

Summary of “White Paper on Nuclear Energy 2017”

July 2018

Japan Atomic Energy Commission



White Paper on Nuclear Energy (1)

Background

- The White Paper on Nuclear Energy has been published on a continuous basis since the launch of the Japan Atomic Energy Committee (JAEC) in 1956 through 2010, the year before the TEPCO Fukushima nuclear power plant accident (the Fukushima accident).
- Subsequent to the 2009 edition (published in March 2010), the White Paper was suspended until two years ago, as attention was focused on responses to the Fukushima accident and subsequent review and reform of the JAEC.
- The report of the Experts Committee for Review of the JAEC suggested that there was value in publishing the white paper, and the Amended Act for Establishment of JAEC clearly called for the task of "the collection of information and conducting of surveys concerning nuclear utilization."
- Based on these, the White Paper on Nuclear Energy was resumed last year for the first time in seven and a half years in order to fulfill the responsibility to provide explanation to the Japanese people about nuclear energy use. (Adopted by the Atomic Energy Commission on September 14, 2017, and decided by the Cabinet on September 15, the same year)

Objectives

- The White Paper on Nuclear Energy is intended to fulfill the responsibility of the Japanese Government to the Japanese people to comprehensively and continuously provide explanation on the Government's initiatives in nuclear energy based on the lessons learned from the Fukushima accident and the changes in attitudes surrounding nuclear energy. Additionally, with attention focused from overseas on the state of nuclear energy in Japan, the White Paper is a suitable means of sharing information with the international community.
- While placing emphasis on the management viewpoints on nuclear energy issues, and developing comprehensive cross-disciplinary ideas that serve as a philosophy for nuclear power, JAEC adopted the "Basic Policy for Nuclear Energy" last year in order to play a role as a compass indicating the direction of nuclear utilization. The Cabinet has decided that this document is respected as the Government. It is essential to present readily understandable information to the Japanese people, including the statement of "Basic Policy for Nuclear Energy".

1. Changing Environment Surrounding Nuclear Energy

- A need exists to sincerely address the public distrust and anxiety about nuclear energy and **rebuild social confidence**
- A new competitive electric power market has emerged with full liberalization of the retail electricity market
- Further substantial reduction of CO2 emissions over a long term will be difficult to achieve simply by applying existing countermeasures
- Increased use of thermal power stations and introduction of a feed-in tariff (FIT) system for renewable energy have led to higher electricity tariffs, which have had a major negative impacts on people's livelihood and economic activities



2. Fundamental issues ingrained in nuclear energy-related organizations

- The unique mindset and groupthink in Japan, the pressure to conform tacitly or **forcibly to the opinion of the majority**, and the tendency to maintain the status quo are all very strong, and they can be a problem.
- Another tendency within organizations is to lapse into **sub-optimization**. Creating a culture in which people can exchange a variety of opinions based on solid grounds, regardless of their standing inside or outside the organization, is necessary.



3. Basic objectives and important initiatives of nuclear energy use

- Appropriate use of nuclear energy with thorough risk-management by responsible organizations is necessary.
- It is important to proceed with the use of nuclear energy with peaceful use and safety assurance as basic preconditions, winning the confidence of the people and bearing in mind both benefits and costs that nuclear technology can bring to the environment, people's livelihood, and economic activities.

1. **Seriously reflect on the Fukushima accident and learn lessons therefrom**

- ◆ Establish a safety culture that overcomes weakness of traditional Japanese organizations and national cultures.
- ◆ Shift in safety assurance of a “culture of prevention” by promotion of risk management.

2. **Pursue nuclear energy use addressing global warming issues and people's livelihood and the economy**

- ◆ The National Government needs to clarify the role that nuclear power generation can play over a long term and examine necessary measures therefor.

3. Basic objectives and important initiatives of nuclear energy use

3. **Nuclear energy in the global context**

- ◆ Collect and share [international knowledge and experiences](#); improve international awareness

4. **Peaceful use of nuclear energy: enhancing non-proliferation and security regimes**

- ◆ Take steps to [assure the international community of Japan's peaceful use of plutonium](#); Ensure [the plutonium balance](#) and [responsible plutonium management](#); [consume plutonium in the form of MOX fuel](#) for light water reactor

5. **Rebuilding public trust, as a major precondition**

- ◆ Create an information base [for people to be able to deepen their understanding](#) of the circumstances surrounding nuclear energy use in Japan based on [scientifically accurate information and objective facts \(evidence\)](#)

6. **Steadily pursuing decommissioning and radioactive waste disposal**

- ◆ The [resolute implementation of disposal of radioactive waste](#) by the current responsible generation.

7. **Expanded use of radiation and radioisotopes**

- ◆ Develop necessary infrastructure to enable [further use of radiation and radioisotopes including the use of quantum beams](#).

8. **Strengthening the foundations for the use of nuclear energy**

- ◆ R&D institutions and nuclear industry should collaborate and develop a deep and broad knowledge base.
- ◆ [Securing qualified human resources](#) and [improving human resources development](#) including on-the-job training



In light of the fact that the environment surrounding nuclear energy will keep changing substantially in the coming years, “Basic Policy for Nuclear Energy” is to be reviewed and revised, as necessary, basically every five years or roughly every five years.

White Paper on Nuclear Energy (2)

Basic Policy for Nuclear Energy (Decided by the Cabinet on July 21, 2017)

White Paper on Nuclear Energy 2017

- Mainly **following up** the “Basic Policy”
- It notes the Reconstruction Agency’s efforts and **both promoting and regulatory perspectives.**

[Structure of the “Basic Policy”]

Basic Objectives of the Important Initiative for Using Nuclear Energy

- (1) **Seriously reflect on** the Fukushima accident and **learn lessons therefrom**
- (2) Pursue nuclear energy use addressing **global warming issues and people’s livelihood and the economy**
- (3) Nuclear energy **in the global context**
- (4) **Peaceful use of nuclear energy** and enhancing non-proliferation and security regimes
- (5) **Rebuilding public trust**, as a major precondition
- (6) Steadily pursuing **decommissioning and radioactive waste disposal**
- (7) Expanded use of radiation and radioisotopes
- (8) **Solid foundation** for nuclear energy use

The Structure of the White Paper on Nuclear Energy and Chapter- Points

Special report

- **Communication** in the nuclear energy field

Chapter 1

- Promotion of a steady **reconstruction and revival** of Fukushima, **utilization of the lessons**, and efforts for the establishment of a **nuclear safety culture**
- **Preventive approach** for safety improvement

Chapter 2

- Role of nuclear energy in the energy scenario

Chapter 3

- Efforts for international collaboration and cooperation

Chapter 4

- **Peaceful use** of nuclear power (**in terms of policy and the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors Act**)
- Updated version of the “**Basic Policy on the Utilization of Plutonium in Japan**” (2003)

Chapter 5

- Efforts for the **establishment of evidence-based information systems**

Chapter 6

- Integrated approach to the decommissioning and processing and disposal of radioactive waste

Chapter 7

- **Increase the economic value of utilizing radiation** and noteworthy case examples
- The importance of **nuclear power as the common ground for science and engineering**

Chapter 8

- **The launch of a collaborative platform** for the solution to issues such as the structure of the Nuclear Power Village and **the construction of a knowledge base**
- **A policy on technological development and R&D** that supports the cost share policy and the importance of **human resources development**

Special Report: Communication in the Nuclear Energy Field

The Fukushima accident caused tremendous suffering to Fukushima residents and other people. Seven years have passed since the accident, but the public distrust and anxiety about utilizing nuclear energy still remains deep-rooted.

In order to seriously face public distrust and anxiety, **deepen public understanding**, and **build trust** with the public, the two following factors are needed.

- Establish information systems based on scientifically accurate information or objective facts (evidence-based) (Chapter 5)
- **Communication activities** with stakeholders (the public and interested parties)

Two-way communication: Realizing mutual understanding through two-way communication with stakeholders
Engagement: Engaging in processes associated with policies or projects that will influence society

[Way of Communication]

<Until Now>

Providing what was decided unilaterally and seek the understanding and support of stakeholders (**push type communication**)

<From Now On>

Listening to stakeholders' interests and opinions (**pull type communication**)

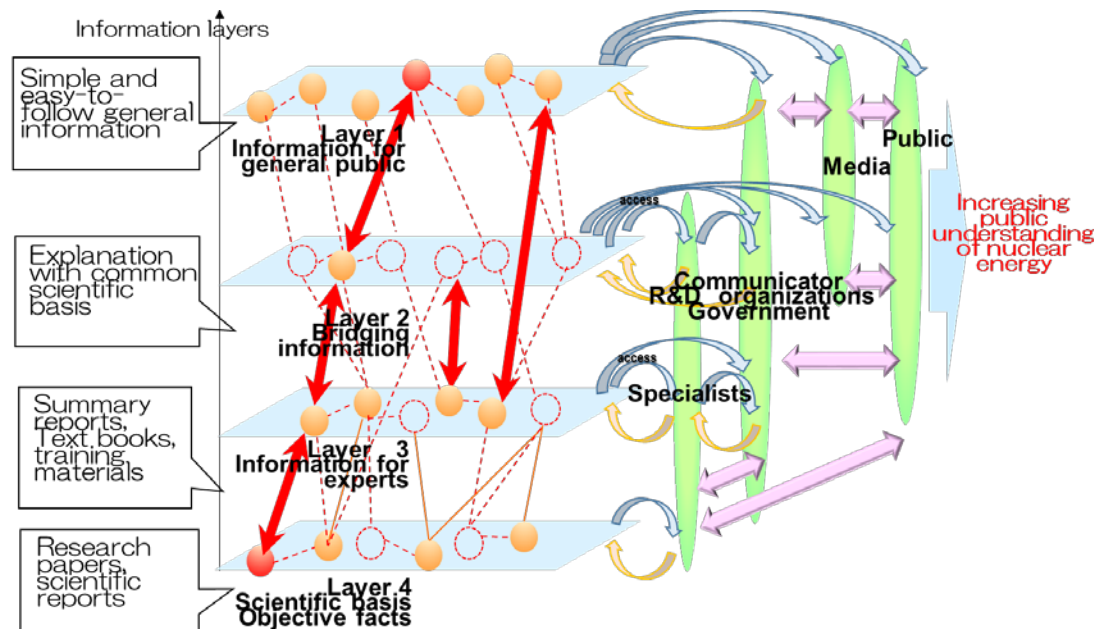
《Viewpoints Needed》

- **Identifying stakeholders**
- **Grasping what stakeholders want to know**
- **Acting in the interests of stakeholders'**

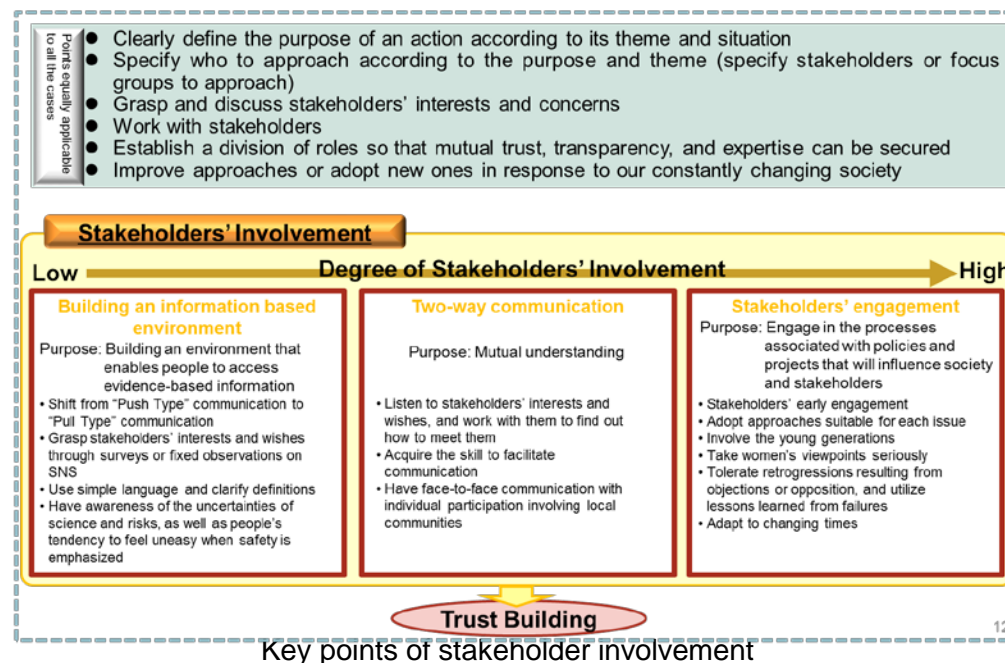
[Summary]

- There is no uniform communication activity. It is important to seriously face stakeholders and issues.
- It is necessary for relevant organizations to think about what ideal communication should be like for trust building, using case examples from foreign countries.

Efforts for Improving Understanding of the Nuclear Energy Policy



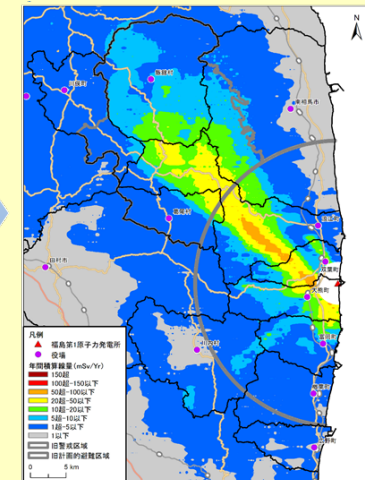
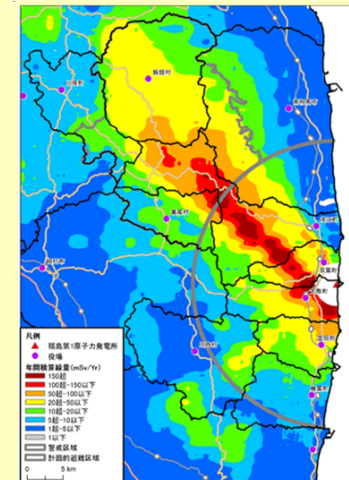
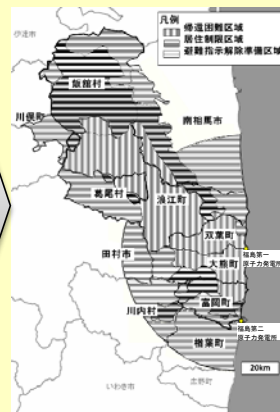
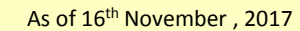
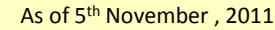
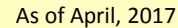
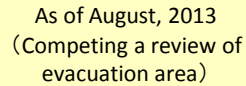
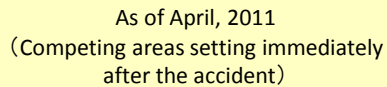
Efforts for improved understanding of the nuclear energy policy
 knowledge-based information network public communication
Efforts for Improving Understanding of the Nuclear Energy Policy



Important Initiatives for Nuclear Energy in Japan and its Direction (1)

Chapter 1: Steady reconstruction and revival of Fukushima and tireless safety improvement with lessons seriously learned

- The Fukushima accident was a terrible upheaval for the nuclear policy as represented by growing public distrust and anxiety. It is important to reflect on the failure to prevent it, further promote efforts for easing the anxiety about nuclear energy, and utilize lessons learned. It notes efforts by the Reconstruction Agency and other ministries and agencies for the reconstruction and revival of Fukushima and the current situations.



Transition of evacuation area (from April 2011 to April 2017)

Air dose rates from a series of aircraft surveys

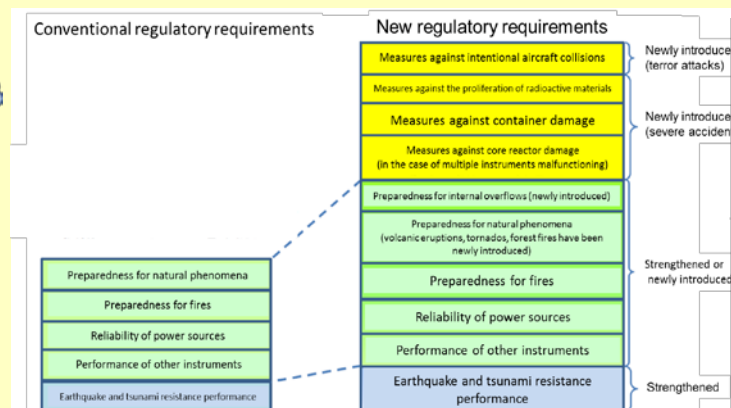
- In response to the recommendations in the accident investigation report, it is important that the government and nuclear agencies **make tireless efforts for safety improvement to establish a culture of safety,** in addition to reviewing the nuclear energy administration and establishing new regulatory requirements for the enhancement of nuclear safety measures.

Level	Purpose	Measure	Goal
Level 1	Prevent an abnormal operation or a mechanical fault	Redundancy design, fail-safe, interlock	Prevent an abnormality from occurring
Level 2	Control an abnormal operation and detect a mechanical fault	Early detection of an abnormality and automatic shutdown of the core reactor	Prevent a situation from developing into an accident
Level 3	Reduce an accident to the design standard levels	Emergency core cooling, measures against core damage	Prevent a situation from developing into a serious accident such as significant damage to the core reactor
Level 4	Control a severe plant state	Container protection, release control and proliferation control	Prevent release of radioactive material early or prevent massive release of radioactive material
Level 5	Reduce the impact of a massive release of radioactive material	Off-site emergency measures (protective measures such as evacuation)	Reduce off-site damage

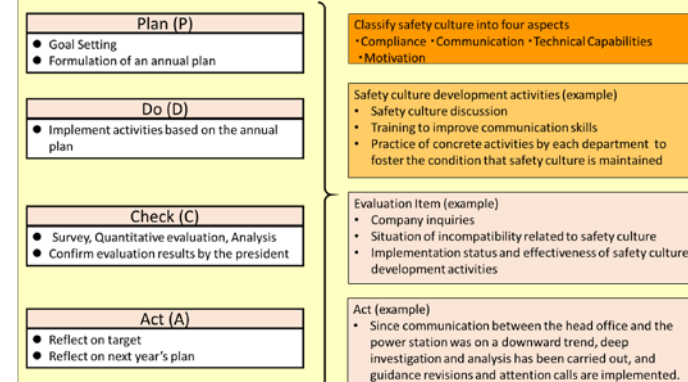
The diagram illustrates the containment system for a nuclear reactor. At the center is the **Core reactor (fuel rods)**, which is housed within a **Containment vessel**. This vessel is further enclosed by a **Container**. The diagram highlights several key measures:

- Protecting the core reactor and sealing it in the reactor vessel as tightly as possible:** This measure is associated with Levels 1 and 2 of the defense strategy.
- Sealing the reactor vessel in the container as tightly as possible:** This measure is associated with Level 3 of the defense strategy.
- Measures against released radioactive material:** This measure is associated with Levels 4 and 5 of the defense strategy.

A cloud labeled **Released radioactive material** is shown outside the container, indicating the potential consequence of a failure in the containment system.



Comparison between conventional and new regulatory standards for a practical nuclear reactor facility

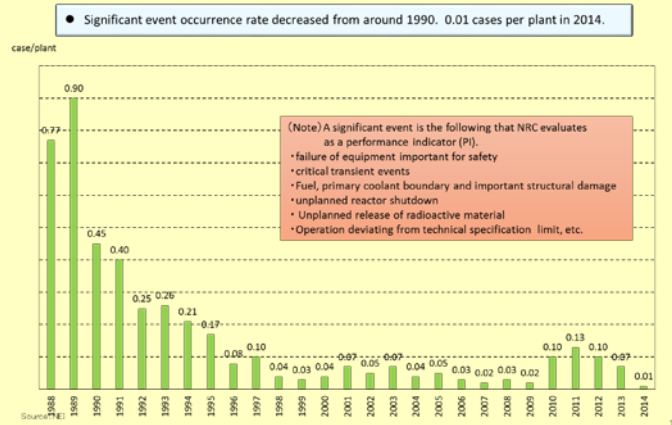


Example of safety culture development activities at Chubu Electric Power Co., Ltd.

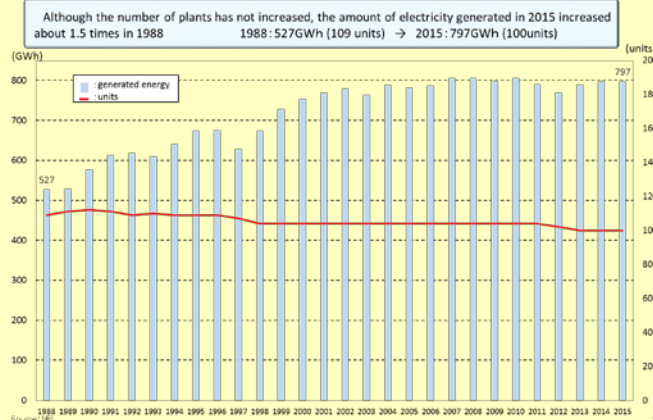
Important Initiatives for Nuclear Energy in Japan and its Direction (2)

(Current situation and the ongoing efforts in America)

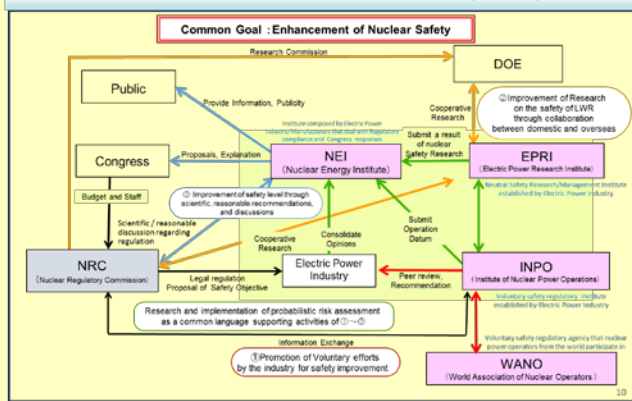
Transition of the significant event occurrence rate of nuclear power plants



Number of NPP and Amount of Generated Electricity

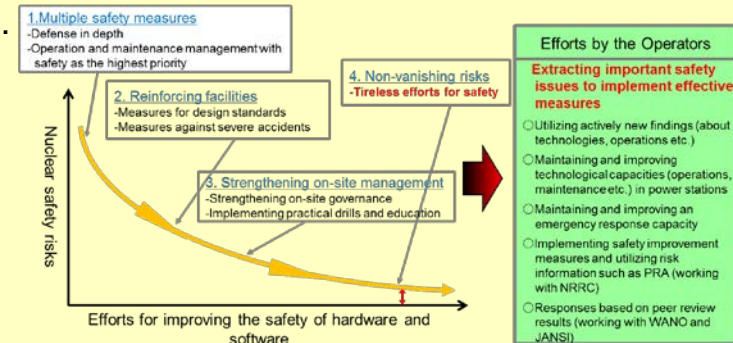


Structure for Enhancement of Voluntary Safety



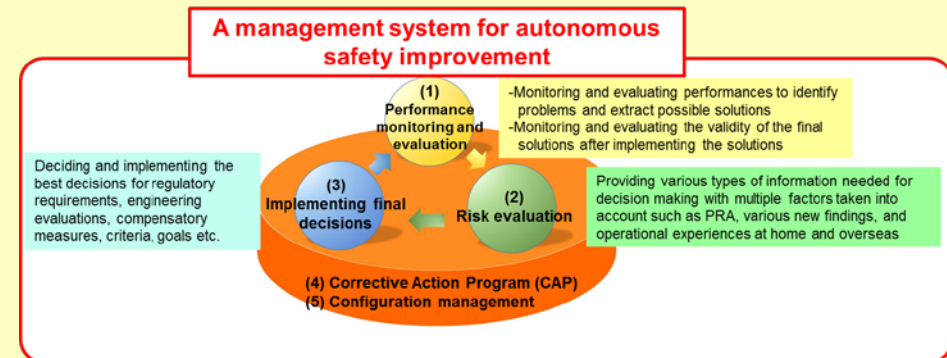
(Direction of Japan)

- Promoting the initiative for safety improvement in the long-term use of light-water reactors
- The relevant industries have founded the **Japan Nuclear Safety Institute**, which, as an organization that helps improve self-motivated nuclear safety, makes safety evaluations and provides advice on their improvement, and is **considering safety efforts utilizing PRA** in cooperation with the **Nuclear Risk Research Center**.



Risk reduction efforts by nuclear operators

- Electric power operators aim to apply **Risk-Informed Decision Making (RIDM)** based on PRA for the risk management of their power plants.



Conceptual diagram of risk management based on RIDM

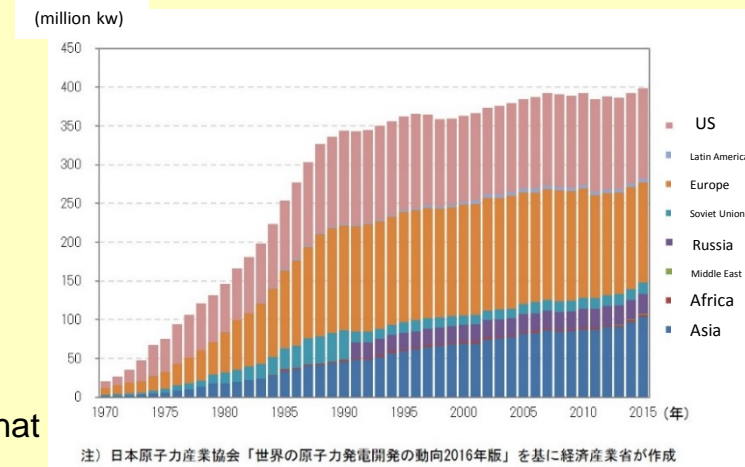
- The relevant industries are considering **the launch of new functions** in order to **enhance cooperation beyond industrial boundaries**, and to establish a system that will raise the safety level of sites.

*The Atomic Energy Agency (ATENA) was founded on July 1, 2018.

Important Initiatives for Nuclear Energy in Japan and its Direction (3)

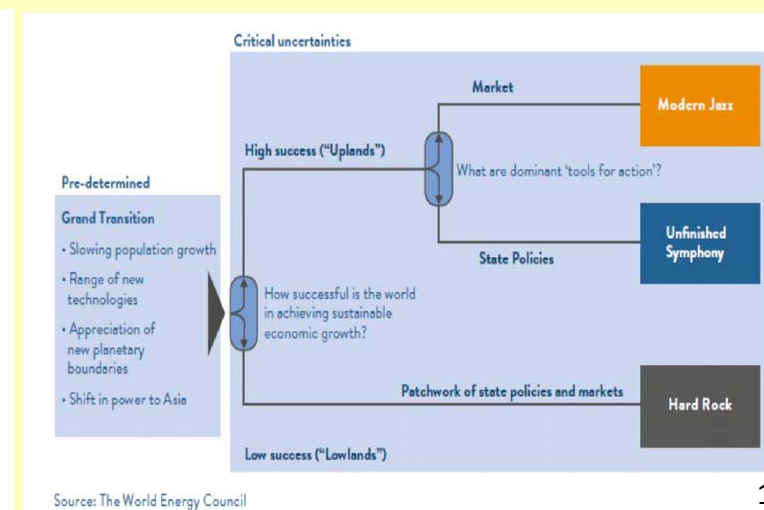
Chapter 2: Nuclear energy use addressing global warming issues and people's livelihood and the economy

- In Japan, because of the full liberalization of electricity retailing and power generation, regional monopolies of electricity and the rate-of-return regulation were abolished, and a competitive environment has appeared.
- Nuclear power is a baseload power source and the long-term stable use of nuclear power is important in terms of global warming, the economy, and the stable supply of electricity. It is necessary to consider measures to take advantage of the characteristics of nuclear power generation under this liberalized environment, and measures for financial issues are discussed.
- It notes that while reports on the current status of nuclear power generation mention that some nations are shifting to denuclearization, other industrial nations are appreciating again nuclear power as a low carbon power source, and that emerging nations are increasingly developing and utilizing nuclear power.
- It notes that in order to promote an ideal use of nuclear power, which is capable of stably supplying electricity at low cost and curbing global warming, energy scenarios in a future world that are likely to come true must be developed to stress the need for responses to nuclear power based on a comprehensive judgment.



The World Energy Council "World Energy Scenarios 2016: The Grand Transition"

CO2 emissions in 2060 are down 28% in the "Modern Jazz" scenario, down 61% in the "Unfinished Symphony" scenario, and up 5% in the "Hard Rock" scenario compared to the 2014 level. The share of nuclear energy in 2060 increases by 91%, 197%, and 166% respectively in comparison to that of 2014. In the "Modern Jazz" scenario, in which the combination of power generation sources depends on market trends, the rate of increase in nuclear energy is lower than in the other scenarios, which means that the scenario promotes global warming prevention. Curbing global warming needs a long-term investment recovery or other policy measures.



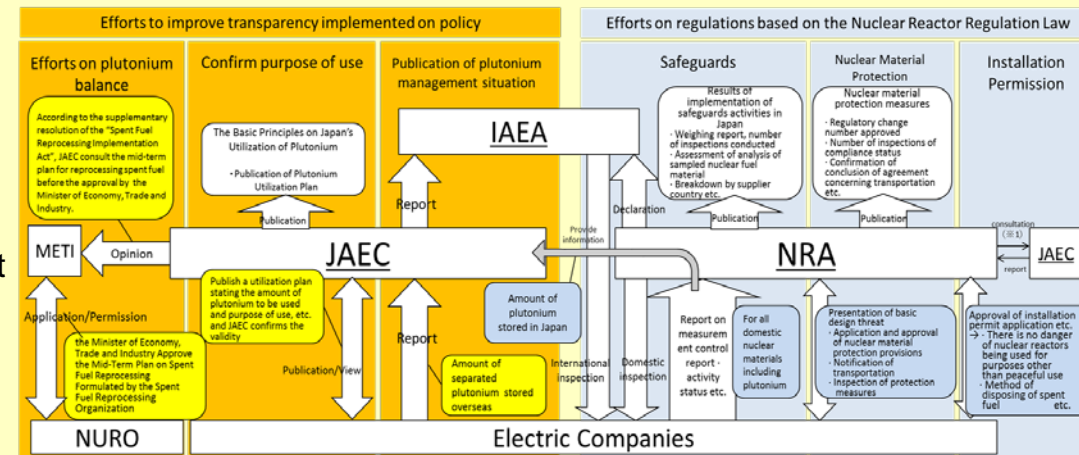
Important Initiatives for Nuclear Energy in Japan and its Direction (4)

Chapter 3: Efforts at home and overseas in the global context

- It focuses on nuclear trends in nations that continue to depend on nuclear energy, or that are promoting nuclear energy development to meet electricity demand and curb global warming.
- It focuses on various actions through participation in, and cooperation with, international organizations, such as the IAEA and OECD/NEA, or bilateral nuclear agreements or cooperation.
- It focuses on various actions in cooperation with members of the International Framework for Nuclear Energy Cooperation (IFNEC) for promoting peaceful use of nuclear energy.
- It focuses on various actions by the Forum for Nuclear Cooperation in Asia (FNCA) such as joint utilization of radiation, joint utilization of research reactors, sharing of issues including nuclear infrastructure and safety ensuring, and of information about the legal frameworks with neighboring Asian nations.

Chapter 4: Peaceful use, non-proliferation, and ensuring nuclear security

- It notes that nuclear research, development and utilization in Japan are limited to peaceful purposes based on the Atomic Energy Basic Law.
- It clarifies “peaceful use in terms of policy” and “peaceful use in terms of the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors Act.” It also notes efforts for the ensuring of peaceful use.
- In addition to compiling explanatory documents regarding the current status of plutonium utilization, JAEC has decided to update the Basic Policy on the Utilization of Plutonium in Japan (2003).
 - The government approve sufficient plutonium to be reprocessed for pluthermal.
 - It is necessary to achieve the goal of reducing Japan's plutonium stockpile in the long run.
- It notes global trends and Japan's actions regarding international frameworks such as nuclear security and the nuclear disarmament/non-proliferation regimes.



※ 1 Conducted on nuclear reactors, storage facilities and reprocessing facilities (legal procedures).

Structure to ensure peaceful use of nuclear energy of Japan

Important Initiatives for Nuclear Energy in Japan and its Direction (5)

Chapter 5: Rebuilding public trust as a precondition for using nuclear energy

※For communication, it is detailed in the special report

- It notes the governmental accident investigation report's criticism that there were many problems with the way the government and TEPCO provided information to the public and that there are many problems in the way information is provided under normal circumstances as well as in the case of emergencies.
- In response to the criticism above, it is essential to foster better understanding of nuclear energy based on scientifically-accurate knowledge and objective facts (evidence-based) and develop an environment for the formation of opinions.(See Page 6)
- It notes that 10 relevant organizations have launched committees and a collaborative platform to consider measures for the establishment of evidence-based information systems.
(Four themes: "3E+S," "safety and disaster prevention," "radioactive waste," and "risk of exposure to radiation")
- It notes that for the establishment of policy information systems, the Agency for Natural Resources and Energy has started to distribute the special content on its website, and that the ideal communication of future efforts and directions are being discussed based on the recommendations and discussions by JAEC.
- It explains measures against issues according to their areas of location with their contributions reaffirmed.

Chapter 6: Decommissioning and the treatment of radioactive waste

- With regard to the decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Plant, the following will be steadily implemented: measures against contaminated water, removal of spent fuel and debris, measures against waste and R&D, human resources development, and international cooperation with the decommissioning. Other nuclear power plants and R&D test facilities in universities and research institutes will be steadily decommissioned (the need for regarding the decommissioning, processing and disposal of radioactive waste as a package is pointed out).
- With regard to the disposal of radioactive waste produced by nuclear energy, it is essential to adhere to the idea of never passing on the costs to future generations, and radioactive waste from TEPCO Fukushima Daiichi Nuclear Power Plant, and other nuclear power plants and research institutes, must be stored and disposed appropriately.
- It notes the institutional frameworks for decommissioning and radioactive waste management policies outside of Japan
- At the request of JAEC, relevant organizations have formed a collaborative platform for dealing with decommissioning and radioactive waste. They are reinforcing it to promote collaboration among nuclear power plants and research institutes, and to put information in order and extract issues.

Important Initiatives for Nuclear Energy in Japan and its Direction (6)

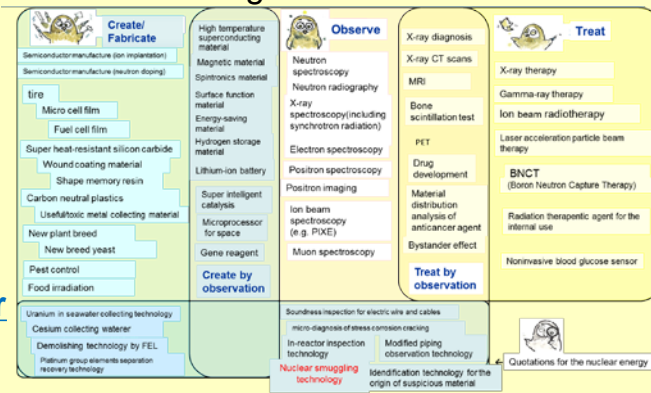
Chapter 7: Promotion of utilizing radiation and radioisotopes

➤ It notes that radiation and radioisotopes, which share the common scientific basis with nuclear energy, have a lot to do with people's lives as they are used in ways inseparable from each other in a wide range of areas, including advanced technologies, industry, medicine (utilized in diagnosis and treatment), agriculture, environmental preservation, nuclear security, and nuclear forensics.

➤ It notes that creating innovation utilizing radiation needs the sharing of the idea that utilizing radiation helps improve people's lives, while radiation's impact on the environment must be studied as well as the renewal of aging facilities and proper organization of personnel, in addition to strategic and effective utilization of the existing infrastructure.

➤ It provides case examples of nuclear power as an interdisciplinary collaboration among the sciences, engineering, medicine etc.

➤ It notes that it is necessary to consider utilizing research reactors based on demand.



Radiation utilization in a wide range of fields

- Types of utilization of radiation
 - (1) Utilization of radiation in accelerators or nuclear reactors etc.
 - (2) Utilization of radiation using radioisotopes (RI)
- Areas in which radiation is utilized
 - (1) Medicine and medical care: Increasingly utilized in recent times
 - Diagnosis: Radiation has been mainly utilized, but RI is now also being used.
 - Treatment: Radiation and RI are utilized (RI capable of diagnosis and treatment has been developed recently).
 - (2) Other areas
 - Industrial use: Material production, non-destructive testing
 - Environmental and food-related material: Disinfecting, environments
 - Environmental pollution: Radioactive pollution etc.

○ Economic scale survey on utilizing radiation (August 29, 2017)

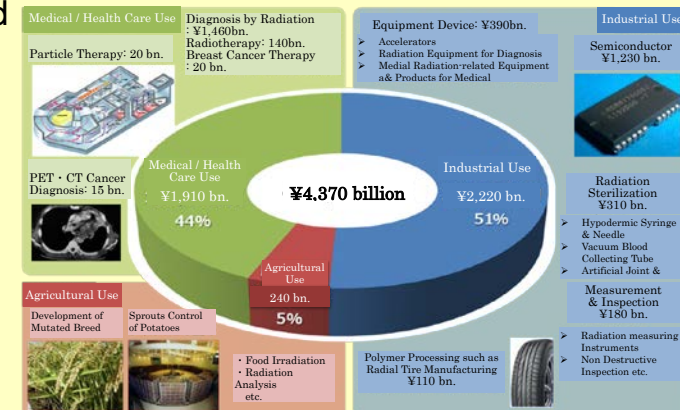
- A market size survey was conducted to grasp the trends in utilizing radiation, for the first time in some 10 years since 2005.

-The market for radiation is growing, conspicuously so in medicine and medical care, compared to 10 years ago.

(billion ¥)

Year	Industry	Medicine & Medical care	Agriculture	TOTAL	Energy Use
FY2015	22,200	19,100	2,400	43,700	3,307
FY2005	23,000	15,000	2,800	41,117	47,410
FY1997	21,773	12,000	1,167	35,000	57,913

Yearly Comparison of Radiation Use

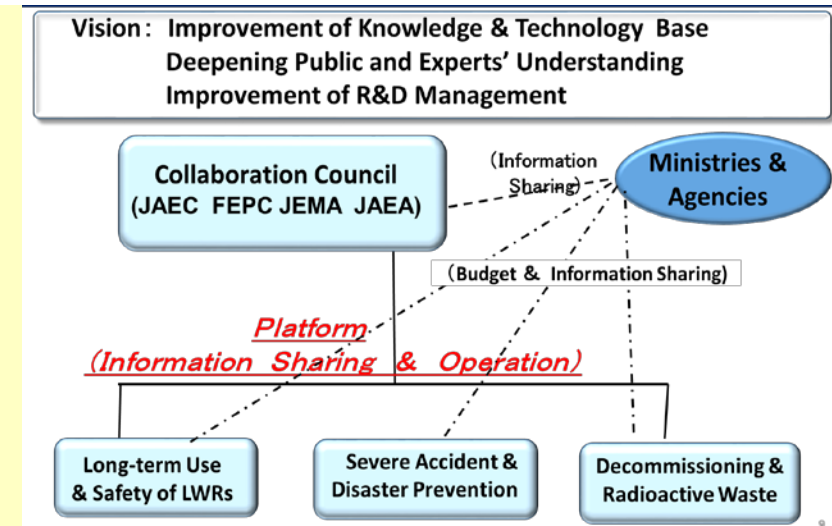


Economic Scale of Utilization of Radiation in Japan(2015) 13

Important Initiatives for Nuclear Energy in Japan and its Direction (7)

Chapter 8: Strengthening the foundations for using nuclear energy

- Sufficient effort on interdisciplinary and cross-organizational cooperation in industrial and academic circles has not been made in the nuclear field in Japan, given that scientific knowledge exists in the organizations.
- JAEC points out in the “Basic Policy for Nuclear Energy” that a network that promotes academic and industrial cooperation and a cross-ministerial system should be constructed immediately referring overseas case examples.
- It notes that for the establishment of a nuclear-related strong knowledge base by relevant organizations, a collaborative platform that promotes academic and industrial cooperation has been launched to focus on the long-term use and safety of light-water reactors, severe accidents and disaster prevention, and decommissioning and radioactive waste.
- It notes that in order for JAEA, which is responsible for basic and fundamental R&D contributing to sustainable utilization and development of nuclear energy, to play a major role in establishing a knowledge base (human resources, knowledge and R&D), it is hoped that the organization will improve its organizational management, particularly focusing on changing the mentality of its organization, improving management methods and systems, and R&D according to demand. It also notes R&D management in foreign countries.
- It notes that JAEA has disclosed its “Policy on Technological Development and R&D,” suggesting that the future technological development and R&D of nuclear power generation should be based on cost sharing, and led by individual power companies or makers with the government supporting them, since nuclear power generation methods should be market determined, and marketable nuclear energy is significant.
- It notes that JAEA has prepared its “Human Resources Development in the Nuclear Field (perspective),” which mentions the importance of human resources development through higher education and career accumulation in R&D and other jobs.
 - Nuclear related universities are required to actively respond to various university reforms such as educational continuity from undergraduate through to graduate levels.
 - For future nuclear use, it is important to develop human resources through R&D and other jobs as well as find excellent students. It is essential that human resources be secured, and knowledge and technologies be passed down even in the face of environmental changes or generational shifts.



Collaboration Program of Nuclear Energy Related Organizations