Current Situation of Nuclear Power Generation in Japan

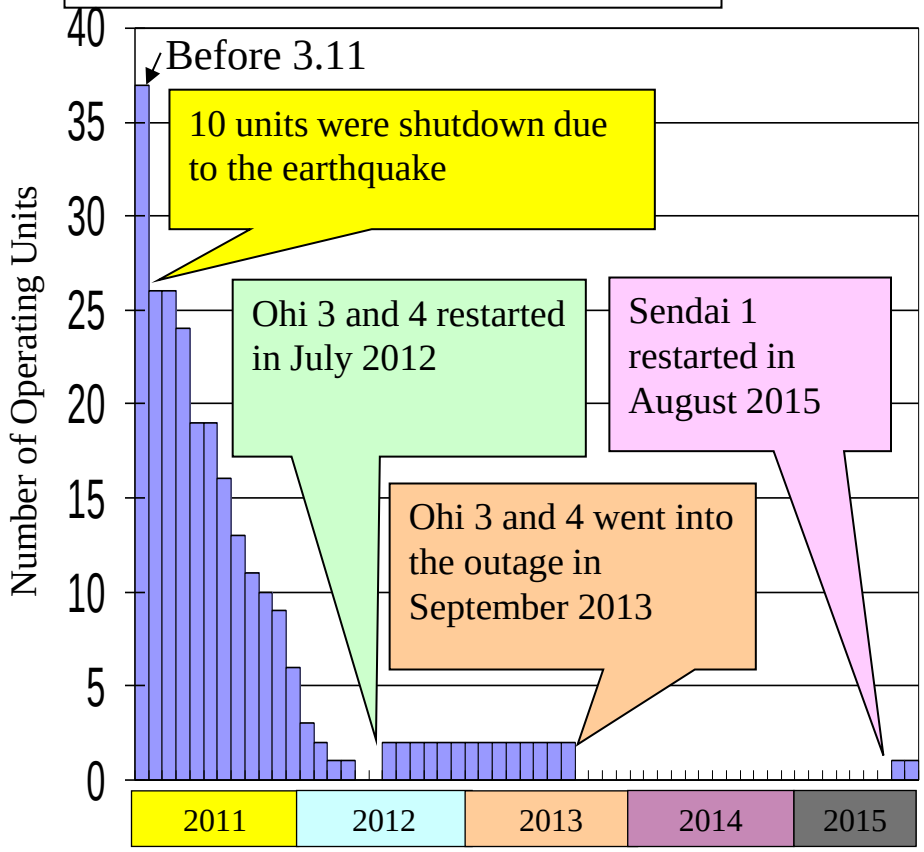
The Federation of Electric Power Companies of Japan

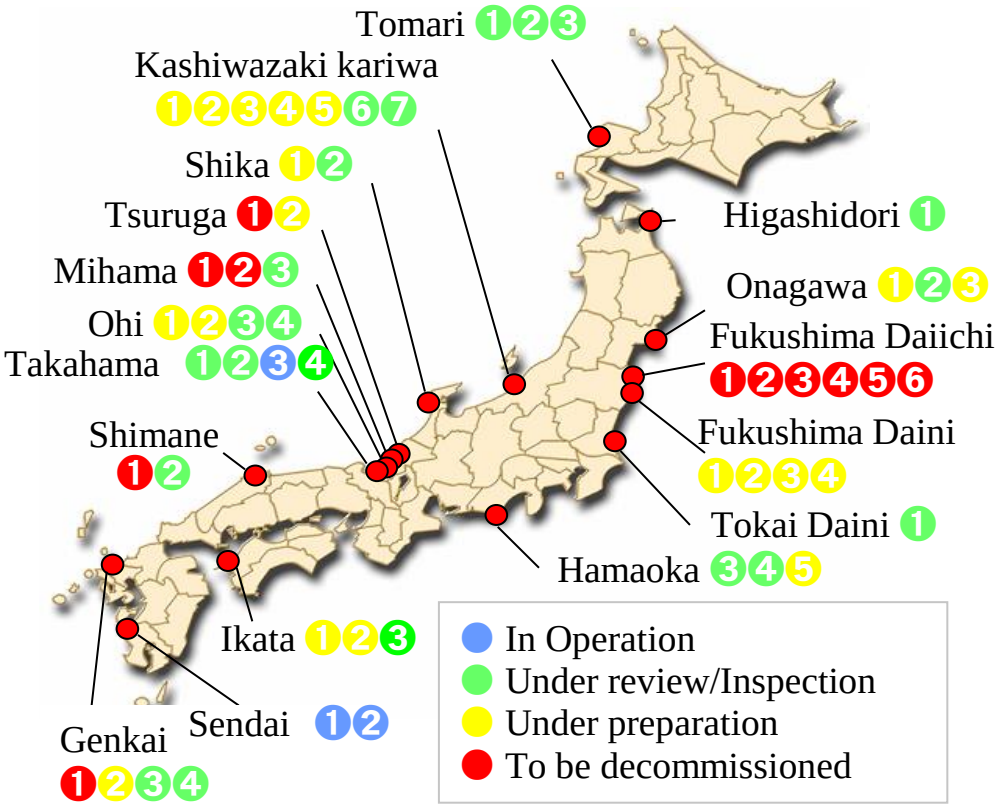
February 24, 2016

Current Situation of Nuclear Power Generation in Japan

- Due to the earthquake on March 11, 2011 and outage that followed, all 54 units were shut down in May 2012.
- Since then, 6 units declared decommissioning due to the accident, and 5 units declared decommissioning in March 2015.
- Sendai Unit 1 restarted commercial operation on September 10, 2015.

Operating Units after 3.11 in Japan



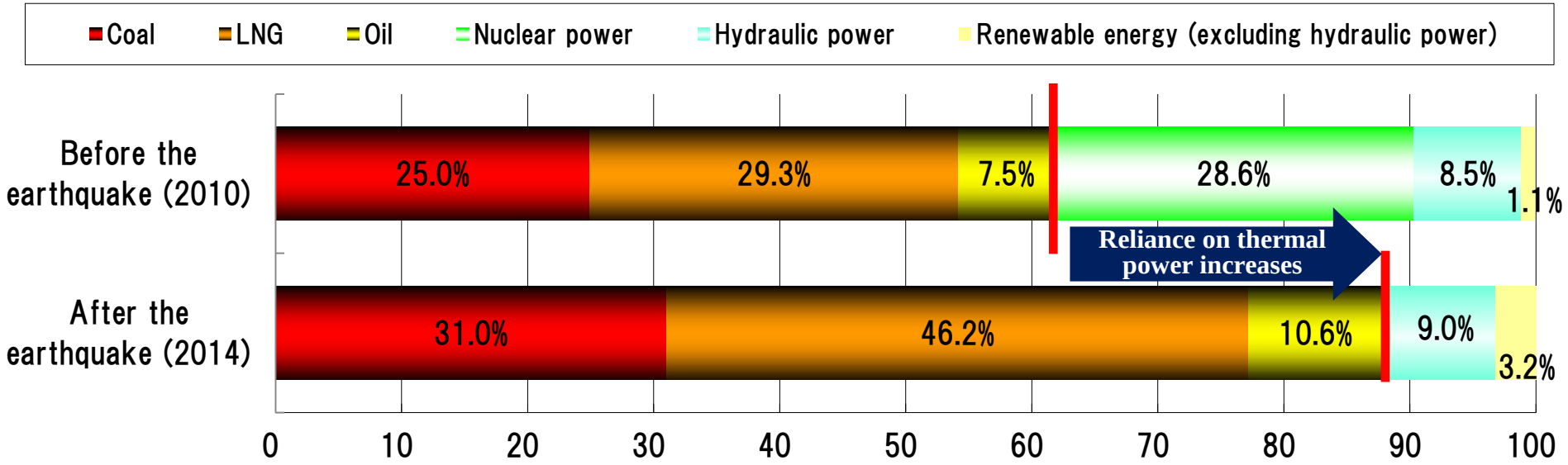


As of 31 Jan., 2016

Impact of Shutdown of Nuclear Power Stations since the Earthquake

◆ Due to increase of burnup at thermal power stations following shutdown of all nuclear power plants after the earthquake, approximately 90% of generated energy relies on thermal power. All 3E's were impaired.

Composition ratio of generated energy



All 3E's (energy security, economy, environmental conservation) are impaired

Energy security	Economy	Environmental conservation
(reliance on fossil fuel)	(increase of thermal power fuel cost)	(increase of amount of CO_2 emitted)
(approx. 60% ⇒ approx. 90%)	**(increase of approx. 4 trillion yen)**	**(increase of approx. 100 million tons of CO_2)**

Note: Figures in red in ( ) are comparison of FY2010 and FY2014

Energy Policy in Japan after the Earthquake

- For simultaneous achievement of S and 3E's, nuclear power generation is an important base load power supply.
- Cost of nuclear power generation is cheap, even when taking accident risk response cost into account.
- Ratio of nuclear power generation among power supplies will be maintained at around 20-22% in FY2030.

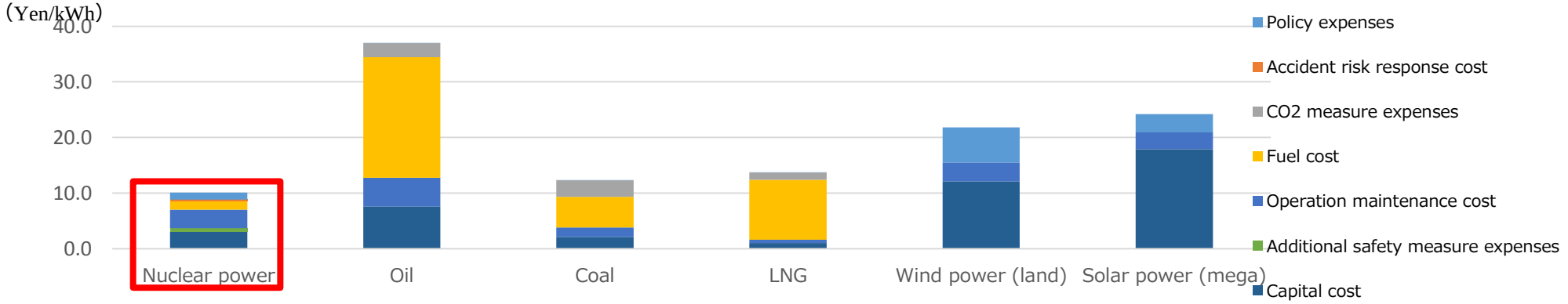
Framework of basic energy plan (related to nuclear power) [April 2014]

○Nuclear power generation is an important base load power supply, but its ratio will be reduced as much as possible

○Restart is promoted for nuclear power stations that have conformed to new regulatory requirements

○Nuclear fuel cycle including reprocessing and use of MOX will continue to be promoted

Trial calculation of cost by power supply (trial calculation of 2014 model plant) [April 2015]



Development of energy mix plan [April 2015]

○Composition ratio of power supply in 2030

Nuclear power	Oil	Coal	LNG	Renewable energy
Around 20-22%	Around 3%	Around 26%	Around 27%	Around 22-24%

Approach of Operators in Japan Concerning Nuclear Power

- We, the operators in Japan, continue to make efforts to use nuclear power station and to establish nuclear fuel cycle.
- For use of nuclear power, major premise is safety.

Viewpoint of "S+3E" is important when thinking about energy

Approach of operators in Japan concerning "nuclear power"

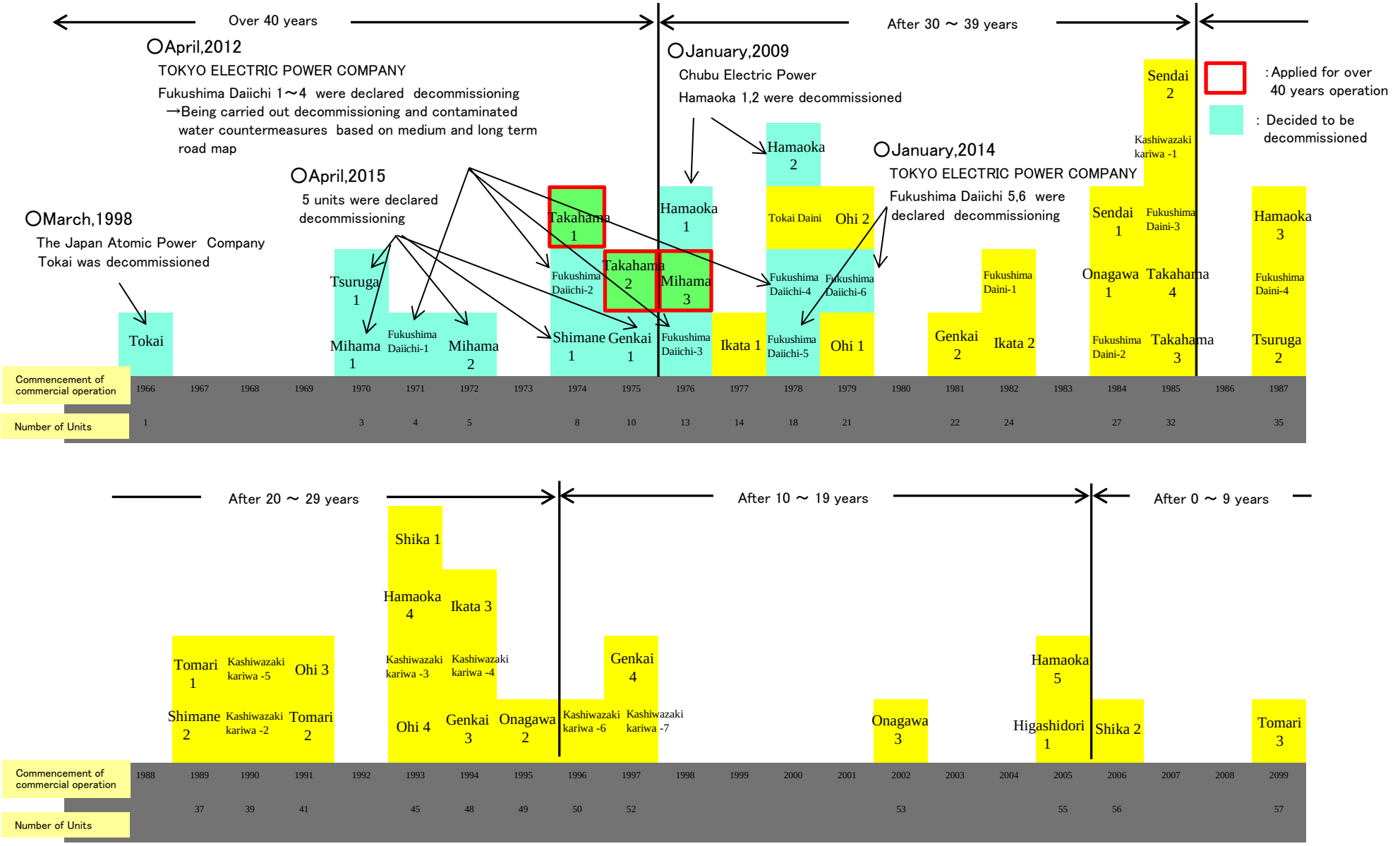
(1) Continue to use nuclear power as an important power supply excelling in 3E's.

(2) Promote restart of nuclear power stations that conform to regulatory requirements, in full-scale.

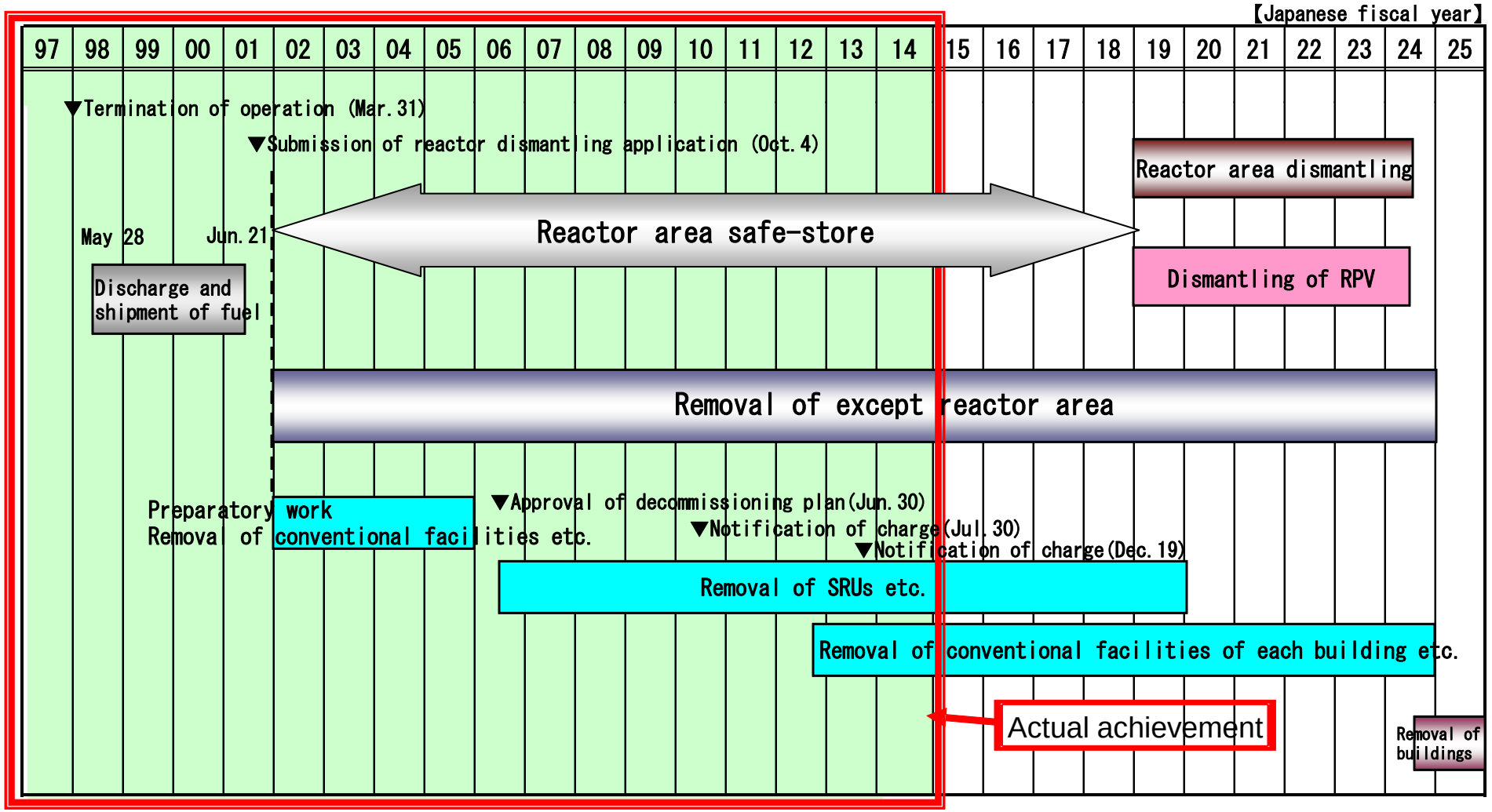
(3) Make efforts for the completion of the reprocessing facility as there is no change in importance of the nuclear fuel cycle.

For use of nuclear power, major premise is safety (S)

Years of Operation about Nuclear Power Generation in Japan (As of January 31,2016)



Decommissioning Schedule（Tokai Power Station）

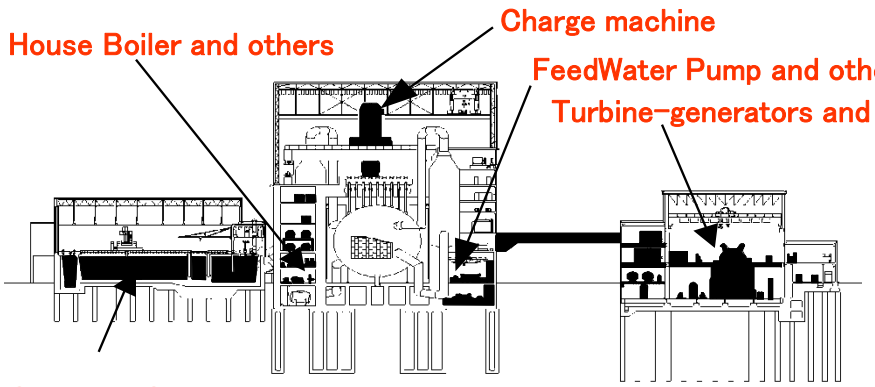


Outline of Tokai Power Station Decommissioning Work

■ : Decommissioning work area

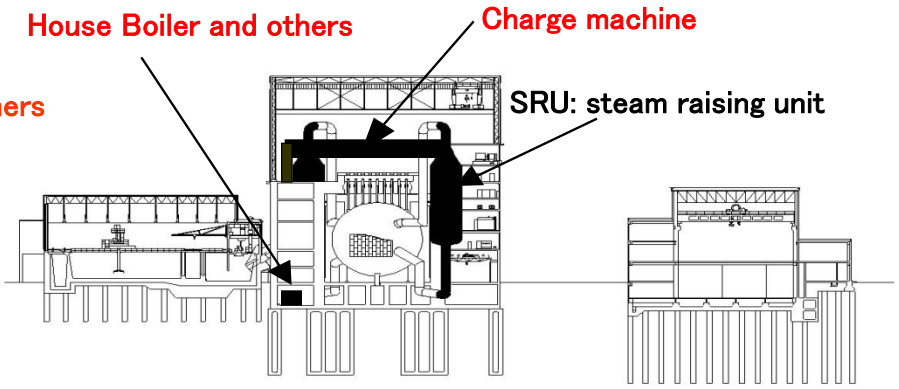
First Phase

Removal of except reactor area



Second Phase

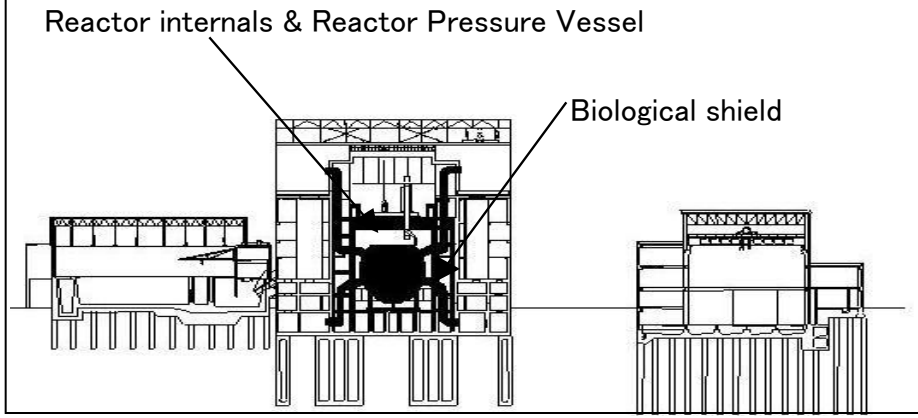
Removal of except reactor area (mainly SRUs)



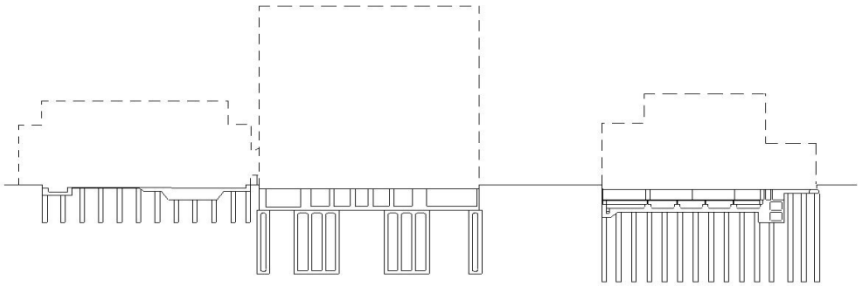
(Figures in red were completed)

Third Phase

Reactor area dismantling

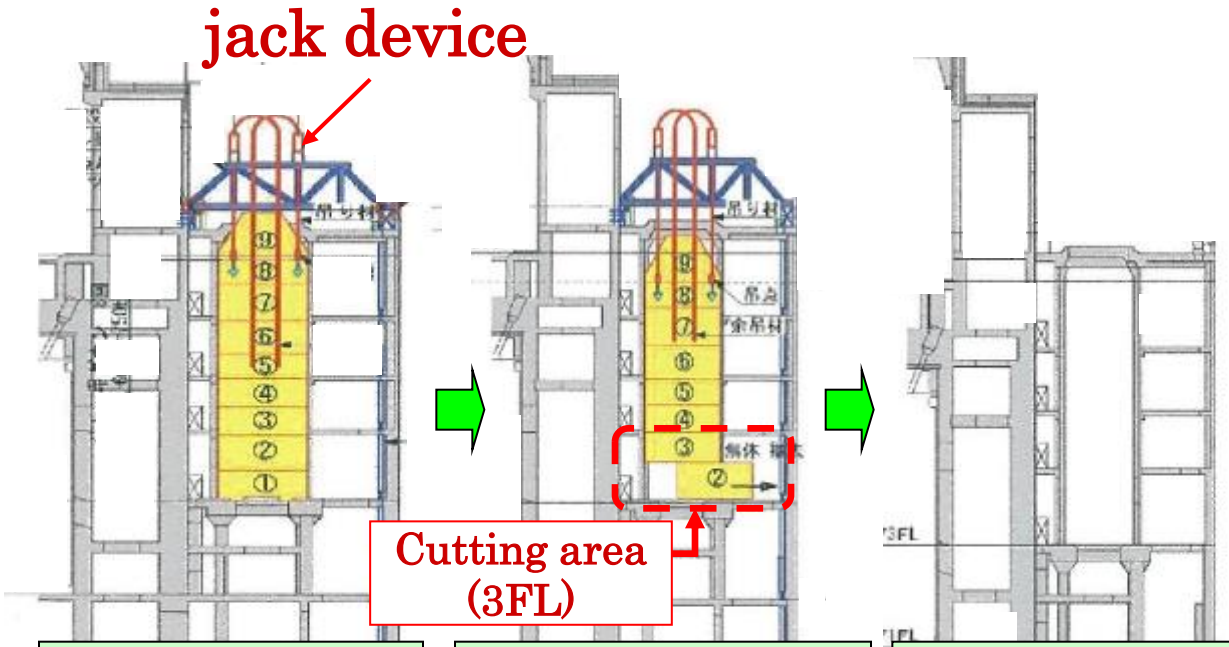


Removal of building



Note: Basement and foundation of building will not be removed

Outline of SRU Removal



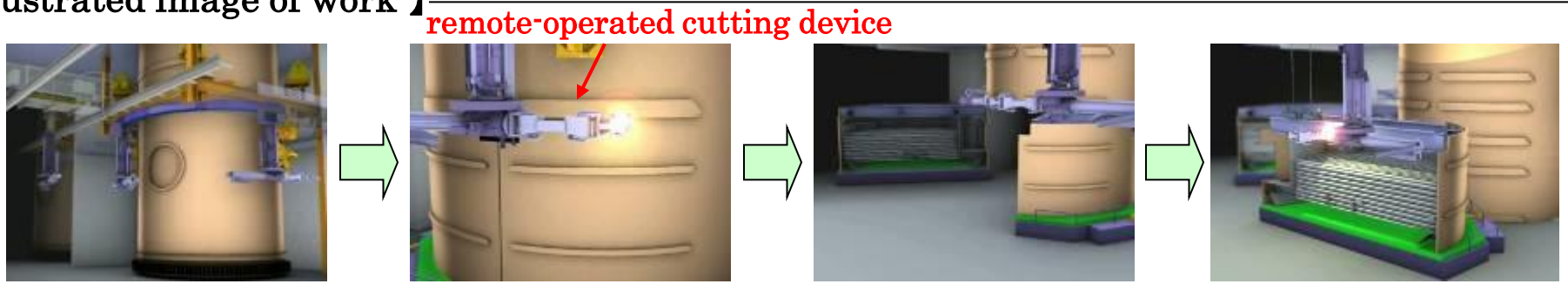
Install of temporary frame and jack device

Jacking down (tier 1-9)

Removal of temporary frame and jack device

- SRU
  - height：24m
  - diameter：6m
  - weight：750t
- 'Tier'
  - height ：1．7～3．2m
  - diameter ：6m
  - weight ：54～135t
  - thickness：54～94mm

【 Illustrated image of work 】



〔Layout of cutting device 〕 〔Primary cutting 〕 〔Transport of cut piece〕 〔Secondary cutting 〕

Enhancement of Safety Improvement Measures after the Fukushima Daiichi Accident

				【Measures before the accident】	【Measures immediately after the accident】	【Further safety improvement measures】
Beyond design basis (severe accident)	5th phase	Prevention of human damages Recovery of environment		Disaster prevention	- Enhancement of emergency response structure - Severe accident measures - Preparation of heavy machinery for removal of debris, etc. - Emergency safety measures Securing of power supply Securing of cooling Flooding measures	- Establishment of nuclear emergency support organization - Securing of power supply - Securing of cooling - Anti-seismic administration building - Filter vent facility - Facilities for handling specific severe accidents
	4th phase	Prevention of large-scale release Prevention of damage of containment vessel (suppression of release / mitigation of spread)		Accident management - Accident management measures by normal system equipment to avoid core damage and containment vessel damage caused		
	3rd phase	Mitigation of impact of accident	Prevention of severe core damage			
			Prevention of core damage Maintaining integrity of containment vessel	Emergency core cooling system, containment vessel spray system, etc.		【Enhancement of design for natural events】 - Enhancement of earthquake measures - Enhancement of tsunami measures - Enhancement of fire measures - Enhancement of tornado measures
Design basis	2nd phase	Prevention of abnormal spread		Detection of abnormality / shutdown system, etc.		
	1st phase	Prevention of abnormality		Interlock, etc.		

(Key)

Scope of measures before the Fukushima Daiichi Nuclear Power Station accident	Scope of measures after the Fukushima Daiichi Nuclear Power Station accident

Measures to Secure Power Supply and Cooling, and to Prevent Flooding (Examples of Measures by Hardware)

Measures immediately after the accident

Emergency safety measures

Securing of power supply

Preparation of power source cars

Securing of cooling

Preparation of portable pumps and hoses

Flooding measures

Application of waterproofing seal to penetration

Further safety improvement measures

Currently being implemented (examples of measures)

Preparation of air-cooled emergency generator

Preparation of large-capacity pump truck

Preparation of reserve seawater pump motor components

Replacement to watertight door

Seawater pump waterpro of wall

Raising of seawall

Anti-seismic building

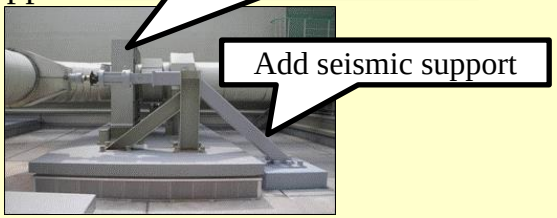
Water cannon

Natural Event Measures (Examples of Measures by Hardware)

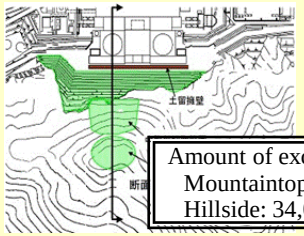
Further safety improvement measures – natural event measures

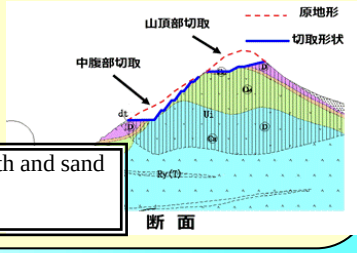
Earthquake measures (example)

(1) Seismic reinforcement of pipe support



(2) Stabilization of surrounding slope



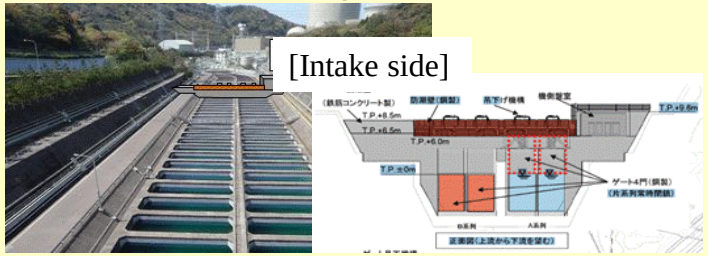


Amount of excavated earth and sand
Mountaintop: 60,200m^3
Hillside: 34,000m^3

Tsunami measures (example)

(1) Raising of seawall

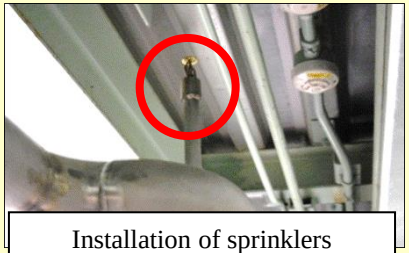
(2) Installation of tide gate



(3) Seawater pump waterproof wall

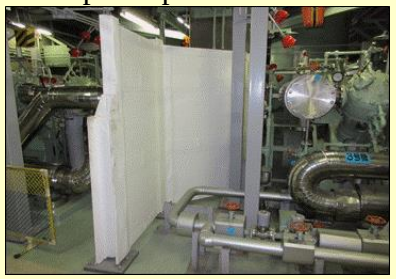
Enhancement of fire measures (example)

(1) Installation of sprinklers



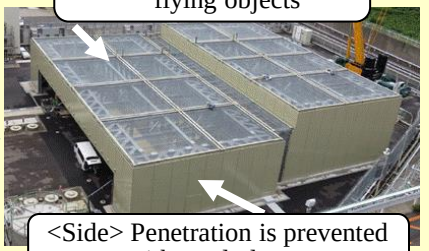
Installation of sprinklers
(approx. 1600 areas / 2 units)

(2) Installation of fire spread prevention wall



Tornado measures (example)

(1) Measure to protect against flying objects



Measures to Improve Emergency Response Structure (Examples of Measures by Software)

Measures immediately after the accident

Enhancement of emergency response structure

- ○Increase of initial response personnel
- ○Development of operation assistance structure
- ○Enhancement of liaison and support structure with manufacturer
- ○Development of manual and training
- ○Securing of communication method that does not breakdown, etc.

Further safety improvement measures

Currently being implemented (examples of measures)

Establishment of nuclear emergency Support Center

- ○24-hour on-call standby for 365 days
- ○Training and development of personnel
- ○Maintenance and management of robots and other equipment and materials, etc.

Robot operation training

Transfer to nuclear emergency support organization

Development as a disaster response organization with the world's highest level of standards that is capable of diversified and high-level disaster response under high radiation dose

Small robot, small UAV

Collection of information, opening and closing of door

Wireless heavy machinery

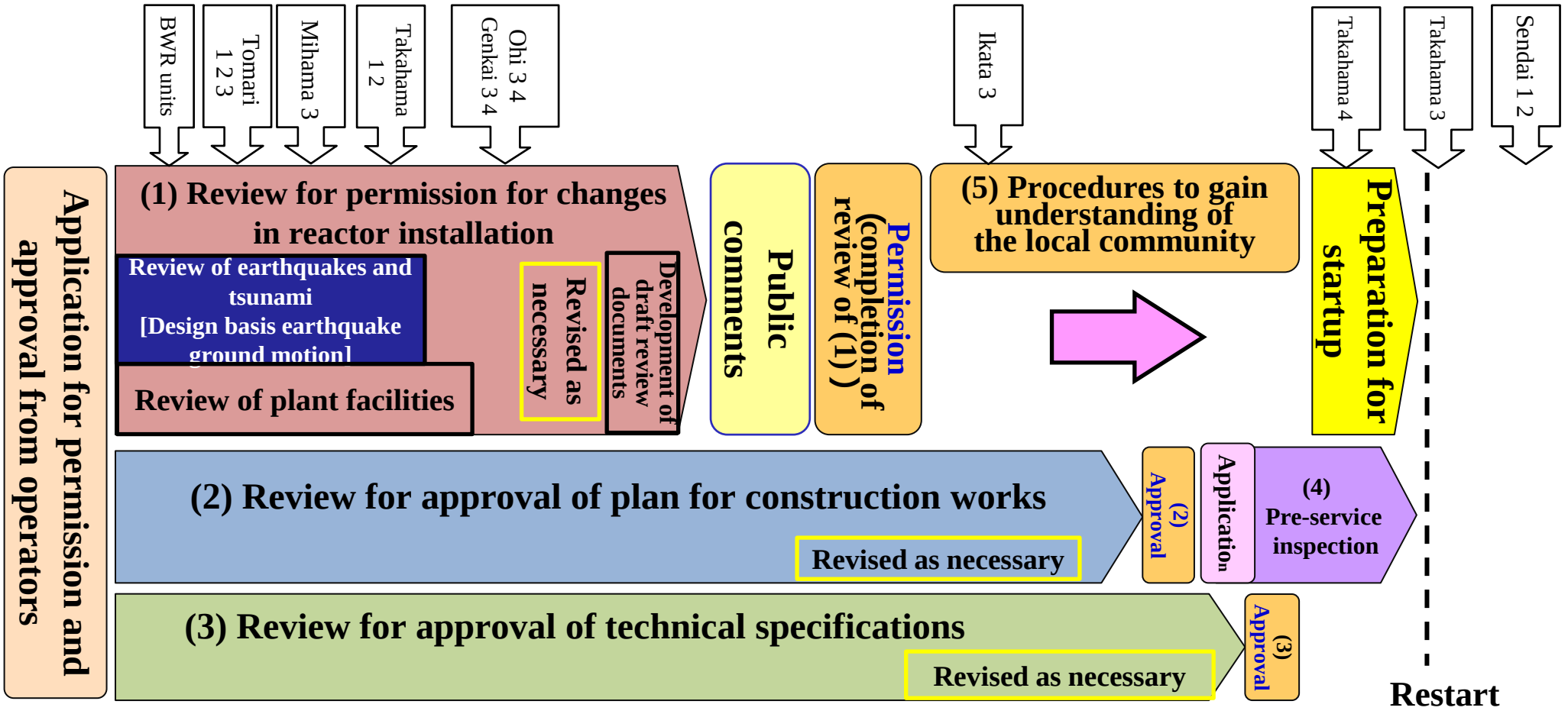
Removal of obstacles and debris

Wireless relay van

Heavy machinery control truck

Status of Review for Checking Conformity to New Regulatory Requirements

- 24 units applied for review for checking conformity to New Regulatory Requirements. 5 units gained permission for changes in reactor installation, 1 unit restarted operation, 2 units are undergoing pre-service inspection, and 2 units are having their plan for construction works reviewed.



*Takahama Units 1 and 2 applied for approval of extension of operation period to 60 years

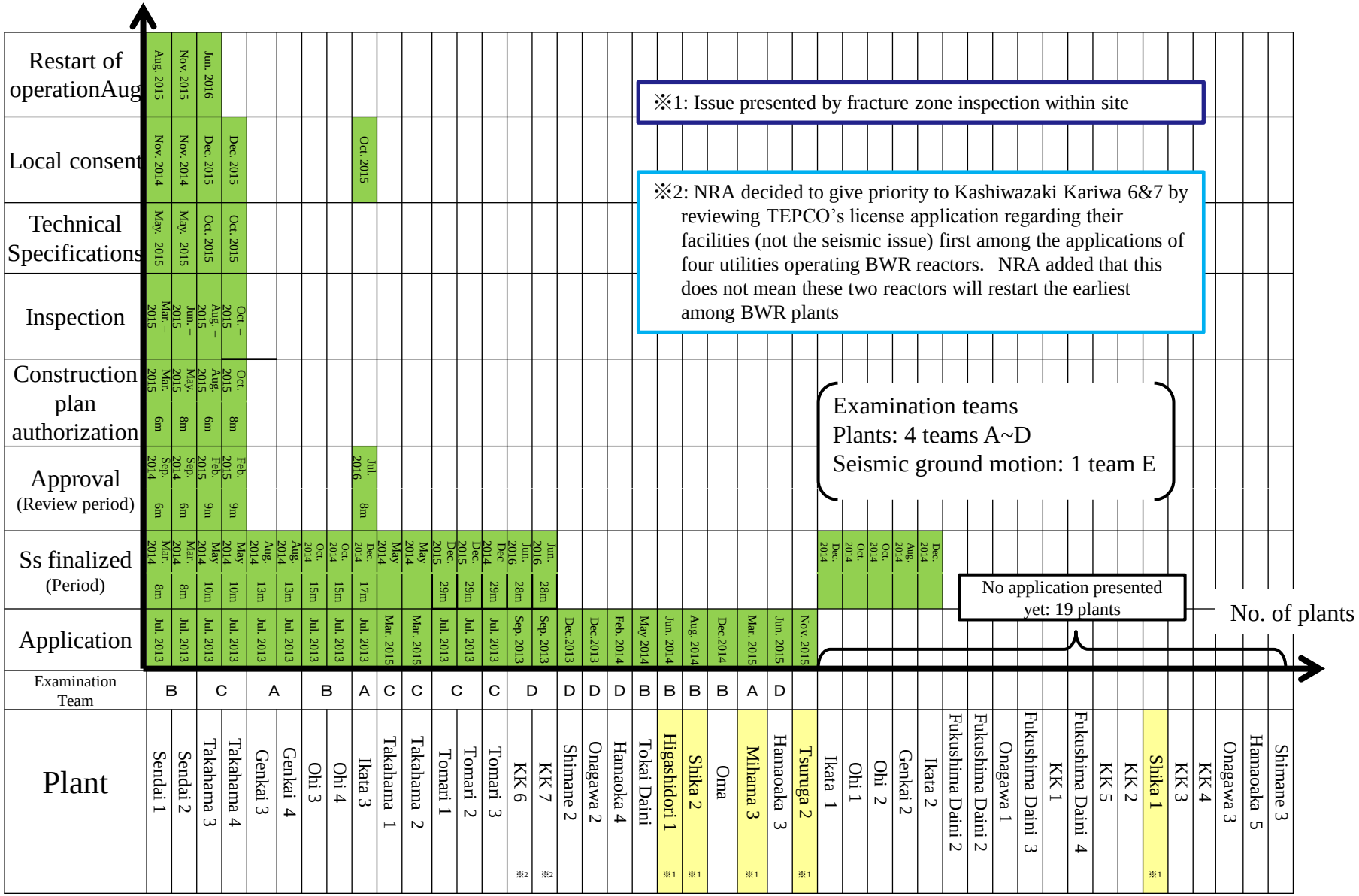
Restart status of nuclear power plants in Japan

【Restart status】

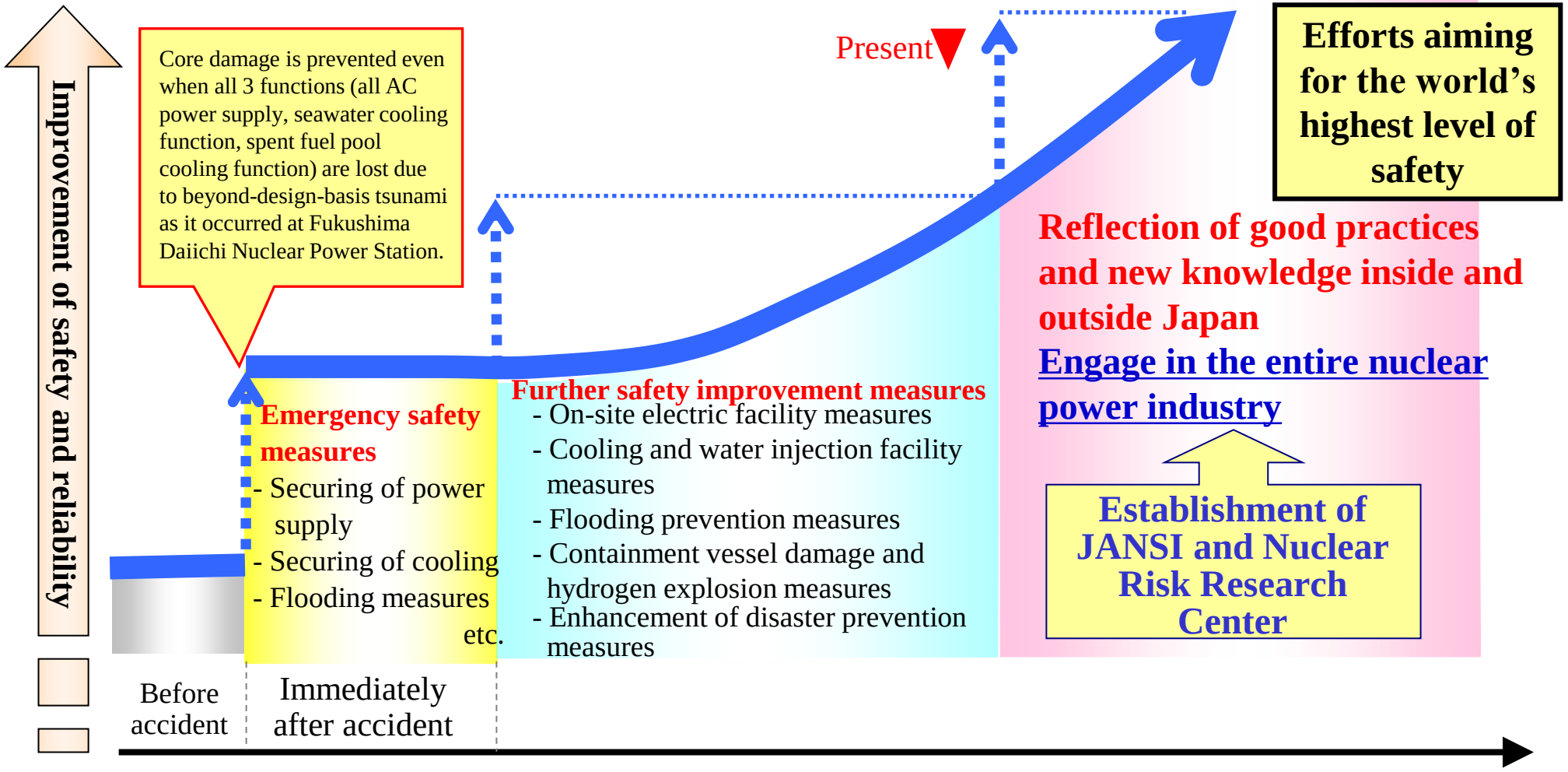
- Sendai unit 1 restarted commercial operation in September 2015, and Sendai unit 2 restarted commercial operation in November 2015.
- Takahama unit 3 started up the reactor (on January 29, 2016) and reached criticality (on January 30, 2016) and connected the generator in parallel and started generating power (on February 1, 2016) and now is preparing for commercial operation.
- Takahama unit 4 finished fuel loading and now is preparing for start-up.

	Takahama unit 3	Takahama unit 4
Plan for construction	Aug. 4, 2015 approval	Oct. 9, 2015 approval
Operational safty program	Oct. 9, 2015 approval	
Pre-operational inspection	Aug. 4, 2015 applied Aug. 17, 2015 started	Oct. 14, 2015 applied Oct. 21, 2015 started
Fuel loading	finished(Dec. 25～Dec. 28)	finished（Jan. 31～Feb. 3）
Reactor startup	Jan. 29, 2016	**In Feb. 2016 scheduled**
Comprehensive inspection	**In late Feb. 2016 scheduled**	**In Mar. 2016 scheduled**

Progress Toward Restart of operation

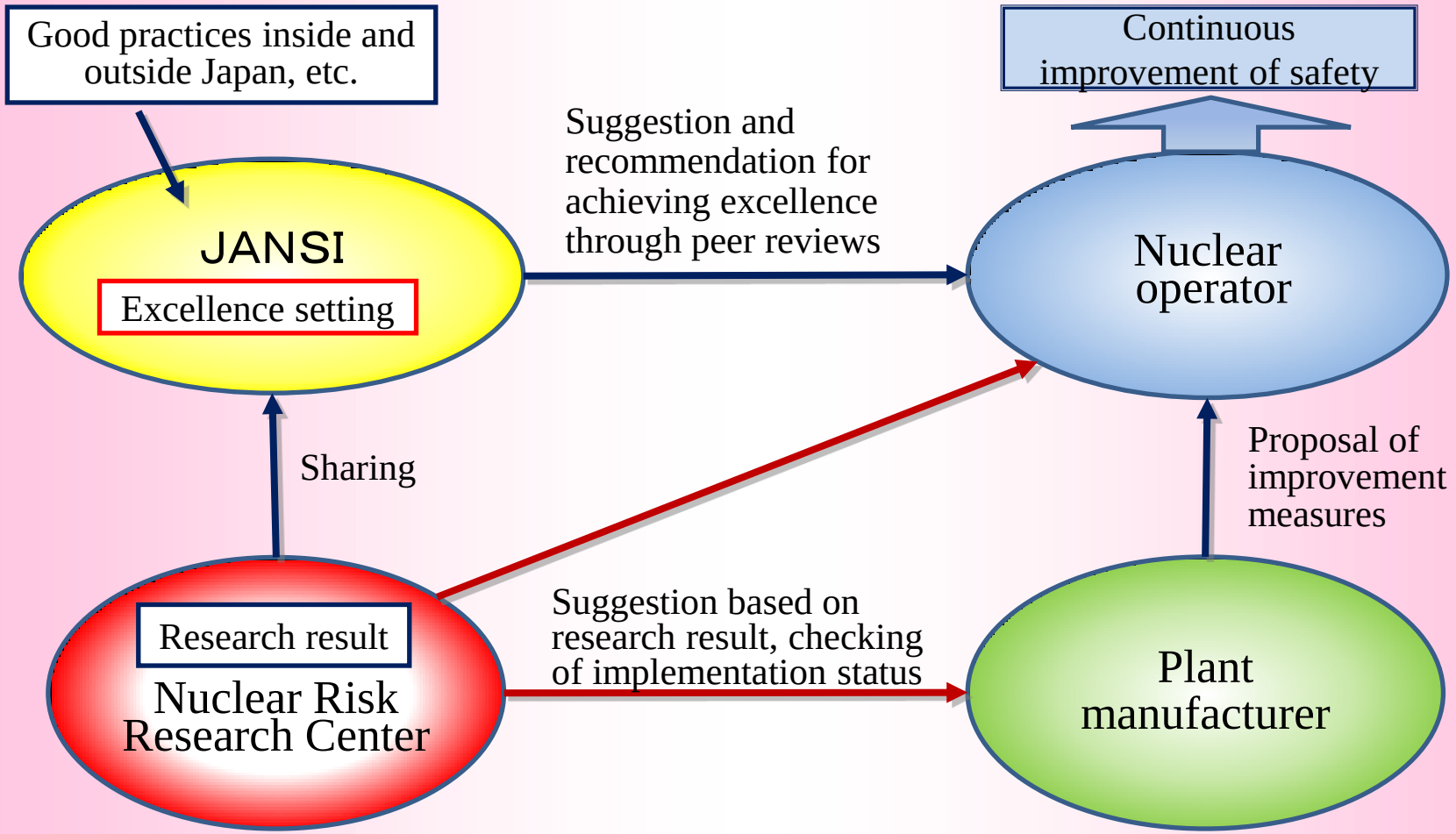


- Thorough safety improvement measures are implemented under a strong leadership with the determination to "continue making reforms and aim for the world's highest level of safety".



Reflection of good practices and new knowledge inside and outside Japan

Role of JANSI and Nuclear Risk Research Center



Efforts of JANSI

JANSI

- All presidents are to support activities of JANSI under the strong sense of crisis that “there will be no future for nuclear power in Japan unless JANSI functions”.

- JANSI was established in November 2012 aiming to become Japan’s version of INPO, under the determination to “never again let the Fukushima Daiichi accident occur”.
  - ✓ Mission is “untiring pursuit of the highest standards of excellence” in Japan’s nuclear power industry.
  - ✓ Aim to acquire equivalency as WANO peer review.
  - ✓ Plan to establish a structure as a self-regulation organization after 5 years of establishment.

Nuclear Risk Research Center (NRRC)

◆Operators are to commit to activities of NRRC and reflect the result in their safety improvement activities, in order to make the risk management structure more robust.

➢ On October 1, 2014, NRRC was established as the base for research and development necessary for voluntary improvement of safety of nuclear power generation.

✓Research concerning low-frequency external events such as earthquakes and tsunami

✓Supports structuring of PRA comparable to international standards, in order to structure “good PRA” which is helpful in decision-making of operators using risk information

Conclusion

- We, nuclear operators in Japan, will continue to proactively take action aiming for world's highest level of safety as the ones with prime responsibility for securing safety of nuclear power stations.
- We will continue to operate nuclear power stations with safety first policy.