. 6162

NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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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 28 OECD member countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Portugal, the Republic of Korea, the Slovak Republic, 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.

Cover credits: Radiological Protection Institute of Ireland, Civil Defence Ireland, Government of Canada (INEX exercise).

FOREWORD

The broad mission of the Committee on Radiation Protection and Public Health (CRPPH) of the OECD Nuclear Energy Agency (NEA) is to provide timely identification of new and emerging issues in radiological protection, to analyse their possible implications and to recommend or take action to address these issues to further enhance radiological protection regulation and implementation. As part of its interest in the area of nuclear emergency preparedness and response, the CRPPH created the Working Party on Nuclear Emergency Matters (WPNEM) to provide a forum for improving efficiency and effectiveness in nuclear emergency management.

In 2004, the WPNEM initiated a review of its collective experience in developing and implementing national and international nuclear emergency exercises in order to extract key themes that could form a strategy for their development, conduct and evaluation. This would consider all aspects of national and international exercises and document the extensive understanding gained to date in terms of key strategies for emergency exercise programmes.

The WPNEM has reviewed and analysed the issues identified, actions arising and lessons learnt from a range of national and international exercises, focusing on the experience gained by the NEA, participating countries and the broader emergency planning community through the NEA International Nuclear Emergency Exercise (INEX) series.

The outcome of the review is a strategy report that articulates the value of radiological and nuclear emergency exercises that are national and international in scope. It is intended that this report will find applicability among national and international emergency authorities, and also among those who are seeking to develop a national exercise strategy, by providing strategies and insights on exercise justification, design, conduct and evaluation, and by providing guidance to the WPNEM itself on future INEX exercise series.

The WPNEM acknowledges the work and contributions of the many international partner organisations and the work of national exercise planners.

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EXECUTIVE SUMMARY

Emergency situations demand that actions be taken by responsible organisations and individuals at the site of the emergency and at the local, national and international levels to mitigate the impact on people and the environment. Effective emergency response requires development and implementation of emergency plans and procedures; established arrangements at the local, national and international levels; acquisition and maintenance of resources (funding, equipment and personnel); training of personnel; conduct of exercises; and a "feedback programme" whereby improvements to the emergency management system are made based on lessons identified from exercises and actual events.

A means for demonstrating the effectiveness of an emergency programme is through the conduct of exercises. Exercises demonstrate the effectiveness of plans, procedures, training and equipment; adequacy of response arrangements and resources; capabilities of response personnel in performing their assigned tasks; ability of individuals and organisations to work together; and provide a forum for exploring and testing revisions, modifications, and new and/or proposed changes to any emergency programme element in near realistic situations. Exercises may range in scope from small-scale drills to large-scale national or international exercises.

There is clear benefit to organisations in supporting, developing and conducting well-managed exercises. Exercising is a resource-intensive tool; however, it is a critical tool for enhancing performance, testing arrangements and identifying areas for improvement. A thoroughly developed strategy should therefore be in place to ensure maximum value from an exercise programme.

This report contributes to the good practice and management of exercise programmes by providing a strategy for improving the value of planning, conducting, participating in and/or supporting exercises. The OECD/NEA International Nuclear Emergency Exercise (INEX) series undertaken over the last fifteen years has addressed a wide range of objectives, scenarios, timescales and participants both nationally and internationally. The observations derived from these exercises provide a base of practical experience from which key themes have been drawn for improving the value of planning, conducting and

evaluating exercises, and following up on lessons identified within a cohesive framework.

Exercise planning and development

A well-managed exercise framework should include both annual and long-term exercise schedules that take into consideration linkages to the schedules of other relevant organisations, neighbouring countries and international organisations. From this schedule, the decision to develop, conduct and participate in a specific exercise will take into consideration its nature (mandatory, optional or imposed), its main objectives, and the mandates of each organisation.

Exercises may involve some or all levels of participation, from on-site staff to international participants, and may be performed independently within a level and/or collectively across many levels. The exercise "owner", who is responsible for ensuring efficient exercise delivery, should ensure that all participants are involved from the beginning of the development process. A modular approach to the development can provide a clearer understanding of training needs and inter-organisation interfaces, and improve resource allocation and management.

Exercises must be effective in maintaining the emergency arrangements they support, and so require clear objectives co-ordinated across participating levels (local, national, international). They may range from testing specific arrangements to investigating new concepts, and may cover all phases of response. Even well-developed emergency management programmes can benefit from exercises that seek new areas of investigation and broad participation. In defining objectives, planners should be aware of the full range of stakeholders relevant to a particular objective or issue.

Exercise conduct and evaluation

The extent of exercise conduct – full or partial – by participating organisations depends on their "relationship" (accident country, nearby or far-field country) to the event being exercised, and to their specific objectives. Each type of exercise provides opportunities to test different aspects of an emergency response. All participating stakeholders should be fully involved during the exercise with their own competencies.

The exercise evaluation provides feedback that authorities can use to assess changes to organisations and arrangements. Evaluations should be keyed to the specific objectives, and consider the success of the exercise planning and

conduct itself. They should be used to capture input from a broad base of participants, to analyse outcomes and identify needs, cross-cutting issues and areas for future national and international collaboration. The analysis should be targeted towards identifying gaps and weaknesses as well as good practices, and aimed at improving the overall performance of the response capabilities at different levels.

National exercises are an opportunity for organisations to i) collectively practice and evaluate their arrangements, ii) build partnerships, and iii) maintain public trust. International exercises are an opportunity for countries to practice, evaluate and identify issues relating to national and international arrangements. Countries should consider involvement in international exercises as opportunities to improve and strengthen arrangements at both the national and international level.

Co-operation and co-ordination between organisations and between countries should extend throughout the entire exercise cycle. Regular sharing of information from exercises enables organisations to profit from each others experiences, and to pool resources to address issues considered difficult to resolve. Emergency response authorities should take full advantage of information sharing mechanisms on lessons identified and experience at the international level.

Conclusions

The *Strategy for Developing and Conducting Nuclear Emergency Exercises* provides an understanding and basis for the decision to exercise rather than detailed guidance on how to exercise. The document capitalises on the collective experiences of nuclear emergency professionals nationally and internationally, the OECD/NEA INEX series, and international work groups to assist national and international emergency authorities in developing their own exercise strategy by providing insights on exercise justification, design, conduct and evaluation. This strategy may also find applicability in developing approaches for other types of non-nuclear emergency exercises.

INTRODUCTION

Emergency situations demand that actions be taken by responsible organisations at the local, national and international level to mitigate their impact on people and the environment. In order to be able to deliver an effective emergency response in both the short and long-term, it is necessary to make and maintain adequate plans and arrangements. Prudence dictates that these be prepared in advance of an emergency situation, contain appropriate elements for preparedness, response and assistance, and take adequate account of international interfaces. The successful management of an emergency, along with the effectiveness of the response arrangements, will be facilitated through the use of well planned tests and exercises.

All organisations involved in an emergency response will be required to employ appropriately qualified staff; however, it is unlikely that, in isolation, the availability of qualified staff and adequate resources and infrastructure will ensure an effective response to all emergencies. Responsible organisations will also ensure that their staffs are aware of their specific emergency response roles, and trained in the requirements of the emergency arrangements, with the ultimate objective of ensuring that the emergency response organisations can implement their emergency plans and procedures.

As a means of demonstrating the efficacy of their training regimes, the effectiveness of responders to perform their roles during an emergency, and the adequacy of response arrangements and capabilities in realistic situations, organisations typically prepare and participate in specific tests and exercises of their arrangements. These may range in scope from small-scale drills to large-scale national or international exercises, with the potential for each type and level of exercise to add its own unique value. While exercising does not replace training, every exercise also has a significant training value, as it is one of the few opportunities for individuals and organisations to work together under realistic conditions (IAEA, 2005). Exercises also provide a forum for exploring and testing new arrangements, for identifying issues that may need to be addressed within overall emergency programmes, and for involving a range of stakeholders who may be involved in various aspects of the response. However, exercising can also put significant demands on organisations and individuals,

and so guidance and strategies for increasing their effectiveness should be considered.

In 2004, the members of the NEA Working Party on Nuclear Emergency Matters (WPNEM) agreed to review their collective experience in developing and implementing national and international nuclear emergency exercises and to extract key themes that could form a strategy for their development, conduct and evaluation. This review would consider all aspects of national and international exercises and document the extensive understanding gained to date in terms of key strategies for national emergency exercise programmes.

The WPNEM has reviewed and analysed the issues identified, actions arising and lessons learned from a range of national and international exercises, focusing on the experience gained by the NEA, participating countries and the broader emergency planning community through the NEA International Nuclear Emergency Exercise (INEX) series.

The outcome of the review is a strategy document that articulates the value of radiological and nuclear emergency exercises that are national and international in scope. Exercising is one tool for enhancing performance, testing plans and identifying areas for improvement; however, it is an important and resource-intensive tool. Therefore, the objective of this document is to provide a summary of strategic considerations for improving the value of planning, conducting and evaluating exercises and following up on lessons identified, drawing on the extensive operational experience of the WPNEM throughout its INEX series of exercises and experience in national and international emergency management programme.

This document provides an understanding, basis and strategy for the decision to exercise rather than detailed guidance on how to exercise. It is thus intended to find applicability to national and international emergency authorities, and to those who are seeking to develop a national exercise strategy, by providing strategies and insights on exercise justification, design, conduct and evaluation based on the WPNEM's collective experience, as well as providing guidance to the WPNEM itself on future INEX exercise series. It is not intended to be a detailed approach to exercise design and conduct, for which other documents exist, in particular those published by the International Atomic Energy Agency (IAEA) on the preparation, conduct and evaluation of exercises (IAEA, 2005).

A brief history of INEX

The OECD/NEA has a long tradition of expertise in the area of nuclear emergency policy, planning, preparedness, and management. Through its standing technical programmes, the NEA offers its member countries unbiased assistance in the nuclear preparedness arena, with a view towards facilitating improvements in nuclear emergency preparedness strategies and nuclear emergency response at the international level.

From the beginning, the NEA's focus of work as carried out by the WPNEM has been on improving the effectiveness of international nuclear emergency preparedness and management. A central approach to this has been the preparation and conduct of the INEX programme which was established in 1993 with the objective to improve the quality and co-ordination of emergency response systems and facilitate consensus on nuclear emergency management approaches between countries. The INEX series of international emergency preparedness exercises has proved successful in testing and developing the arrangements for responding to nuclear emergencies.

The first series, the INEX 1 Tabletop Exercise (1993), brought together participants from across the world to separately consider the issues raised by a simulated emergency at a fictitious nuclear power plant affecting fictitious countries. A follow-up workshop addressed common experiences and issues, and identified areas for future development work. The second series of exercises, INEX 2, built upon the foundations laid by INEX 1. INEX 2 was conducted as a "command-post" exercise designed to use real time communications with actual equipment and procedures. Four individual exercises were arranged between 1996-1999, each hosted by a designated country simulating the "accident-country" with a number of other countries playing simultaneously as near-field or far-field countries in order to test common aspects of both national and international arrangements. The INEX 2 series of exercises culminated in INEX 2000, which focused on some of the key outcomes and work of the INEX 2 series. INEX 2000 was jointly organised by several international agencies through the Inter-Agency Committee for the Response to Nuclear Accidents (IACRNA). Many important issues were identified from the INEX 1, 2 and 2000 exercises and evaluation workshop programmes, and subsequently valuable lessons have been learned and implemented regarding the early phase response to nuclear emergencies.

In order to address the desire of NEA member countries to better master the later phase response to a nuclear or radiological emergency, the NEA developed the INEX 3 consequence management exercises. The INEX 3 exercise series conducted during 2005-2006 was designed to build upon the

lessons learnt to date in early-phase response while addressing the issues likely to be raised in the medium to longer-term following a nuclear or radiological emergency. To reach beyond the nuclear power community, the exercises were based on technical scenarios and events designed to deliver the challenges for medium to late phase consequence management that did not require as previously, a nuclear power plant or other nuclear fuel-cycle facilities. As with the previous series, INEX 3 was followed by an evaluation workshop aimed at identifying areas for improvement and opportunities for their resolution.

The overall series of INEX exercises developed and conducted over almost 15 years has addressed a wide scope of objectives, emergency scenarios, timescales and participants at the national and international level (see Table 1). Based on these exercises and the follow-up workshops that have focused on specific aspects of emergency management, the NEA has prepared a series of exercise reports and strategy documents that have been widely distributed (see bibliography). These documents have distilled the major themes identified by countries that participated in the various INEX series, and have in many cases been used by these countries and others to refine and develop national nuclear emergency response plans and arrangements, and address international interfaces and arrangements.

The extensive observations, experiences and lessons in exercise development, conduct and follow-up derived from these international nuclear exercises, in addition to the experience of the WPNEM members in their own national programmes, provide a extensive base of practical experience from which common themes aimed at increasing the value of exercises and improving the efficacy of exercise programmes can be drawn.

Table 1: Summary of objectives of the INEX Series

INEX 1 (1993) tabletop exercise:

- To examine the process for alerting and communicating with neighbouring countries and the international community in case of a nuclear accident, taking into consideration bilateral/ multilateral agreements and international obligations.
- To examine the process for reaching conclusions on the need for national interventions or protective measures.
- To examine actions proposed in relation to the export and import of contaminated food and foodstuffs.
- To examine the process for identifying the need for, and requesting, assistance to cope with a radiological emergency.

INEX 2 (1996-1999) early-phase command-post exercise:

- 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.
- Use of real weather for real time forecasts.

INEX 2000 (2001) early-phase command-post exercise and liability workshop:

- To test features of the *Monitoring and Data Management Strategies for Nuclear Emergencies* (NEA, 2000) such as:
  - the effectiveness of the developed key 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 implementation of the Conventions on Third Party Liability.
- To identify how participants incorporated the lessons learned from INEX 2 exercises.

INEX 3 (2005-2006) consequence management exercise:

- Agricultural countermeasures and food restrictions.
- Decision making on soft/light countermeasures, such as travel, trade, and tourism.
- Recovery management.
- Public information.

EXERCISE DEVELOPMENT AND PLANNING

"Planning is an unnatural process. It is much more fun to do something. The nicest thing about not planning is that failure comes as a complete surprise rather than preceded by a period of worry and depression" – Sir John Harvey-Jones.

The broad objective of this document is to provide an understanding and a basis for addressing the question "*Why exercise*" rather than "*How to exercise*". Within this question, there are a number of factors that require further examination. In order to adequately answer the question "*Why exercise*" it is important to gain some insight into the strategic requirements that can be fulfilled by planning, conducting and evaluating exercises. Furthermore, the work programmes implemented upon the issues and recommendations identified from exercises may be usefully shared between national bodies and international organisations to great effect.

Planning to exercise

It is assumed that national authorities are seeking to conduct exercises in a competent manner according to their own needs. The discussion of the planning process therefore, seeks to bring additional value by considering the structure or framework within which national exercises may be undertaken.

Exercise schedules

Based on the experience of the INEX planning process over many years, it is suggested that national level exercise schedules should provide both a detailed annual plan as well as a longer term plan that identifies the main types or levels of exercises over a 5 to 10 year cycle. When developing a national exercise schedule, efforts should be made to consider building on or linking with the exercise schedules prepared by neighbouring or near field countries, as well as those of international organisations. Similarly the consideration of other organisations exercise schedules may yield benefits to others.

Additional benefits may be derived from adding other types of radiological/nuclear scenarios to the schedule of national exercises.

Co-ordination with all relevant organisations is important to ensure that there are neither too few nor too many exercises in the schedule. The objectives of each individual exercise may be linked to demonstrate the effectiveness of international, national and internal arrangements.

A pair of key considerations in terms of participation in exercises is that all parties are provided the exercise programme well in advance and that the programme is reviewed and maintained on a regular basis. Publication or distribution of the national exercise schedules may allow other key national or international partners to plan their participation and to develop their specific exercise objectives as required. By identifying the likely exercise schedule well in advance and providing an indication of the level of participation desired in each exercise, national planning teams may better ensure sufficient flexibility in the programme to account for unforeseen changes, modifications or changes in priorities.

It is recognised that in many NEA member countries, emergency planning arrangements have become part of the greater contingency or continuity plans in the event of other disruptions. Indeed, emergency exercises should also take account of organisational contingency plans in order to demonstrate organisational effectiveness in conducting normal business functions. However, with these broader contingency plans have come additional burdens for exercising them in a structured framework. It has become apparent that many of the organisations with responsibilities for delivering nuclear emergency arrangements have similar roles and responsibilities under other plans and are therefore likely to be subject to additional requests for support. Issues may include links into externally imposed exercise schedules beyond those accepted within "regulatory" requirements for licensed facilities, as for example is sometimes the case for "non-accidental" or counter-terrorism scenario exercises developed by other ministries or organisations. This highlights the importance for national planning teams to give sufficient consideration to the short- and long-term schedules for all exercises.

Decision to exercise

National emergency preparedness arrangements should identify the organisations that are responsible for ensuring that response arrangements are fit for purpose and appropriate for all circumstances considered. These responsibilities will include the means by which the arrangements are to be demonstrated as such. All organisations with responsibilities for demonstrating the effectiveness of their arrangements, including their interaction with others, require a clear management remit to commit time and resources to the planning, preparation and conduct of an exercises.

National level decisions regarding the exercise programme and schedule should address the following different exercise motivations:

- Mandatory exercises (e.g. required by regulatory requirements or international conventions).
- Optional exercises (e.g. suggested as part of the international exercise framework).
- Imposed exercises (e.g. requested participation in external exercise programmes, such as counter-terrorism exercises initiated externally and outside normal exercise schedules).

While the overall exercise schedule represents general decisions to stage an exercise, the decision to participate in a specific exercise will be based upon the mandates, roles and responsibilities of individual organisations and should be taken by each organisation well in advance of exercise conduct as part of the national/international exercise programme framework. All work undertaken in support of exercises should therefore begin with clear decisions to:

- Stage and participate in an exercise (in general, and within each organisation), based on a set of clear and unequivocal exercise objectives.
- Review changes or amendments to existing emergency arrangements.
- Review or identify organisational objectives.
- Review the outcomes of previous exercises.

As part of the decision to exercise, the review of the arrangements, the issues identified from previous exercises and the future exercise schedule should allow organisations to determine the level of commitment that they wish to make to any exercise. Recognising that benefits may be gained from the participation of other organisations, it should be possible for individual organisations to determine whether or not to participate in exercises with clearly identified objectives, scope and limitations.

Levels of exercises

Many countries adopt a modular approach in terms of planning, preparation and conduct of their exercise programme. A manifestation of this modularity is in terms of the scale or design of exercises. In broad terms, this may include drills and tests of the on-site plan, on-site and off-site tests of the local plan, tests of the local level to national level interfaces and multi-national tests of the international arrangements. Exercises may involve some or all levels

(from on-site to the international organisations), and may be performed independently within a specific level and/or collectively across many levels. However, it is noted that while there are many reasons for suggesting that all exercises be planned within an overall national or international framework, there is no requirement to test the national level arrangements in every exercise. Indeed there is firm evidence to suggest that this approach is counter-productive.

A modular approach to testing and demonstrating the effectiveness of particular aspects of emergency response arrangements can yield benefits in terms of clearer understanding of training requirements, resource allocation and management and interfaces between different organisations. Such an approach enables the responsible organisations to focus on specific features of their emergency plans. This is useful if specific aspects are particularly important to the overall response or require specially trained staff to perform their roles under pressure. A modular approach facilitates individual exercise planning and conduct, but it needs to be integrated into overall planning process to ensure that all aspects are ultimately exercised and that no key components are missed.

Modular exercise design may also improve resource utilisation if certain design elements such as exercise planning materials, guidance and scenarios can be reused effectively in different exercises, or by different participants. The generic technical materials prepared by the WPNEM for use in the preparation of the national-level INEX 3 exercises are an example of the successful implementation of this approach. Such an approach provides flexibility for implementation in any region or sub-region of the world, broad applicability to countries both with and without nuclear power plants (depending on the scenario), and easy accessibility to exercise planning materials for use in national or international exercises.

Ownership of exercises

Regardless of level, all exercises must have a clearly identified "owner" organisation.[1] Within the owner organisation, the exercise must also have an empowered owner charged with the responsibility for ensuring the timely and efficient delivery of the exercise. The exercise owner is responsible for the planning, preparation, conduct and evaluation process, and for the commitment

1. An exercise owner is an individual or organisation that assumes the overall responsibility for the whole exercise process. The exercise owner provides the focus for the management of this process and fulfils the leadership requirement for its development, planning, conduct and evaluation.

of their organisation's resources as well as for ensuring the adequate commitment of other participating organisations.

It is recommended that the exercise owner organisations have an intimate understanding of the arrangements that are to be tested. Indeed there is a good and reasonable case to be made for the exercise owner to be responsible for the emergency plans and arrangements to be tested. The exercise owner may delegate the responsibility for the delivery of specific aspects of the exercise but retains overall responsibility. With a clear remit and sufficient commitment from the owner organisation, the exercise owner may begin to determine the objectives, the scope and the limitations of the exercise that is to be prepared.

Planning requirements

Whilst the remit of this document is to provide an understanding of the reasons to exercise the emergency arrangements, this cannot be effectively achieved in isolation of the work that must be carried out to plan, prepare and conduct an exercise. Many other organisations have prepared both generic and more specific guidance regarding the means of planning and preparing exercises (IAEA, 2005). The following strategy regarding the planning process is based upon the experience of the WPNEM during the preparation for the INEX series.

The planning process requires the co-ordination of all participants and relevant partners from local level to international organisations. The following list is provided as a generic series of planning requirements:

- Identify overall exercise objectives and specific sub-objectives.
- Develop terms of reference for planning groups and technical support, etc.
- Agree on the overall scope and limitations of the exercise.
- Agree on the specific level of participation required, including decision-making mechanisms and/or involvement of decision makers.
- Determine the participation in the planning process, including relevant stakeholders.
- Determine the participation in the exercise conduct, including the full range of identified stakeholders.
- Determine the evaluation mechanisms.
- Identify the financial and resource commitments.
- Determine the level of "realism" required.

- Determine the overall progression of events, the timeline of the scenario and duration of the exercise play.
- Ensure that the roles and responsibilities of players correspond to their actual functions.
- Determine the strategy for informing the public about the exercise.
- Identify a structured planning process, recognising the amount of elapsed time that it will take to complete each phase.
- Identify and consider the possible follow-up actions that may be required.
- Acknowledge the roles and responsibilities of participants, and decide on whether they need to be independent or not (e.g. players as evaluators, etc).

Many exercises are sufficiently large in scale and participation that a series of planning meetings may be required and furthermore, that a series of planning groups may also be required to deliver all aspects of the exercise. It is the experience of the WPNEM that all planning meetings need clearly defined objectives and agendas. Similarly, all planning groups need terms of reference, endorsed by the exercise owner(s), that clearly state the remit of each group and the owner of each part of the planning process. The exercise owner should ensure that, from the earliest planning meetings, all participants are involved. It is essential to the orderly development of the exercise that the level of participation, any limitations on the exercise conduct, and clearly defined and measurable objectives be defined for each participant.

Recognising and dealing with exercise artificialities

All exercises will include some level or form of artificiality dependent on the scope of the exercise and the level of participation. It is not possible to perform exercises without artificialities (e.g. time jumps or compressions, simulation of missing components of the emergency response or structure). It is recommended that the exercise owner, together with the planning groups, clearly define the expected artificialities as part of the planning requirements, take this into account and manage any unforeseen issues these may cause during the conduct of the exercise.

Strategic requirements and political issues may also impact significantly upon the planned exercise. The exercise owner should make sufficient allowance for these factors within the overall planning process. As examples, the objectives should be consistent with the level of decision making required or that which may be reliably obtained in terms of the commitment of senior staff

or politicians. The exercise planning teams will need to be able to demonstrate how to involve the decision makers as it is recognised that this is always difficult.

Objectives and scope of emergency exercises

All emergency exercises and exercise programmes are required to be effective in terms of the maintenance and further development of the national and international arrangements that they support. In order to be effective, all exercises and exercise programmes require clearly defined and unequivocal objectives. The development of these objectives must be co-ordinated across all participating levels (local, national and international). Objectives could range from the testing of specific plans and arrangements to investigating new approaches or concepts, and may cover all phases of an emergency. Exercises are also an opportunity to remind the public, the elected politicians and the media regarding the protective arrangements that will be put in place in an emergency.

In defining objectives, planners should be aware of the full range of stakeholders that are relevant to a particular objective (e.g. involvement of agriculture representatives to investigate agricultural countermeasures, public information professionals, etc). The exercise planners may limit the scope of involvement, but need an awareness of the full range of relevant stakeholders with regards to a particular issue.

Types of emergency exercises

National and international exercises should cover a range of different types of emergency situations, scenarios and timescales (early-phase through longer-term and recovery operations). A broad range of exercises should be designed to meet the specific objectives and deliver against the identified requirements of the programme and exercise plans. IAEA documentation (IAEA, 2005) outlines the categories of exercises that could be detailed in exercise plans and conducted on a structured and planned basis. Drills, tests, full-scale command-post exercises, field exercises and table-top exercises should all be considered as part of a comprehensive exercise plan to address various aspects of the national emergency response arrangements in a modular fashion, as well as the entirety of response arrangements at national and international levels. In all cases, it is suggested that exercises involve both technical response and programme elements and that the exercise plan strive to cover all phases of an emergency response.

Countries that are beginning to develop exercise programmes might consider concentrating on the alert and notification arrangements and early emergency phase in the short-term. Other countries might focus more effort on the later phases and recovery operation planning. For example, the INEX 3 consequence management exercises conducted in 2005-2006 were designed to exercise longer-term aspects of emergency response systems not usually tested in early phase exercises. The outcomes clearly demonstrated the value to participants of moving beyond the more frequently conducted early-phase exercises to investigate arrangements for later-phase decision making. This suggests that even well-developed emergency preparedness and response programmes can benefit from exercises that seek new areas of investigation and broad participation.

In all cases, the types of exercise should be chosen to match the specific objectives. This should include consideration of exercises that will facilitate the development of improved capabilities or new approaches to emergency and consequence management. The inclusion of other "non-accidental" or counter-terrorism scenarios will bring different challenges, different organisations and in many cases different arrangements into the exercise process.

Participation in emergency exercises

Exercises are more successful if the "right" people participate. National exercise programmes can benefit from involving actual decision makers as well as a broad segment of stakeholders both within and external to the emergency preparedness communities. This has the advantage of increasing the exercise realism and building working relationships between stakeholders as part of preparedness. Involving local and municipal governments and non-government organisations in planning a national exercise programme can identify larger issues and facilitate workable solutions. As an example, a conclusion from the INEX3 exercises that was observed due to the involvement of a broader range of stakeholders was that international guidance is of no value if not accepted by the relevant stakeholder community during the emergency response. This approach will also facilitate information exchange between the radiological/ nuclear response community and other stakeholders who may be involved in a broader range of emergency situations. For example, experience in evacuation has been gained from evacuation of large populations during severe weather conditions.

International exercises provide a forum for information sharing and a basis for decision making with regards to international arrangements. Ongoing communications fostered through regular exercises provides a platform for mutual understanding of decisions taken during emergencies. International

collaboration in this field has three aspects: near-country interactions that require detailed planning and information sharing on issue specific topics (e.g. intervention levels); far-country interactions that might entail sharing practices, requests for assistance and environmental information, and; interactions with and between international organisations.

National exercises can benefit from working within a structure that provides frequent collaboration with international organisations with emergency management responsibilities such as the NEA, European Commission (EC), and IAEA, with interagency committees such as the IACRNA, and from the direct participation of international organisations and officials from other countries as exercise players or as part of the exercise control team. Such organisations should be included as regular exercise partners to keep communications channels up to date and to develop a process that will produce accurate and sufficient information for emergency management communities. These organisations should also refine and practice their communications channels to facilitate timely and accurate information within the international groups to reduce multiple notifications. The integration of other perspectives and experience can help advance national programmes and will likely receive support and interest from higher level officials (e.g. Ministers/Secretaries of State).

The value of exercising

National level exercises can provide an opportunity for all responsible organisations to collectively practice and evaluate their emergency management arrangements and capabilities. National exercises can vary in scale from notification tests, to strategic management meetings, to the full implementation of the emergency arrangements to demonstrate the authorities' capability to the deliver the response to the public. With appropriate participation and effective management of the exercise process, national emergency arrangements can be continually developed. With effective national exercises, the authorities can deliver partnership building between responsible organisations and thereby maintain the public's trust and confidence in their ability to mitigate the consequences of an emergency.

The longer term goal of national exercises should be the processes that capture and implement improvements to the national arrangements and capabilities within a defined cycle. This cycle or period of time must be sufficiently short for the arrangements to be maintained whilst conversely sufficiently long enough to allow the issues to be identified, actions to be implemented and lessons to be learnt.

International level exercises provide an opportunity for participating countries to practice and evaluate existing arrangements and capabilities at the national and international level, either collectively and simultaneously (e.g. INEX 2, CONVEX 3) or individually while addressing common defined objectives (e.g. INEX 3). These international exercises can also vary in scale from alert and notification tests of communications to full implementation of the emergency arrangements across participant countries. International organisations should integrate their exercise schedules where possible (for example under the auspices of the IACRNA) to allow participating countries to have maximum benefit from national and international resources.

International exercises provide a unique opportunity for testing objectives relating to international arrangements and interfaces, such as requirements under the IAEA conventions on notification and assistance, bi-lateral and multi-lateral agreements between countries, information exchange, co-ordination of advice, trade issues, and decision making as a near- or far-field country. International exercises may also help to identifying issues that might remain unexplored or hidden if only exercising independently at the national level. The INEX experience has shown that participation in international exercises can increase the profile of an exercise, and thus the likelihood of senior management and senior decision-maker involvement in the exercise conduct.

EXERCISE CONDUCT AND EVALUATION

Models for exercise conduct

Models for conducting and evaluating exercises are documented in the NEA INEX series reports and in IAEA documentation (see bibliography). The IAEA has provided detailed processes for exercise conduct that can be tailored to national requirements. The INEX series provide some developed scenarios, instruction documents for exercise players and design teams, and a compilation of lessons that other countries have learned when conducting their national and international exercises.

The INEX 2 and 2000 series of exercises, conducted between 1996 and 2001 provide useful models for the conduct of national and international exercises. To allow different geographical regions to "host" an INEX 2 exercise, separate exercises were held roughly equally spaced in time during the six-year period, each hosted by an "accident" country in each region (Switzerland, Finland, Hungary, Canada and France). For each of these regional exercises, the "accident host" country used a planned and scheduled national-level command-post exercise as a platform for exercising additional INEX 2 objectives and simultaneously involving other participating countries. These other countries activated their own emergency command posts and used existing bilateral and multilateral notification and communication agreements, as well as such agreements with international organisations to receive and transmit information. This is a very efficient and effective approach for co-ordinating and leveraging exercise efforts, and proved extremely useful not only for participating countries, but also for participating international organisations; a similar approach is now used for the IAEA CONVEX-3 series. In order to increase exercise efficiency, countries and international should seek to take advantage of existing exercises as appropriate to their identified needs.

It is noted that the extent of conduct – full or partial – in such exercises will depend on whether a participant is involved as the emergency "host" country, a nearby country, or a far-field country. The INEX experience has shown that in all cases, the extent of conduct by organisations, teams and specialists depends on their "relationship" to the event being exercised, and to their specific objectives for the exercise. Each provides opportunity to test

different aspects of an emergency response that a country may face in an actual event.

In the case of partial or limited scope exercises, the active participation of some organisations may be essential while others need only be observers. Each participating organisation should clearly identify the scope of its participation and any limitations on the normal extent of that participation (IAEA, 2005). For national and international exercises, participants may choose to exercise limited elements of their overall emergency response organisations. Accident and near-field effects may suggest active measures to address near-term consequences for one organisation; for another, far-field involvement may be more easily addressed through notifications, data sharing, increased monitoring, and ongoing liaison beyond the early phase of the response.

Exercise conduct

The conduct of exercises based on the models above will advance national and international emergency management by involving many of the stakeholder groups that would be part of the response on all levels, for example local first response teams, industry representatives or non-governmental organisations. Planners should expand their planning network to include segments of industry or the private sector that could increase their response knowledge base.

When the scope of an exercise is increased to include a broad range of relevant participants or stakeholders, this will affect the way the exercise is planned and conducted. All participants should be provided the opportunity to add their organisation-specific exercise objectives. The scenario must then provide the opportunity for all exercise objectives to be demonstrated. For example, if an off-site monitoring capability at the state/provincial level is added to an exercise involving an on-site release of hazardous materials, the scenario and exercise data must be inclusive and enable them to meet their objectives. At the international level, the need for a country to demonstrate an objective may involve similar adjustments to the planning, scenario, and conduct of the exercise. Exercise planners should be prepared to involve the invited stakeholders as full participants during the exercise conduct, with their own experience and perspective in their area of competence. This will increase the realism of the exercise and provide opportunities for mutual education.

International exercises are excellent opportunities to foster co-ordination between countries in the planning, development, conduct, and evaluation of exercises. When the host country conducts an exercise, its neighbours can activate elements of their emergency response organisations and practice and test their own emergency plans. Apart from just providing emergency

notifications, these activities may extend to other elements, such as consequence assessment, protective actions, and public information and education. Such co-operation serves the role of testing arrangements for international interfaces during emergencies, provides a platform for investigating international implications of national decisions, and creates opportunities for assistance among and between countries with bilateral or multilateral agreements. Countries should consider involvement in international exercises not simply as fulfilment of obligations, but rather as opportunities to improve and strengthen arrangements at the national and international level.

Exercise evaluation

Documented evaluation processes provide information that national and international planners can use to assess changes to response arrangements and organisations. The principle purposes of an exercise are to test the appropriateness and robustness of procedures and resource allocations, and identify good practices, gaps and weaknesses, and areas where improvement would benefit the local, national or international emergency planning community at large. It is important for exercise evaluations to be keyed to specific objectives. This enables the evaluators to focus on findings that directly relate to an organisation's objectives. The post-exercise evaluation should also include consideration of the exercise planning and conduct itself, and its appropriateness in delivering the intended requirements of the exercise.

IAEA (2005) identifies two basic types of evaluation. The first type of evaluation focuses on the overall process and whether or not the organisation is able to achieve its response objectives. The second type of evaluation is the performance-based evaluation, which focuses on results, rather than on process, and addresses such questions as "was the response objective achieved, and in what time was it achieved?" Such performance-based evaluation relies upon objectives that are clearly stated and measurable in relation to an organisation's published plans and procedures. Process evaluation is important because every system is more than the sum of its parts; it is vital to know that the different response elements can function together to achieve the overall objectives of the organisation. Performance-based evaluation is essential to diagnose root-causes for observed problems and address them through corrective activities that may extend to the individual responder level.

Various evaluation processes may be used, each with their own value. The evaluation process may include:

- Formal debriefing immediately after the exercise in each control unit, late debriefing at the national level, and regular experience feedback

on the whole exercise programme to identify issues relating to the response procedures and areas for follow-up.

- Informal evaluation by similar organisations or levels of government to provide insight and perspectives for advancing national and international programmes. Such peer evaluation at all levels helps increase knowledge and builds trust across borders. These evaluations can be held as a separate and distinct part of the final exercise reporting process.

It is vital to capture feedback as soon as possible after the exercise is terminated. The usual approach is to conduct debriefing sessions for the exercise participants at each activity point. These sessions are generally conducted by the Lead Controller or Evaluator. Information gathered in these sessions is recorded and carried forward into the formal evaluation meetings between the exercise staff that will eventually result in the production of the formal exercise report. Findings are ranked according to their severity, i.e., the potential affects on health, the environment, or security represented by the exercise objective not being met. Findings that have potentially serious impacts should result in corrective actions to address the performance shortfalls. These corrective actions need to be managed to assure that root causes are identified, appropriate actions to address the findings are taken, and that those actions are verified and validated to ensure they address and correct the findings. Lessons learned should also be tracked and improvements identified and implemented as part of an organisation's quality control and continuous improvement processes.

Additionally, the INEX experience has shown that post-exercise evaluation workshops are another proven vehicle to gain and share input from a broader base of participants and stakeholders (other organisations, levels of government, countries, and non-government organisations), to strategically analyse the exercise results and identify needs, cross-cutting issues and areas for future collaboration at the national and international level. The INEX series has successfully used this forum to advance radiological/nuclear preparedness within member countries and should be considered by countries as part of their evaluation process.

FOLLOW-UP ACTIONS AND MOVING FORWARD

International experience has shown that cooperation and co-ordination between organisations and countries should extend throughout the entire exercise cycle. External and independent review of emergency plans, procedures, and other response arrangements benefits all parties, as they share approaches and solutions to common problems. Sharing foundation documents also enables organisations and countries to better plan for their interaction and cooperation during emergencies. Regularly sharing findings, issues, and lessons-learned from exercises enables the cooperating organisations to profit from each others experiences, and to pool their resources to address items and issues considered difficult to implement. Documenting and following through on findings and issues, and the corrective actions taken to address them, enables programmes to share the results of the exercise process and their successes in improving their readiness to respond to potential emergencies.

Based on the exercise and evaluation outcomes, realistic action plans for following up on identified issues or implementing lessons identified should be developed with timelines for completion that link with national and international timelines. National planners should collate identified gaps and areas for improvement into a master list that will be used to improve processes and plans. They should develop a framework that includes evaluating and learning from advances in non-radiological response processes. For example, evacuation techniques used for other emergency events such as floods and earthquakes could be of relevance to nuclear emergency response arrangements; likewise, becoming more involved with all-hazard response groups could provide opportunities for exercising on a regular basis.

Other actions could include identifying a national organisation that will track progress and ensure that plans, supporting documentation and training will be modified to reflect the changes mentioned in the master list. The INEX 2/2000 exercises have showed the importance of testing the implementation of lessons identified in previous exercises in follow-up exercises. Such a process will be facilitated through a co-ordinated approach to their tracking.

As shown by the INEX experience, various kinds of follow-up are possible, each with their own value. These could include:

- Changes and modifications in planning and conduct of exercises.
- Changes and modifications to response arrangements and capabilities at local, national and international levels.
- Targeted task teams, working groups or workshops to address specific issues.
- Increasing role of a variety of stakeholders.

Finally, emergency response authorities should take full advantage of mechanisms for sharing information on lessons identified and experience at the international level.

CONCLUSION

The review carried out by the NEA WPNEM has drawn attention to a series of generic conclusions regarding the strategies that may be adopted by national and international emergency management authorities for the development and conduct of radiological and nuclear emergency exercises. These conclusions are generic in nature and could lead to further investigations and/or work programme activities. It is expected that the conclusions reached should find various levels of applicability in the nuclear emergency management programmes of member countries and international organisations, as well as in other types of non-nuclear emergency exercise programmes.

The WPNEM will continue to develop its INEX exercise programme based on the input from its member countries while leveraging the opportunities put forward by other international exercise regimes, such as CONVEX-3, in order to further advance national and international emergency preparedness and response in a co-ordinated and effective manner.

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Appendix 1

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