

Technical Volume 1

“Description and Context of the Accident”



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International Atomic Energy Agency

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The Fukushima Daiichi Accident
Technical Volume 1

INTRODUCTION



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Writing Technical Volume 1

Key statistics

- 3 year process (2013-2015)
- 6 Working Group meetings,
- 6 additional meetings of Co-Chairs, and
- Participation of Co-Chairs and experts in consultancy meetings in Japan and at the IAEA
- Numerous hours spent by experts outside of Working Group meetings drafting sections of the report in their respective countries

Writing Technical Volume 1

A complex process

- Define the purpose and develop a plan but remain flexible
- Put together a team to coordinate the process
- Identify areas of expertise and assign specific section of the report to experts
- Ensure continuous review and feedback from external experts

A meticulous task

- Reference sources: key to credibility of information and traceability
- TV1 formed the basis for the assessment of the various aspects and causal factors of the accident
- Specific investigations of the facts are presented in subsequent TVs

Interface with other Working Groups

Interfaced with other Working Groups through strong collaboration during the drafting process by providing factual information on:

- Technical and regulatory aspects
- Human and organizational factors
- Source term (amount of radionuclides released)
- Emergency response structure and requirements
- Stabilization, remediation, recovery, decommissioning and waste management

The Content

Describes in detail the accident for addressing the causes, consequences, as well as lessons and observations

- Description of the event is based on objective and factual information, and is presented largely in a chronological manner
- Describes the Fukushima Daiichi NPP site
- The reactor designs
- Structure of the nuclear industry in Japan
- Japanese regulatory framework at the time of the accident.
- Actions taken at the Fukushima Daiichi NPP and elsewhere for accident and post-accident management up to December 2014¹

¹ In some cases information until May 2015 was included, where needed.

Highlights

- Provides an overall picture of situation before, during and after the accident
 - Includes a description of the nuclear industry in Japan and the Japanese regulatory framework at the time of accident
 - Describes the initial status at the units and the sequence of events at each unit from the plant manager's perspective
 - Addresses safety aspects such as site selection, station blackout, emergency preparedness and mitigation measures/equipment
- Compares accident consequences with other affected nuclear power plants by the earthquake and tsunami



The Fukushima Daiichi Accident
Technical Volume 1, Section 1-1

SUMMARY OF THE ACCIDENT

Summary of the Accident

- Gives the “description of event”
- Presents the main events in a chronological order to provide an overview
- Demonstrates events that occurred in parallel or affected actions at different parts of the site
- Illustrates the integrated response to a multi-unit site accident from the perspective of:
 - Emergency response centre(s) (ERCs)
 - Common main control rooms (MCRs)
 - The off-site organizations

Event Description

14:46, 11 March 2011

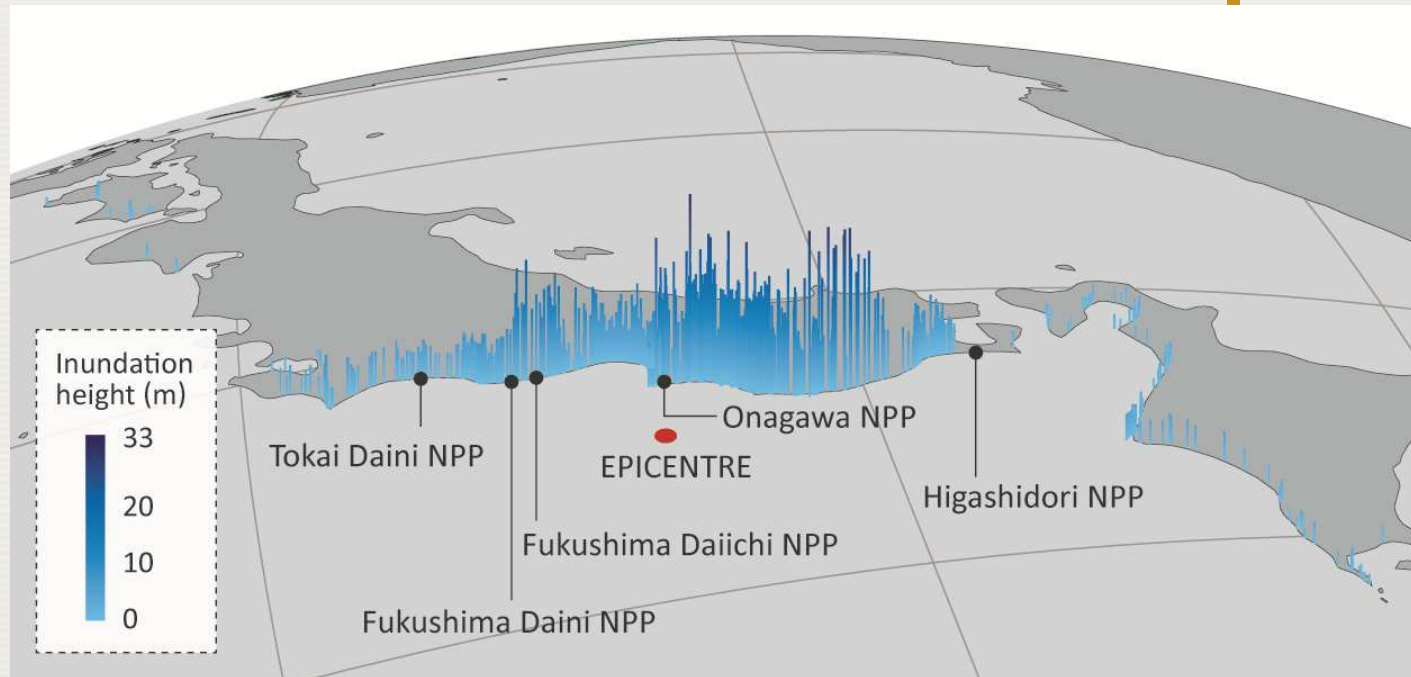
Great East Japan Earthquake

Loss of off-site power, all operating reactors automatically shut down

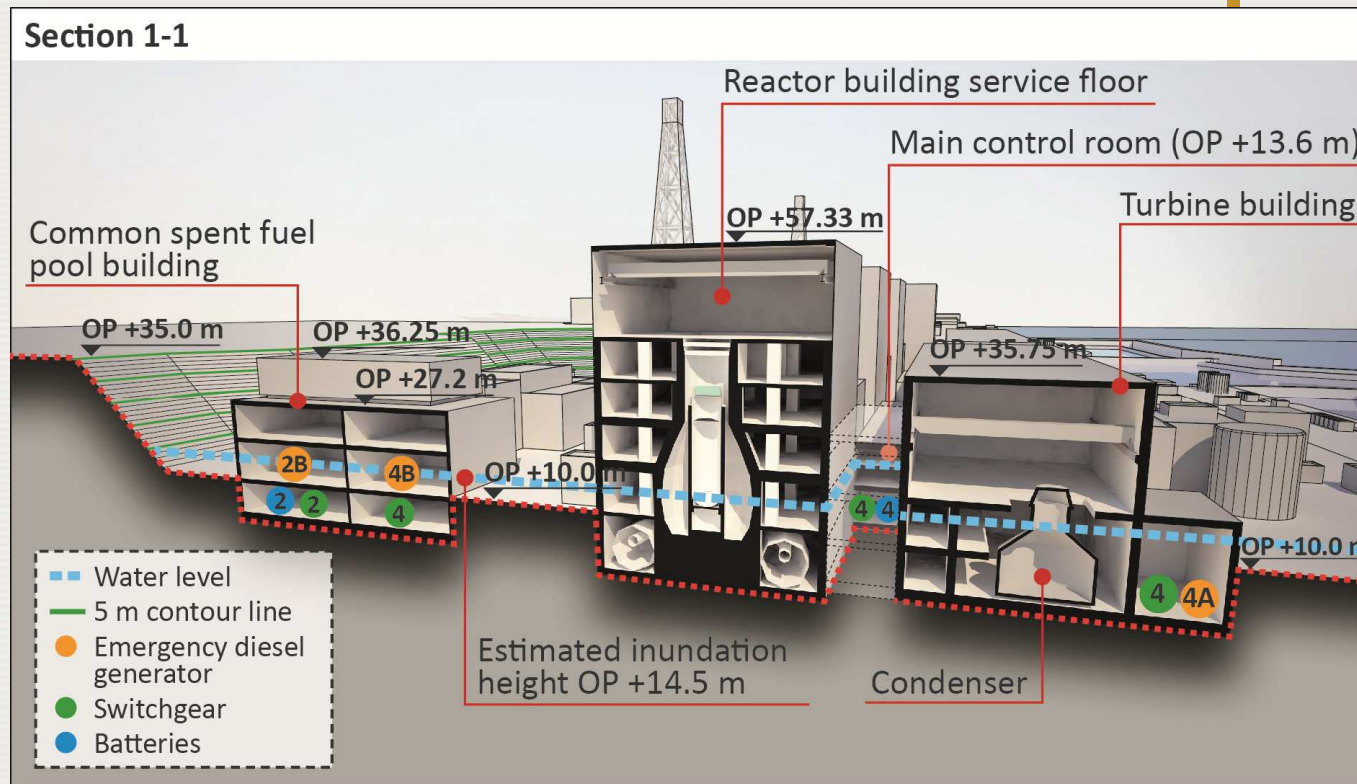


11 March, 15:27-15:37

Tsunami waves overwhelmed the tsunami barriers of Fukushima Daiichi nuclear power plant (NPP) site. Flooding primary and backup power systems and equipment, as well as the ultimate heat sink systems and structures, of all six units on the site



Compounding off-site power loss that occurred due to the earthquake damage to the transmission system. Flooding resulted in the loss of on-site power sources (and/or on-site power distribution systems)





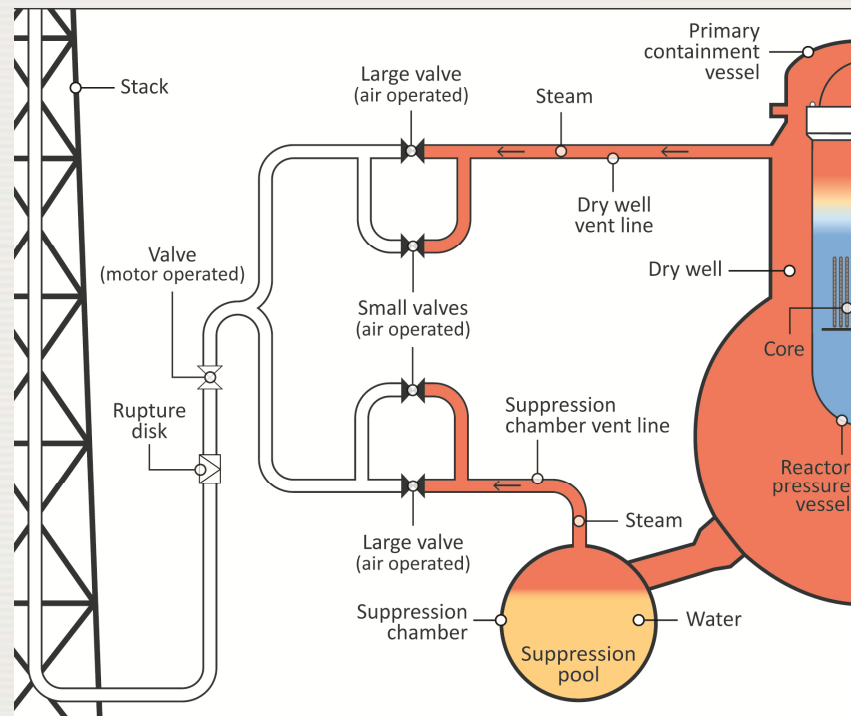
11 March, 15:42

Station blackout (SBO) occurred in Units 1-5. The units experienced extended SBO events, which exceeded 9 days in Units 1 and 2, and 14 days in Units 3 and 4

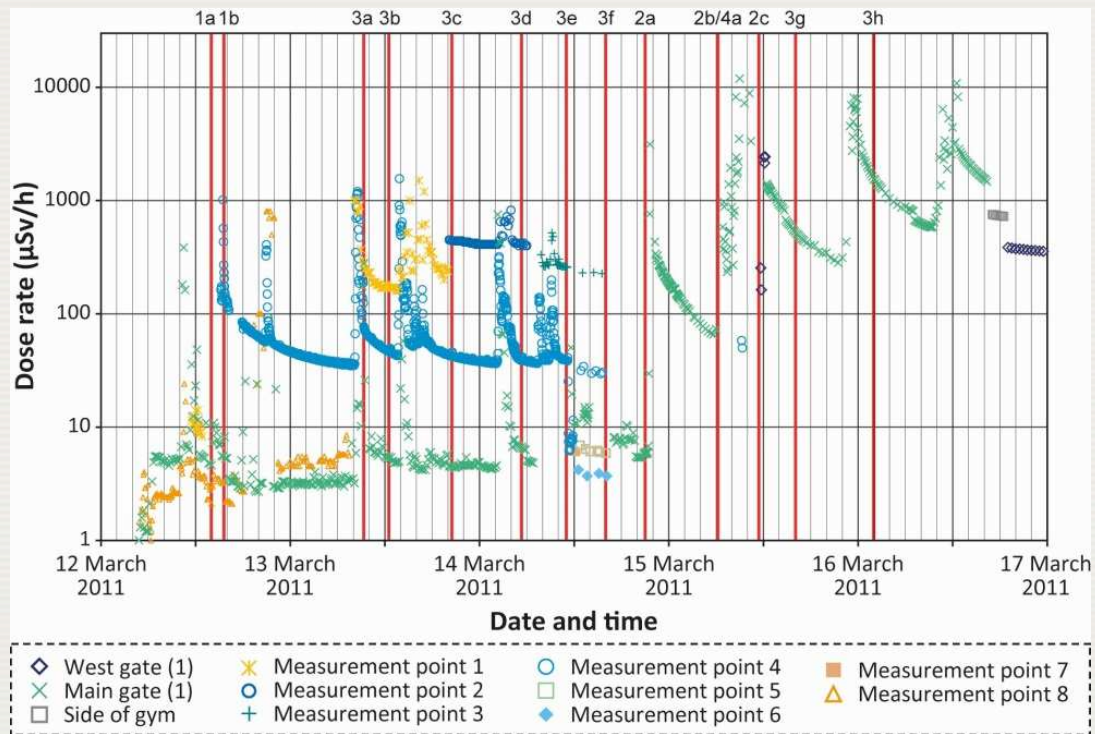
12-15 March, 2011

The nuclear units were unable to cope with the extended loss of electrical power and plant heat removal, and the reactors of Units 1, 2 and 3 suffered damage as the fuel overheated and melted. The reactor pressure vessels (RPVs) that enclose the reactor cores were eventually breached in those units, and radioactive material escaped from the reactors

The radioactive material confined in the primary containment vessels (PCVs) was further released directly to the environment either in a controlled manner, i.e. by venting of the reactors' PCVs, or in an uncontrolled manner upon damage and failure of the confinement structures



The radioactive releases resulted in radiological exposure of the workers at the site and the general public residing in the surrounding communities and caused radiological contamination of the environment in those areas





25 March 2011 - Present

In order to reduce radiation exposures, people within a radius of 20 km of the site, as well as other specified areas, were evacuated, and restrictions were placed on the distribution and consumption of food and drinking water

Although no loss of life has been attributed to the radiological releases, the accident caused social and economic impacts, especially in Japan

Following the stabilization of the conditions of the affected reactors, activities to prepare these reactors for their eventual decommissioning have also been initiated



The Fukushima Daiichi Accident
Technical Volume 1, Section 1-2

CONTEXT WITHIN WHICH THE ACCIDENT OCCURRED

Situation at the Time of the Accident

- Addresses the Japanese nuclear power program, its nuclear industry and the governmental/legal/regulatory framework in place at the time of the accident
- Describes the characteristics of the Fukushima Daiichi site, the plant systems and its six units
- Describes the plant's resources and capacity with respect to the qualifications and abilities of its staff as well as the tools available to them at the time of the accident

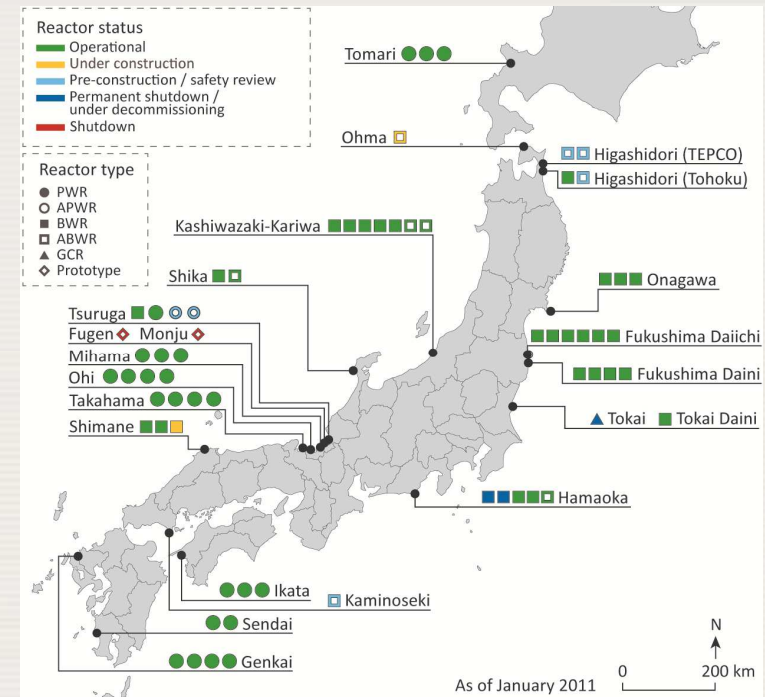
To determine technical, regulatory and human/organizational contributing causes.

- Assessment in Technical Volumes 2 and 3

Nuclear Industry in Japan

Provide relevant aspects of:

- The nuclear power policies in Japan
- Industry programmes and processes
- Safety culture
- Industrial and international cooperation at time of or before the accident



Nuclear Law and Regulation in Japan

The key aspects of the main laws and their evolution are of particular relevance to the Fukushima Daiichi accident:

- Atomic Energy Basic Act (the Basic Act)
- Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors (Reactor Regulation Act)
- Electricity Utilities Industry Law (the Electricity Business Act), and
- Act on Special Measures Concerning Nuclear Emergency Preparedness (Nuclear Emergency Act)

Legislation	Cabinet Order	Ministerial Ordinance	Ministerial Public Notice
Atomic Energy Basic Act			
Reactor Regulation Act	Cabinet Order for Reactor Regulation Act	Ministerial Ordinance for Commercial Power Reactors	Ministerial Public Notice for Dose Limit Based on Provisions of Commercial Power Reactor
		Ministerial Ordinance for Reactors at the Stage of Research and Development	Ministerial Public Notice for Criteria on Person Responsible for Operation
			Ministerial Public Notice for Technical Details of Transport of Nuclear Fuel Material, etc. in Factory or Place of Business
			Ministerial Public Notice for Important Safety Related Equipment
Radiation Hazard Prevention Act	Cabinet Order for Radiation Hazard Prevention Act	Ministerial Ordinance for Radiation Hazard Prevention Act	Ministerial Public Notice for Dose Limit Based on Provisions of Reactors at the Stage of Research and Development
Electricity Business Act	Cabinet Order for Electricity Business Act	Ministerial Ordinance for Electricity Business Act	Ministerial Public Notice for Technical Requirements on Dose Equivalent, etc. due to Radiation Relating to Nuclear Power Generation Facilities
		Ministerial Ordinance for Establishing Technical Standards for Nuclear Power Generation Facilities	
		Ministerial Ordinance for Establishing Technical Requirements for Nuclear Fuel Material of Power Generation	
Disaster Countermeasures Basic Act			
Act on Special Measures Concerning Nuclear Emergency Preparedness	Cabinet Order for enforcement of the Act on Special Measures Concerning Nuclear Emergency Preparedness	Ministerial Ordinance for enforcement for the Act on Special Measures Concerning Nuclear Emergency Preparedness	

Regulatory Oversight of Nuclear Industry

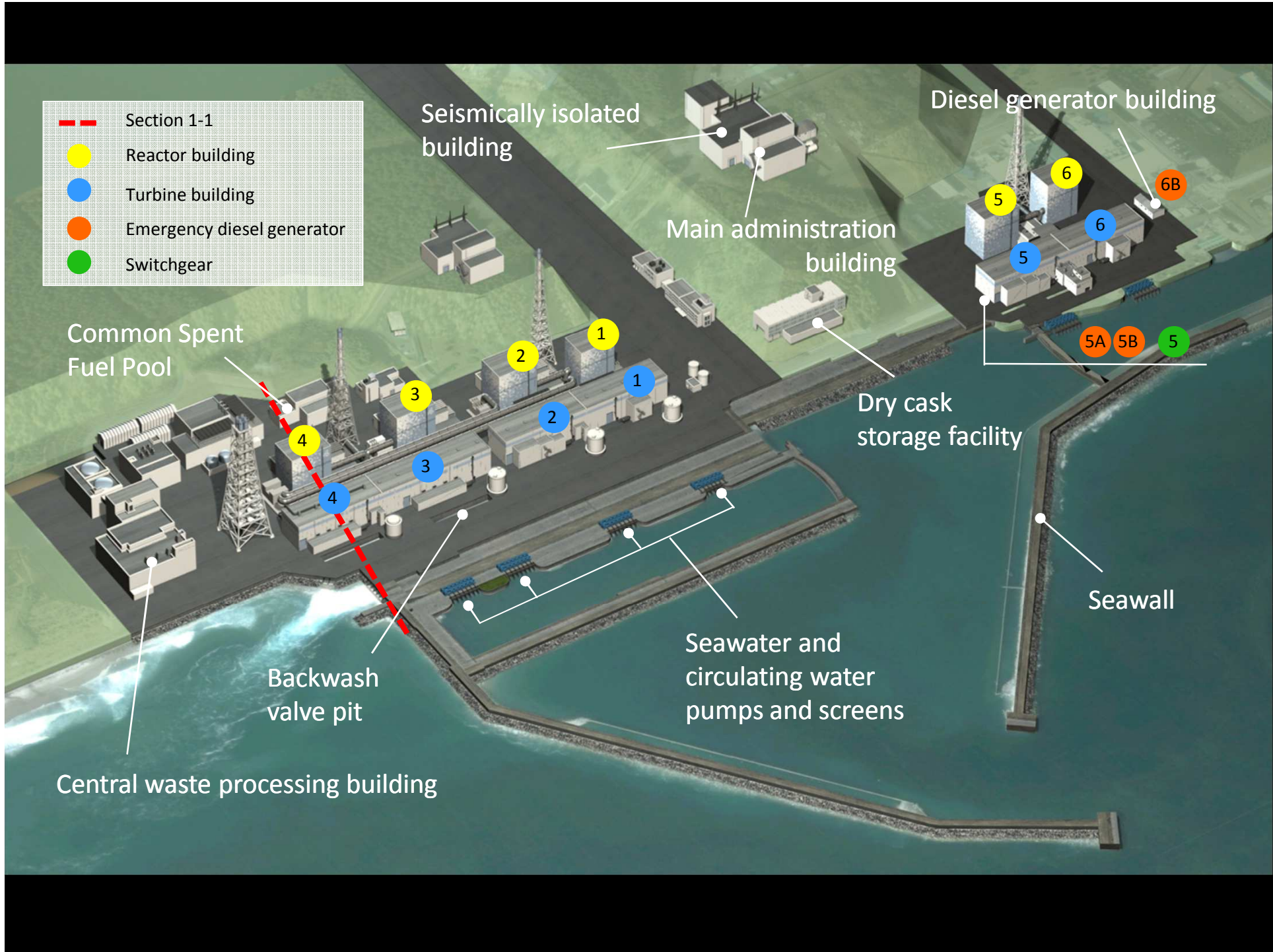
Commercial nuclear power reactors are exempt from certain provisions of the Reactor Regulation Act






- Approval of design and construction methods
- Pre-service inspection
- Welding methods
- Inspection

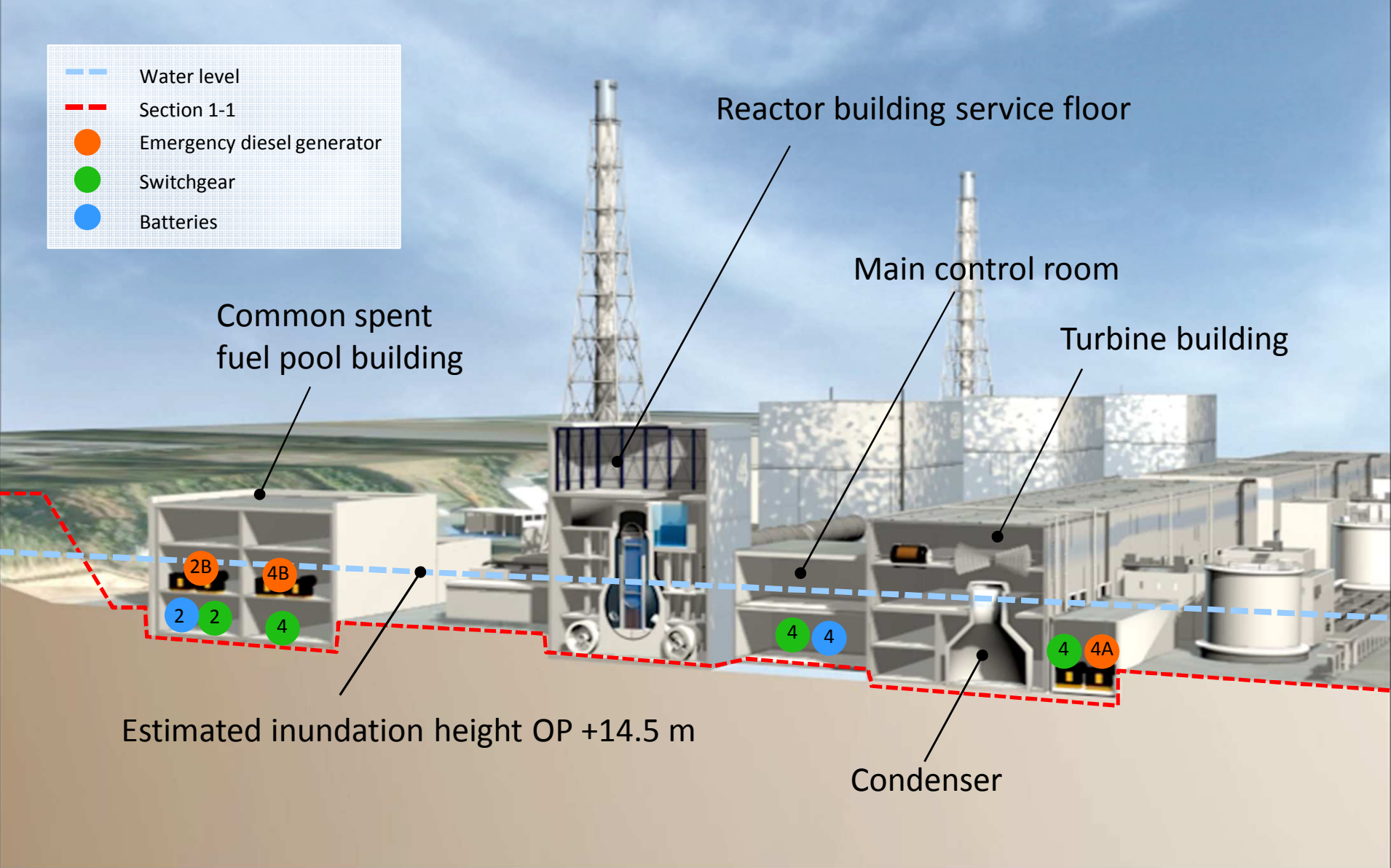
**These activities are subject to the
'Electricity Utilities Industry Law'**

Onset and progression of the accident

- Explains how an extreme natural event, combined with design and operational issues, led to a severe nuclear accident
- Describes the effects of the initiating event (the Great East Japan Earthquake) and its concurrent and dependent natural event (the tsunami) on the Fukushima Daiichi NPP site
- Provides a sequence of events at each unit
- Describes the human and organizational response to the accident and during the following month



-  Water level
-  Section 1-1
-  Emergency diesel generator
-  Switchgear
-  Batteries



Common spent fuel pool building

Reactor building service floor

Main control room

Turbine building

Estimated inundation height OP +14.5 m

Condenser

2B

4B

2

2

4

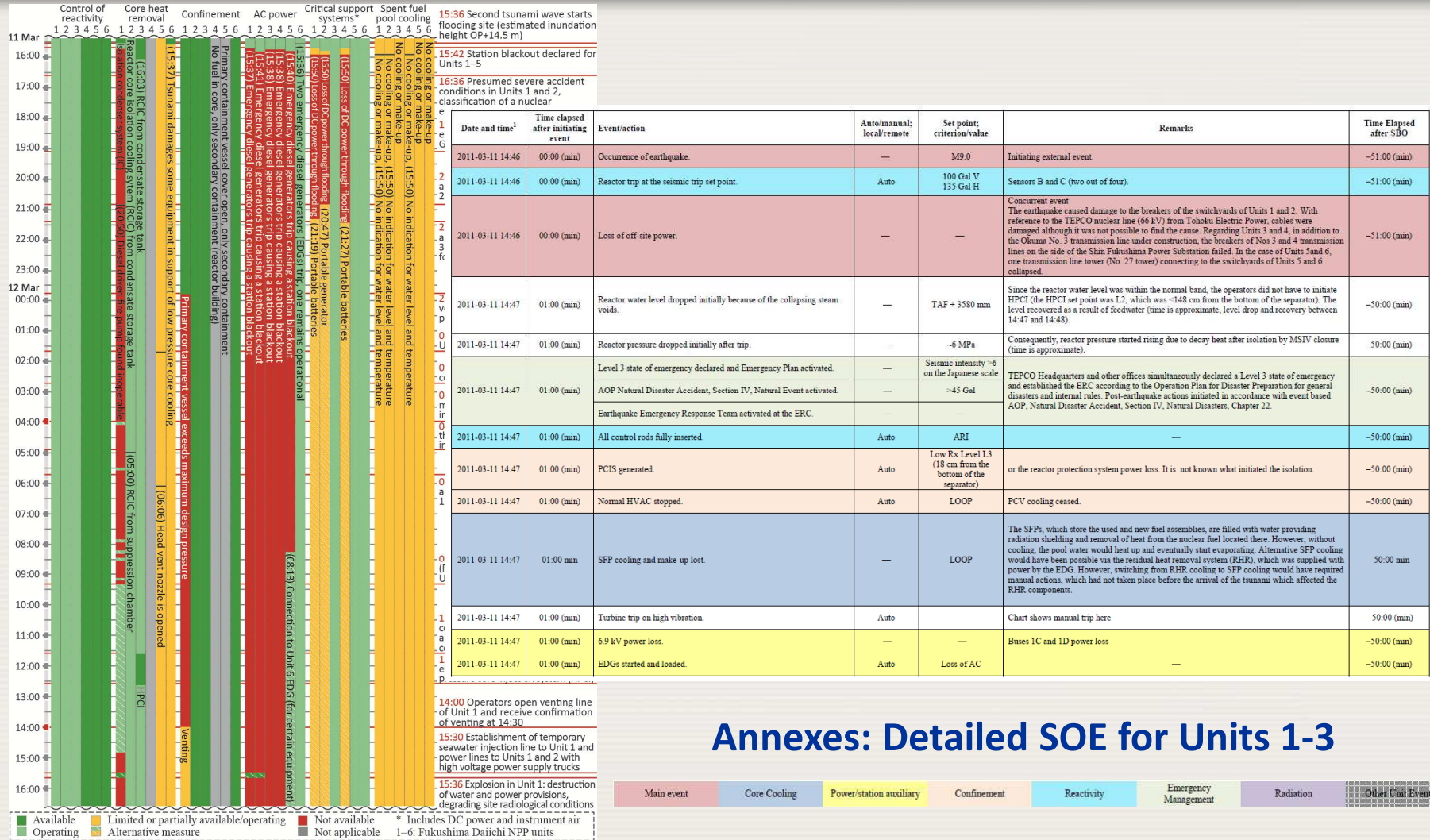
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4

4A

Fundamental Safety Functions and Detailed SOE



Annexes: Detailed SOE for Units 1-3





The Fukushima Daiichi Accident
Technical Volume 1, Section 1-4

RADIONUCLIDE INVENTORY AND RELEASES

Radionuclide Inventory and Releases

- Reconstructs the source term
- Describes the initial releases of radionuclides to the environment, resulting from the failure of the fission product barriers at the time of the accident
- Presents other events afterwards that caused additional radioactive releases from the accident site

To Determine Radiological Impacts on People and the Environment

What Happened?

- Radioactive materials were emitted into the atmosphere and transferred to the land and ocean through wet and dry deposition
- Contaminated fresh and seawater was directly released to the ocean
- Assessments are in Technical Volume 4



The Fukushima Daiichi Accident
Technical Volume 1, Section 1-5

ACTIONS BY ORGANIZATIONS OTHER THAN TEPCO

Accident Response in Japan and the World

Addresses the response to accident progression by:

- Offsite entities
- Actions of Japan's national, prefectural and local governments
- IAEA and other international and regional organizations



The Fukushima Daiichi Accident
Technical Volume 1, Section 1-6

ACTIONS TAKEN IN THE AFTERMATH OF THE ACCIDENT

Post-accident Recovery

Covers subsequent actions taken at the Fukushima Daiichi NPP by TEPCO, government organizations, the Japan's nuclear industry and internationally *to address challenges and issues after the accident*

- Includes current activities and plans on the site decommissioning and remediation
- Assessments are in Technical Volume 5



The Fukushima Daiichi Accident
Technical Volume 1

CONCLUSION

Conclusion

TV1 is a comprehensive description on the background and context of the accident

- It comprises a detailed timeline of the accident
- It provides factual information required for an appropriate assessment of the accident
- It is the result of a multi-national/organizational efforts
- It will be a valuable resource for countries to validate and compare their action plan post-Fukushima
- Is a general reference account of the accident and the aftermath

TV1 is a basis for analysis in other TVs

THANK YOU



IAEA
International Atomic Energy Agency