Japan's current Nuclear Energy Policy

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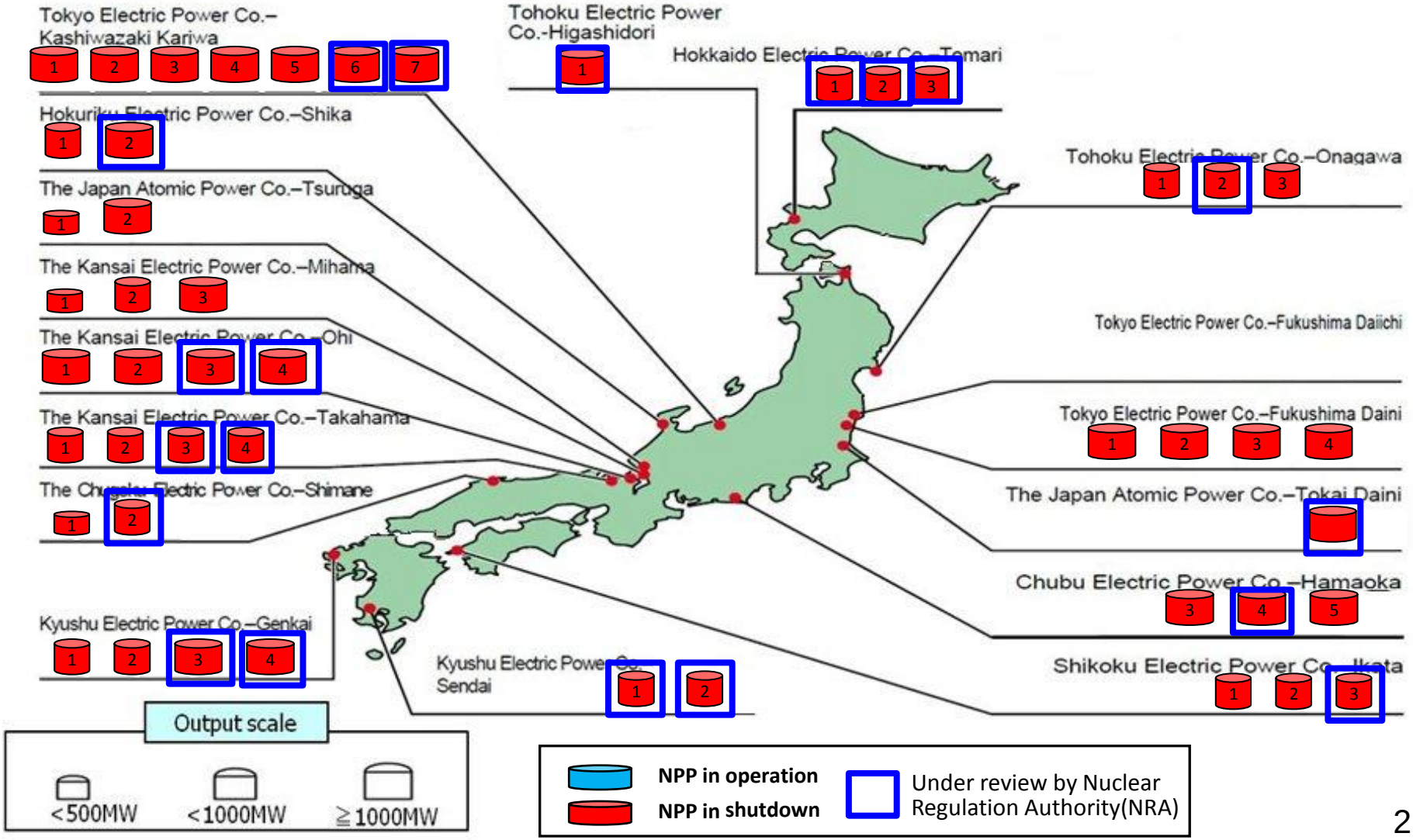
Evaluation and Policy Timeframe of Nuclear Power

＜Description in the Strategic Energy Plan of Japan＞

1. Nuclear power's energy output per amount of fuel 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; 1) superiority in stability of energy supply and efficiency, 2) low and stable operational cost and 3) free from GHG emissions during operation.
2. On the premise that safety comes before everything else and that every possible effort is made to resolve the people's concerns, judgment as to whether nuclear power plants meet the new regulatory requirements will be left to the Nuclear Regulation Authority (NRA) and in case that the NRA confirms the conformity of nuclear power plants with the new regulatory requirements ,which are of the most stringent level in the world, GOJ will follow NRA's judgment and will proceed with the restart of the nuclear power plants. In that case, GOJ will make best efforts to obtain the understanding and cooperation of the host municipalities and other relevant parties.
3. 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.

Nuclear power plants in Japan

1. 20 units (in blue squares) are under review for restart by the Nuclear Regulation Authority (NRA) in accordance with its new safety regulations.
2. Two of the NPPs, Sendai 1st and 2nd units, have got the first permissions in September towards their restart.



Efforts towards restart of Sendai NPPs

1. NRA's Safety Review

- Kyushu Electric Power submitted its application to make changes to the reactor installment license of Sendai NPS Unit 1 and 2 in July 2013.
- **NRA compiled a draft evaluation report in 16th July 2014** which admits that Sendai NPPs satisfies new regulatory requirements.
- After the public comment process (until 15th August) and reviewing of the submitted opinions, **NRA granted a permission(changes to the reactor installment license) in 10th September for the basic design and safety features of Sendai NPPs**.
- Sendai NPPs can be restarted after **i) acquiring approval of the detailed design and construction of the nuclear reactors and ii) completing pre-service inspection of operational safety programs**.

Sendai NPP

18,600 page document was reviewed & 62 review meetings were held for 110 hours

2. Disaster prevention and evacuation plan

- A regional disaster prevention plan (including evacuation plan) against nuclear disaster should be formulated by local authorities based on the Regional Basic Act on Disaster Control Measures.
- Although formulation of regional disaster prevention plan is not a legal requirement for restart, the plan is important to ensure safety of local residents. The government will support local authorities to make a sufficient plan.

3. Local Consent of the restart of Sendai NPPs

- Kagoshima prefecture and Satsumasendai City, hosting Sendai NPPs, will play leading role in the local consent process for the NPPs.
- NRA and the Japanese government is now proceeding with local briefing sessions at all the municipalities in the 30km circle of Sendai NPPs.

Nuclear Fuel Cycle Policy

【Promotion of the nuclear fuel cycle policy】

1. Regarding the nuclear fuel cycle, it is important to take this situation seriously and solve the problems, including technical challenges that we face, one by one. GOJ will make efforts to reduce the volume and harmfulness of radioactive waste and create a nuclear fuel cycle that contributes to effective utilization of resources while adequately taking the past history into consideration and continuing to seek the understanding of relevant municipalities and the international community and will promote reprocessing and plutonium use in LWRs.
2. Specifically, GOJ will promote plutonium use in LWRs, and proceed with such measures as completion of the Rokkasho reprocessing plant, construction of a MOX fuel processing plant, and completion of the Mutsu interim storage facility on the underlying premise of ensuring safety. GOJ remains committed to the policy of not possessing reserves of plutonium without specified purposes. Also GOJ will promote R&D of fast reactors, etc., through international cooperation with the U.S. and France etc.
3. GOJ will position Monju as an international research center for technological development, such as reducing the amount and toxic level of radioactive waste and technologies related to nuclear nonproliferation. GOJ will take necessary measures for issues to be overcome , such as the re-establishment of systems to implement the above mentioned actions on its own responsibility.
4. Problems related to the nuclear fuel cycle are closely related to the estimation of the future operating volume of nuclear power plants, the amount of nuclear fuel, and quantity of spent fuel produced, they will be conducted while taking into consideration all of these factors and ensuring strategic flexibility in accordance with changes in the situation.

Management of spent fuels

【 Expanding capacity of spent fuel storage】

1. The process to implement final disposal of high-level radioactive waste will take a long time. In the meantime, spent fuels produced by nuclear power generation must be safely managed. It is therefore necessary to expand the capacity for storing the spent fuels and is urgently important to broaden the range of choices for managing the spent fuels while ensuring safety.
2. It will make flexibility of policies and response, and contribute to medium-term energy security.
3. Based on this concept, the storage capacity of spent fuels will be expanded. Specifically, while studying a wide range of locations as possible sites, regardless of whether they are inside or outside the premises of a power plant, GOJ will strengthen its effort for facilitating construction and utilization of new intermediate storage facilities and dry storage facilities.

【 Promotion of technology development on volume reduction and mitigation of degree of harmfulness of radioactive waste 】

1. Regarding spent fuels, including those which have already been produced, appropriate measures must be taken with due consideration given to the following issues: 1) the fuels must be safely managed and appropriately processed and disposed of on a long-term basis; and 2) volume reduction and mitigation of degree of harmfulness of radioactive waste are important for lowering long-term risks.
2. Therefore, GOJ will promote technology development on volume reduction and mitigation of degree of harmfulness of radioactive waste. Specifically, development of technologies for decreasing the radiation dose remaining in radioactive waste over a long period of time and enhancing the safety of processing and disposal of radioactive waste, including nuclear transmutation technology using fast reactors and accelerators, will be promoted by utilizing global networks for cooperation. Also, while GOJ examines the situation of study and progress in terms of final disposal, it studies the feasibility of integrated implementation of the R&D for final disposal and reduction of volume, international research cooperation and a researcher resource development related to them.

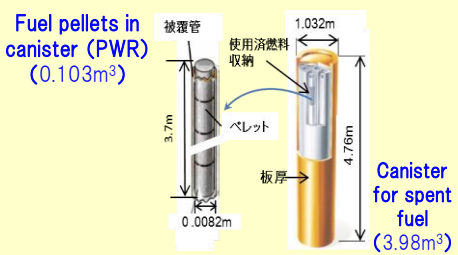
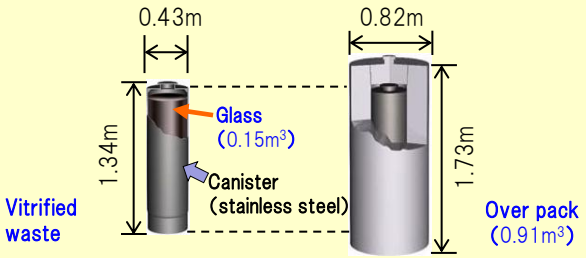
(Ref) Reprocessing and spent fuel management

(1) Reprocessing spent fuel in LWRs enables a 75% volume reduction of high-level radioactive waste, and shortens the period required to reduce the radioactive harmfulness level down to that of natural uranium to below 1/10th.

(2) Implementation of the FR fuel cycle might be able to further reduce the long-term residual radiation dosage in high level radioactive waste, and substantially mitigate the environmental load per energy generated.

※ In case of direct disposal, fission products such as uranium and plutonium remain in the waste. On the other hand, in case of vitrified radioactive materials after reprocessing, uranium and plutonium are removed and they subsequently lower the degree of radiotoxicity.

※In case of FR, since radioactive nuclides with extremely long half-lives can be used, further mitigation of the degree of radiotoxicity could be expected.

Comparison Items \ Technical Option		Direct Disposal	Reprocessing	
			LWR	FR
Waste Image of Disposal				
Volume Ratio of Waste Generated※1		1	Reduction to about 1/4 app. 0.22	Reduction to about 1/7 app. 0.15
Potential Radiotoxicity	Reduction Period down to Natural Uranium Level※2	app. 100,000 yrs	Mitigation to about 1/12 app. 8,000 yrs	Mitigation to about 1/330 app. 300 yrs
	Radiotoxicity after 1,000 yrs※2	1	app. 0.12	app. 0.004
cost※3	Nuclear Fuel Cycle – Total (Total of Front End & Back End)	JPY 1.00 ~ 1.02 / kWh	JPY 1.39 ~ 1.98 / kWh	N/A ※The reprocessing plant for FR is required
	Cost of Disposal	JPY 0.10 ~ 0.11 / kWh	JPY 0.04 ~ 0.08 / kWh	

※1 Based on the estimate by Japan Atomic Energy Agency. The figure shows the relative value compared to the canister for the direct disposal set as 1.

※2 Source: Nuclear Energy Policy Guideline The upper column shows the period required to make equivalent to the potential harmfulness level of the volume of natural uranium necessary for the power generation of 1 GWy. The lower column shows the relative value compared to the harmfulness of the direct disposal set as 1.

※3 Provisional Estimate by Nuclear Regulation Authority (Nov. 2011) (Case of Discount Rate 3 %) The figures of LWR disposal were calculated with two models, one with the current reprocessing & storage of used fuel, and the other with continuous reprocessing.

(Ref) Nuclear Fuel Cycle in Japan

5.5～6.5tPuf/y Plutonium usage by 16 to 18 MOX fuel load nuclear reactor
(Including 1.1tPuf/y plutonium usage by Ohma Nuclear Power Plant)

MOX Fuel

Nuclear Power Plant

Spent Fuel Pool etc.

Storing: approx.14,000tU
Storage capacity: approx.21,000tU

Spent Fuel

Separated plutonium: over 4tPuf/y

JNFL

Rokkasho Reprocessing Plant

Storing: approx.2,960tU
Storage capacity: 3,000tU

Max. capacity: 800t/y
(Plan of completion: Mar. 2016)

JNFL

MOX Fuel Fabrication Plant

Max. capacity: 130t-HM/y

(Start of construction: 2010
Plan of completion: Oct. 2017)

MOX fuel from reprocessing companies

Plutonium quantity possessed by electric utilities:
13.5tPuf (in UK)
10.6tPuf (in France)

NUMO

Geological disposal repository

Vitrified Waste

RFS

Off-site storage facility
(Spent fuel interim storage)

Electric utilities
(Tokyo Electric Power co./ Japan Atomic Power co.)

Mutsu: 5000tU
(Start of construction: 2010
Plan of operation(3000tU): Mar. 2015)

Spent Fuel

Next reprocessing plant

Fast Reactor (FR)

Waste from operation and decommissioning

Study on implementation of sub-surface disposal for waste from decommissioning(2002FY~)

JNFL

Vitrified Waste Storage Center

JNFL

Low-Level Radioactive Waste Disposal Center

JNFL

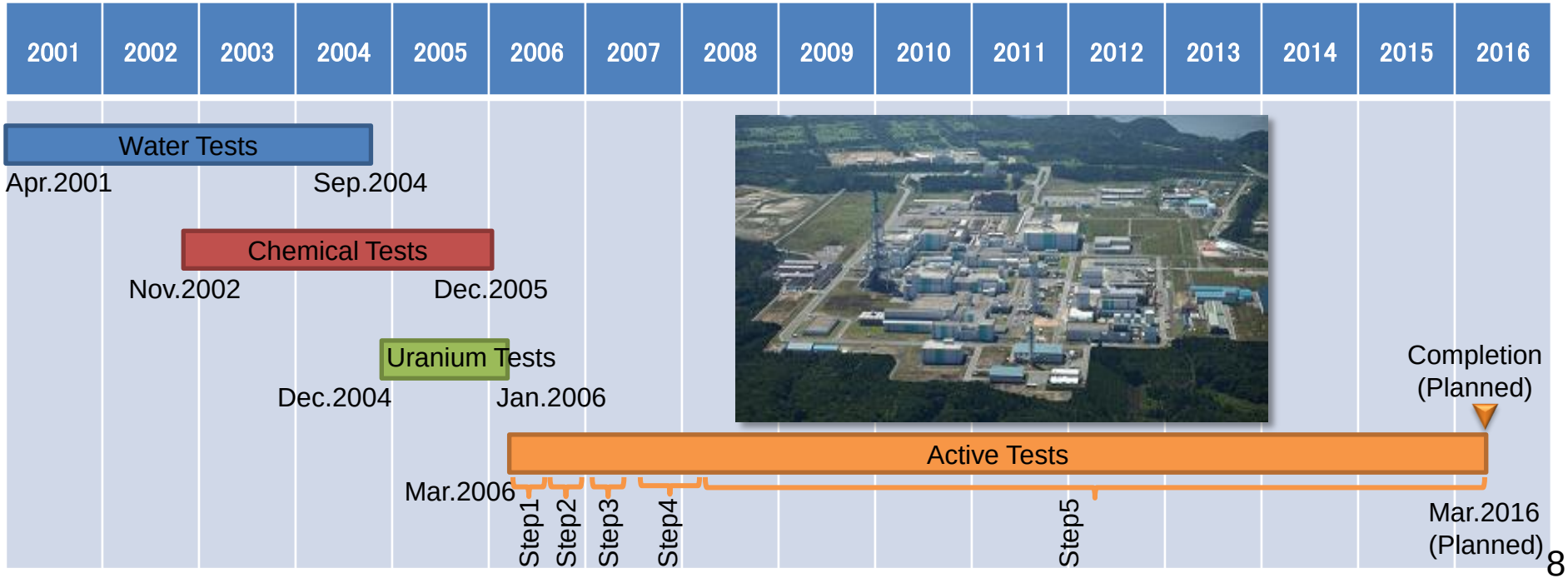
sub-surface disposal test cavern

Waste (from spent fuel reprocessing) returned from UK and France

JNFL: Japan Nuclear Fuel Limited
RFS: Recyclable-Fuel Storage Company
NUMO: Nuclear Waste Management Organization of Japan
MOX: Uranium-plutonium mixed oxide

(Ref) Current situation of Rokkasho Reprocessing Plant

- RRP began Active Tests in March 2006 with actual spent fuels. The tests such as extracting plutonium and uranium process were finished successfully. Although it took time to resolve some problems with the HALW(High Active Liquid Waste) vitrification process, the last stage regarding its stable operation was finally accomplished in May 2013.
- In January 2014, JNFL applied for a conformity assessment with the new regulatory requirements which were enforced in December 2013.
- JNFL now plans to complete the RRP in March 2016.



(Ref) Current situation of MOX Fuel Fabrication Plant

- Although JNFL started construction work of MOX Fuel Fabrication Plant in October 2010, construction work was interrupted temporarily by the influence of the earthquake etc.
- In January 2014, JNFL applied for a conformity assessment with the new regulatory requirements which were enforced in December 2013.
- JNFL now plans to complete the MOX Fuel Fabrication Plant in October 2017.

Maximum fabrication capacity	130 ton-HM / year
Products	MOX fuel assembly for domestic Light Water Reactors（BWR and PWR）
Size of main building	85 m x 85 m 3 basements, 2 elevated
Location place	Neighborhood of Rokkasho Reprocessing Plant
Construction cost	210 billion yen

Progress of construction: 8.6%
(September 2014)

OMA Full MOX-ABWR has the Policy-oriented roll in enhancing the flexibility of Japanese MOX utilization (*1)

- OMA acquired the Safety Establishment Permit in 2008 from uranium to full MOX core.
- Construction completed by 37.6% (2011/3/20)
- Turn over: to be fixed by construction progress with Fukushima countermeasures

Reactor Building

Date (*2)
2013/5/23

Turbine Building

Note (*1) Reprocessing of spent fuel and reuse of reprocessed U and Pu

(*2) Ref: http://www.jpower.co.jp/bs/field/gensiryoku/project/construction/schedule/index.html

(Ref) Current situation of Monju

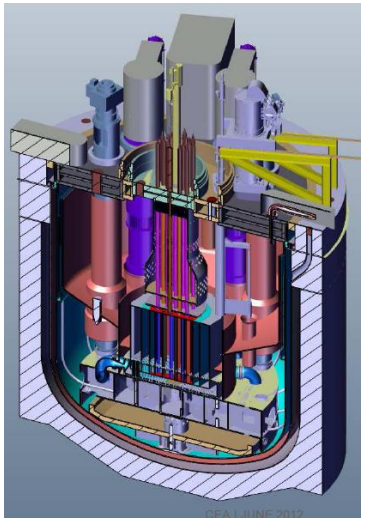
- **New Strategic Energy Plan (Apr.11, 2014)**
  - **Monju is positioned as an international research center for radioactive waste reduction, non-proliferation technology**
- **Activities toward Restart of Monju**
  - **Actions for "orders of measures necessary for maintenance based on Article 36, Section 1 of the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material, and Nuclear Reactors"**
  - **Countermeasures for external hazards and long-term SBO as one of the top safety priorities.**
  - **Future issues are to improve design and operation procedure in accordance with a new regulation safety standard mainly on the severe accident on the basis of Fukushima Dai-ichi accident.**

(Ref) Japan-France Cooperation on ASTRID Project- Outline of Cooperation -

- **General arrangement**
  "GENERAL ARRANGEMENT ON THE ASTRID PROGRAM AND SODIUM FAST REACTOR COLLABORATIONBETWEEN THE FRENCH COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, THE JAPANESE MINISTRY OF ECONOMY, TRADE AND INDUSTRY AND THE JAPANESE MINISTRY OF EDUCATION, CULTURE, SPORTS, SCIENCE AND TECHNOLOGY" was signed on May 5th, 2014 (Termination: Dec. 31st, 2019).
- **Implementing Arrangement**
  "IMPLEMENTING ARRANGEMENT ON THE ASTRID PROGRAM AND SODIUM FAST REACTOR COLLABORATION BETWEEN THE FRENCH COMMISSARIAT À L'ÉNERGIE ATOMIQUE ET AUX ÉNERGIES ALTERNATIVES, AREVA NP, JAPAN ATOMIC ENERGY AGENCY, MITSUBISHI HEAVY INDUSTRIES, LTD., AND MITSUBISHI FBR SYSTEMS, INC. " was signed on August 8th, 2014 (Termination: Dec. 31st, 2019).
- Japan and France are cooperating SFR development, including ASTRID program in the area of plant system design and R&Ds (Component and analysis code development, Measures for severe accident, Fuel).

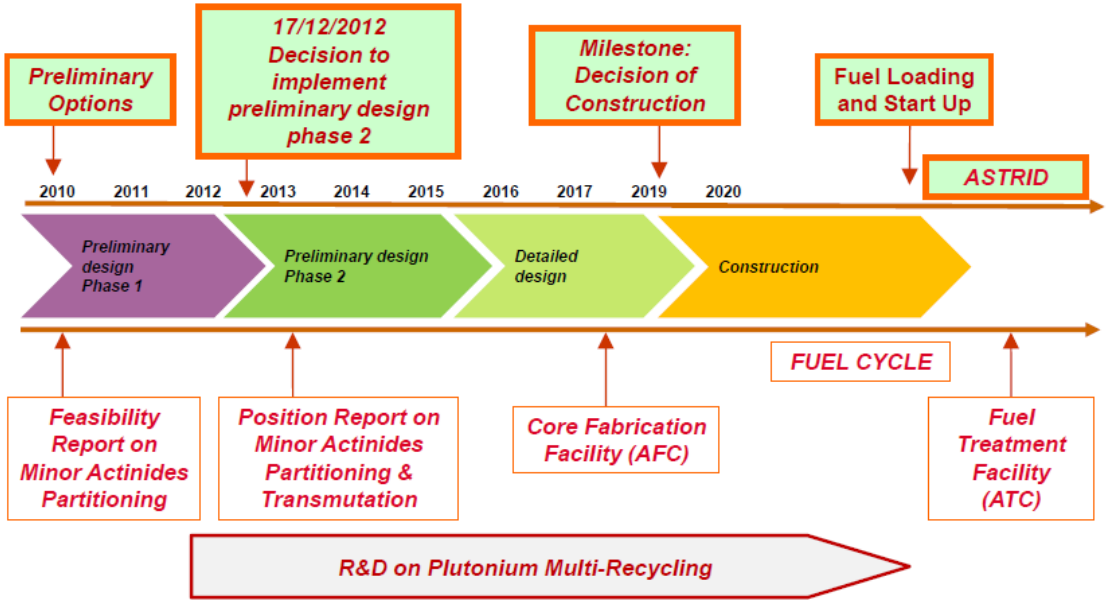
General Arrangement
Signing Ceremony at Palais de l'Élysée
(May 5th, 2014)

(Ref) Japan-France Cooperation on ASTRID Project



ASTRID:
Advanced Sodium Technological Reactor for Industrial Demonstration

【Main Features】
- Pool-type Sodium cooled fast Reactor
- Output: 600 MWe
- Strategy for severe accident (Core catcher, etc.)
- DHRS (Decay Heat Removal System)
- **Long-life nuclides transmutation (TRU burning) capability**



【Schedule】

2010～2012	Pre-Conceptual Design
2013～2015	Conceptual Design
2016～2019	Basic Design
2019	Decision to Build

Total Budget（2010～2017）
650 M€