Building Guidelines and a Cooperative Framework in East Asian Countries for Radioactive Emergencies

edited by

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List of Abbreviations and Acronyms

ANSN	Asian Nuclear Safety Network
ASEAN	Association of Southeast Asian Nations
ECURIE	European Community Urgent Radiological Information Exchange (EU)
ENSI	Swiss Federal Nuclear Safety Inspectorate (Switzerland)
EP&R	emergency preparedness & response
IAEA	International Atomic Energy Agency
LNG	liquefied natural gas
NEOC	National Emergency Operations Centre (Switzerland)
NERIS	European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery (EU)
NPP	nuclear power plant
R&D	research and development
TRM	Top Regulators Meeting

Indonesia

AELB	Atomic Energy Licensing Board
BATAN	National Nuclear Energy Agency
BAPETEN	Nuclear Energy Regulatory Agency
BNPB	National Board for Disaster Management
DEN	National Energy Council
KESDM	Ministry of Energy and Mineral Resources
NEPIO	Nuclear Energy Program Implementing Organization
OTDNN	National Nuclear Emergency Preparedness and Response
PPA	Power Purchase Agreement
RUPTL	Electric Power Generation Master Plan

•Japan

GOJ	Government of Japan
JAEA	Japan Atomic Energy Agency
METI	Ministry of Economy, Trade and Industry
NRA	Nuclear Regulation Authority
TEPCO	Tokyo Electric Power Company

•Korea

APPRE	Act on Physical Protection and Radiological Emergency
AtomCARE	Atomic Computerized Technical Advisory System for a Radiological Emergency
BPE	Basic Plan of Long-Term Electricity Supply and Demand
EOF	Emergency Operations Facility
IEF	Information Exchange Framework
KINS	Korea Institute of Nuclear Safety
KAIST	Korea Advanced Institute of Science and Technology
KEPCO	Korea Electric Power Corporation
KHNP	Korea Hydro & Nuclear Power Co., Ltd.
KINAC	Korea Institute of Nuclear Non-proliferation and Control
KIRAMS	Korea Institute of Radiological and Medical Sciences
LEMC	Local Emergency Management Center

NEMC	National Nuclear Emergency Management Committee
NSSC	Nuclear Safety and Security Commission
OEMC	Off-site Emergency Management Center
RadLot	Radiation Source Location Tracking System
RASIS	Radiation Safety Information System
RETAC	Radiological Emergency Technical Advisory Center (KINS)
REMSC	National Radiation Emergency Medical Center
SIREN	System for Identifying Radiation in Environments Nationwide

•Malaysia

AELB	Atomic Energy Licensing Board
MKN	National Security Council
NPIDP	Nuclear Power Infrastructure Development Plan
NPRIDP	Nuclear Power Regulatory Infrastructure Development Plan
NSC	National Security Council
RAD	Radiological Accident Disaster
SOP	Standard Operating Procedure

•Philippines

BHDT	Bureau of Health Devices and Technology
BNPP	Bataan Nuclear Power Plant
CDRRHR	Center for Device Regulation, Radiation Health and Research
DOE	Department of Energy
DOST	Department of Science and Technology
ERA	Energy Reform Agenda
FDA	Food and Drug Administration
IES	Inspection and Enforcement Section
LRES	Licensing Review and Evaluation Section
NDRRMC	National Disaster Risk Reduction and Management Council
NPC	National Power Corporation
NRD	Nuclear Regulatory Division
NSSS	Nuclear Safeguards and Security Section
PAEC	Philippine Atomic Energy Commission
PEP	PNRI's Emergency Response Plan
PNRI	Philippine Nuclear Research Institute
RADPLAN	National Radiological Emergency Preparedness and Response Plan
RIAS	Radiological Impact Assessment Section
RSDS	Regulations and Standards Development Section
TWG	Technical Working Group

•Singapore

CPPNM	Convention on the Physical Protection of Nuclear Material
EMA	Energy Market Authority
ESI	Energy Studies Institute
HCEG	Homefront Crisis Executive Group
HCMC	Homefront Crisis Ministerial Committee
HCMS	Homefront Crisis Management System
IM	Incident Manager
MCI	Ministry of Communications and Information
MoH	Ministry of Health
MSF	Ministry of Social and Family Development
NEA	National Environment Agency

NEPR	National Energy Policy Report
NETF	Nuclear Education and Training Fund
NRF	National Research Foundation
NSREP	Nuclear Safety Research and Educational Program
NUS	National University of Singapore
PMO	Prime Minister's Office
RPNSD	Radiation Protection & Nuclear Science Department
SCDF	Singapore Civil Defence Force
SNRSI	Singapore Nuclear Research and Safety Initiative
SPF	Singapore Police Force

•Thailand

EGAT	Electricity Generating Authority of Thailand
EPPO	Energy Policy and Planning Office
MOEN	Ministry of Energy
OAP	Office of Atoms for Peace
Thai AEC	Thai Atomic Energy Commission for Peace

•Viet Nam

EVN	Vietnam Electricity
EVNNPB	Vietnam Electricity Nuclear Power Project Management Board
MOC	Ministry of Construction
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MOST	Ministry of Science and Technology
NCNS	National Council for Nuclear Safety
SSC	State Steering Committee
TSC	Centre for Technical Support
VARANS	Vietnam Agency for Radiation and Nuclear Safety

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Executive Summary

This study aims to establish guidelines for providing the appropriate support and collaboration on nuclear safety enhancement and on radioactive emergency preparedness for ASEAN and the East Asia region.

MAIN ARGUMENT

Several ASEAN member countries plan to introduce commercial nuclear reactors in the 2020s in order to meet their rapidly growing demand for energy. In the 1st Working Group meeting, the current development plan of nuclear energy, as well as the safety regulatory systems, emergency preparedness, and participation in international activities, was shared among ASEAN member countries. Taking into account the comments and recommendations from member countries in the 2nd Working Group meeting, together with the lessons learned from European countries, a draft outline of the guidelines for regional collaboration between East Asian countries in the case of a radioactive emergency was discussed. The major findings were as follows:

- All member countries have a common awareness that every country should play a role in regional cooperation on nuclear emergency preparedness and response, irrespective of the development status of commercial nuclear power generation.
- East Asian countries can learn practices and guidelines in European countries, especially Nordic countries, with regard to regional information-sharing and collaborating systems in the case of a radioactive emergency.
- It would be appropriate to make use of a relevant framework in East Asia, such as the ASEAN Network of Regulatory Bodies on Atomic Energy (ASEANTOM) concept, in order to achieve the most effective emergency preparedness and response.

POLICY IMPLICATIONS

- A regional framework of close coordination in nuclear emergency preparedness and response would significantly improve the nuclear safety of East Asian countries.
- A reliable information and communication network, a shared database, and a joint

working group for establishing recommendations on practical methods for emergency preparedness would provide benefits, such as systematic support to member countries considering the introduction of nuclear energy.

- Specific support measures may include technical assistance for establishing guidelines on emergency preparedness and response in East Asian countries, human resources development, and financing in related research and development (R&D) projects.
- Sharing the database on nuclear facilities and alert systems across East Asian countries is recommended in order to collect accurate information to protect public health and the environment of East Asian countries, including accident prognosis and dispersion.

Chapter 1

Purpose of the Project

Some countries in East Asia intend to proactively introduce and expand nuclear power generation in the future to respond to the rapidly increasing demand for electricity. If any significant accident were to occur at a nuclear power plant (NPP), it would not only affect the country that was the source of the accident, but would also cause widespread damage in other East Asian countries and raise concerns over nuclear safety and radioactive hazards. Therefore, it is necessary to review appropriate nuclear security and nuclear safety management measures, and to establish a shared awareness in light of the energy situations, infrastructure, technological levels, and other circumstances of emerging countries in East Asia.

Based on the above-described goals, this research targets emerging countries in East Asia that plan to introduce or expand nuclear power generation, or are considering the possibility of doing so, and compares the present situation in these countries with regard to safety regulation and nuclear security systems. This is aimed at identifying problems in establishing an information-sharing system for accidents and in considering desirable cross-border cooperation. Through these efforts, the aim is to achieve the so-called '3Ss'—enhancement of nuclear safety standards and nuclear security, and establishment of nuclear non-proliferation safeguards—in East Asia, and thereby contribute to promoting the utilisation of nuclear energy on a scale appropriate to the increase in energy demand in this region. The research project was endorsed by East Asia Summit Energy Ministers Meetings from 2012 to 2014, as the importance of nuclear safety management became ever more relevant.

This report collects and assembles information and outputs obtained from discussions through the working group meetings, country reports from members and research trips to Nordic countries. Chapter 2 contains information from the members of the working group with regard to safety regulatory systems, emergency preparedness, and participation in international activities. Chapter 3 reports regional collaborative activities in European countries, especially in Nordic countries, and reviews some

frameworks on existing international cooperation. The final chapter, Chapter 4, presents some proposals for establishing guidelines for regional collaboration in East Asian countries in the case of a radioactive emergency, including ideas and suggestions from members.

Chapter 2

Country Reviews in Asia

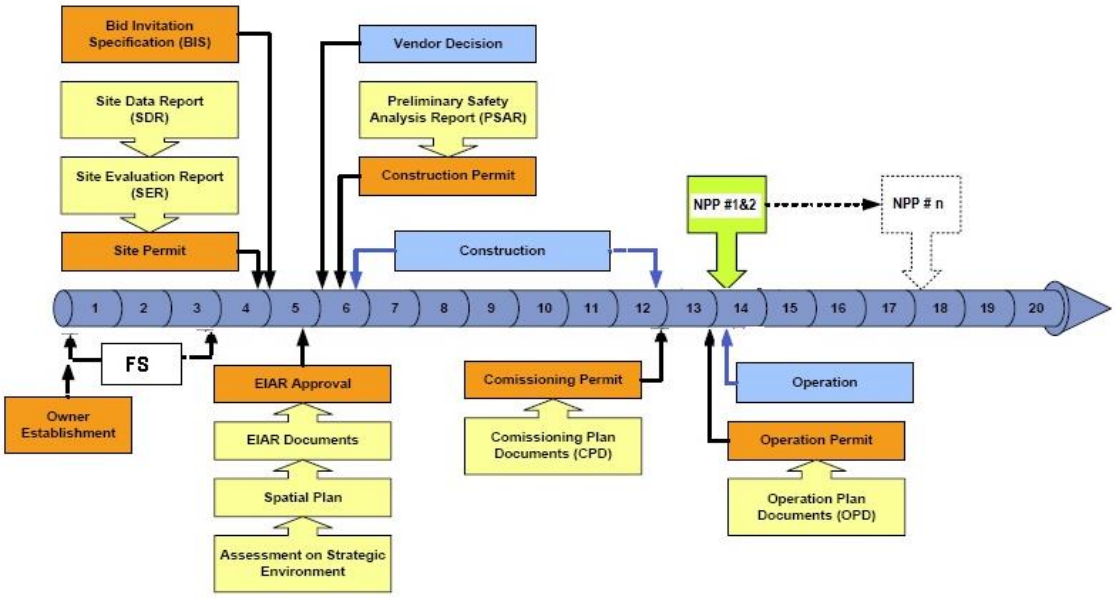
2-1. Indonesia[1]

2-1-1. Nuclear Development Policy

The status of nuclear development in Indonesia is as follows:

- National decisions and commitments are in line with Law No. 17/2007 (National Energy Policy).
- Acceleration of nuclear power plant (NPP) construction in Bangka Island is necessary.
- A national team is needed (owner, technology, location, and socialisation).
- National participation could reach 25 percent (civil- and non-safety-related components).
- NPPs will stimulate industrial development and local economies where they are located.

Figure 2-1-1: Accelerating Programme on NPP Construction in Bangka Island, 2014–2025



Source: Provided by Working Group member.

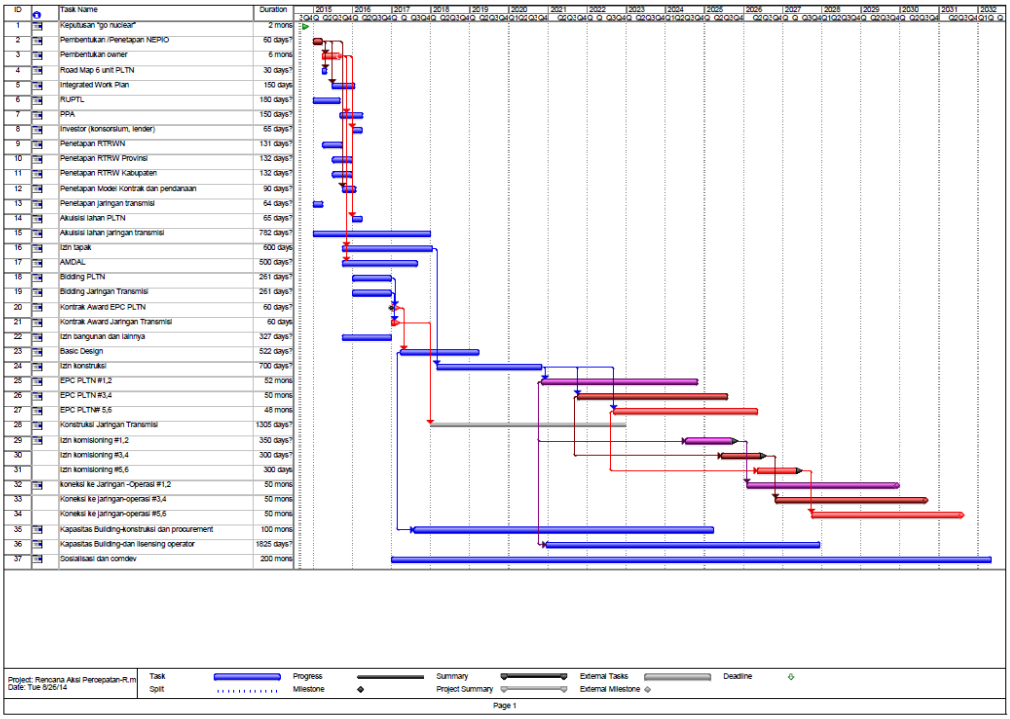
[1] Based on 1st and 2nd Working Group presentation materials of Indonesia.

Figure 2-1-2: Action Plan on Accelerating Programme of 5,000 MW NPP Construction

No	Action Plan	Target	Focal Point	Supporting institution	Remark
1	"Go nuclear" decision	2014	KESDM	DPR, BATAN, BAPETEN, Bappenas, Pemda, PT PLN	PerPres/InPres/ KepMen ESDM
2	Establishment/ formation of NEPIO	Q1- 2015	KESDM	BATAN, BAPETEN, PT PLN, Bappenas, Pertamina, KLH	PerPres/InPres/ KepMen ESDM
3	Establishment of Owner (NPP#1 ...5??)	Q1-Q3 2015	NEPIO	KESDM, BATAN, BAPETEN, PT PLN, Bappenas, Pertamina, KLH	NEPIO decision
4	Road Mapof 6 unit NPPs	Q1- 2015	NEPIO	BATAN, BAPETEN, PT PLN, Bappenas, KLH	NEPIO decision
5	Integrated Work Plan	Q3-2015	Owner	NEPIO, BATAN, BAPETEN, PT PLN, Bappenas, KLH	
6	RUPTL	Q1-2015	PLN	KESDM, DEN	
7	PPA	Q4-2015	Owner-PLN		Perjanjian
8	Investor (consorsium, lender)	Q1-2016	Owner	lender	

NEPIO = Nuclear Energy Programme Implementing Organisation, NPP = nuclear power plant, PPP = power purchase agreement, RUPTL = Electric Power Generation Master Plan.
Source: Provided by Working Group member.

Figure 2-1-3: Proposed Agenda for NPP Construction Acceleration (Draft)



NPP = nuclear power plant.
Source: Provided by Working Group member.

2-1-2. Safety Regulatory System

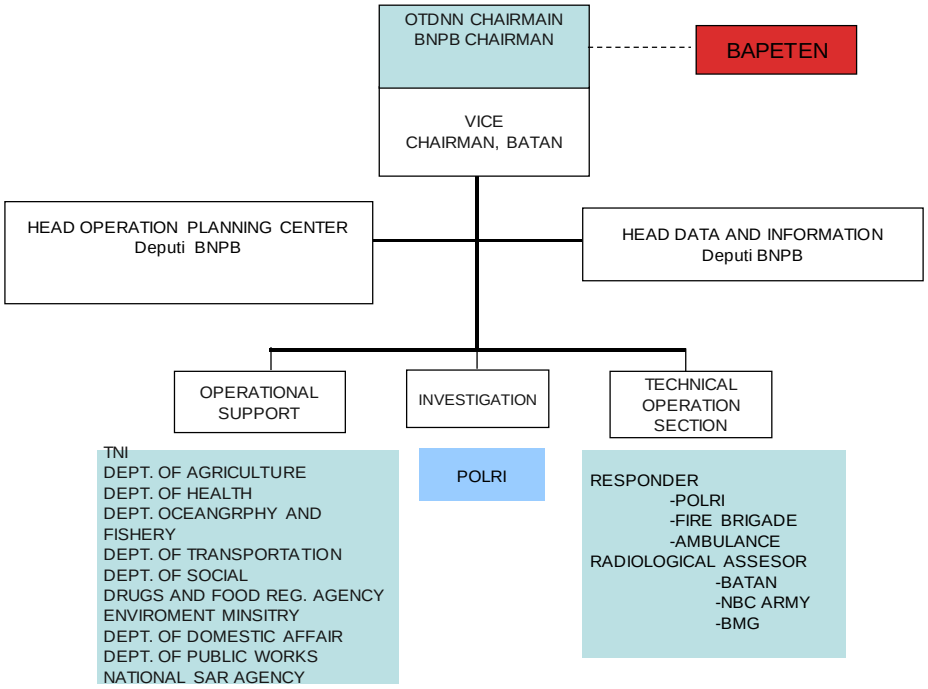
The following organisations are involved in nuclear safety regulations:

- BAPETEN (Nuclear Energy Regulatory Agency) implements the surveillance of all activities of the use of nuclear energy in Indonesia through regulation, licensing, and inspection.
- The government, the Ministry of Energy and Mineral Resources (KESDM), together with the National Energy Council (DEN), propose a national energy policy.
- Parliament approves/disapproves NPPs proposed by the government.
- The National Nuclear Energy Agency (BATAN) implements research, development and the utilisation of nuclear science and technology.
- The Indonesian National Board for Disaster Management (BNPB), together with the Nuclear IC, implements disaster management in a planned, integrated, coordinated, and comprehensive fashion.
- The Ministry of Environment issues environmental licensing through an environmental impact evaluation.

2-1-3. National Emergency Preparedness and Response Framework

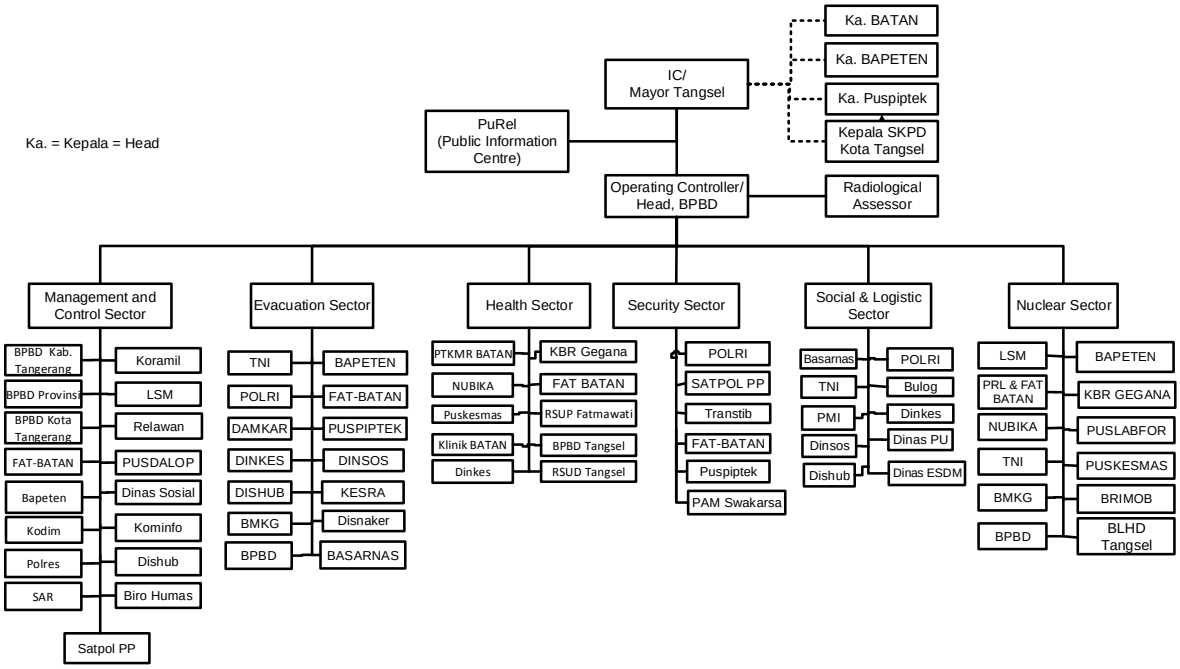
The framework is as follows.

Figure 2-1-4: National Nuclear Emergency Preparedness and Response (OTDNN)



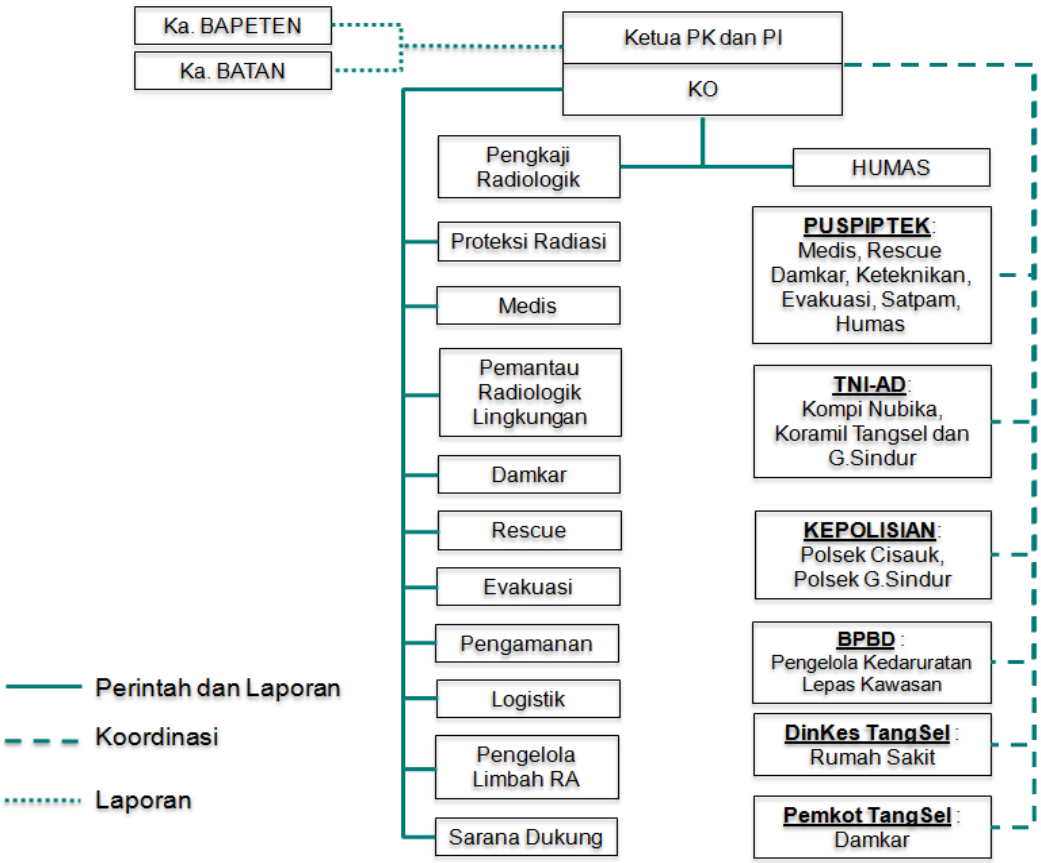
Source: Provided by Working Group member.

Figure 2-1-5: Municipality Nuclear Emergency Preparedness and Response



Source: Provided by Working Group member.

Figure 2-1-6: On-site Nuclear Emergency Preparedness and Response



Source: Provided by Working Group member.

2-1-4. Regional and International Cooperation on Emergency Preparedness and Response (EP&R)

Indonesia's participation in international organisations, research programmes, or conferences related to nuclear safety includes:

- International Atomic Energy Agency (IAEA)
  - Emergency Preparedness Review (EPREV) mission, 1999 and 2004 (and 2015)
  - Expert missions on nuclear safety and radiation protection and others
  - Joint Convention on Nuclear Safety
- Asian Nuclear Safety Network (ANSN) (on Topical Group)
  - Emergency Preparedness and Response

  - Safety Analysis
  - Operational Safety
  - Safety Management of Research Reactors, etc.
- Forum for Nuclear Cooperation in Asia (FNCA) (on Project)
  - Research Reactor Network
  - Nuclear Safety Culture
  - Radiation Safety and Radioactive Waste Management
  - Safety Management Systems for Nuclear Facilities, etc.
- World Association of Nuclear Operators (WANO)
- Korea Advanced Institute of Science and Technology (KAIST) of Korea,
- Electric Power Research Institute (US EPRI), US Department of Energy (DOE),
- Nuclear Regulatory Commission (NRC) [please fill up space]

2-2. Malaysia

2-2-1. Nuclear Development Policy

Malaysia has no NPPs, but nuclear energy has been recognised as an important energy source in terms of energy security in the Malaysia Plan-10: 2011–2015. In December 2010, the Government of Malaysia said that its first NPP (1cGW) would be operational in 2021 and the second one in 2022. However, the anti-nuclear movement has swelled following the Fukushima accident in Japan and the government has since become more cautious.

The Nuclear Power Infrastructure Development Plan (NPIDP) of Malaysia is roughly divided into a project development study, and a legal and regulatory study, which include various initiatives and human resources development.

Nuclear development policy on legal infrastructure

Currently, the activities to develop the legal infrastructure for nuclear power facilities are as follows:

- A more comprehensive Nuclear Act is being reviewed (based on IAEA standards) and the Atomic Energy Licensing Board (AELB) is in discussions with various

agencies to strengthen the legal infrastructure of nuclear activities in Malaysia.

- Adoption of 49 IAEA standards related to research reactors and NPPs.
- Developing the documents for licensees on NPPs.
- ASEAN Network of Regulatory Bodies on Atomic Energy (ASEANTOM)-IAEA Regional Project – 'Regional Cooperation Project Concept in South East Asia to Support Regional Environmental Radioactivity Database and Nuclear Emergency Preparedness & Response'.
- European Commission – 'Feasibility Study on Regional Cooperation on Emergency Preparedness & Response on South East Asia'.

Project development study

- Nuclear Power Infrastructure Development Plan (NPIDP)
- Feasibility studies
- Site evaluation
- Bid document

Legal and regulatory study

- Legislation Gap Analysis
- International legal instruments
- Revised Atomic Law
- Nuclear Power Regulatory Infrastructure Development Plan (NPRIDP)
- Develop 22 regulations/guidelines

• Objectives of the study

- To determine and assess the current level of national capabilities and state-of-preparedness
- To compare and benchmark the current level of national capabilities and state-of-preparedness based on best international practices
- To identify gaps that may exist and to recommend appropriate strategies and plans of action required to close the gaps
- To recommend Malaysia's industrial infrastructure requirements and analyse national participation possibilities for localisation during construction and

operation

- To coordinate a national self-assessment of the conditions to achieve the milestones in 19 key nuclear infrastructure areas, as recommended by the IAEA.

Documents

Standard Operating Procedures for Industrial Disaster

- Published on 8 June 2001
- Explains the action plan for handling fires, explosions, toxic and radioactive emissions by various agencies
- AELB is responsible as the expert agency
- Zoning system in which the RED ZONE is sub-divided into 'hot zone', 'warm zone' and 'cool zone'.

Human resources development programme

- IAEA Safety Assessment Education and Training Program (SAET)

The SAET was established and launched in 2009 as a systematic programme for the training of regulatory and operational staff in the skills needed for informed decision-making and technical review of NP documentation.

- SAET programme objective:
  - Support member countries in building and maintaining independent safety assessment competency and capacity.
- The IAEA programme funded by the Norwegian Funded Safety Assessment Capacity Building Programme to assist IAEA member states to build capacity in safety assessment.
- Malaysia and Viet Nam joined the pilot programme in 2010 as countries introducing NPP.
- The objective is to assist Malaysia to further build its human capacity generally in aspects of nuclear safety and specifically in safety assessment of NPP capacity to perform independent safety case reviews in support of informed decision-making competency.

In addition to the above, the Malaysia Nuclear Agency is a certified training centre for the following seven sectors: (1) radiation protection course, (2) non-destructive testing, (3) radiation safety and health, (4) environmental safety and health, (5) medical x-ray, (6) nuclear instrumentation, and (7) research reactor operators.

2-2-2. Safety Regulatory System

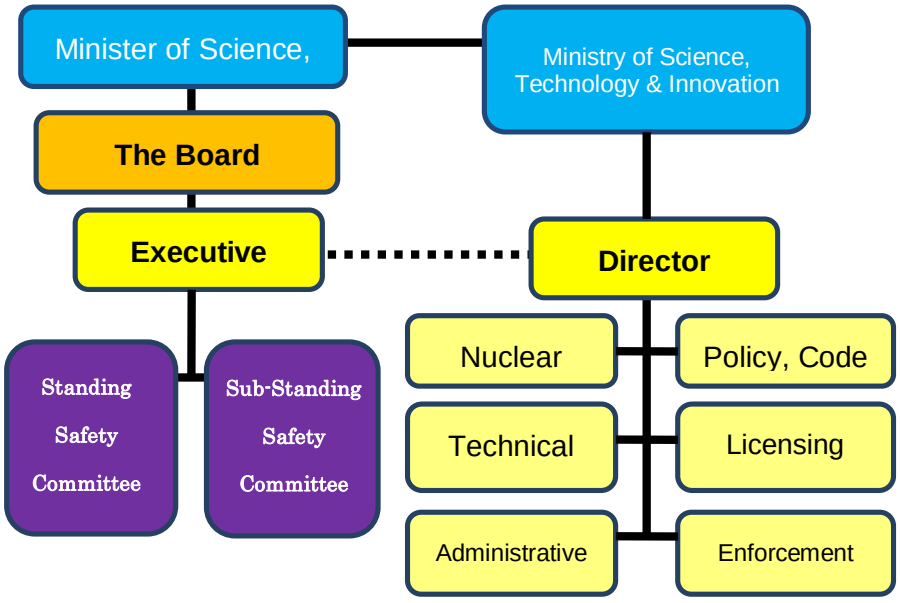
Atomic Energy Licensing Act 1984 (Act No. 304)

- To regulate and control atomic energy
- To establish standards on liability for nuclear damage
- To deal with matters connected therewith or related thereto.

Regulatory body:

- Atomic Energy Licensing Board (AELB) was established under Section 3 of Act No. 304.
- Ensuring safety, security, and safeguarding peaceful nuclear activities.

Figure 2-2-1. Atomic Energy Licensing Board



Source: Provided by Working Group member.

2-2-3. National Emergency Preparedness and Response Framework

National Security Council Directive No. 20 outlines the response in the event of a radiological and nuclear emergency:

- AELB - lead agency (Hotline No.: 1-800-88-7999)
- First Responder – Royal Malaysian Police, Fire and Rescue Department, Medical Service Department, SMART Team, etc.
- Supporting agencies – Malaysia Nuclear Agency, Metrological Department, Public Work Department, Social Welfare Department, etc.

Radiological Accident Disaster Plan

- Outlines the government's concept of operations based on specific functions.

Emergency Standard Operating Procedures

- Practical guidance on responding to a specific radiological accident/incident.

2-2-4. Regional and International Cooperation on Emergency Preparedness and Response (EP&R)

Malaysian participation in global activities

Malaysia participates in a number of global activities, including those of the IAEA, the ANSN, and the European Union, and has bilateral relationships with developed countries in Europe, such as Sweden and France. The Malaysian government has exchanged memoranda of understanding on nuclear safety with the Korea Institute of Nuclear Safety (KINS) and on nuclear defence and nuclear non-proliferation with the Japan Atomic Energy Agency (JAEA).

The first meeting of the newly established ASEAN Network of Regulatory Bodies on Atomic Energy (ASEANTOM) was held in Phuket in September 2013. The scope-of-network activities included nuclear safety and information sharing in the

event of an emergency, as well as development and training of human resources at normal times.

In terms of international cooperation, the following actions are proposed: environment monitoring and the fostering of specialists, signing of the Convention on Nuclear Safety, nuclide management, export control and ratifying additional protocols, educational training, and information exchange.

2-3. Philippines

2-3-1. Nuclear Development Policy

The Energy Reform Agenda (ERA) crafted at the onset of the Aquino administration serves as the guiding framework of the Department of Energy (DOE) in formulating policies and implementing various plans and programmes in the energy sector. One of the pillars under the ERA is to ensure energy security. In simple terms, this means that the government is considering various energy options to ensure that increasing energy demand is sustainably and economically provided for. Energy supply security will remain a continuing challenge facing the energy sector.

Cognizant of the attributes of nuclear energy for power generation, the nuclear strategy still remains a long-term option of the country as espoused in the Philippine Energy Plan 2007–2014. Currently, the government still has to establish its position on whether or not to pursue the nuclear option for power generation in the long term. Reluctance to pursue the nuclear option for power generation does not mean there is an absence of national policy, but rather that the government is looking into and considering various options before it makes such a crucial decision. On the contrary, this means it is imperative for the government to have a clear and defined national policy on nuclear for power generation.

In the absence of a policy on nuclear power generation, there exists an Inter-Agency Core Group on Nuclear Energy.[2] The Core Group is primarily mandated

[2] The Inter-Agency Core Group on Nuclear Energy was created by virtue of Joint Department Order (JDO) No. 2009-01-0001 issued on 26 January 2009. Its creation was also based on the recommendation of the

to (i) study the prospects for introducing nuclear energy generation into the country's energy system, and (ii) undertake or commission a feasibility study to determine whether the Bataan Nuclear Power Plant (BNPP) can still be rehabilitated and what the attendant costs are if this is undertaken. The Core Group is chaired by the DOE and co-chaired by both the Department of Science and Technology (DOST) and the National Power Corporation (NPC). Correspondingly, a technical working group was formed in order to undertake studies and activities pertaining to the 19 infrastructure requirements of a nuclear power programme as prescribed by the IAEA. The technical working group comprises eight study teams, namely (1) Legal and Regulatory Team, (2) Public Information and Consultation Team, (3) Technical, Commercial and Policy Team, (4) NPP Technology and Fuel Cycle Assessment, (5) Environmental Assessment Team, (6) Visiting Team, (7) Manpower Development Team, and (8) Electric Market and Generation Mix Assessment Team.

As a parallel effort on the mandate of the Core Group, the NPC and the Korea Electric Power Corporation (KEPCO) signed a memorandum of understanding in 2008 for KEPCO to conduct a feasibility study on the possible rehabilitation of BNPP. KEPCO submitted its Final Feasibility Report on BNPP in January 2010 and, based on its general assessment, 80 percent of the plant equipment requires overhauling and inspection, whereas the remaining 20 percent requires replacement. The report also pointed out that BNPP could be successfully rehabilitated and recommissioned, with attendant costs for recommissioning estimated at about US$1 billion over four years.[3]

In 2010, a series of information, education, and communication (IEC) campaigns on nuclear energy were conducted by the Core Group, particularly the Public Information and Consultation Team. Most attendees to the IEC campaigns were energy stakeholders from across the country. The IEC campaign zeroed in on the benefits of nuclear technology and its wide range of applications in various areas (e.g.

IAEA Expert Mission in February 2008.

[3] Source: BNPP Presentation by Engr. Mauro Marcelo in Barangay Nagbalayong, Morong, Bataan last 19 August 2014.

power generation, medicine, industry, agriculture, etc.). Moreover, a perception survey was also administered to the IEC participants. Results showed that about 62 percent of participants expressed support for nuclear energy as a long-term option for power generation to ensure security of energy supply.

Institutional framework on nuclear energy

Although the current government has not made a definitive decision on whether nuclear power generation will be pursued in the long term, the institutional framework is partially in place, which may serve as a rationale for the eventual utilisation of nuclear power generation. The institutional framework already established includes the Philippine Constitution, the creation of the Philippine Nuclear Research Institute (PNRI), and DOE's policy declaration.

Article II, Section 8 of the 1987 Philippine Constitution stipulates that, 'The Philippines, consistent with the national interest, adopts and pursues a policy of freedom from nuclear weapons.' Interpreting the Constitution would imply that the country is not veering away from its core interest in nuclear energy and its wide range of peaceful applications.

Another testament that the government is mindful of the attributes of nuclear energy is the reorganisation of the Philippine Atomic Energy Commission (PAEC) into the PNRI by virtue of Executive Order No. 128 signed on 30 January 1987. The reorganisation of the PAEC into the PNRI has resulted in the retention of the former's mandate by the PNRI. As mandated, the PNRI is responsible for undertaking research and development (R&D) activities into the peaceful uses of nuclear energy, instituting regulations on those uses, and carrying out the enforcement of regulations to protect the health and safety of workers involved in nuclear energy and the general public.[4]

It may be noted that Section 2 (Declaration of Policy) of Republic Act (RA) 7638 or the DOE Act of 1992 converses on the attainment of self-sufficiency to ensure a continuous, adequate, and economic supply of energy without sacrificing ecological integrity. This can be realised by developing and managing the country's indigenous

[4] Source: http://www.pnri.dost.gov.ph/index.php/aboutpnri

resources, conserving and efficiently using energy, and integrating and coordinating the various programmes of the government towards self-reliance.

Public forum on nuclear energy

In July and August 2014, the DOE, together with the NPC, conducted the Public Forum for the People of Bataan (stakeholder involvement) on the Rehabilitation of BNPP. The forum was conducted in Bagac and Barangay Nagbalayong, Morong, Bataan. The forum primarily aimed to assess public perceptions towards the possible rehabilitation of BNPP and give expression to the concerns of people living and doing business in and around the BNPP area. Moreover, the activity served as an avenue for the DOE to touch base with, and address and respond to, energy-related concerns of local government units.[5]

During the forum, a pre- and post-survey on social acceptability of BNPP rehabilitation and awareness on nuclear energy was administered. The survey results in Bagac showed that three out of five participants (60 percent) expressed their support for nuclear energy for power generation as a long-term option. The level of support increased to 80 percent after the forum. Based on the results, the primary reason for favouring rehabilitation is that it would provide a stable and reliable source of electricity to address growing energy demand. The survey results in Barangay (village) Nagbalayong showed that 7 out of 10 participants (70 percent) expressed their support for nuclear energy. Post-forum results showed that the proportion of those who were unsure whether to support nuclear energy or not slightly increased, whereas those who were willing to support nuclear energy (68 percent) declined. The survey also indicated that majority of respondents (71 percent for pre and post forum) were in favour of rehabilitating BNPP.

2-3-2. Safety Regulatory System

[5] The Secretary of Energy, Sec. Carlos Jericho L. Petilla, upon assumption of his post in 2012 directed the DOE to work more closely and establish good working relationships with local government units throughout country.

The PNRI serves as the lead agency in the case of a radioactive emergency and therefore is the country's designated nuclear safety authority. The regulation of nuclear technologies and facilities, as well as radiation devices and facilities, falls within the mandate of two government agencies, namely the PNRI, which is under the DOST, and the Center for Device Regulation, Radiation Health and Research (CDRRHR),[6] which is under the Food and Drug Administration (FDA). Currently, the PNRI's function is twofold, as it undertakes both regulation and promotion.

The PNRI's functions relative to Executive Order 128 are to:

- Conduct R&D on the application of radiation and nuclear techniques.
- Undertake the transfer of research to end users, including technical extension and training services
- Operate and maintain nuclear research reactors and other radiation facilities.
- License and regulate activities relative to production, transfer, and utilisation of nuclear radioactive substances.[7]

In reference to its mandate and function, nuclear regulation is the responsibility of the PNRI. The regulatory function is carried out by the Nuclear Regulatory Division (NRD), which is primarily mandated to oversee licensing and regulate the possession and use of nuclear and radioactive materials and facilities. The NRD also implements the PNRI's Policy on Internal Nuclear Regulatory Control Program, and it coordinates nuclear and radiological EP&R activities.[8]

Five sections comprise the NRD: a Regulations and Standards Development Section (RSDS), a Licensing Review and Evaluation Section (LRES), an Inspection and Enforcement Section (IES), a Nuclear Safeguards and Security Section (NSSS), and a Radiological Impact Assessment Section (RIAS).

[6] CDRRHR was formerly the Bureau of Health Devices and Technology (BHDT) under the DOH. The BHDT was restructured under the FDA by virtue of the Republic Act 9711 or the Food and Drug Administration (FDA) Act of 2009.
[7] Source: http://www.pnri.dost.gov.ph/index.php/aboutpnri/functions
[8] Source: http://www.pnri.dost.gov.ph/index.php/nuclear-safety-and-regulations

Table 2-3-1. Sections of the Nuclear Regulatory Division and Their Corresponding Functions

NRD Section	Function
RSDS	• Formulates nuclear safety policy, develops and establishes nuclear regulations, guides and criteria consistent with internationally acceptable guidelines and best practices.
LRES	• Reviews, evaluates and carries out assessment of applications to import, export, acquire, possess, transport, handle and use nuclear and radioactive material and operate atomic energy facilities in order to ensure compliance with established regulations and standards. • Recommends the issuance of license and prepares the license
IES	• Conducts inspection and enforcement activities/actions of licensed radioactive materials and atomic energy facilities to ensure compliance with regulatory requirements and licensees' commitments
NSSS	• Coordinates and carries out inspections in support of international nuclear safeguards commitment and the physical protection of nuclear and other radioactive materials and facilities, and coordinates the implementation of foreign-assisted projects on nuclear security
RIAS	• Implements regulatory research and studies in support of the various regulatory functions of the NRD as well as plans and coordinates the nuclear and radiological emergency preparedness and response activities
Source: http://www.pnri.dost.gov.ph/index.php/nuclear-safety-and-regulations	

The BHDT (now the CDRRHR under the FDA) is responsible for developing plans, policies, national objectives, programmes, projects, and strategies for regulating health technologies, medical and health devices, radiation devices and facilities, and other health-related devices that may pose hazard to human health. The BHDT also formulates and implements rules, regulations, and standards for registration, licensing, and accreditation. Provision of technical assistance is also carried out by the BHDT, especially for end users of devices such as radiation-emitting equipment.[9]

Proposed legislation on regulation

Recognising that regulation should be a function of an independent body, two bills were filed in the 16th Congress (during the 1st and 2nd regular sessions) that aimed to achieve this goal. House Bill No. 147, or the Comprehensive Nuclear and Radiation Safety Regulation Act of 2013, authored by Hon. Francis Gerald A. Abaya, sought to establish the Philippine Nuclear Radiation Safety Commission, which will exercise regulatory control over the peaceful uses of nuclear and other radioactive materials, facilities, and radiation equipment. Meanwhile, House Bill No. 4930, or the

[9] Source: http://www.doh.gov.ph/bhdt.html

Comprehensive Nuclear and Radiation Safety Regulation Act of 2014, filed by Hon. Francisco Ashley L. Acedillo and Hon. Gary C. Alejano on 1 September 2014, will transfer the regulation of ionising radiation function of PNRI to the CDRRHR (Table 2-3-2).

Although different in approach, both bills have the objective of ensuring that a regulatory function is lodged in an independent agency or transferred to another agency.

Table 2-3-2. Nuclear Regulation Bills Filed in the 16th Congress

Proposed Legislation	Date Filed	Objective	Author
House Bill 147 (Comprehensive Nuclear and Radiation Safety Regulation Act of 2013)		• Establish the Philippine Nuclear Radiation Safety Commission to exercise regulatory control over the peaceful uses of nuclear and other radioactive materials, facilities and radiation generating equipment	Hon. Francis Gerald A. Abaya
House Bill 4930 (Comprehensive Nuclear and Radiation Safety Regulation Act of 2014)	1 September 2014	• Unify the nuclear regulatory body in the country by transferring the function of the PNRI under DOST in regulating ionizing radiation to the FDA-CDRRHR which is compliant to the IAEA requirement of having an independent regulatory body separate from promoting functions	Hon. Francisco Ashley L. Acedillo and Hon. Gary C. Alejano

Source: Provided by Working Group member.

Nuclear regulatory body on reviving BNPP

The DOE Secretary has stated in a newspaper article that a nuclear regulatory body must be in charge of reviewing the possibility of reviving the mothballed BNPP. This regulatory body will decide on BNPP as it is a sensitive issue, according to the Secretary. Apart from looking at the possible revival of the mothballed plant, it will also address the various safety concerns raised by different sectors that are against BNPP revival.

2-3-3. National Emergency Preparedness and Response Framework[10]

The PNRI is in charge of developing and updating the emergency plan, or the National Radiological Emergency Preparedness and Response Plan (RADPLAN) for all radiation-related accidents that may affect the country. The RADPLAN is set into action by the National Disaster Risk Reduction and Management Council (NDRRMC). A formal declaration will be made by both the NDRRMC and the PNRI in the activation of the RADPLAN, followed with the notification of concerned participating agencies and local disaster coordinating councils. The PNRI coordinates all nuclear-related responses, whereas the NDRRMC coordinates all non-nuclear response activities.

The RADPLAN aims to establish an organised emergency response capability for timely, coordinated action by Philippine authorities in the case of a peacetime radiological incident or emergency to protect public health and safety. In terms of scope, it covers all kinds of radiological emergencies involving the operation of nuclear and radiation facilities, the use and transport of radioactive materials, and accidents occurring outside the Philippines with a significant impact on the country. The first RADPLAN was approved in 2001. RIAS, under the NRD, serves as the emergency planning and preparedness secretariat. RIAS is also responsible for the maintenance of the RADPLAN.

Revision of the RADPLAN is currently being undertaken. Carrying out the revision necessitates ensuring that it is consistent with the NDRRMC national preparedness plan and the concept of operations of various organisations. It also needs to be consistent with the requirements of the IAEA General Safety Requirements (GSR) Part 7 (formerly GSR 2) on emergency preparedness and response. The RADPLAN was subject to a peer review by the IAEA Emergency Preparedness Review Mission Experts in July 2010 and again in August 2014. Moreover, the US Department of Energy (DOE) National Nuclear Security Administration (NNSA) Radiation Emergency Management also provided an expert review in November 2014.

Before submission and approval of the final revised version, the RADPLAN must be tested in a national drill or exercise. In addition, a general memorandum of

[10] Source: Inputs from PNRI-NRD.

agreement/understanding between participating agencies must also be updated, as well as reinforced, to ensure an effective multisectoral, inter-agency, and community-based response. The review is also being carried out based on the lessons learned from the Fukushima accident and on recent developments in nuclear security and terrorism.

Among the relevant features of the Draft Revised RADPLAN are inclusion of acts of terrorism, addition of two types of emergency (due to malevolent act and severe overexposure), more participating government/non-government organisations are duly recognised, gives importance to records and data management, and highlights the need for maintaining emergency preparedness.

PNRI's Emergency Response Plan (PEP)[11]

This is intended that all PNRI personnel be involved in a response action and have the capability to respond to an actual or potential radiation-related emergency, regardless of whether the event arises from technological or natural hazards. This is an all-hazard approach that follows the RADPLAN requirements on EP&R. This was approved by the PNRI Director in October 2014 and consequently underwent review by the PNRI's Radiological Emergency Committee and the US DOE's NNSA Radiation Management Experts in November 2014.

The all-hazard approach also contains a concept of operations based on the alert level and the type of emergency, and the manner in which the PNRI EP&R has to be carried out.

As the regulatory authority for the control and regulation on the use of radioactive materials and operation of nuclear facilities, the PNRI requires its licensees to have an emergency plan (from Section 17.1 of the Code of PNRI Regulations Part Standards for Protection against Ionizing Radiation). The PNRI also has taken an initiative under the Internal Regulatory Program to develop and establish a licensee's Emergency Plan.

[11] Source: Inputs from the Philippine Nuclear Research Institute Nuclear Regulatory Division (PNRI-NRD).

Contact information in the case of an emergency

The focal person designated by the PNRI in the case of an emergency is Mr Teofilo V. Leonin, Chief of the NRD. Moreover, the PNRI's website provides contact information in case of nuclear-related emergencies (Table 6). Aside from the listed telephone numbers, the PNRI also has an Online Incident Notification Report Form that can be downloaded, filled in, and emailed to pnrihelp@pnri.gov.ph.

Table 2-3-3. PNRI's Contact Information on Cases of Nuclear-Related Emergencies

	Telephone Numbers
Trunkline	(632) 929-6011
Direct Lines	
Office of the Director	(632) 920-8738
Nuclear Regulations Division Office	(632) 920-8796
Nuclear Services Division Office	(632) 920-8784
Radiation Protection	(632) 920-8757
Information and Library Section	(632) 920-8787
Source: http://www.pnri.dost.gov.ph/index.php/programs-a-projects/120	

2-3-4. Regional and International Cooperation on Emergency Preparedness and Response (EP&R)

The country as represented by the PNRI has been a signatory to a number of Safety and Security Conventions and Agreements under the IAEA (Table 2-3-4). In the context of nuclear emergency and response, the two applicable conventions are the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

Table 2-3-4. Conventions and Agreements under IAEA

Safety and Security	Signature	Instrument	Date of Deposit	Entry into Force
1. Convention on Early Notification of a Nuclear Accident		Accession	05 May 1997	05 June 1997
2. Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency		Accession	05 May 1997	05 June 1997
3. Joint Convention on the Safety of Spent fuel Management and on the Safety of Radioactive Waste Management	10 March 1998			
4. Convention on Physical Protection of Nuclear Materials	19 May 1980	Ratification	22 Sept. 1981	08 Feb. 1987
5. Vienna Convention on Civil Liability for Nuclear Damage	21 May 1963	Ratification	15 Nov. 1965	12 Nov. 1977
6. Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage	10 March 1998			
7. Optional Protocol Concerning the Compulsory Settlement of Disputes	21 May 1963	Ratification	15 Nov. 1965	13 May 1999
8. Convention on Supplementary Compensation for Nuclear Damage	10 March 1998			
9. Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention	21 Sept. 1988			
10. Convention on the Suppression of Nuclear Terrorism	15 Sept. 2005			
Source: Inputs from PNRI-NRD				

IAEA = International Atomic Energy Agency.

2-4. Republic of Korea

2-4-1. Nuclear Development Policy

The demand for electricity has risen sharply in the Republic of Korea (henceforth, Korea) in recent years, increasing about 1.3 times in the five years from 2007 to 2012. In contrast, the demand for electricity has fallen in major developed countries such as the US, the United Kingdom, and Japan.

Coping with such a dramatic increase in electricity demand, at the 6th Basic Plan of Long-Term Electricity Supply and Demand (BPE for short) for 2013–2027 in February 2013, the Government of the Republic of Korea announced that it was maintaining a reserved stance on building new NPPs. In accordance with the BPE, which makes announcements every two years, the installed capacity of NPPs in Korea will increase from 26.4 percent (2012) to 27.4 percent (2027) on the basis of peak contribution. At the end of 2014, 24 units were in operation and 10 units are planned to be constructed by 2024, such that 34 units in total are expected to be in operation by the end of the 6th BPE period (2027). An additional four new reactors between

2025 and 2027 would not be made until the final announcement of the 7th BPE, due to anti-nuclear sentiment in the wake of Japan's 2011 Fukushima accident and strong opposition from local residents.

Early in 2014, the Korean government finalised the 2nd Korean National Energy Master Plan calling for a target level of 29 percent reliance on nuclear power by 2035. Achieving a 29 percent reliance on nuclear power by 2035 will require the building of around 5 to 7 new NPPs in addition to the 24 NPPs that are currently operational and the 10 NPPs that are currently being built or planned. Previous plans from the first master plan made five years ago called for 41 percent reliance on nuclear power by 2035, compared with 29 percent reliance in the second master plan. Currently, nuclear power in Korea accounts for 26 to 29 percent of total national electricity generation.

Table 2-4-1. Expected Installed Capacity of NPPs with the 6th BPE Period (as of 2014)

Year / Item	2012	2015	2020	2027
No. of Operating NPPs	23	26	30	34
Installed Capacity on the Basis of Peak Contribution (MWe) (Ratio: %)	20,716 (26.4)	24,516 (24.5)	30,116 (23.9)	35,916 (27.4)

NPP = nuclear power plant.
Source: Provided by Working Group member.

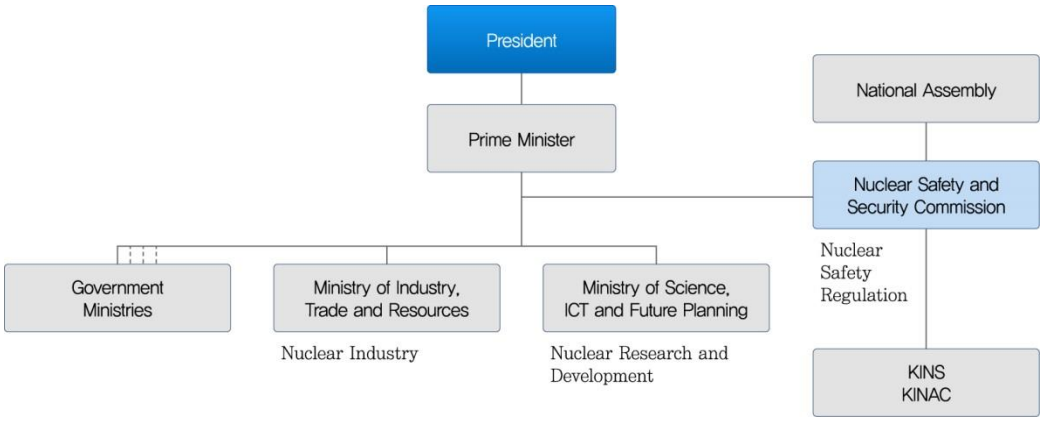
2-4-2. Safety Regulatory System

Nuclear energy plays a vital role as credible energy resources in Korea. However, the global situation has become less favourable for nuclear energy after the Fukushima accident. Therefore, the role of nuclear safety must be further strengthened if nuclear energy were to remain an affordable, economically efficient, and environment-friendly energy source in the future. In the use of nuclear energy, nothing can take precedence over the assurance of nuclear safety.

Today, the nuclear safety and regulatory system of Korea is composed of the Nuclear Safety and Security Commission (NSSC), the regulatory authority, and the KINS and the Korea Institute of Nuclear Non-proliferation and Control (KINAC), as regulatory

support organisations. The NSSC is in charge of nuclear safety regulation, including licensing matters for all the nuclear installations; the Ministry of Industry, Trade and Resources is responsible for promotion of nuclear industry; and the Ministry of Science, ICT and Future Planning is responsible for nuclear R&D. The government structure relating to nuclear energy is shown in Figure 2-4-1.

Figure 2-4-1. Government Organisations on Nuclear Energy



Source: Provided by Working Group member.

The NSSC is composed of nine members including the chairman. The chairman and one member are standing members. The standing member holds an additional position of Secretary General of the NSSC. The chairman is appointed by the President among nominees referred by the Prime Minister. Four members including the standing member are appointed by the President with the nominees referred by the chairman of the NSSC, whereas the other four members are appointed by the President with referral to the National Assembly.

2-4-3. National Emergency Preparedness and Response Framework

2-4-3.1 Laws and legal system

In general, emergency preparedness is based on the Basic Act on Management of Disasters and Safety, which addresses disasters and safety management at a national level, along with the Basic Act on Civil Defense. Meanwhile, the Act on Physical

Protection and Radiological Emergency (APPRE) has been promulgated to consider the uniqueness of nuclear accidents and radiological disasters, as a unique special law governing a nuclear emergency.

Pursuant to the APPRE, the NSSC is responsible for developing a National Radiological Emergency Preparedness Plan in association with the Basic Plan for National Safety Management, which is prepared according to the Basic Act on Management of Disasters and Safety every five years. To implement the plan, a National Radiological Emergency Preparedness Execution Plan is developed in detail and implemented every year. Local governments under the jurisdiction of the emergency planning zone develop and implement a Local Radiological Emergency Preparedness Plan in accordance with the two national plans, whereas the licensee prepares and executes a Radiological Emergency Plan under the approval of the NSSC.

The APPRE was revised in May 2014 to classify the emergency planning zone as the precautionary action zone (PAZ) and the urgent protective action planning zone (UPZ). This was to incorporate IAEA standards, which recommend designating the PAZ up to 3–5 km from the NPP and the UPZ within a 20–30 km radius of a damaged NPP. Accordingly, the subordinate statute was revised to allow the nuclear operator to designate the PAZ and the UPZ, taking into account the characteristics of the site, such as road access and topography within the framework of the APPRE. This revision was completed in May 2015.

2-4-3.2 National radiological emergency response structure

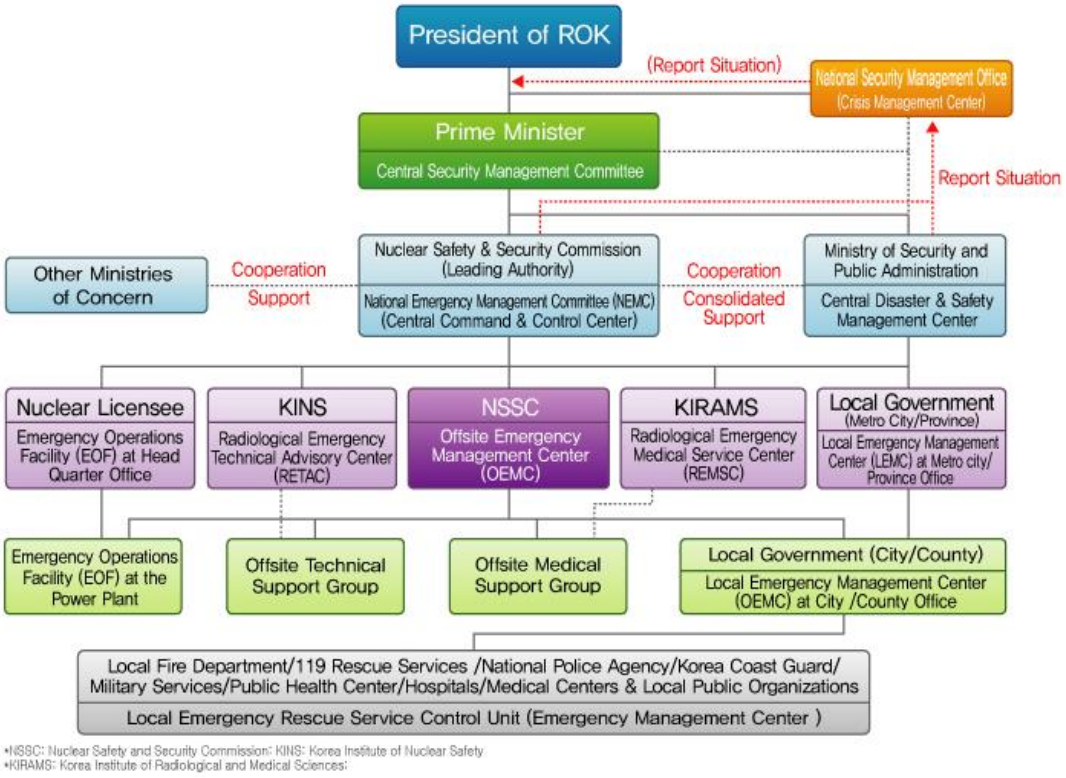
The central government, through the NSSC, is responsible for controlling and coordinating the countermeasures against radiological disaster in South Korea. The radiological emergency response scheme is composed of the National Nuclear Emergency Management Committee (NEMC), which is chaired by the Chairman of the NSSC, the Off-site Emergency Management Center (OEMC), the Local Emergency Management Center (LEMC), the Radiological Emergency Technical Advisory Center (RETAC) of KINS, the National Radiation Emergency Medical Center (REMSC) of the

Korea Institute of Radiological and Medical Sciences (KIRAMS), and the emergency operations facility (EOF) of the nuclear operator as shown in Figure 2-4-2.

When an accident occurs, the NSSC installs and operates the NEMC and the OEMC as command and control centres for emergency responses at the headquarters office and field offices, respectively. The OEMC is chaired by the standing member (Secretary General) of the NSSC. It consists of experts from the central government; local governments; local military and police; fire-fighting and educational institutes; nuclear safety expert organisations, radiological medical service institutes; and the nuclear operator. Meanwhile, the OEMC is responsible for the coordination and management of radiological emergency response, such as accident analysis, radiation (radioactivity) detection, and decision-making on public protective actions (sheltering, evacuation, food restriction, distribution of thyroid protection medicine, and control of carrying out or consumption of agricultural, livestock and fishery products). The OEMC comprises a number of working groups, each with their own responsibilities, and a Joint Disaster Countermeasures Council, which is established as an advisory body to the director of the OEMC. The Joint Information Centre is also operated as one of the working groups to provide prompt, accurate, and unified information about a radiological disaster.

The LEMC, established by the local governments concerned, implements the OEMC's decision on protective measures for residents.

Figure 2-4-2. National Radiological Emergency Preparedness Scheme



Source: Provided by Working Group member.

It also coordinates and controls emergency response activities utilising local fire stations, police stations and military units.

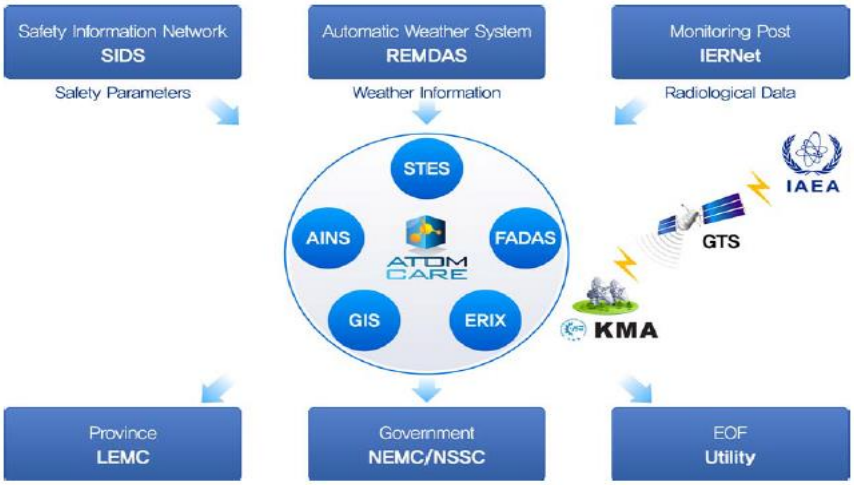
When an accident occurs, the Korea Hydro & Nuclear Power Co., Ltd. (KHNP), the operator of nuclear installation, is responsible for organising an emergency operations facility (EOF) and for taking measures to mitigate the consequences of the accident, restore installations, and protect the on-site personnel.

Meanwhile, KINS organises the Radiological Emergency Technical Advisory Center (RETAC), which is in charge of providing technical advice on the radiological emergency response, dispatching technical advisory teams to the affected site, initiating emergency operation of all nationwide environmental radioactivity monitoring stations, coordinating and controlling off-site radiation monitoring, offering radiation monitoring cars, and monitoring the response activities of the operator.

2-4-3.3 Major technical infrastructure for Korean EP&R system

In order to implement technical support activities to efficiently and effectively protect the public and the environment in a nuclear emergency, KINS has developed and is now operating an 'Atomic Computerized Technical Advisory System for a Radiological Emergency' (AtomCARE). As shown in Figure 2-4-3, AtomCARE is a computer-based decision-aiding system for protecting the public and the environment under accident conditions, by identifying the characteristics of an accident based on real-time operating parameters. Currently, AtomCARE system enables not only the rapid analysis and evaluation of radiological emergencies and radiation impacts, but also provides timely recommendations to the NEMC and the OEMC on the comprehensive management of information to protect the public and the environment.

Figure 2-4-3. Structure of Atomic Computerised/Technical Advisory System



Source: Provided by Working Group member.

Since 1999, a Radiation Safety Information System (RASIS) has been operated as a comprehensive safety information management system of radioisotopes through the Internet. RASIS has been integrated into relevant information in order to maximise support from the public and to simplify the administrative procedure of transacting relevant business to cope with the urgency of radioisotope safety management under rapidly growing utilisation of radioisotopes in Korea. RASIS aims at not only promoting the use of radioisotopes and upgrading efficiency of related safety management work, but also minimising the occurrence of orphan sources throughout the radioisotope source life cycle, as summarised in Table 2-4-2.

Table 2-4-2. Main Contents of RASIS

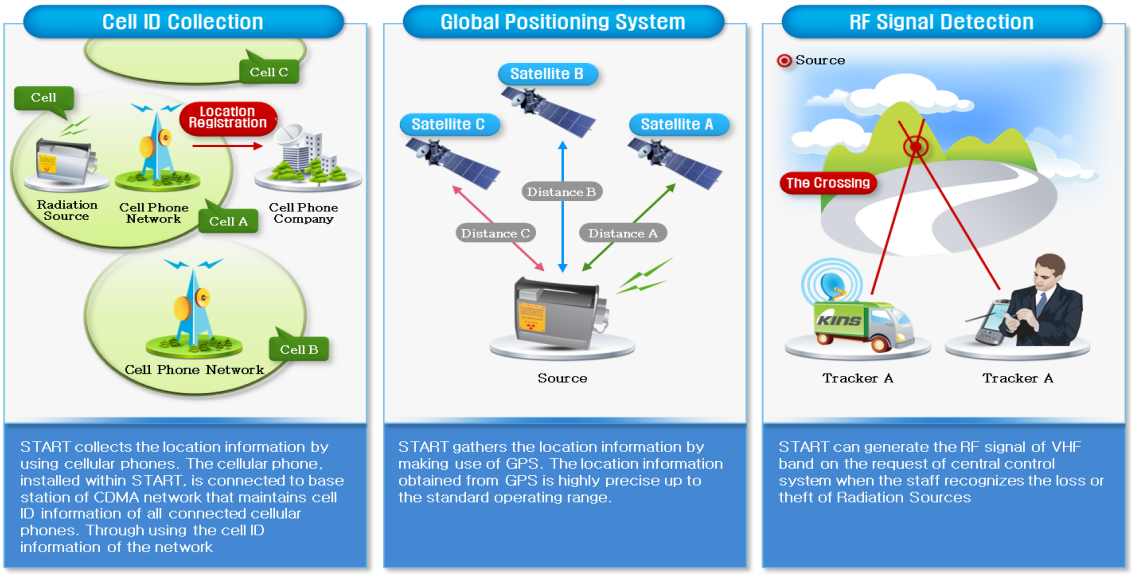
Main function	Contents
Report management	Status management of periodic report : management of inventory report, production or acquisition state, distribution state, transport state, disposal state
Tracking management	Management of source tracking : sealed source, unsealed source, radiation generator
Inventory analysis	Source inventory analysis : inventory management of sealed source, unsealed source, radiation generator
Statistics	Status of source export and import, education, worker, safety accident

RASIS = Radiation Safety Information System.
Source: Provided by Working Group member.

Against any radiation emergency caused by hazardous radioactive sources, the Radiation Source Location Tracking System (RadLot) has proven to be one of the most effective countermeasures in Korea. The RadLot system was developed and operated by applying state-of-the-art information and communication technology (ICT). The system aims to prevent or minimise public damage in the event of such a radiation accident as loss or theft, by real-time tracking of the location of radiation sources, as well as monitoring of the trend of radiation levels at the same time.

As illustrated in Figure 2-4-4, the system uses real-time monitoring of irradiators to show location information and the route of the location tracking mobile data terminal fixed to a mobile source, using global positioning system (GPS) and the CDMA network in periodic or pre-time settings by the user. As a result, the RadLot system serves to monitor radiation sources not only in the event of accidents but also under normal working conditions.

Figure 2-4-4. Location Tracking Methods for the RadLot System



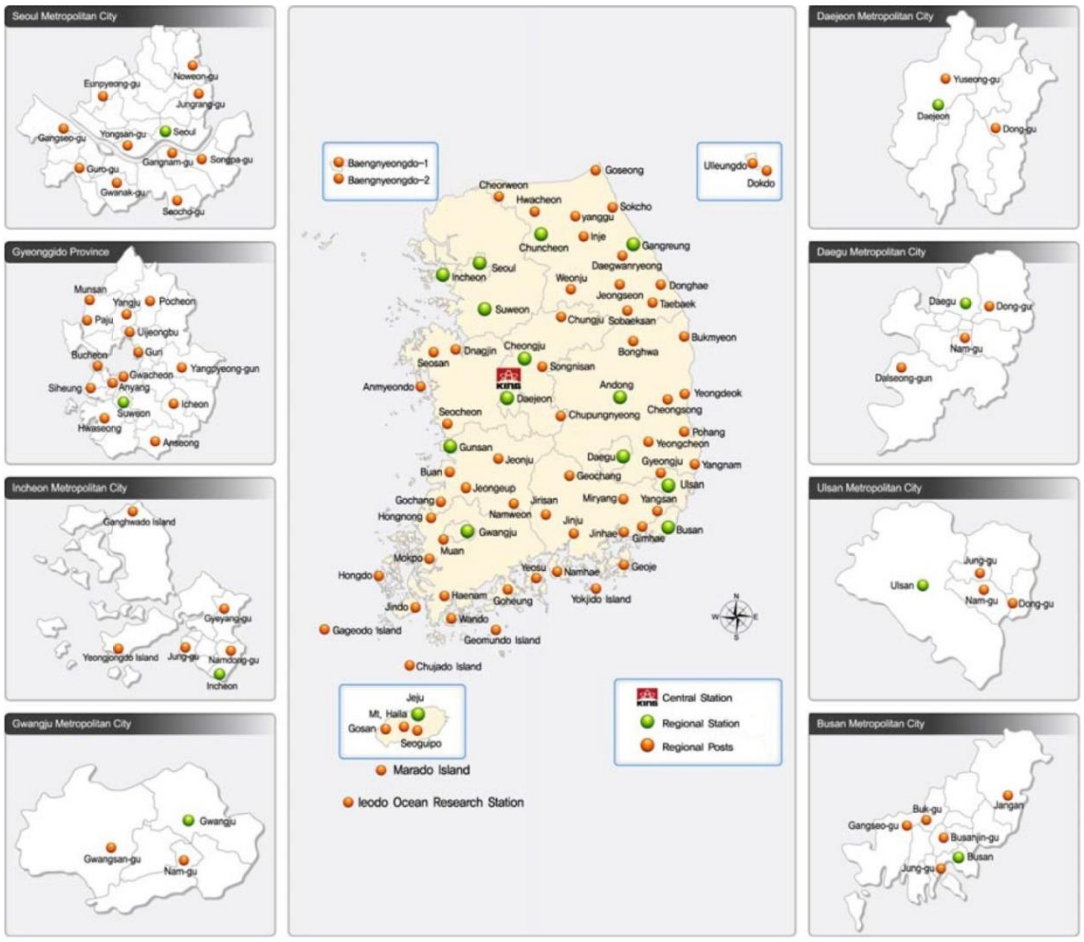
Source: KINS, May 2015.

Korea has run a national environmental radiation monitoring network since 1997. Shortly after the Fukushima accident in 2011, KINS expanded and upgraded the national network for environmental radiation monitoring. At present, the national monitoring network has been extended to 128 locations, with both manned monitoring stations and unmanned monitoring posts distributed throughout the country as shown in Figure 2-4-5.

By integrating all the monitoring networks for environmental radioactivity and radiation with monitoring results of each monitoring network, early detection capability from domestic and foreign radiological emergencies or abnormalities can be dramatically enhanced. In this regard, the System for Identifying Radiation in Environments Nationwide (SIREN) was also developed and is now operational. SIREN, which combines the monitoring results of radiation and radioactivity monitoring networks nationwide, is effectively used as the system capable of continuously monitoring environmental radioactivity in the entire territory before and after an emergency situation, and detects abnormal conditions in their early stages.

As of today, all the radiological monitoring data collected from 128 monitoring posts are open to the public through the web (IERNet.kins.re.kr) and a mobile app (eRAD@now). This is aimed at building public trust given the serious concerns over nuclear safety after several serious nuclear accidents.

Figure 2-4-5. National Environmental Radioactivity Monitoring Network



Source: KINS, May 2015.

2-4-4. Regional and International Cooperation on EP&R

Since the early 1970s, the notification of an accident and the request for assistance from international organisations and nations concerned have been made according to the procedures specified in the Convention on the Early Notification of Nuclear Accidents and the Convention on Support during Nuclear Accidents or Radiological Emergencies, led by the IAEA. Recently, Korea joined another IAEA-based international obligation for emergency, named the IAEA Response Assistance Network (RANET), in addition to both conventions mentioned earlier.

As for bilateral arrangements, Korea has formal arrangement schemes with several countries, including Japan, US, Russia, France, and China, among others, to exchange technical information in the event of a nuclear emergency.

The NSSC and the US Nuclear Regulatory Commission (NRC) maintain a radiological emergency cooperation scheme, by mutual consent, pursuant to the Arrangement between the USNRC and the NSSC for the Exchange of Technical Information and Cooperation in Regulatory and Safety Research Matters. Between the NSSC and the Nuclear Regulation Authority (NRA) of Japan, there is bilateral agreement to maintain an early notification network that allows prompt notification if a nuclear accident occurs.

In addition, KINS has signed the memorandum of cooperation with the National Nuclear Safety Administration (NNSA) of China to maintain cooperation for emergency measures in preparation for nuclear accidents, and to set up an emergency cooperation system with the China Institute for Radiation Protection (CIRP) in accordance with the Agreement on Technological Cooperation for Nuclear Safety and Radiological Protection.

Regarding regional agreements in Northeast Asia, a memorandum of cooperation at the Top Regulators Meeting (TRM) in August 2009 was signed to enhance nuclear safety capacity of the region between Korea, China, and Japan. Under the TRM framework, the three nations are continuously discussing ways to improve mutual cooperation, such as a tri-party system for nuclear accident information exchange and joint exercises for radiological emergency preparedness. In November of 2014, Korea held a unified emergency exercise at its Kori site, taking the first turn on an annual basis under the TRM framework. The NSSC invited liaison officers and observers from China and Japan to attend. It will be considerably beneficial to exchange information and experience gained in exercises and drills, cooperate in organising such exercises and drills, and participate in exercises operated by the authorities in neighbouring states.

2-4-5. Implications for Regional Cooperation on Radiological Emergency in Asia

There is growing demand to promote international partnerships through regional cooperation in order to cope with the challenges of nuclear emergency

response and nuclear safety faced by governments. As mentioned above, Korea has participated in the TRM (Northeast Asian Top Regulators' Meeting on Nuclear Safety), which was established between Korea, China, and Japan, to enhance regional cooperation on nuclear safety and emergency situations in Northeast Asia in 2009. In 2012, the three regulatory organisations—NNSA of China, NRA of Japan, and NSSC of Korea—decided to establish an information exchange framework in order to construct an effective cross-border cooperation scheme in the event of a radiological emergency from any nuclear installation of the three countries.

Possibly triggered by the TRM initiative, cross-border collaboration on radiological emergencies between Asian countries is helping establish the principles for an information exchange framework that would enable the active sharing of experiences of national emergency arrangements, reflecting any lessons learned from previous major radiological accidents.

Subsequently, a two-step approach may be appropriate for realistic cross-border cooperation considering TRM activities as a model protocol. First, in the event of an emergency including incident conditions (presumably rated on the International Nuclear Event Scale as Level 1 and above), each Asian country must designate and establish points of contact as a first-step activity. Through a designated contact point, an event that occurs in one country should be communicated by an initial email and by emergency phone calls to other contact points across the Asian region, briefly outlining the information available. In a normal situation, the points of contact would work as liaison officers as requested. The following information should be included in the reports from the contact points:

- time and exact location of the accident (or incident)
- nature, the assumed cause, and the foreseeable development of the radiological accident (or incident)
- the extent of the damage to the structure, system, and components
- the general characteristics of the radioactive release
- the information on current and predictable meteorological conditions in order to estimate the extent, scope, and direction of the trans-boundary release of the

radioactive materials

- the situation of radiation exposure
- the information on protective measures taken or planned on/off site.

The information exchange framework may be utilised effectively for the Regional Cooperation Project, which was established among regional states to perform joint R&D on radiological emergencies. The collaboration project should consider joint R&D approaches in the development of regional emergency arrangements to promote the capability of emergency responses in each country.

Since regional information sharing can be supplemented by video conferences, when necessary, the relevant organisations should be equipped with teleconference systems. In addition, regional countries should be invited to the emergency preparedness drills as observers hosted by one of the regional states.

As a further step, an online group website should be established through which information concerning operational performance and the status of nuclear installations across the region could be shared. Developing such a group website to be exclusively shared across the Asian region would provide faster and more effective information sharing between the relevant organisations. However, given the sensitivity of the information, the group website should not be open to the public.

To encourage use of the group website, the database for the Asian region should be extended further to include major design features of nuclear installations in operation and under construction. The information on design features could help neighbouring countries understand an accident at an installation and its impacts in greater detail. At the same time, the group website could be utilised to share measurement results from each environmental radiation monitoring system across the Asian region. In the case of an emergency, the environmental radiation monitoring results would be helpful in conducting a timely emergency response by all regional states in the most effective way. Depending on the development of an emergency situation, other relevant information transferred to neighbouring states through the contact points could also be shared on the group website based on a regional

agreement.

Finally, for more successful information exchange, the language used in communication between the authorities across the Asian region should be English. Supplementary information such as press releases and summary reports may, however, be better provided in the native language of respective countries.

2-5. Singapore

2-5-1. Nuclear Development Policy

2-5-1.1 Singapore energy policy – National Energy Policy Report

Singapore's National Energy Policy Report (NEPR), first released in 2007, outlines three policy objectives: economic competitiveness, energy security, and environmental sustainability. These three objectives translate into five strategies: enhancing infrastructure and systems, improving energy efficiency, strengthening the green economy, the market as the determinant of the price of energy, and diversifying energy sources.

The strategic thinking behind Singapore's energy security policies is shaped by a combination of factors such as the country's lack of natural energy sources; its reliance on oil imports for its refinery and petrochemical industries and its transportation sector; its reliance on piped natural gas imports to generate electricity for its industries and households; and its refineries, oil trading, and the manufacturing of oil derivatives, which are key to the country's economic growth.

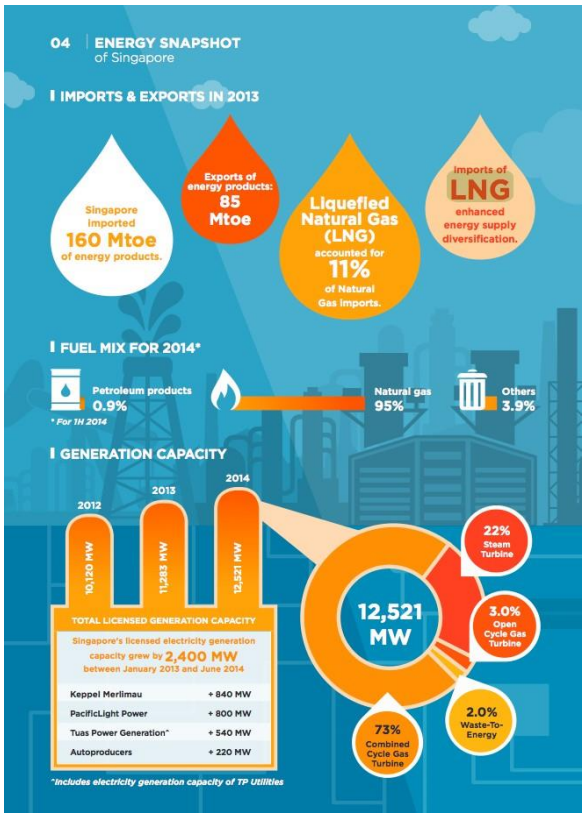
Without the availability of any fossil fuels, Singapore has to rely mainly on piped natural gas imports from Malaysia and Indonesia. In 2014, Singapore's fuel mix for power generation comprised mainly natural gas (95.4 percent); 'others' such as municipal waste, coal, and bio-mass (3.7 percent); and petroleum products (0.9 percent). The 2014 statistics also show that the percentage share of natural gas in the national fuel mix steadily increased from 60.8 percent in 2003 to 95.4 percent in 2014. However, the country's reliance on piped natural gas will gradually decrease with the introduction of liquefied natural gas (LNG) into its energy mix

from 2013 onwards. In 2014, LNG comprised 11 percent of natural gas imports (Figure 2-5-1); this will gradually increase as Singapore expands its LNG storage capacity.

As of 2013, the LNG terminal is able to store up to 6 million tonnes per annum (Mtpa). The terminal's throughput capacity will increase to 9 Mtpa with the addition of a fourth tank in the near future. The LNG terminal is one of the key supply initiatives that were outlined in the NEPR. The LNG terminal will enable Singapore to import gas from countries beyond the Southeast Asian region, such as Qatar, Trinidad, and Queensland, Australia.

Therefore, despite Singapore's lack of natural energy sources, its LNG, piped natural gas, and crude oil imports remain sufficient to meet the country's energy demand for the foreseeable future.

Figure 2-5-1. Singapore Fuel Mix for Electricity Generation (2014)



Source: Energy Market Authority (2014).

2-5-1.2 Singapore's policy on nuclear energy

In 2012, the Ministry of Trade and Industry, based on its nuclear energy pre-feasibility study, concluded that existing nuclear energy technologies are unsuitable for Singapore given its small country size and high population density.

In 2014, despite its status as a non-nuclear power country, Singapore was invited to attend the Third Nuclear Security Summit, which was held in the Netherlands. In its press statement, the Government of Singapore added that the agenda for the summit was to 'assess the progress made over the past four years on national and international measures to enhance nuclear security, identify unmet objectives from the previous two Summits, and propose how these can be achieved'. Singapore was invited based on its status as a global trading hub.

At the summit, the Singapore government announced that it would make preparations to accede to the Convention on the Physical Protection of Nuclear Material (CPPNM) and its 2005 Amendment. Essentially, by acceding to the CPPNM, Singapore will undertake measures to 'protect, detect and respond to threats to nuclear security…by ensuring the safe passage of nuclear materials during international transport'. Singapore's plan to accede to the CPPNM is a strategic necessity in strengthening the global nuclear safety and security architecture, because as a global trans-shipment hub, Singapore has one of the busiest maritime ports and airports in the world.

A month after the government's decision to accede to the CPPNM, the National Research Foundation (NRF) announced a S$63 million five-year research and education programme– Nuclear Safety Research and Educational Programme (NSREP)–in the areas of nuclear safety, science, and engineering. The NRF is a department that was set up within the Prime Minister's Office (PMO) in 2006 and whose primary role is to set the national direction for R&D. The primary objective of the NSREP is to increase the nation's scientific and engineering expertise in the areas of nuclear safety and security. This programme targets mainly Singaporean undergraduate and postgraduate students. The government hopes to train up to 10 people annually.

The NSREP comprises two components: the Singapore Nuclear Research and Safety Initiative (SNRSI) and the Nuclear Education and Training Fund (NETF). The SNRSI focuses on supporting R&D capabilities in nuclear safety, science and engineering, specifically in the areas of radiochemistry, radiobiology, and the safety analysis of NPPs through the use of modelling and simulations. The NETF supports education and training in those areas. Both programmes are housed in the National University of Singapore.

In May 2014, the Singapore Parliament introduced a bill to amend the Radiation Protection Act with the intention of better aligning the definition of 'nuclear material' with the CPPNM. In September 2014, the government formally deposited its instruments of accession to the CPPNM and its instrument of acceptance of the 2005 Amendment to the Convention. In October 2014, the National Research Foundation (NRF), which is part of the Prime Minister's Office, announced nine research projects to build up the country's nuclear safety and security expertise. The nine projects include areas such as radiochemistry, radiobiology and safety analysis, and medical physics.

2-5-2. Safety Regulatory System

Singapore's accession to the CPPNM will have an impact on its national nuclear safety and security framework. Its national framework comprises the Radiation Protection Act and its regulator, the Radiation Protection and Nuclear Science Department (RPNSD).

Radiation Protection and Nuclear Science Department

The RPNSD is the national regulatory authority for radiation protection in Singapore. As a regulator, it administers the country's Radiation Protection Act through licensing, notification, authorisation, inspection, and enforcement on irradiating apparatus and radioactive materials. The RPNSD is a department within the National Environment Agency, which is part of the Ministry of Environment and Water Resources.

The contact details of the RPNSD can be found at the Singapore Government Directory Index.[12]

Radiation Protection Act

The Radiation Protection Act was first implemented in 1973. Essentially, under the Act, licenses are required for the import, export, sale, manufacture, possession, and use of radioactive materials and irradiating equipment. Similarly, a license is required for the transportation of radioactive materials.

In 2007, the Act was repealed and re-enacted with further amendments with the intention of preparing the country for its ratification of the IAEA's Additional Protocol.

The Radiation Protection Act has evolved from when it was first enacted in 1973 to reflect the growing complexities surrounding the use of radioactive materials and equipment in Singapore and set against the context of the country's relationship with the international community. In May 2014, the government further announced that it had introduced a bill to amend laws that would enhance its nuclear security, which was part of its preparations to accede to the CPPNM. According to a news report, the Prime Minister explained, 'We [Singapore] are small and densely populated. Any nuclear or radiological incident would be a major disaster, perhaps an existential one… We are also an international hub—our economy, trade and security can easily be affected by a nuclear accident elsewhere.'

Other than streamlining the definition of 'nuclear material' with that of the CPPNM's definition, the amendments seek to criminalise the use of nuclear material if it could 'cause death, serious injury or substantial property damage'. In addition, nuclear offences will be made extraditable crimes and the country will be empowered to deal with a nuclear offence committed outside the country, according to the news report. Furthermore, the amendment seeks to increase the maximum jail term from two to five years for the import, export, and possession of radioactive materials or apparatus without a license or if in breach of licensing terms.

[12] http://app.sgdi.gov.sg/listing.asp?agency_subtype=dept&agency_id=0000013856

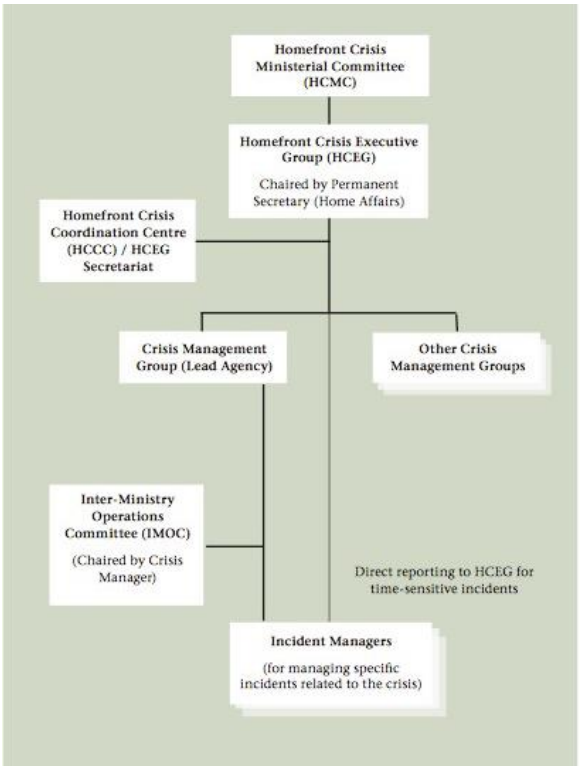
2-5-3. National Emergency Preparedness and Responses Framework

As of May 2015, Singapore had no nuclear energy facilities and its nuclear EP&R plans are part of a larger national civil emergency response framework. These include key scenarios such as major fire outbreaks, transport incidents, industrial-type accidents, major mass-casualty incidents, and acts of terrorism that involve hazardous materials, such as chemicals, biological and radiological materials, and explosives. Overall, Singapore's crisis and consequence management approach is premised around three key principles: manage public resilience, resume normalcy, and restore public confidence as quickly as possible.

In the case of any civil emergency scenarios, the Singapore Civil Defence Force (SCDF) is the incident manager and primary emergency response and management team. The SCDF is a uniformed organisation that is part of the Ministry of Home Affairs. The SCDF's main role is to 'provide fire-fighting, rescue and emergency medical services, and mitigate hazardous materials incidents, as well as formulate, implement, and enforce regulations on fire safety and civil defence shelter matters.' Over the years, the SCDF has developed deep capabilities in managing radiological incidents such as improvised explosive devices laced with radiological materials, transportation accident involving vehicle carrying radiological sources, and laboratory fires storing radiological services.

SCDF's emergency response is part of a larger national crisis and consequence management framework called the Homefront Crisis Management System (HCMS) (Figure 2-5-2). The HCMS has two divisions, the Homefront Crisis Ministerial Committee (HCMC) and the Homefront Crisis Executive Group (HCEG). The Minister for Home Affairs chairs the HCMC and its role is to provide strategic and political guidance in handling a crisis. Supporting the HCMC is the HCEG, which is chaired by the Permanent Secretary of the Ministry of Home Affairs.

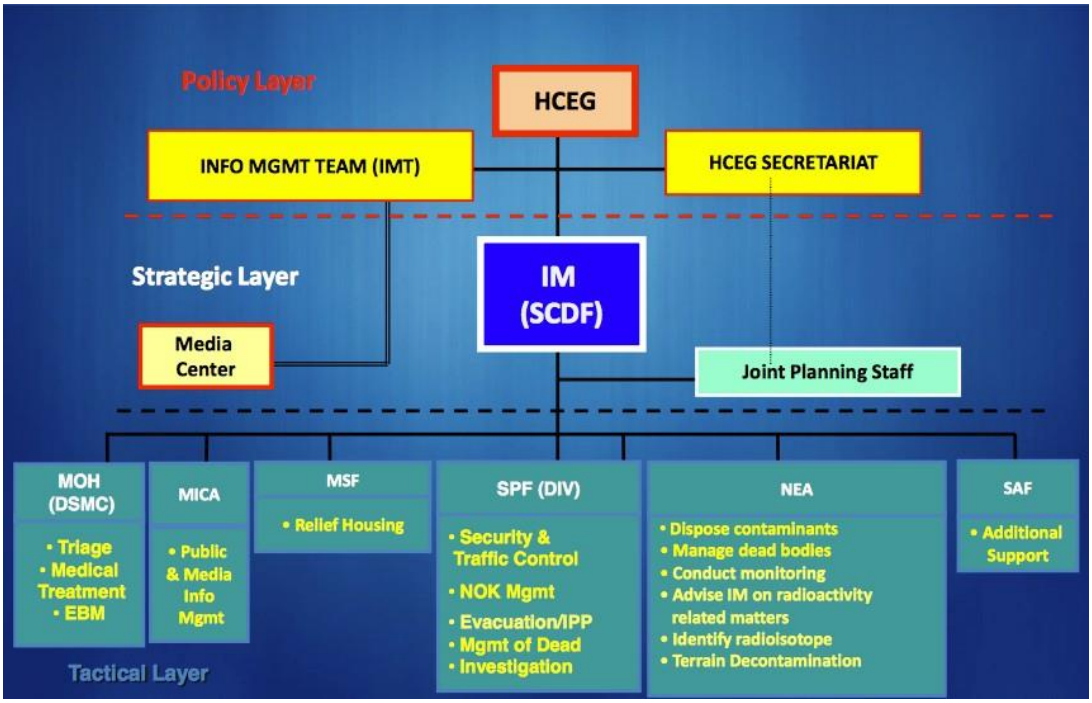
Figure 2-5-2. Homefront Crisis Management System Structure



Source: National Security Coordination Secretariat, Singapore.

The Homefront Crisis Executive Group comprises high-level representatives from several ministries and government agencies (Figure 2-5-3). The three ministries that are directly involved are the Ministry of Health (MoH), the Ministry of Communications and Information (MCI), and the Ministry of Social and Family Development (MSF). The government agency is the National Environment Agency (NEA). The Singapore Police Force (SPF) would also be mobilised, while the Singapore Armed Forces would be triggered to provide additional support, if needed. The MoH's primary function would be to provide triage and medical support, whereas the MCI would coordinate the public and media information, and the MSF would provide relief housing if necessary. The SPH would manage security and traffic control, among other things. The NEA would undertake contaminant disposal, conduct environmental monitoring, advise the incident manager on radioactivity matters, identify radioisotopes, and conduct terrain decontamination. It should be noted that the RPNSD is a division within the NEA.

Figure 2-5-3. Homefront Crisis Management System



Source: Asian Nuclear Safety Network.

Figure 2-5-4 lists other ministries and government agencies that would also be involved in crisis management when necessary.

Figure 2-5-4. Related Agencies for Ops Civil Emergency

Source: Asian Nuclear Safety Network.

In the larger operational scheme of things and in view of the numerous government ministries and agencies involved, the primary duty of the Homefront Crisis Executive Group is to ensure that the decisions and directives of the Homefront Crisis Ministerial Committee are carried out, while at the same time providing strategic guidance to the incident manager.

2-5-4. Regional and International Cooperation on EP&R

As part of Singapore's NEPR strategies, the country has been actively involved at both Track-I and Track-II level energy diplomacy, specifically in the area of energy cooperation. Track-I diplomacy refers to activities conducted between governments, whereas Track-II refers to activities that involve non-governmental officials and non-state actors. Track-II activities complement rather than substitute Track-I activities.

Singapore is represented in several Track-I and Track-II networks, such as the East Asia Summit's Energy Task Force, Asia-Pacific Economic Cooperation Energy Task Force, ASEAN Nuclear Energy Cooperation Sub-Sector Network (NEC-SSN), and the Council for Security Cooperation in Asia-Pacific (CSCAP). Singapore's participation in the CSCAP is represented through the S. Rajaratnam School of International Studies, Nanyang Technological University. The Energy Market Authority (EMA), which regulates Singapore's electricity and natural gas industries and power system operator, is the country's representative at the NEC-SSN. The EMA is a statutory body under the Ministry of Trade and Industry. Singapore is a party to the Southeast Asia Nuclear-Weapon-Free-Zone Treaty, also known as the Bangkok Treaty. Singapore is also a member of the ASEAN Network of Regulatory Bodies on Atomic Energy (ASEANTOM).

2-6. Thailand

2-6-1. Nuclear Development Policy

2-6-1.1 Energy Policy

Thailand's energy policy, which was delivered by General Prayuth Chan-o-cha, Prime Minister and Head of the National Council for Peace and Order, on 12 September 2014, consists of the following:

- Reform the structure of fuel pricing to reflect the costs and set up a reasonable tax system for different oil types and users in order to increase energy efficiency in Thailand.
- Implement the exploration and production of natural gas and crude oil, both on land and offshore.
- Promote the construction of fossil-fuel and renewable-energy power plants in a fair, open, and transparent manner.
- Cooperate with neighbouring countries in energy development.

2-6-1.2 Future development of nuclear power

As for the latest PDP 2010 Rev. No. 3, 2,000 MW of nuclear power from commercial operations will come on stream in 2026 and 2027.

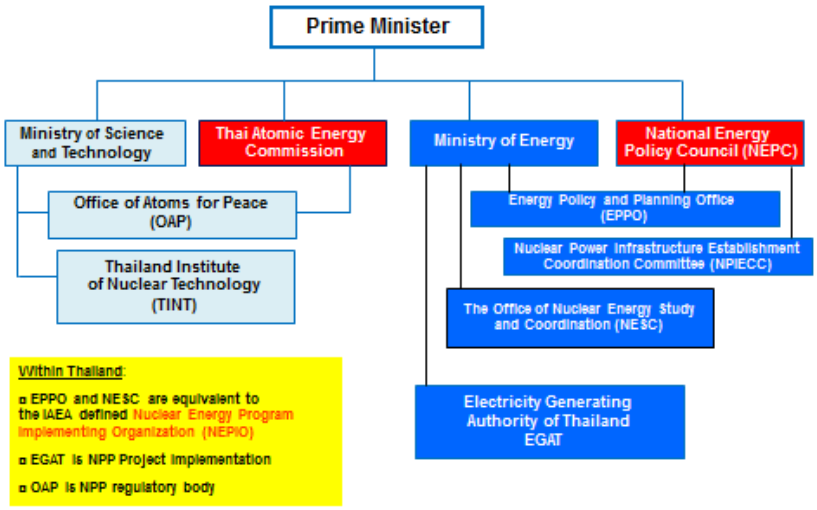
Table 2-6-1. Planned Nuclear Power Plants

Station/Project name	Type	Capacity (MW)	Expected Construction Start Year	Expected Commercial Year
EGAT Nuclear Power Plant # 1	LWR	1,000	2020	2026
EGAT Nuclear Power Plant # 2	LWR	1,000	2021	2027

Source: Provided by Working Group member.

2-6-1.3 Management mechanism for the nuclear power programme

Figure 2-6-1. Nuclear Power Programme Management Mechanism

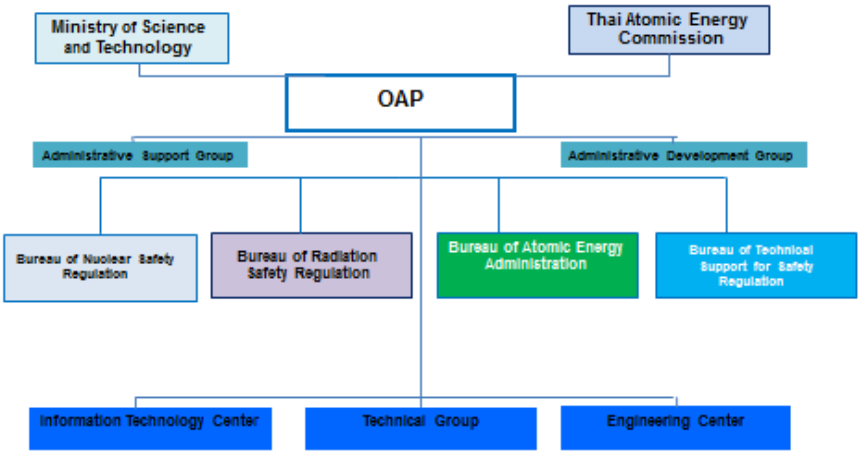


Source: Provided by Working Group member.

2-6-2. Safety Regulatory System

Emergency preparedness and responses are the responsibility of Office of Atoms for Peace (OAP), which was established in 1961, when the Atomic Energy for Peace Act was also enacted. The Act established the Thai Atomic Energy Commission for Peace (Thai AEC), which is Thailand's regulatory authority for issuing licences and regulating facilities and activities involving radiation and nuclear issues.

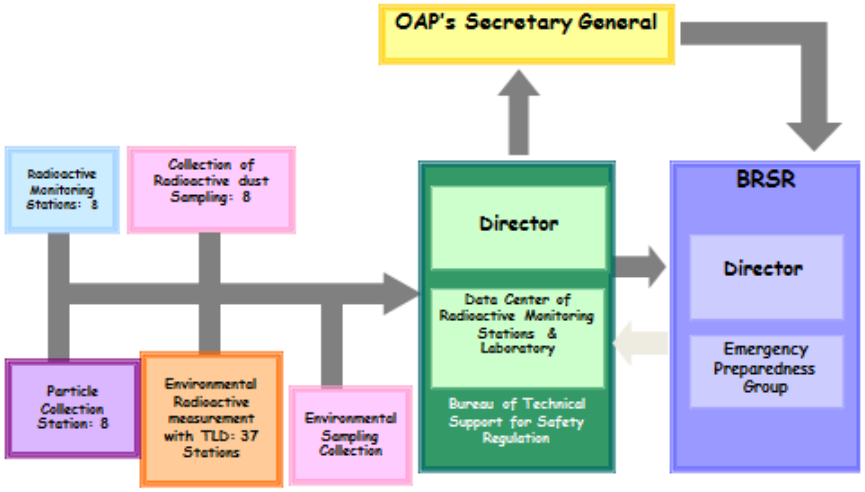
Figure 2-6-2. Thailand Safety Regulation System



Source: EPPO, May 2015.

In terms of dealing with the impact of the Fukushima accident on Thailand, the OAP immediately established a centre of command and information within the organisation in order to disseminate information, notify countermeasures to be implemented by Thais inquiring about the Fukushima accident situation and its impact, and provide information to the mass media. The mechanism of emergency response management is in Figure 2-6-3.

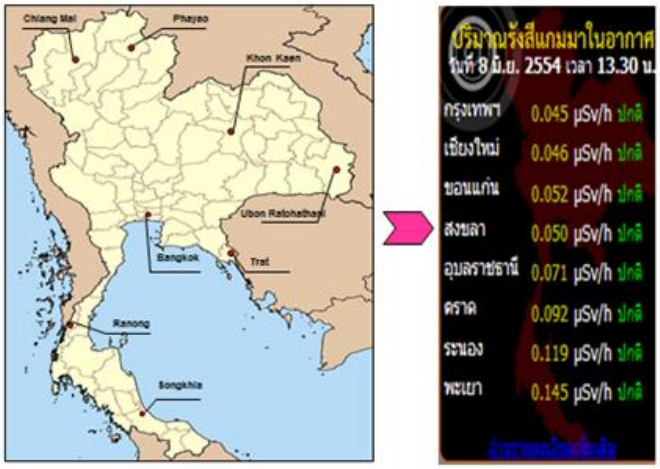
Figure 2-6-3. Process of Emergency Preparedness and Response



Source: EPPO, May 2015.

Moreover, OAP carried out external contamination screening by checking the contamination of airline crews, and checking cargoes and aircraft coming from Japan. As for internal contamination checking, OAP provided examinations and RAM-OAP 40+ services for people who suspected themselves of being contaminated. In addition, OAP monitored the amount of gamma radiation in the atmosphere more frequently than usual. In 2011, there were eight gamma radiation monitoring stations across the country, consisting of two stations in the north (located in Phayao, Chiang Mai), two stations in the northeast (located in Khon Kaen, Ubon Ratchathani), one station in central Thailand (located in Bangkok), one station in the east (in Trat), and two stations in the south (in Songkhla and Ranong).

Figure 2-6-4. Ambient Gamma Monitoring Station



Source: Office of Atoms For Peace (OAP) website, http://www.oaep.go.th/index_en.php

For water gamma contamination monitoring, OAP collaborated with the Pollution Control Department, at the Ministry of Natural Resources and Environment, and with the Department of Fisheries, at the Ministry of Agriculture and Cooperatives. All the collected information was made available to the public on the OAP's website (www.oaep.go.th). Another area of monitoring was the levels of radioactivity in foodstuffs imported from Japan, such as rock fish, octopus, pickle plums, etc. The monitoring was conducted in collaboration with the Food and Drug Administration, at the Ministry of Public Health. The monitoring established that no radioactive contamination or radiation hazards were found to have entered Thailand.

In order to enhance emergency preparedness, in the period 2011–2013, four additional radiation monitoring stations were established (located in Tak, Sakon Nakorn, Kanchanaburi, and Phuket). Furthermore, by 2020 nine radiation monitoring stations will be in operation.

2-6-3. National Emergency Preparedness and Response Framework

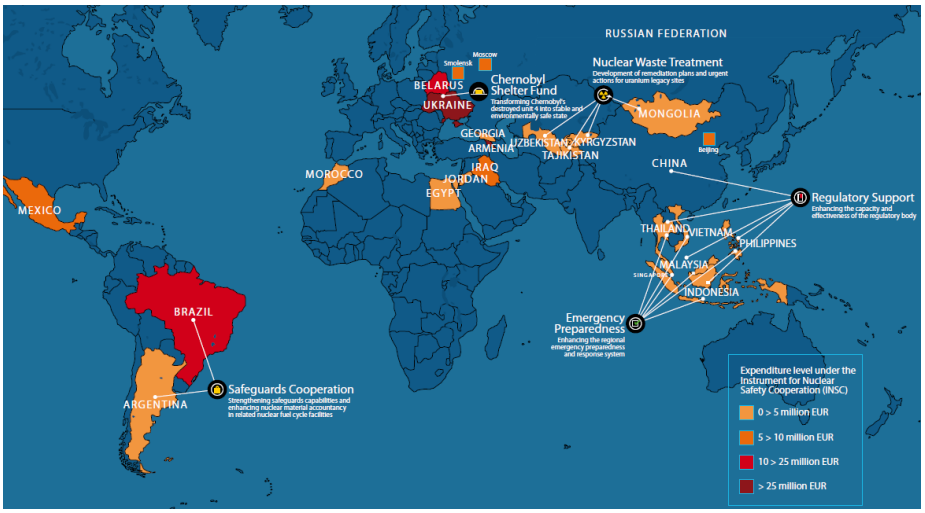
Also described in Section 2-6-2.

2-6-4. Regional and International Cooperation on EP&R

Thailand has cooperated with international agencies as follows:

- IAEA under the Convention on Assistance in the Event of Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.
- Cooperation with the European Union: To establish a nuclide station in Nakorn Pathom Province under the Instrument for Nuclear Safety Cooperation (INSC).

Figure 2-6-5. INSC Expenditure (2007–2013)



INSC = Instrument for Nuclear Safety Cooperation.

Source:

http://ec.europa.eu/europeaid/sites/devco/files/Information%20brochure_INSC_Building%20Nuclear%20Safety%20Together_20140115_en.pdf

2-7. Viet Nam

2-7-1. Nuclear development policy

2-7-1.1 Nuclear energy policy

- On 3 January 2006, the Prime Minister approved the Strategy on the Peaceful Use of Atomic Energy up to 2020, in Decision No. 01/2006/QD-TTg.

- On 23 July 2007, the Prime Minister approved the Master Plan for the Implementation of the Long-term Strategy on the Peaceful Use of Atomic Energy up to 2020, covering all activities related to the development of nuclear infrastructure and capabilities for future self-reliance on NPP technology.

- On 17 June 2010, the Prime Minister approved the Orientation Planning for Viet Nam NPP development up to 2030, in Decision No. 906/QD-TTg.

- On 18 March 2010, the Prime Minister approved the Master Plan for the implementation of the Ninh Thuan NPP, in Decision No. 460/TTg-KTN.

- On 24 July 2010, the Prime Minister approved Decision No. 957/QD-TTg on the Strategy and Master Plan identifying the priorities for development of nuclear energy applications in the coming years, including Nuclear Power Focusing on the construction of the first and second units, coming on stream by 2020 and in the following years.

In Viet Nam, major electricity power sources are currently coal-fired thermal, gas-fired thermal, and hydropower sources. New and renewable energy sources such as wind, solar, tidal, and geothermal, given their production costs and scattered locations, can only provide relatively small sources of energy and, hence, make only a minor contribution to the overall energy balance. Viet Nam's natural energy resources are diverse but not abundant. Therefore, exploitation and efficient use of natural energy resources, as well as their protection and preservation for future generations,

constitute one important orientation of national energy policy in the foreseeable future.

According to forecasts, electricity demand for production under the base-case scenario (with an assumed annual GDP growth rate of 7.1–7.2 percent in the period 2001–2020) will be 201 billion kWh by 2020 and 327 billion kWh by 2030. Meanwhile, domestic energy sources can supply only 165 billion kWh by 2020 and 208 billion kWh by 2030 at most. In other words, according to the base-case scenario, Viet Nam will have an energy supply deficit of 36 billion kWh by 2020 and nearly 119 billion kWh by 2030. The increasing shortage of electricity supply is only likely to continue to worsen in subsequent periods under this scenario.

To achieve a stable balance in energy demand and supply, one power supply scheme proposed by the Ministry of Industry and Trade (MOIT) in its strategy for the development of Viet Nam's power industry in 2004–2010 and its orientation towards 2020 is the construction and commissioning of NPPs. With advantages as such high technology, safety, stability, low costs, and small volumes of fuel reserves, less environmental pollution, and competitive pricing compared with other types of thermal power, nuclear power is a feasible option for achieving power demand–supply balance in Viet Nam by 2020. Accordingly, Viet Nam's first NPP will be built with a capacity of 4,000 MW, representing 5 to 6 percent of total national power generation capacity, with the level of nuclear power generation increasing to about 10 percent or more of total power generation by 2030 or after.

National policy in nuclear energy is based on the basic plan for energy formulated by the government and the framework for nuclear energy determined by the Law of Atomic Energy 2008. In November 2009, the National Assembly issued Resolution No. 41/2009/QH12, according to which the first nuclear power project in Viet Nam will be built in Ninh Thuan Province, with Vietnam Electricity (EVN) nominated as the project investment owner. This project will include four NPPs with a total capacity of 4000 MW, with the two first NPPs of 1,000 MW each becoming operational in early 2020.

2-7-1.2 Nuclear power development plan

According Viet Nam's power sources development programme in the orientation period of 2011–2020 and after, namely Master Plan No. 7 (Decision No. 1208 dated 21 July 2011), the current grid capacity of Viet Nam is about 22,000 MW, with estimates of demand for 75,000 MW by 2020, rising to 146,800 MW by 2030. By 2030, nuclear power will account for 10.1 percent of total power generation (70 billion KWh), whereas the total capacity of NPPs will be about 10.700 MW/146,800 MW total.

Table 2-7-1. Orientation Plan to Build NPPs in Viet Nam

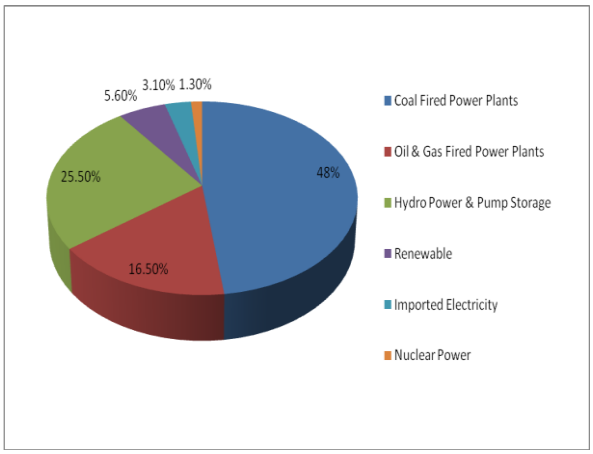
Nuclear power project	Commissioning time (year)
Ninh Thuan 1, # 1, 1,000 MW	2020++
Ninh Thuan 2, # 1, 1,000 MW	2020++
Ninh Thuan 1, # 2, 1,000 MW	2021++
Ninh Thuan 2, # 2, 1,000 MW	2021++
NPP 3, # 1, 1,000 MW	2022
NPP 3, # 2, 1,000 MW	2023
NPP 4, # 1, 1,000 MW	2026
NPP 4, # 2, 1,000 MW	2027
NPP central 1 ,# 1, 1,350 MW	2028
NPP central 1 ,# 2, 1,350 MW	2030

NPP = nuclear power plant.

Source: Provided by Working Group member.

The following diagram shows the power sources development programme up to 2020, with its orientation up to 2030, namely Master Plan No. 7, with Viet Nam's energy demand up to 2020 at a total capacity of about 75,000 MW.

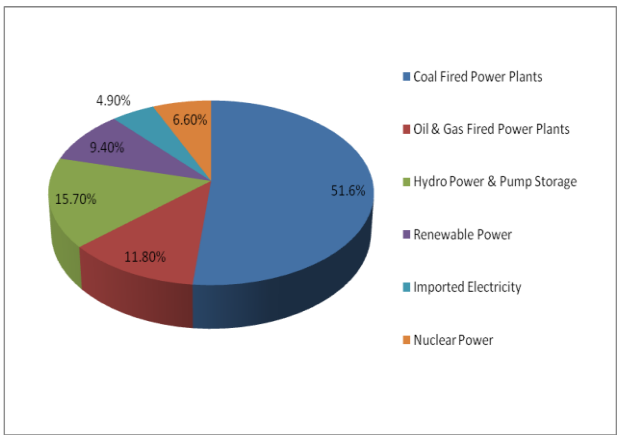
Figure 2-7-1. Power Sources Development Programme in Viet Nam up to 2020



Source: Provided by Working Group member.

The following diagram shows the power sources development programme up to 2020, with its orientation up to 2030, namely Master Plan No.7, with Viet Nam's energy demand up to 2030, at a total capacity of about 146,8000 MW.

Figure 2-7-2. Power Sources Development Programme in Viet Nam up to 2030

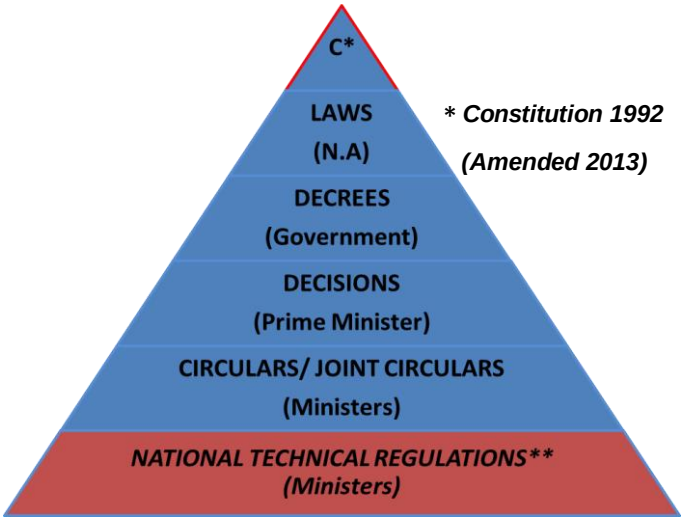


Source: Provided by Working Group member.

2-7-2. Safety Regulatory System

2-7-2.1 Legal system

Figure 2-7-3. Regulatory Hierarchy System in Viet Nam



Source: Provided by Working Group member.

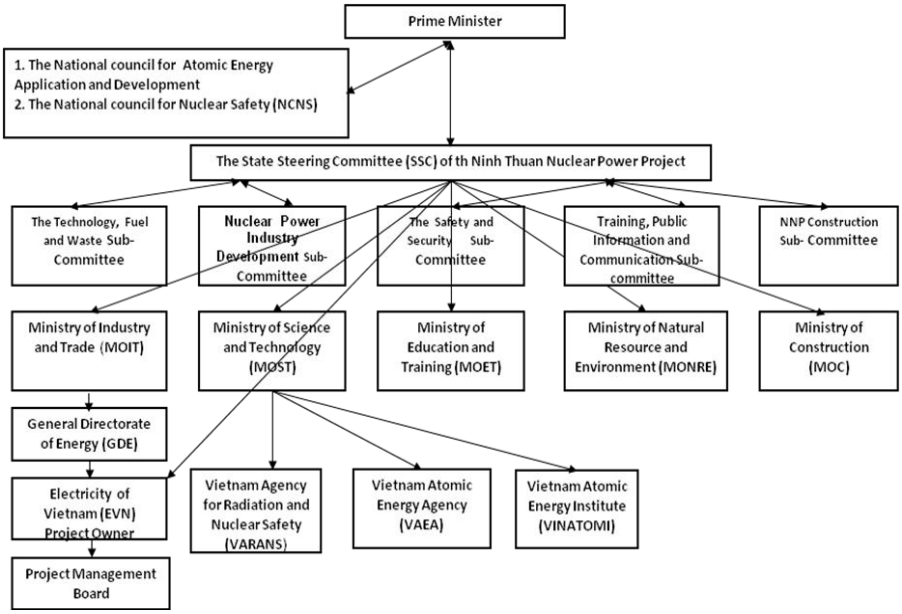
Law on Atomic Energy: This law stipulates activities in the field of atomic energy and the assurance of safety and security for those activities (No. 18/2008-QH12).

Government Decree: No. 70/2010/ND-CP dated on 22 June 2010 by the government on detailing and guiding a number of articles of the Law on Atomic Energy regarding NPPs. This decree guides the provisions of the Law on Atomic Energy regarding investment in, and the selection of, locations, designing, building, installation, operation, and termination of operation of NPPs, and the assurance of safety and security in these activities, including conditions applying to organisations and individuals that invest in building NPPs.

The 2008 Law on Atomic Energy will be revised and promulgated as soon as possible (2015–2016) to ensure an effectively independent regulatory body; a clear delineation of responsibilities of the authorities involved in the nuclear power programme; and adequate provisions on emergency preparedness and response, radioactive waste and spent-fuel management, decommissioning, nuclear security, safeguards, and civil liability for nuclear damage. At present, the Vietnam Agency for Radiation and Nuclear Safety (VARANS) is chairing the project for the amendment of the Law on Atomic Energy.

2-7-2.2 Organisations Related to the nuclear power development programme

Figure 2-7-4. Organisations Related to Nuclear Power Programme



Source: Provided by Working Group member.

The responsibility of the State Steering Committee (SSC) is not only limited to the Ninh Thuan Nuclear Power Project. The outcomes of the SSC are distributed to all participating organisations as government orders requiring necessary action to be taken. The SSC of the Ninh Thuan Nuclear Power Project was established according to the Decision No. 580/QD-TTG of the Prime Minister on 4 May 2010 and the SSC is chaired by the Deputy Prime Minister of Viet Nam.

Five technical subcommittees under the SSC have been established. The formulation of two subcommittees was established in the first quarter of 2013, and the remaining three by the end of 2013 and 2014. The subcommittees comprise the following: Nuclear Safety and Security chaired by the Ministry of Science and Technology (MOST); NPP Technology, Nuclear Fuel, and Radioactive Waste chaired by MOIT; Construction chaired by the Ministry of Construction; Nuclear Power Industry Development chaired by MOIT; and Training, Public Information, and Communication chaired by MOST.

The Permanent Office of the SSC was established and staffed (six staff) under

MOIT in 2011. The main responsibilities are to provide advice and assistance for the SSC, to coordinate the work between SSC members and the relevant ministries, agencies and local authorities, and to assist the SSC in supervising and monitoring the implementation of the project.

According to the Atomic Energy Law (Article 9) and Prime Minister Decision No. 446/QD-TTg issued in April 2010, the National Council for Nuclear Safety (NCNS) was established as the consultancy body for the Prime Minister on nuclear safety. VARANS is the standing organisation of the NCNS and is responsible for preparing the working programme of the NCNS, including all conditions for the operation of the NCNS. The President of the NCNS is the minister of MOST, the vice-presidents of the NCNS are deputy ministers of MOST and MOIT, and the committees comprise deputy ministers of Security, Defence, the Ministry of Natural Resources and Environment (MONRE), Medical, the General Director of VARANS, and some experts on nuclear safety.

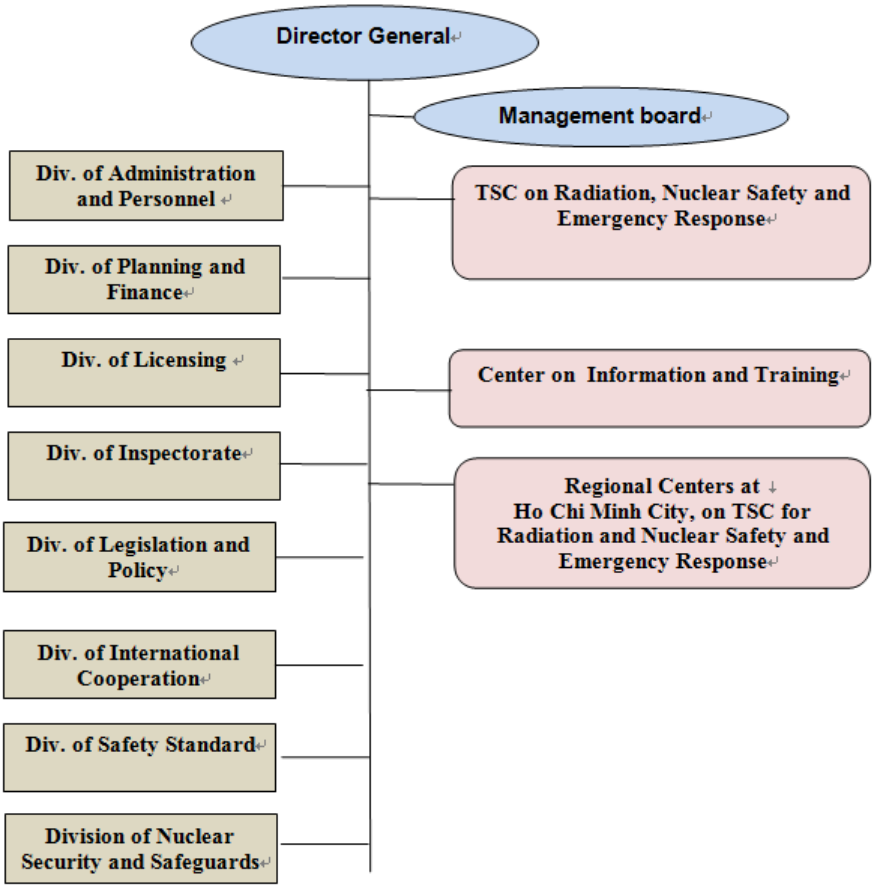
The National Council for Atomic Energy Application and Development was established as the consultancy body for the Prime Minister on Atomic Energy Application and Development for Peaceful Purposes. The MOIT issues licences for commissioning and electricity operation based on comments from the National Council for Nuclear Safety. MOST issues licences for the construction of NPPs based on comments from the NCNS. MONRE cooperates with MOST in guiding the environmental impact assessment (EIA) for NPPs and evaluating and approving the EIAs of NPPs. The EVN was designated as the owner of the Ninh Thuan NPP Projects and subsequently the EVN Nuclear Power Project Management Board (EVNNPB) was established.

2-7-2.3 Vietnam Agency for Radiation and Nuclear Safety (National Nuclear Regulatory Body)

Decision No. 217/QĐ-BKHCN, dated 18 February 2014 on issuing the regulation on the organisation and operation of VARANS, replaced the previous regulation. Under the new regulation, the duties of VARANS are more clearly and fully defined, including state management of radiation and nuclear safety; state management of the security of radioactive sources, nuclear materials, and nuclear facilities; nuclear control for preventing nuclear proliferation; and other activities supporting management activities. VARANS is responsible for enhancing and developing international cooperation activities in radiation and nuclear safety as assigned by the ministry, and participating in the execution of international treaties and other international agreements on radiation and nuclear safety.

Following as Decision No. 217/QĐ-BKHCN dated 18 February 2014, the organisational structure of VARANS includes eight divisions and three centres: the Division of Administration, the Division of Planning and Finance, the Division of Legislation and Policy, the Division of Licensing, VARANS Inspectorate, the Division of Nuclear Security and Safeguards, the Division of Safety Standards, the Division of International Cooperation, the Centre for Information and Training, the Centre for Technical Support (TSC) for Radiation and Nuclear Safety and Emergency Response, and the Centre for Technical Support for Radiation and Nuclear Safety and Emergency Response (TSO for nuclear power programme). Currently, the TSC has about 45 technical staff members working in different groups, such as safety analysis and systems; risk assessment; site evaluation and structural analysis; material and mechanical equipment; radiation safety; nuclear and radiological emergency response; and environmental radioactivity.

Figure 2-7-5. Organisational Structure of the Nuclear Regulatory Body



Source: Provided by Working Group member.

2-7-3. National EP&R framework

Viet Nam has established the framework for radiological and nuclear emergency planning (preparedness and response), which allows for the implementation of EP&R arrangements that are commensurate with the currently recognised threats.[13] However, with the implementation of its nuclear power programme, Viet Nam is also establishing a national radiological and nuclear emergency response plan to deal with the consequences of emergencies at NPPs.

[13] 25/2014/TT-BKHCN.
http://www.moj.gov.vn/vbpq/Lists/Vn%20bn%20php%20lut/View_Detail.aspx?ItemID=29193

2-8. Japan

2-8-1. Nuclear Development Policy

The Fourth Strategic Energy Plan, formulated in April 2014, states the following with regard to nuclear energy: 'The energy output per amount of fuel for nuclear power is overwhelmingly large and it can continue producing power for several years only with domestic fuel stockpile. Nuclear power is an important base-load power source as a low carbon and quasi-domestic energy source, contributing to stability of energy supply–demand structure, on the major premise of ensuring of its safety, because of the perspectives on (1) superiority in stability of energy supply and efficiency; (2) low and stable operational cost; and (3) free from GHG emissions during operation.'

However, taking into account public objections against the use of nuclear power arising after the accident at Tokyo Electric Power Company's (TEPCO) Fukushima Daiichi Nuclear Power Plant, the Fourth Strategic Energy Plan also states the following:

> 'Dependency on nuclear power generation will be lowered to the extent possible by energy saving and introducing renewable energy as well as improving the efficiency of thermal power generation, etc. Under this policy, GOJ will carefully examine a volume of electricity to be secured by nuclear power generation, taking Japan's energy constraints into consideration, from the viewpoint of stable energy supply, cost reduction, global warming and maintaining nuclear technologies and human resources.'

Currently, the Subcommittee on the Long-term Energy Supply–Demand Outlook is deliberating the long-term outlook of the energy supply and demand balance, based on the policy stated in the Fourth Strategic Energy Plan. The extent of nuclear power generation as of 2030 is to be recommended by the subcommittee. After the subcommittee reaches its conclusion, the government will consider policies necessary for achieving an energy supply and demand balance.

2-8-2. Safety Regulatory System

In the past, the Nuclear and Industrial Safety Agency was responsible for 'Regulation' of nuclear safety under the Ministry of Economy, Trade and Industry (METI), which itself was responsible for nuclear power 'Utilisation'. To ensure the transparent separation of these two sectors, nuclear safety regulation was decoupled from the METI, and a new Nuclear Regulation Authority (NRA) was established in September 2012. The NRA is an external organisation of the Ministry of the Environment, with a high degree of independence and is classed as an 'Article 3 Authority.'[14]

The roles and responsibilities of nuclear safety and security regulations for nuclear facilities and radioactive materials, which were shared among several governmental organisations (i.e. the Nuclear and Industrial Safety Agency; the Nuclear Safety Commission; the Ministry of Education, Culture, Sports, Science and Technology), all now come under the auspices of the NRA. The role and responsibility of nuclear non-proliferation safeguards,[15] which had been the responsibility of the Ministry of Education, Culture, Sports, Science and Technology, have also been integrated into the NRA.

The NRA disseminates nuclear regulations and other activities (e.g. materials, summary reports, and minutes of NRA's meetings including meetings with the licensees) by several proactive and prompt channels, including the NRA website. Excluded for security reasons is information on nuclear security and related issues. NRA meetings are generally open to the public.

Taking into account the lessons learned from the TEPCO Fukushima Daiichi Nuclear Power Station accident, and current state-of-the-art science and technology knowledge, the NRA has been enhancing nuclear regulations in the following areas:

[14] "Article 3 Authority" is a council system organisation based on Article 3, Clause 2 of the National Government Organisation Act, ensuring its independence without any control or supervision by other organisations (i.e. ministers of other governmental organisations).
[15] Safeguards are a verification activity to ensure that nuclear materials are used for peaceful purposes and are not diverted for such purposes as the production of nuclear weapons.

a) Development of countermeasures against severe accidents.

It is required to develop preventive measures against the abnormal release of radioactive materials into the environment following a serious accident.

b) Preventive measures will be included in licensees' Operational Safety Programmes.

Introduction of back-fit systems. All nuclear reactor facilities will meet all new regulatory requirements.

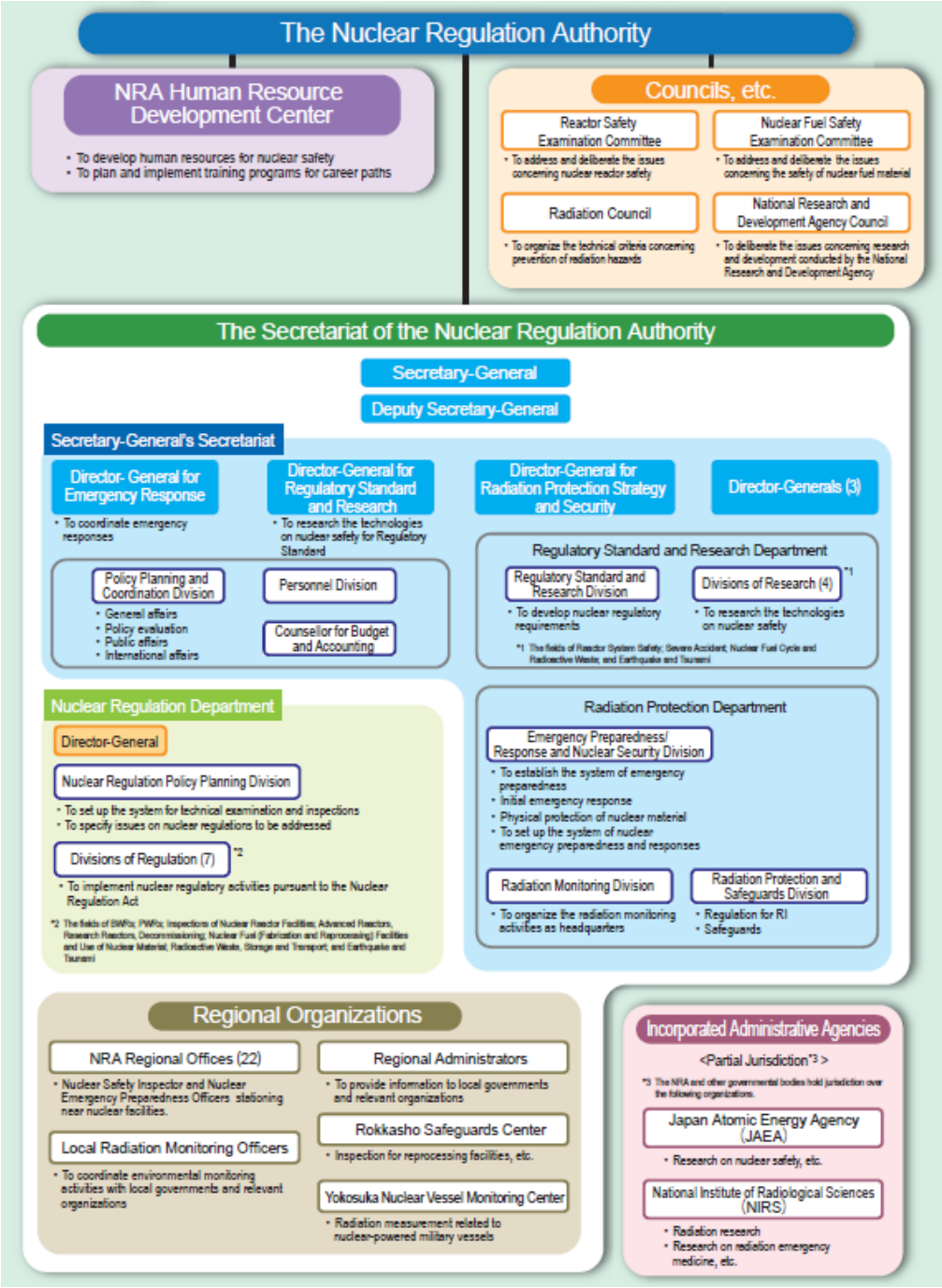
c) Introduction of a 40-year operational time limit[16] for nuclear reactor facilities.

This 40-year operational time period will begin on the day operations start.

The following is the organisational chart of the NRA.

[16] The operation of a nuclear reactor for more than 40 years will be permitted by the NRA only in cases where the nuclear reactor and its related facilities meet the regulatory requirements governing the state of degradation.

Figure 2-8-1. The Nuclear Regulatory System



Source: http://www.nsr.go.jp/english/e_nra/nsr_leaflet_English.pdf

2-8-3. National Emergency Preparedness and Response Framework

In light of the lessons learnt from the accident at TEPCO's Fukushima Daiichi Nuclear Power Plant, the Act on Special Measures concerning Nuclear Emergency Preparedness was revised in September 2012. This Act mainly determines the following issues.

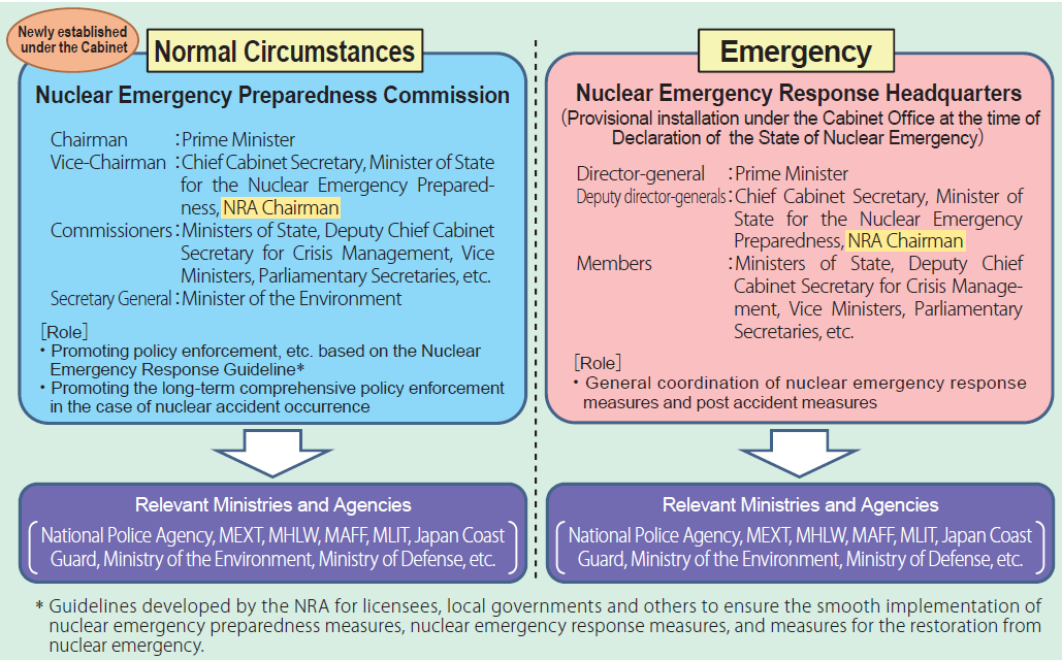
- The State will take all possible measures to prevent nuclear disasters, anticipating large-scale natural disasters and terrorism.
- The NRA will formulate the Nuclear Emergency Response Guidelines.
- A nuclear operator will report the results of nuclear emergency response drills to the NRA and the NRA can order the operator to improve the methods of nuclear emergency response drills and to take other necessary measures if the results of nuclear emergency response drills are found to be insufficient to prevent the occurrence of a nuclear disaster.

Based on this Act, the Nuclear Emergency Preparedness Commission was established permanently under the Cabinet Office. It was decided that the Nuclear Emergency Response Headquarters would be installed under the Cabinet Office in case of a nuclear emergency.

In October 2013, an integrated nuclear emergency response drill was carried out at Sendai Nuclear Power Plant for the first time after the accident at TEPCO's Fukushima Daiichi Nuclear Power Plant. Around 3,300 people from about 130 organisations participated in the drill for two days. Through the drill, the nuclear emergency response measures established by the Nuclear Emergency Response Guidelines, such as the evacuation procedure and the radiation exposure medical care system, were tested and confirmed.

The relevant organisations, such as the Cabinet Office, the NRA, and nuclear operators, continue to strengthen their EP&R systems.

Figure 2-8-2. National Emergency Preparedness and Responses Framework



Source: NRA website, http://www.nsr.go.jp/english/e_nra/nsr_leaflet_English.pdf

Figure 2-8-3. The Integrated Nuclear Emergency Response Drill Conducted at Sendai NPP

Source: Kyusyu Electric company website,

http://www.kyuden.co.jp/library/pdf/nuclear/sendai/sendai_news_27.pdf

2-8-4. Regional and International Cooperation on EP&R

The Topical Group on Emergency Preparedness and Response (EPRTG), which is installed under Asian Nuclear Safety Network (ANSN), performs activities under the IAEA to strengthen emergency preparedness and response systems in Asian countries. Since the EPRTG started its activities in 2005, the Nuclear Emergency Assistance and Training Center, which was established by the Japan Atomic Energy Agency (JAEA), has been sending coordinators to the EPRTG.

In October 2013, the Regional Workshop on Observing a Nuclear Emergency Response Exercise of a Local Government, which was part of a capacity-building initiative in Asian countries organised by the ANSN and the IAEA, was hosted by the Japan Atomic Energy Agency (JAEA) and the Japan Nuclear Energy Safety Organisation. The objective of the workshop was to observe a nuclear emergency exercise, and to share observations, experience, and knowledge, so that they could be used to improve EP&R plans in IAEA member countries. Twenty-seven participants from eight ANSN member countries, as well as an expert from Canada and IAEA representatives, participated in the workshop. Through these activities, Japan is enthusiastically contributing to the strengthening of EP&R systems in Asian countries.

Figure 2-8-4. The Regional Workshop on Observing a Nuclear Emergency Response Exercise of a Local Government, October 2013

Source: ANSN website,
https://ansn.iaea.org/Common/report/ANSN%20Progress%20Report%202013.pdf

2-8-5. Implications for Regional Cooperation on Radiological Emergency in Asia

Reports suggest that inadequate communication between the relevant organisations, such as the government, the Nuclear and Industrial Safety Agency (at that time), and the operator, led to some of the confusion in the emergency response in the accident at TEPCO's Fukushima Daiichi Nuclear Power Plant. In light of such lessons, Japan has been taking the necessary measures, such as a revision of the Acts relevant to nuclear EP&R, the implementation of nuclear emergency response guidelines, etc.

In the case of a nuclear emergency in an Asian country, information sharing between neighbouring countries will be crucial in mitigating the impacts of a serious nuclear accident. Therefore, Japan's experience of the Fukushima nuclear accident and the measures taken in light of the lessons learnt from that accident are valuable in strengthening emergency preparedness and response systems across Asian countries.

Chapter 3

Regional Collaborative Activities in European Countries

3-1. Switzerland

In Switzerland, the National Emergency Operations Centre (NEOC) is the competent federal authority for exceptional incidents. The duties of NEOC include constantly observing and assessing the situation. If an event results in an increase in radioactivity, if there are biological, chemical, or natural events or technical incidents (satellite crash, breakdown of infrastructure, etc.), NEOC will inform its partner organisations, portraying the overall situation and acting as a coordinator. In the wake of events leading to an increase in radioactivity, NEOC can in urgent cases prescribe measures to protect the population. In certain types of occurrence, such as major chemical incidents, the breaking and spilling over of dams, or if there is a danger of a satellite crashing, NEOC assumes further situation-specific tasks. Furthermore, the Federal Council may assign additional tasks to the centre at any time.

The Swiss Federal Nuclear Safety Inspectorate (ENSI) is the national regulatory body responsible for the nuclear safety and security of Swiss nuclear facilities. ENSI supervises all Swiss nuclear facilities, namely nuclear power stations, the interim storage facility for radioactive waste, the nuclear research facilities at the Paul Scherrer Institute (s) in Villigen, the Ecole Polytechnique Fédérale in Lausanne, and the University of Basel. Its regulatory remit covers the entire life of a facility, from initial planning, through operation to final decommissioning, including the disposal of radioactive waste. Its remit also includes the safety of staff and the public, and their protection from radiation, sabotage, and terrorism.

On 1 June 2011, the operators of Swiss nuclear power plants (NPPs) established a common external storage for emergency equipment at a former munitions depot of the Swiss Army at Reitnau in Aargau. ENSI ordered operators to set up the store following the Fukushima accident. This accident has shown that NPPs need speedy access to additional pumps, emergency generators, tubing, fuel, and other equipment following a serious external event. As a result, ENSI also insisted that the emergency equipment should be

transportable by helicopter. The equipment at Reitnau is, therefore, transportable by air and can be flown quickly to any required location in a Swiss Army Super Puma. The equipment will be used if the emergency diesel supply at an NPP failed, or if water from nearby rivers cannot be used for emergency cooling. The storage is situated at an altitude that is secure from flooding and is located in bunkered buildings. The operators of all NPPs in Switzerland have access to the storage facility.

Figure 3-1-1. A Cable Module Set in the External Storage Centre for Emergency Equipment

Source: Provided by Working Group member.

On 11 February 2015, ENSI welcomed the international experts of a working group of the Heads of European Radiological Protection Competent Authorities (HERCA). For a number of years now, this working group has focused on harmonising emergency preparedness in Europe. A new Euratom directive (Directive 2013/59/Euratom) came into force in the European Union at the start of February 2014. This directive stipulates safety standards to regulate protection against ionising radiation. The HERCA Action Plan requires measures to be implemented in various areas, including emergency preparedness. The member countries have until February 2018 to implement this directive. It is also envisaged that Switzerland will implement the directive. At the meeting in Brugg, the experts developed a shared understanding of the directive's concepts and requirements. Work was also undertaken on guidelines for bilateral agreements.

Figure 3-1-2. International Meeting at ENSI on Harmonisation of Emergency Preparedness in Europe

Source: Swiss Federal Nuclear Safety Inspectorate ENSI website, http://www.ensi.ch/en/2015/02/11/international-meeting-at-ensi-on-harmonisation-of-emergency-preparedness-in-europe/

3-2. European Union

3-2-1. European Community Urgent Radiological Information Exchange (ECURIE)[17]

The European Community Urgent Radiological Information Exchange (ECURIE) system is the technical implementation of Council Decision No. 87/600/Euratom on European Union (EU) arrangements for the early notification and exchange of information in the event of a radiological or nuclear emergency. This decision requires all member countries to promptly notify the European Commission (EC) and all member countries potentially affected when a member state intends to take countermeasures to protect its population against the effects of a radiological or nuclear accident. The EC will immediately forward this notification to all member countries. Following this first notification, all member countries are required to inform the EC at appropriate intervals about the measures being taken and the radioactivity levels that have been measured. All 28 EU member countries, as well as Switzerland, have signed the ECURIE agreement.

The ECURIE system consists of three major components:

1. The Convention Information Structure (CIS), which describes in detail what type of information may be sent, as well as the format in which it has to be sent;

[17] https://rem.jrc.ec.europa.eu/RemWeb/activities/Ecurie.aspx
http://cordis.europa.eu/result/rcn/156479_en.rtf&rct=j&frm=1&q=&esrc=s&sa=U&ved=0CBQQFjAAahUKEwiKurj-0eHGAhXjGaYKHW-LBSU&usg=AFQjCNFT2hKQ16mwCM0mwLHFjUI6V4Y3zw

2. Dedicated ECURIE web systems to create, send, and receive notifications through different channels, i.e. phone calls, SMS, fax, web services using the International Radiological Information Exchange (IRIX) format; and
3. A network of contact points and competent authorities officially nominated by each member state and by the EC to operate the ECURIE system.

ECURIE contains several research projects. 'EURANOS,' European Approach to Nuclear and Radiological Emergency Management and Rehabilitation Strategies, is an example of one current project. Major meetings and workshops were held from 2002 to 2006 on such workflows as:

- Collate information on the likely effectiveness and consequences of a wide range of countermeasures.
- Provide guidance to emergency management organisations and decision-makers on the establishment of an appropriate response strategy.
- Further enhance advanced decision support systems through feedback from their operational use.
- Create regional initiatives leading to information exchange based on state-of-the-art information technologies.
- Develop guidance to assist member countries in developing a framework for the sustainable rehabilitation of living conditions in contaminated areas.
- Maintain and enhance knowledge and competence through emergency exercises, training and education, thus fostering best practice in emergency response.

Two generic handbooks*, Management of contaminated food production systems* (Version 2) and *Management of contaminated inhabited areas* (Version 2), are the major outputs of this project. The first handbook is to assist in the management of contaminated food production systems, whereas the second handbook is to assist in the management of contaminated inhabited areas in Europe following a radiological emergency. Both handbooks have been developed in conjunction with stakeholder panels from around Europe and both provide guidance on customisation at the national/local level, as well as on how to develop processes for engaging stakeholders in the further development and application of the handbooks. The handbooks were translated into Japanese by an expert group in the Atomic Energy Society of Japan in 2011 to provide useful and accurate information to the public.

3-2-2. European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery (NERIS)[18]

The mission of the NERIS, 'European Platform on preparedness for nuclear and radiological emergency response and recovery', is to establish a forum for dialogue and methodological development between all European organisations and associations taking part in decision-making of protective actions in nuclear and radiological emergencies and recovery in Europe. NERIS-TP and PREPARE are the major projects in the framework of NERIS.

The project NERIS-TP (Technology Platform) aims on the one hand to keep the momentum gained through the European Project EURANOS in establishing a platform where the operational and research community can meet to discuss with all relevant stakeholders the topics related to emergency response and recovery preparedness. On the other hand, it aims to tackle urgent research topics in the area of nuclear emergency response and recovery preparedness. Through a collaboration of industry, research, and governmental organisations in Europe, methodological aspects and computational models will be developed to be consistent with recent recommendations from international bodies such as the International Commission of Radiation Protection (ICRP) and improve Europe's response by coupling decision support systems with an emergency information system, such as the European-wide information system, ECURIE. Within this project, a platform will be established that will be a unique place for combined meeting of the research and the operational community.

The project PREPARE intends to review existing operational procedures in dealing with long-lasting releases, address the cross-border problematic in monitoring and safety of goods, and will further develop still missing functionalities in the decision-support system ranging from improved source term estimation and dispersion modelling to the inclusion of hydrological pathways for European water bodies. As the management of the Fukushima accident was viewed in Europe as being far from optimal, it is proposed to develop the means on a scientific and operational basis to improve information collection, information exchange, and the evaluation for such types of accidents. This will be

[18] http://www.eu-neris.net/.

achieved through a collaboration of industry, research, and governmental organisations in Europe taking into account the networking activities carried out under the NERIS-TP project. Furthermore, the NERIS Platform member organisations (so far 43 partners) will be actively involved in the development.

3-3. Nordic Countries

3-3-1. History and Outline of Activities

The five Nordic countries (Denmark, Iceland, Finland, Norway, and Sweden) have a long tradition of cooperation, owing to their geographic proximity and facilitated by similar economic, cultural, and societal structures. A Nordic mutual assistance agreement for radiation accidents has existed since 1963, and all Nordic countries are parties to the International Atomic Energy Agency (IAEA) Convention on early notification in case of a nuclear accident, signed in 1986.

There have been three major cornerstones of cooperation in Nordic countries. First, in 1993, chiefs of the Nordic radiation protection and nuclear safety authorities established a working group, the Nordic working group on Emergency Preparedness (NEP) for cooperation, coordination, exchange of information, and assistance in the field of emergency planning and response. A work plan is made for a two-year period and approved by the chiefs meeting.

Emergency contact information details are kept continuously updated by NEP members. Even temporary short-term changes are communicated. The members of the NEP consist of representatives from all Nordic radiation protection and nuclear safety authorities that are centrally involved during relevant incidents or emergencies. Each authority nominates its representative(s). The participating authorities are:

- Denmark: Danish Emergency Management Agency (DEMA)
- National Institute of Radiation Hygiene (SIS)
- Finland: Radiation and Nuclear Safety Authority (STUK)
- Iceland: Icelandic Radiation Protection Institute (GR)
- Norway: Norwegian Radiation Protection Authority (NRPA)
- Sweden: Swedish Radiation Safety Authority (SSM)

In 2006, 'The Nordic Manual'[19] was established. The document describes practical arrangements and cooperation to fulfil obligations stated in bilateral agreements between the Nordic states. It also considers the international definition of nuclear and radiological incidents and emergencies, as well as other important international aspects for preparedness and response in the Nordic states.

Furthermore, in 2014, 'The Nordic Flag Book'[20] was published by the Nordic radiation protection and nuclear safety authorities for proactive measures in early and intermediate phases of a nuclear or radiological emergency. The document is intended as generic guidelines covering all types of scenarios and is therefore relevant for both accidents and intentional acts. The Nordic guidelines and recommendations are based on the Finnish guides for radiological emergency situations (STUK, VAL-guides), and further developed through close Nordic cooperation. The VAL-guides implement the new ICRP approach and, in addition, the recommendations are in line with international guidelines and draft available at that time.

3-3-2. Findings and Implications

Through a research trip to Nordic countries and interviews with staff of the nuclear safety authorities during the trip, the following findings were identified:

- Mutual reliance is the top crucial success factor for regionally collaborating in case of an emergency.
- Similar languages and cultures can be one of the keys.
- Each country has an EP&R system of its own and these systems are all different.

`The major implications that could be learned in Asia from the challenges faced by Nordic countries with regard to regional cooperation in case of emergency include:

- Operational intervention levels should be determined considering the reference levels in each country.
- Common 'triggers' should be shared in advance.

Common database, information platform, joint research or/and training programme are strongly recommended for Asian countries.

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[19] The manual is titled *Co-operation, Exchange of Information and Assistance between Nordic Authorities in Nuclear or Radiological Incidents and Emergencies*, and it is available here: http://www.stuk.fi/sateilyvaara/fi_FI/index/_files/81806227499122865/default/nordicmanual_rev1_29102008.pdf

[20] The book is titled 'Nordic guidelines for nuclear and radiological emergencies' and it is available here: http://www.stralsakerhetsmyndigheten.se/Global/Pressmeddelanden/2014/Nordic%20Flagbook%20February%202014.pdf

Chapter 4

Building an 'East Asian Manual' and the Way Forward

As noted in the previous section, Nordic countries developed practical guidelines in the form of the 'Nordic Manual' to exchange information and cooperate in cases of nuclear emergencies. These cooperation activities and the improvement of the manual are continuing successfully.

Of course, it is easy to find consensus on the importance of cooperation on emergency preparedness and response (EP&R) in East Asian countries, but more difficult to gain consensus on developing mechanisms that involve many duties. To improve the effectiveness of emergency preparedness and response in East Asian countries, it is important to continue improving activities with as many members as possible. Therefore, to attract a larger number of members, the items to be described in the draft guidelines must be carefully selected.

In this section, we describe the items required in the draft guidelines based on the Nordic Manual and the proposals from working group members, and the activities required after creating the draft guidelines.

The key principles to develop the draft guidelines reported in the 2nd Working Group Meeting are as follows:

- East Asian Working Group of Emergency Preparedness should be established and it must be a permanent entity.
- In the draft guidelines, the items should be the minimum required (minimum obligation), but misinterpretations in the guidelines for a nuclear emergency should be avoided.

4-1. Draft Guidelines for an 'East Asian Manual'

Proposed items to be described in the draft guidelines in the 2nd Working Group Meeting are as follows:

1. Objectives

2. Membership

3. Operational Procedures

- Working Group
- Training
- Information tool
- Fax, Group website, E-mail, phone, Satellite-based communication system
- Language

4. Resources

5. Next Steps

The proposals from working group members in the final country reports also suggested the following for the draft guidelines:

- It is important to utilise existing communication networks/channels rather than create new ones. For example, these are regulators through the ASEAN Network of Regulatory Bodies on Atomic Energy (ASEANTOM) network, the TRM (Northeast Asian Top Regulators' Meeting on Nuclear Safety).
- In an emergency, the member (the personnel in charge of a country contact point) directly involved may be busy obtaining information. Therefore, one-way tools (e.g. fax or e-mail) are appropriate for information sharing in an emergency.
- Redundancy is important for information-sharing tools in an emergency.

The details of the provisional 'draft guidelines' are attached as follows:

Co-operation, Exchange of Information and Assistance between East Asian Countries in Nuclear or Radiological Incidents and Emergencies

(Provisional)

1. Objective

There are many nuclear facilities in the East Asia Region. Severe nuclear or radiological emergencies like the Fukushima Accident (2011) might give a direct or indirect impact on many countries. To minimize the impact, the members must improve the effectiveness of preparedness through co-operation in nuclear emergency.

2. Membership

List of Members organizing the working group for cooperation in nuclear emergency Indonesia, Malaysia, Republic of Korea, Philippines, Singapore, Thailand, Viet Nam, Japan

3. Operational Procedures

- Working Group

-Working Group members should held the annual meeting and discuss about the revision of the guidelines.

- Training

-Communication training should be held every year.

- Information tool

-Fax and E-mail are recommended as an initial notification in emergency.

- Information to be shared in emergency

-To be determined in the Working Group

- Information to be shared as a routine work

-The locations and specs of nuclear facilities in members' countries

- Language

-English shall be the official language of this activity except otherwise agreed.

4. Resources

The contribution of resources to carry out working activities is voluntary by members.

5. Next Steps

This document will be revised promptly.

4-2. Actions to Be Recommended

As described in 4-1, the initial draft guidelines will include only minimum items. To improve the effectiveness of the guidelines, the working group must conduct continuous reviews and revisions, and it is desirable that additional items and contents are discussed through training and discussion sessions. This section lists potential actions to be recommended after developing the draft guidelines. The steps to reach the regional level are as follows:

- Step 1: Draft guidelines
- Step 2: Brush up
- Step 3: Training
- Step 4: Detailed guidelines similar to the 'Nordic Guidelines and Recommendations' and establish a 'Centre of Excellence' (if needed)
- Step 5: Keep improving information exchange and effectiveness of coordinated response to an emergency if it happens.

4-2-1. Information Sharing by Regular Meetings and Workshops (Brush up)

As a result of the Fukushima accident, all members learned that a large amount of useful information should be shared in the case of a serious nuclear emergency. This information not only covers the accident itself but also basic information, such as the

location of the facilities and the technical specifications of the facilities, etc. First, the working group should collate all the information to be shared in an emergency. Then, working group members should share the basic information in a workshop and practice information sharing in the emergency.

Specifically, information that should be shared during an emergency should include the following:

(Basic Information)

- The contact point that would be active during a nuclear emergency
- The location and specifications of nuclear facilities (most of the information has already been shared in this report. However, more detailed items, for example, the inventory of fuels, should be also included).
- The supervisor of the nuclear facilities, etc.

(Information on the accident)

- International Nuclear Event Scale (INES) level
- The possibility of radioactive material release
- Wind direction
- Necessity for evacuation
- Intake restrictions, etc.

4-2-2. Training

There are two approaches to training. The first is training conducted on the Internet by each member in his own country (web training), whereas the second is joint training. Although web training is more realistic, in order to improve the guidelines, joint training is also recommended. For example, observing the disaster prevention training in a nuclear facility may raise particular implications for certain members and numerous issues could be discussed, such as:

- How often should the working group hold the joint training?
- How should the type of training facilities for working group members be decided upon?
- How should members select those who should participate joint training?

As described above, although remaining issues should be discussed before implementing joint training, the following proposal was provided to the 2nd Working Group as a possible joint training facility.

Daejeon (Korea) would be one of the potential cities for joint training because

- the emergency response facilities of Korea Institute of Nuclear Safety (KINS) are located in Daejeon;
- there are many national institutes in Daejeon (KAERI, Korea Advanced Institute of Science and Technology, etc.); and
- Daejeon has good accessibility, being only one hour from Seoul by KTX.

Figure 4-2-1. Map of Daejeon

Source: KAERI website, https://www.kaeri.re.kr/english/sub/sub01_08.jsp

4-2-3. Centre of Excellence

The Centre of Excellence (CoE) is expected to promptly provide additional information, such as time, location and the nature of the event, facility or activity involved,

assumed or established cause, general characteristics of radioactive release, meteorological conditions, monitoring data, protective actions, and predicted behaviour of radioactive release in the case of a radioactive emergency. The CoE should be established, if necessary, in a country that has already commercialised nuclear power, such as:

- China (Beijing)
- Korea (Seoul or Daejeon)
- Japan (Tokyo)

The factors to be considered as conditions for establishing the CoE were discussed in the Working Group meeting. First, the CoE should be equipped with abundant human resources and knowledge in nuclear engineering. Second, a certain level of industrial infrastructure, such as electricity, transportation, buildings, computers, and so on, should be prepared so that they could be used in an emergency. Third, the official language should be English.

4-3. The Way Forward

More detailed and comprehensive discussion is necessary to improve the draft guidelines on regional collaboration in the case of a nuclear emergency in East or Southeast Asian countries. These initial draft guidelines for the EP&R in Asia are proposed, and any comments or further recommendations would be welcome in order to revise, confirm, and put into practice the draft guidelines.

Appendix
List of Nuclear Facilities

A-1 Indonesia

Operator (Owner)	Facility name	Capacity	Status	Address
BATAN	Multipurpose Reactor G.A. Siwabessy	30 MWth	In operation	Bld. 30 BATAN Puspiptek Serpong, Setu, Tangerang Selatan Banten 15314
PT INUKI	Radioisotope and Radiopharmaceutical production facility	...	Not in operation	Bld. 30 BATAN Puspiptek Serpong, Setu, Tangerang Selatan Banten 15314
BATAN	TRIGA 2000 Reactor	2 MWth	Not in operation	PSTNT BATAN Bandung
BATAN	Kartini Reactor	100 kWth	In operation	PSTA BATAN Yogyakarta
PT INUKI	Fuel Element Production Installation	..	In operation	Bld. 30 BATAN Puspiptek Serpong, Setu, Tangerang Selatan Banten 15314
BATAN	•4 Gamma irradiators •2 Electron Beam Machines	• ^{60}Co, 10 – 400 kCi • 1-15 Mrad and 0.06 – 4.8 Mrad	In operation	PAIR BATAN, Pasar Jumat, Jakarta

A-2 Malaysia

Operator (Owner)	Capacity (kW, tonU/y etc)	Status	Address
Synergy Sterilisation (M) Sdn Bhd	Cobalt-60 (Co-60), Activity: 8000000 Ci	In Operation	Plot 203, Kuala Ketil Industrial Estate, Kedah
Synergy Sterilisation Rawang (M) Sdn Bhd	Cobalt-60 (Co-60), Activity: 296000 TBq	In Operation	Lot 42, Rawang Integrated Industrial Park, Rawang, Selangor
Ansell NP Sdn. Bhd.	Cobalt-60 (Co-60), Activity: 4000000 Curie	In Operation	Lot 92, Kawasan Perindustrian Air Keroh, Ayer Keroh, Melaka
Grand Ten Holdings Sdn Bhd.	Cobalt-60 (Co-60), Activity: 5000000 Curie	In Operation	Lot 5754, Jalan 2, Kawasan Perusahaan Bandar Baru Salak Tinggi, Selangor
Nuclear Malaysia (LPTA/A/724)	Cobalt-60 (Co-60), Activity: 200000 Ci	In Development	Kompleks Puspati, Bangi, Kajang, Selangor

A-3 Philippines

Table 1. List of Nuclear and Nuclear-related Facilities in the Philippines, as of January 2015

Government Agency	Facility Name	Address	Capacity (in MW)	Status	URL Link
National Power Corporation (NPC)	Bataan Nuclear Power Plant (BNPP)	Napot Point, Morong, Bataan	620	Non-operational (Mothballed)	http://www.napocor.gov.ph/index.php/bataan-nuclear-power-plant
Philippine Nuclear Research Institute (PNRI)	Philippine Research Reactor (PRR-1)	PNRI Compound, Diliman, Quezon City	1	Decommissioned (shut down in 1988)	
Philippine Nuclear Research Institute (PNRI)	Radioactive Waste Management Center	PNRI Compound, Diliman, Quezon City	550 drums; 750 drums (newly created trench)	Operational	http://www.pnri.dost.gov.ph/index.php/facilities/radiation-protection-services

A-4 Republic of Korea

Commercial Operation	Plant	Reactor Type	Capacity (MWe)	Remarks
1978. 04	Kori Unit 1	PWR	587	24 units are in Operation (21,716MWe) *1. Formally, Younggwang *2. Formally, Ulchin
1983. 04	Wolsong Unit 1	PHWR	679	
1983. 07	Kori Unit 2	PWR	650	
1985. 09	Kori Unit 3	PWR	950	
1986. 04	Kori Unit 4	PWR	950	
1986. 08	Hanbit*1 Unit 1	PWR	950	
1987. 06	Hanbit Unit 2	PWR	950	
1988. 09	Hanul*2 Unit 1	PWR	950	
1989. 09	Hanul Unit 2	PWR	950	
1995. 03	Hanbit Unit 3	PWR	1,000	
1996. 01	Hanbit Unit 4	PWR	1,000	
1997. 07	Wolsong Unit 2	PHWR	700	
1998. 07	Wolsong Unit 3	PHWR	700	
1998. 08	Hanul Unit 3	PWR (OPR 1000)	1,000	
1999. 10	Wolsong Unit 4	PHWR	700	
1999. 12	Hanul Unit 4	PWR (OPR 1000)	1,000	
2002. 05	Hanbit*[1] Unit 5	PWR (OPR 1000)	1,000	
2002. 12	Hanbit Unit 6	PWR (OPR 1000)	1,000	
2004. 07	Hanul[*2] Unit 5	PWR (OPR 1000)	1,000	
2005. 04	Hanul Unit 6	PWR (OPR 1000)	1,000	
2011. 02	Shin-Kori Unit 1	PWR (OPR 1000)	1,000	
2011.12	Shin-Kori Unit 2	PWR (OPR 1000)	1,000	
2012.03	Shin-Wolsong Unit 1	PWR (OPR 1000)	1,000	
2014.12	Shin-Wolsong Unit 2	PWR (OPR1000)	1,000	
2015.09	Shin-Kori Unit 3	PWR (APR1400)	1,400	4 units are under construction (total 5,600 MWe)
2016.09	Shin-Kori Unit 4	PWR (APR1400)	1,400	
2017.04	Shin-Hanul Unit 1	PWR (APR1400)	1,400	
2018.02	Shin-Hanul Unit 2	PWR (APR1400)	1,400	
2018.12	Shin-Kori Unit 5	PWR (APR1400)	1,400	Under Licensing Review for CP
2019.12	Shin-Kori Unit 6	PWR (APR1400)	1,400	

A-5 Singapore

N.A.

A-6 Thailand

Operator (Owner)	Facility name	Capacity	Status	Address
1. Thailand institute of Nuclear Technology (TINT)	Research Reactor-1 (TRR/M1)	2 MW	In Operation	16 Vibhavadi Rangsit 42 Ally, Lane 16 Lat Yao, Bangkok
2. TINT	Radioactive Waste Managemen t Centre	1st unit: 65 square metres, height 4.5 m, three floors 2nd unit: 80 square metres, height 4.5 m, four floors 3rd unit: 300 square metres, height 5 m, three floors 4th unit 1,050 square metres, height 5m, three floors	In Operation	9/9 Moo 7, Sai Moon, Ongkharak, Nakorn Nayok
3. TINT	Gems Irradiation		In Operation	9/9 Moo 7, Sai Moon, Ongkharak, Nakorn Nayok
4. TINT	Radioisotope Centre		In Operation	9/9 Moo 7, Sai Moon, Ongkharak, Nakorn Nayok
5. TINT	Irradiation Centre		In Operation	9/9 Moo 7, Sai Moon, Ongkharak, Nakorn Nayok
6. TINT	Gamma Irradiation Facility		In Operation	37 Moo 3 Technnothane, Klong 5, Klong Luang, Pathumthani

A-7 Viet Nam

(Orientation plan)

Nuclear power project	Commissioning time (year)
Ninh Thuan 1, # 1, 1000 MW	2020++
Ninh Thuan 2, # 1, 1000 MW	2020++
Ninh Thuan 1, # 2, 1000 MW	2021++
Ninh Thuan 2, # 2, 1000 MW	2021++

A-8 Japan

Commercial Operation	Plant	Reactor Type	Capacity (MWe)	Remarks
1989	Tomari-1	PWR	579	
1991	Tomari-2	PWR	579	
2009	Tomari-3	PWR	912	
1976	Mihama-3	PWR	826	
1974	Takahama-1	PWR	826	
1975	Takahama-2	PWR	826	
1985	Takahama-3	PWR	870	
1985	Takahama-4	PWR	870	
1979	Ohi-1	PWR	1175	
1979	Ohi-2	PWR	1175	
1991	Ohi-3	PWR	1180	
1993	Ohi-4	PWR	1180	
1977	Ikata-1	PWR	566	
1982	Ikata-2	PWR	566	
1994	Ikata-3	PWR	890	
1984	Sendai-1	PWR	890	
1985	Sendai-2	PWR	890	
1981	Genkai-2	PWR	559	
1994	Genkai-3	PWR	1180	
1997	Genkai-4	PWR	1180	
1987	Tsuruga-2	PWR	1160	43 units are in Operation (40,480MWe)
1984	Onagawa-1	BWR	524	
1995	Onagawa-2	BWR	825	
2002	Onagawa-3	BWR	825	
2005	Higashidori	BWR	1100	
1982	FukushimaDaini-1	BWR	1100	
1984	FukushimaDaini-2	BWR	1100	
1985	FukushimaDaini-3	BWR	1100	
1987	FukushimaDaini-4	BWR	1100	
1985	KashiwazakiKariwa-1	BWR	1100	
1990	KashiwazakiKariwa-2	BWR	1100	
1993	KashiwazakiKariwa-3	BWR	1100	
1994	KashiwazakiKariwa-4	BWR	1100	
1990	KashiwazakiKariwa-5	BWR	1100	
1996	KashiwazakiKariwa-6	ABWR	1356	
1997	KashiwazakiKariwa-7	ABWR	1356	
1993	Shika-1	BWR	540	
2006	Shika-2	ABWR	1206	
1987	Hamaoka-3	BWR	1100	
1993	Hamaoka-4	BWR	1137	
2005	Hamaoka-5	ABWR	1267	
1989	Shimane-2	BWR	820	
1978	TokaiDaini	BWR	1100	
-	Monju	FBR	280	4 units are under construction (total 4,421 MWe)
-	Ohma	ABWR	1383	
-	Shimane-3	ABWR	1373	
-	Tokyo-Higashidori	ABWR	1385	