Restart Status of Japanese NPPs & Super Engineer Education Project

Development of High Efficiency Multi-Nuclide Aerosol Filters for Radiation Protection for Decommissioning Fukushima Daiichi

ISOE ALARA Symposium, January 9, 2018

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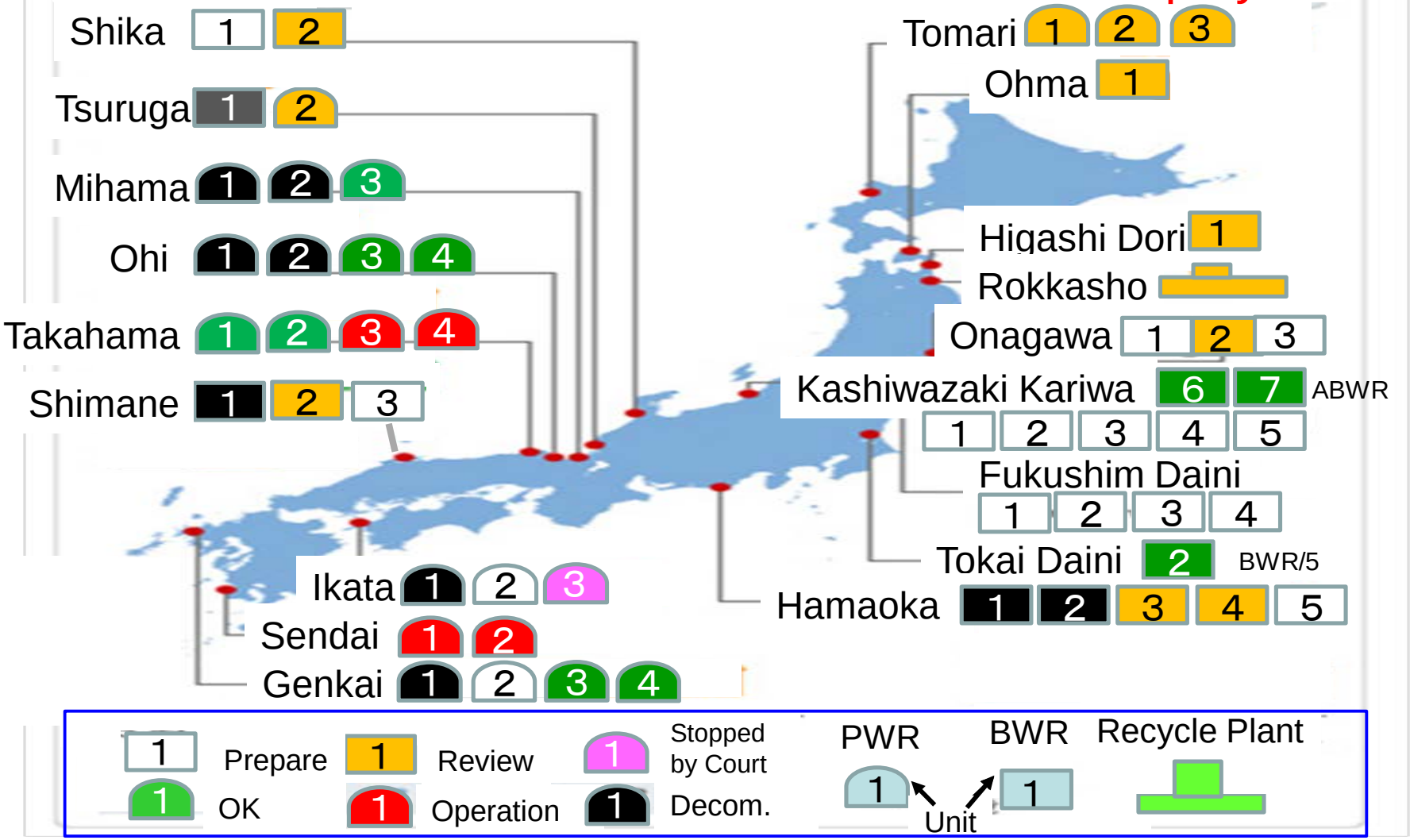
Professor, Nuclear & Environmental Systems,
Hokkaido University

Restart Status of Japanese NPPs

- New Regulatory Passed: PWR 12NPPs, BWR 2NPPs+1NPP
- Five NPPs restarted, but Ikata NPP forced to stop by court



5 PWRs restarted in 2015 and 2016

Sendai 1, 2 restarted in December 2015.

Risk of Justice is bigger than that of natural hazards, in Japan.

Ikata 3 restarted, Aug., 2016. But Court ordered to stop operation, Dec., 2017.

A judge ordered to stop operation of Ikata 3, on Dec. 17. The reason is a volcano 90,000 years ago.

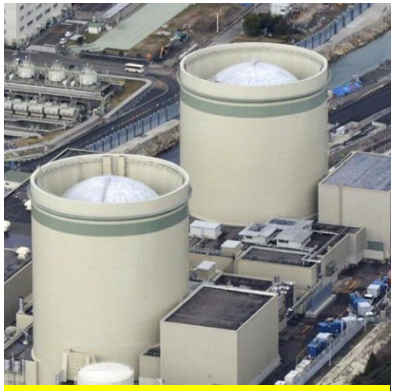
Takahama 3,4 restarted in 2016, after 1 year stop by court .

4 PWRs will restart in 2018

Genkai 3,4 and Ohi 3,4 will restarted from March to May, 2018.

Genkai 3,4

Ohi 3,4



Takahama 1,2

- Takahama 1,2 will restart Oct. 2019, by 60 years license.
- Mihama 3 will restart after March 2020, by 60 years license.
- Mihama 1 and Ohi 1,2 will be decommission because of high cost of renewal.

Mihama 3

Mihama 1

Ohi 1,2 (Ice Condenser CV)

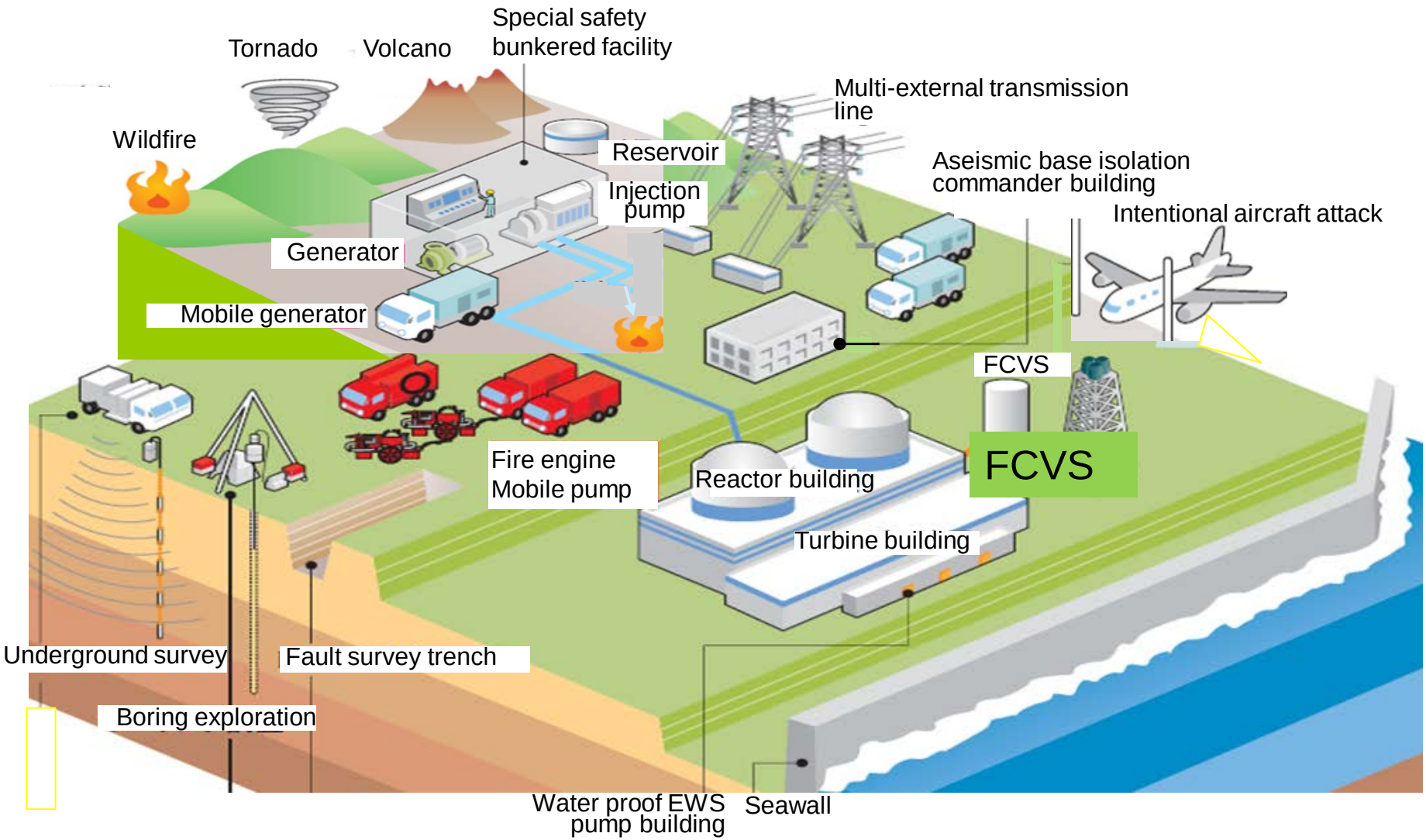
Kashiwazaki Kariwa passed for Restart

- Tepco Passed NRA (Nuclear Regulatory Authority Japan)'s review to restart Kashiwazki Kariwa 6,7.
- Reactor building was enforced to be a castle for ECCS survival.

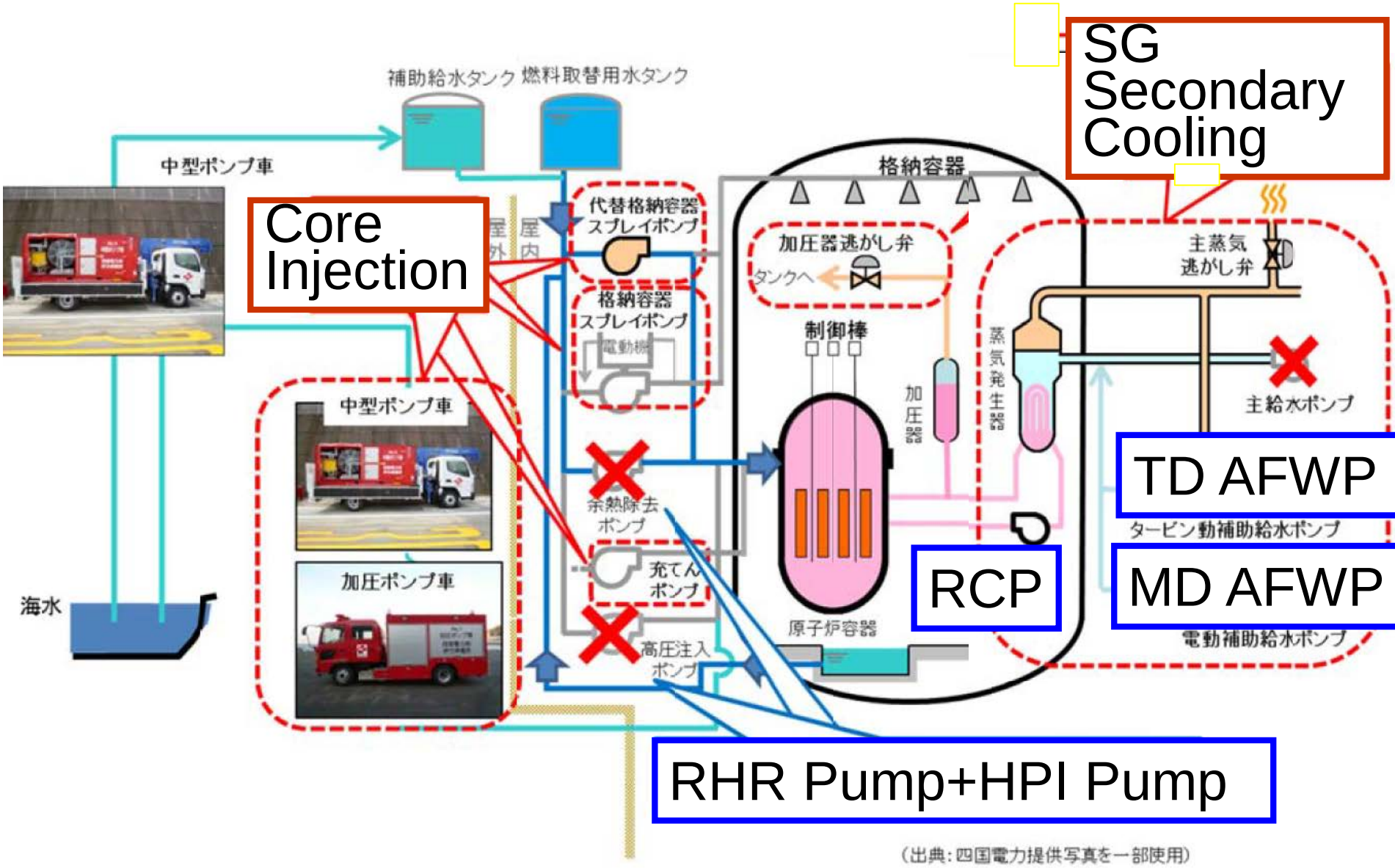
Kashiwazaki Kariwa 6,7 (ABWR 1356MW X 2)

Grand Elevation of KK 7 is 12m

New Regulatory Requirements



Depressurization & Core Cooling for PWR



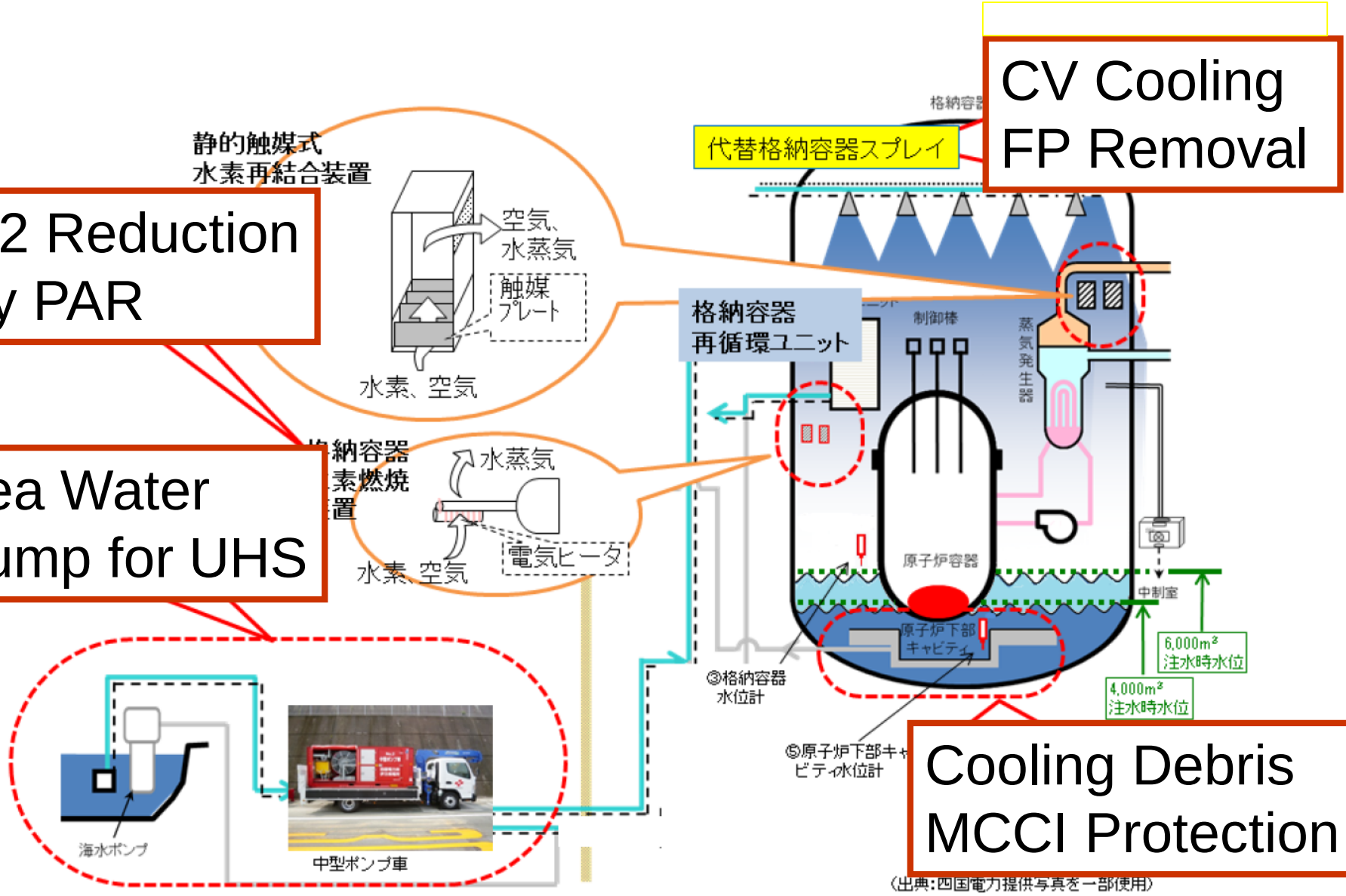
Containment Vessel Cooling after BDBA

CV Cooling
FP Removal

H2 Reduction
by PAR

Sea Water
Pump for UHS

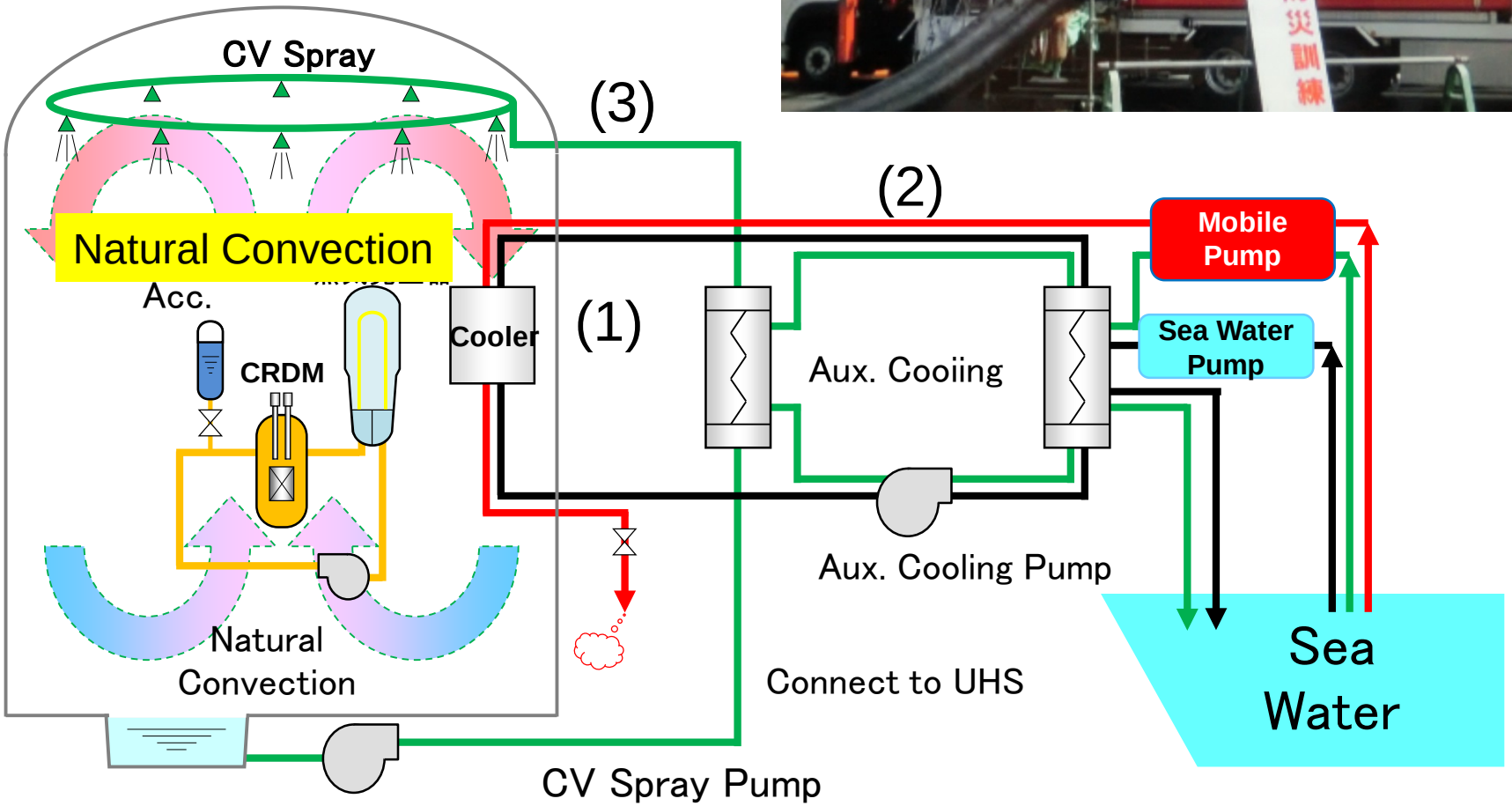
Cooling Debris
MCCI Protection



（出典：四国電力提供写真を一部使用）

CV Cooling using a Mobile Pump

(1)CV Cooling unit
(2)Seawater (3) CV Spray



Tsunami Protection: Water proof door

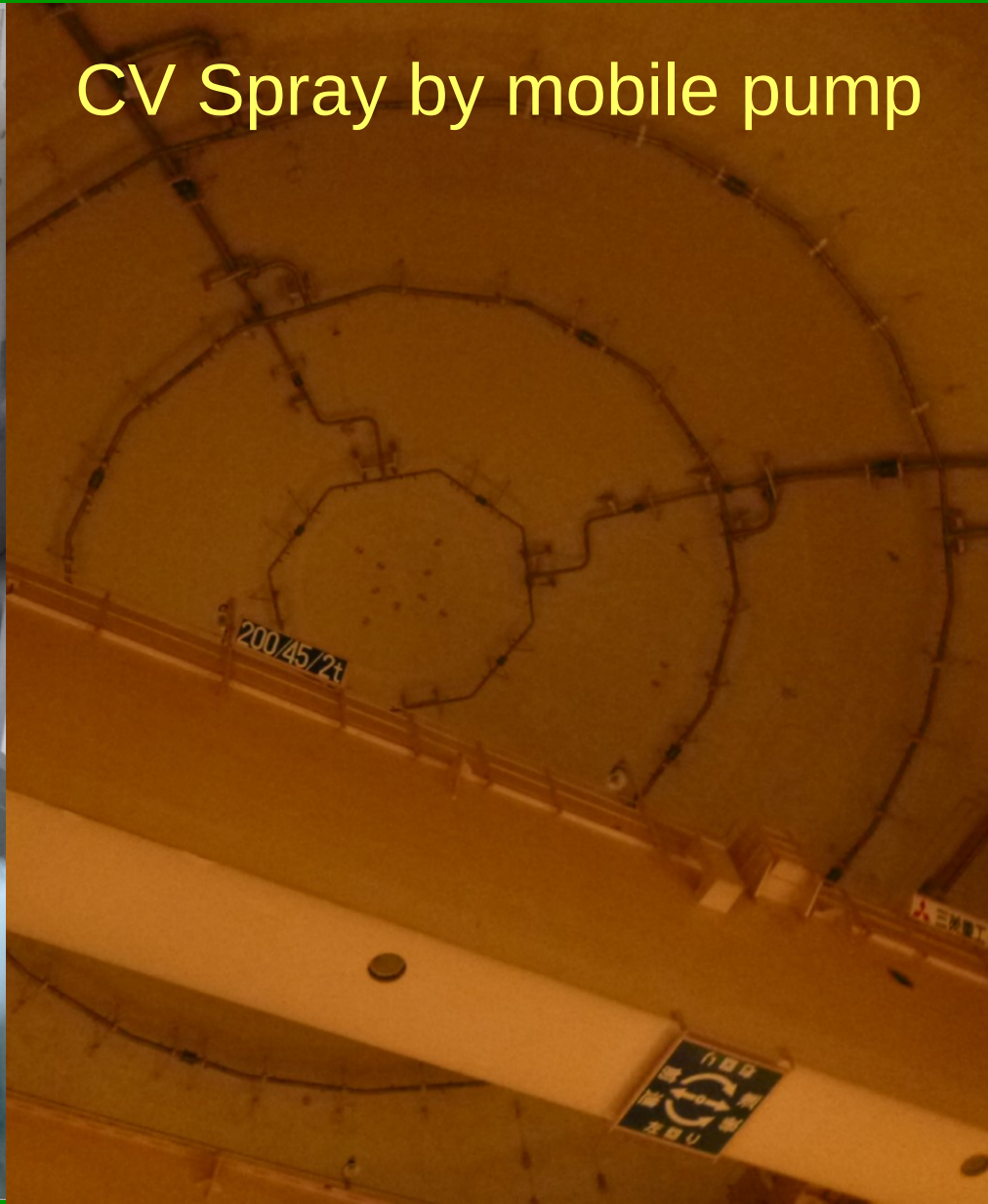
Water Proof Door

Motor Driven Mobile Pump

Alternative Injection Pump

Diesel Engine Driven Mobile Pump

Resilience for CV Cooling



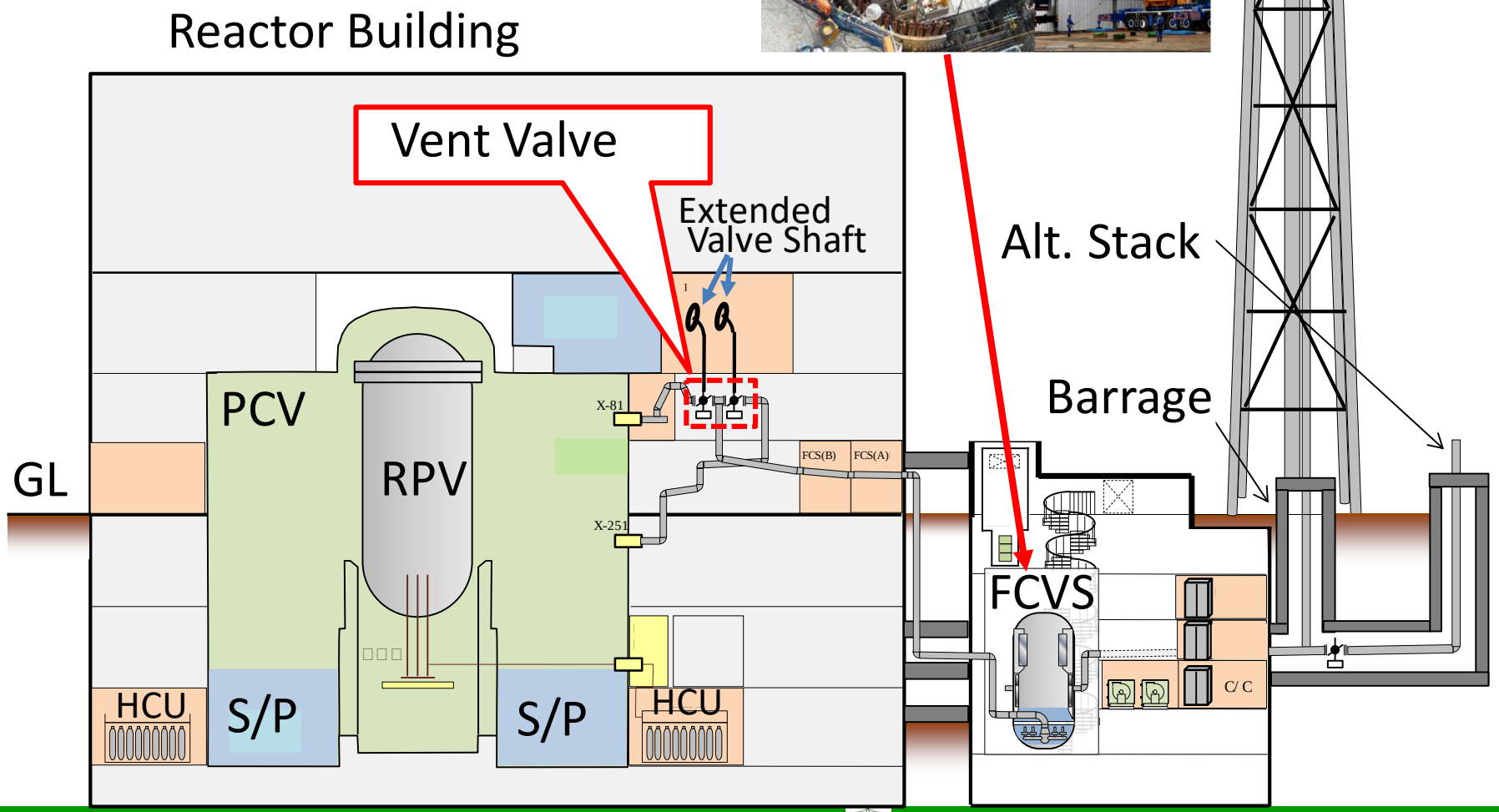
Resilience for H_2 Accumulation

Hydrogen Passive Autocatalystic Recombiner

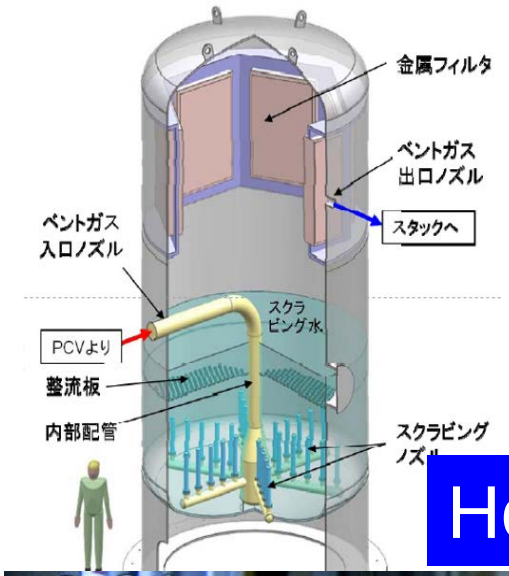
Heated Ignaiter

FCVS will be installed under ground Pit

- FCVS will be installed under ground Pit (Banker)



Filtered Containment Venting system



AgX RASA

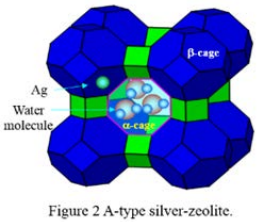
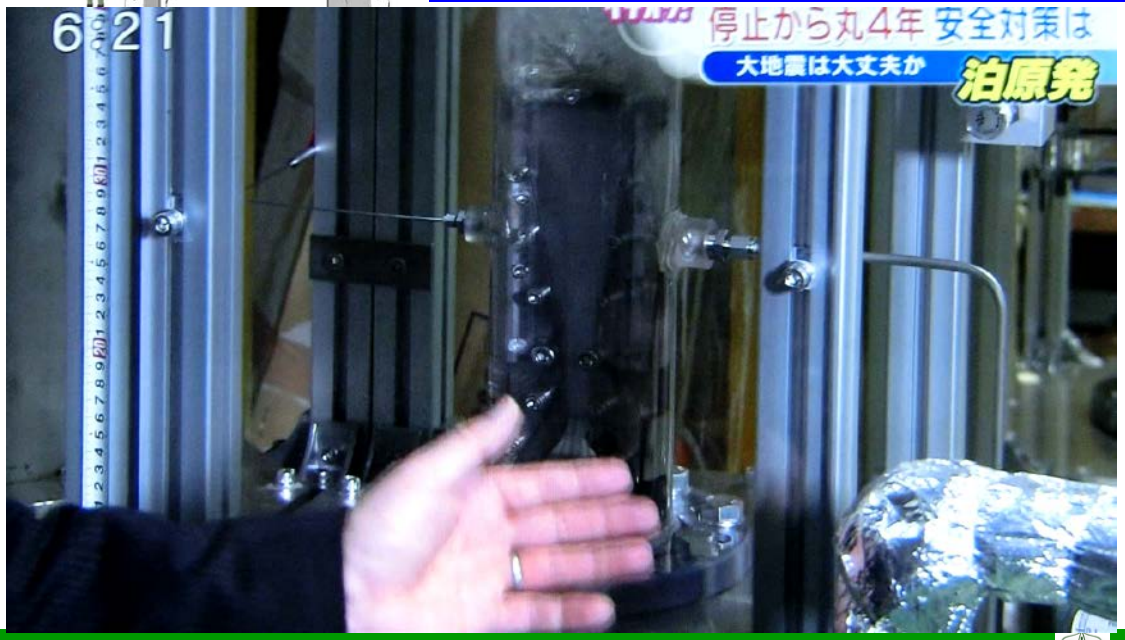


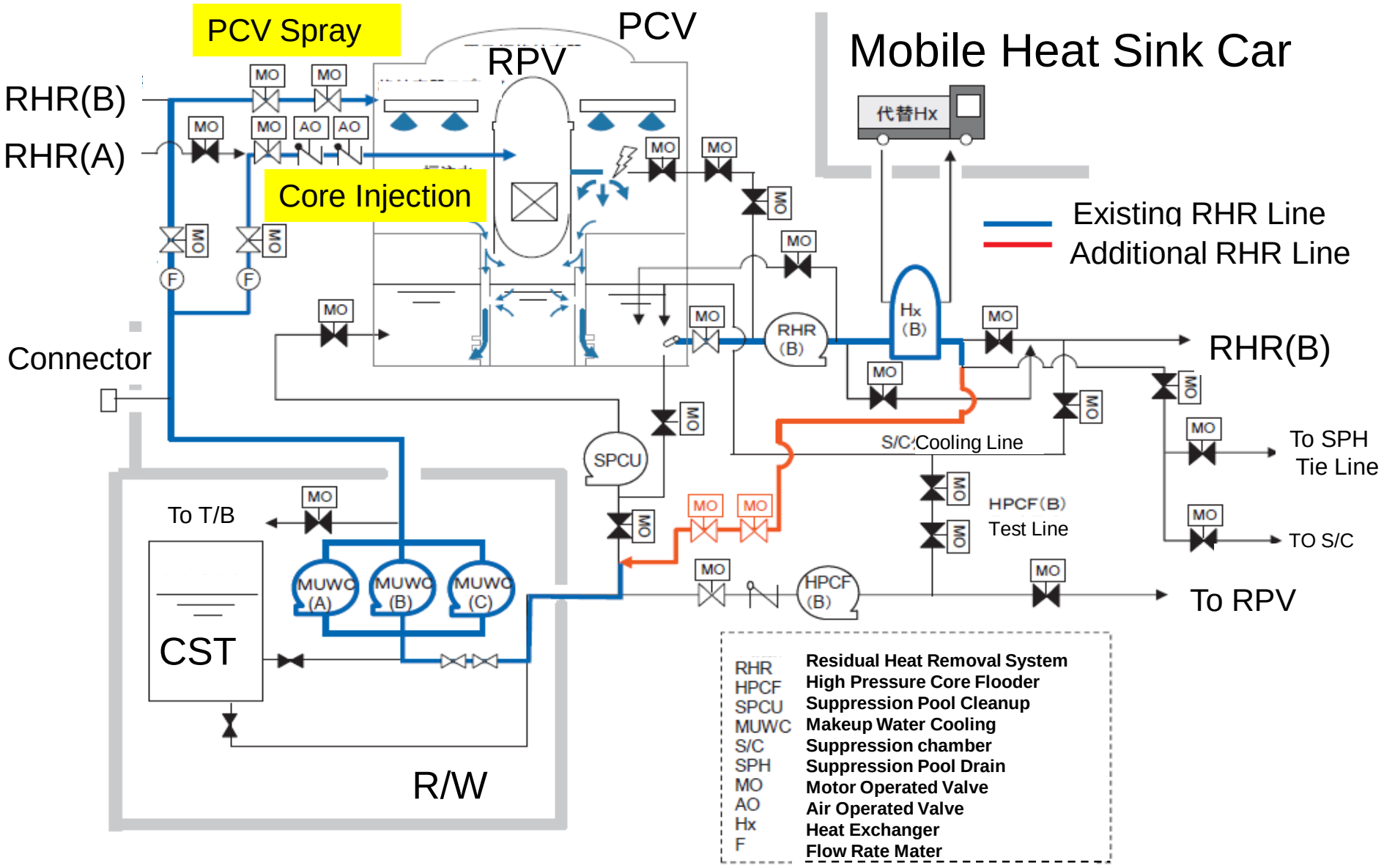
Figure 2 A-type silver-zeolite.

Kashiwazaki Kariwa
TEPCO

Hokkaido University



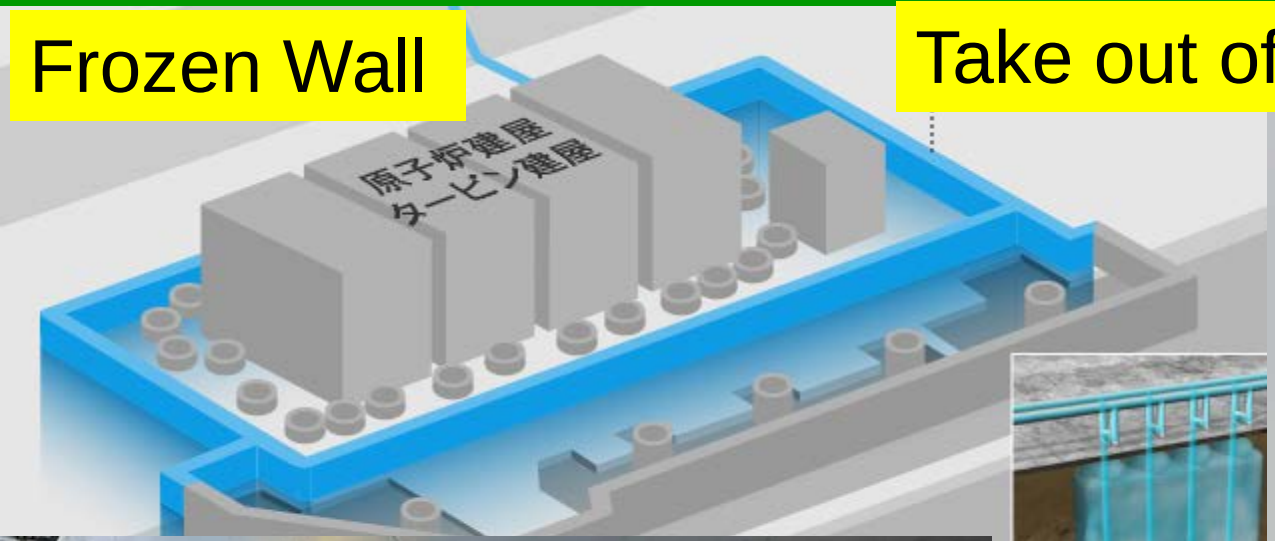
Alternate RHR system by using the Heat Sink Car



Mobile Heat Sink Car and Fire Engines

Decommissioning of Fukushima Daiichi

Frozen Wall

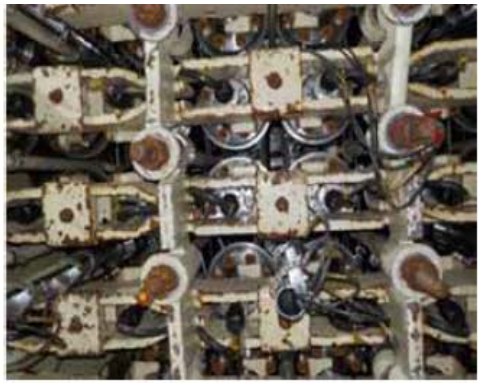


Take out of spent fuel for 1F-3

Progress Report of Fukushima Daiichi

Investigation of Unit 3 Pedestal

Fish type Robot was used to investigatie debris in pedestal



Ref. CRD Support 1F-5

CRD Exchange Guide Rail

CRD Exchange Guide Rail

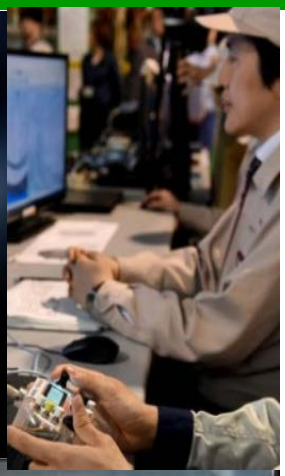
CRD Housing Support

CRD Housing Flange

Fish Type Robot “Mini-Sunfish” took Video

Melted CRD Housing

Mini-Sunfish
IRID/TOSHIBA



CRD Housing Support

CRD Housing Flange

Fish Type Robot “Mini-Sunfish” took Video

Isolation Ball Valve was open

MEXT Project for Nuclear Human Resource Development

Development of a high efficiency multi-nuclide aerosol filters for radiation protection during a process of cutting core debris at Hokkaido University

Rasa

Kimura Chemical Plants

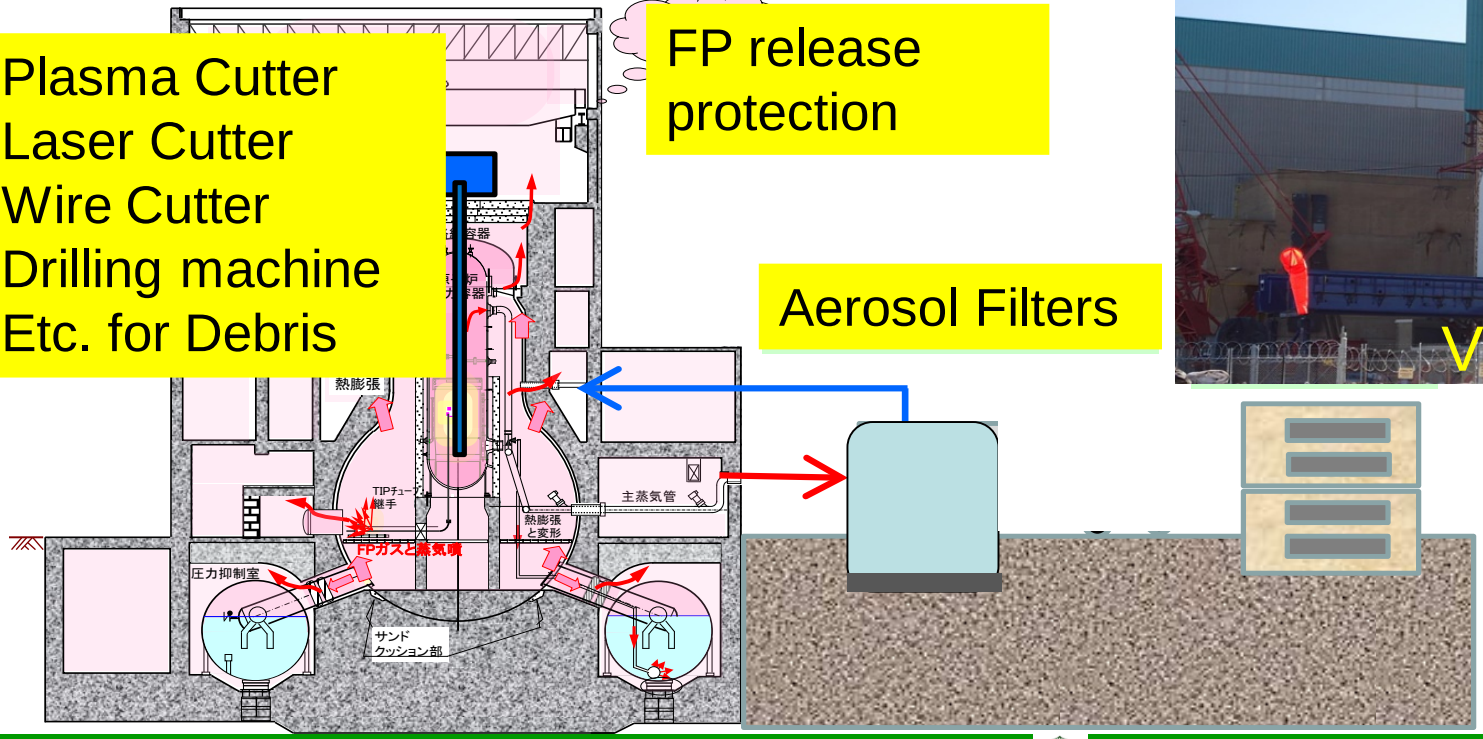
For Fukushima-Daiichi Decommissioning Radiation protection during a process of cutting core debris should be needed.

- In order to develop an air clean up system for radiation protection during a cutting core debris of the Fukushima Daiichi NPP as a process of their decommissioning, a high efficiency filters should be developed, such as a wet-type aerosol filter, a metal fiber filter, a silver zeolite

Plasma Cutter
Laser Cutter
Wire Cutter
Drilling machine
Etc. for Debris

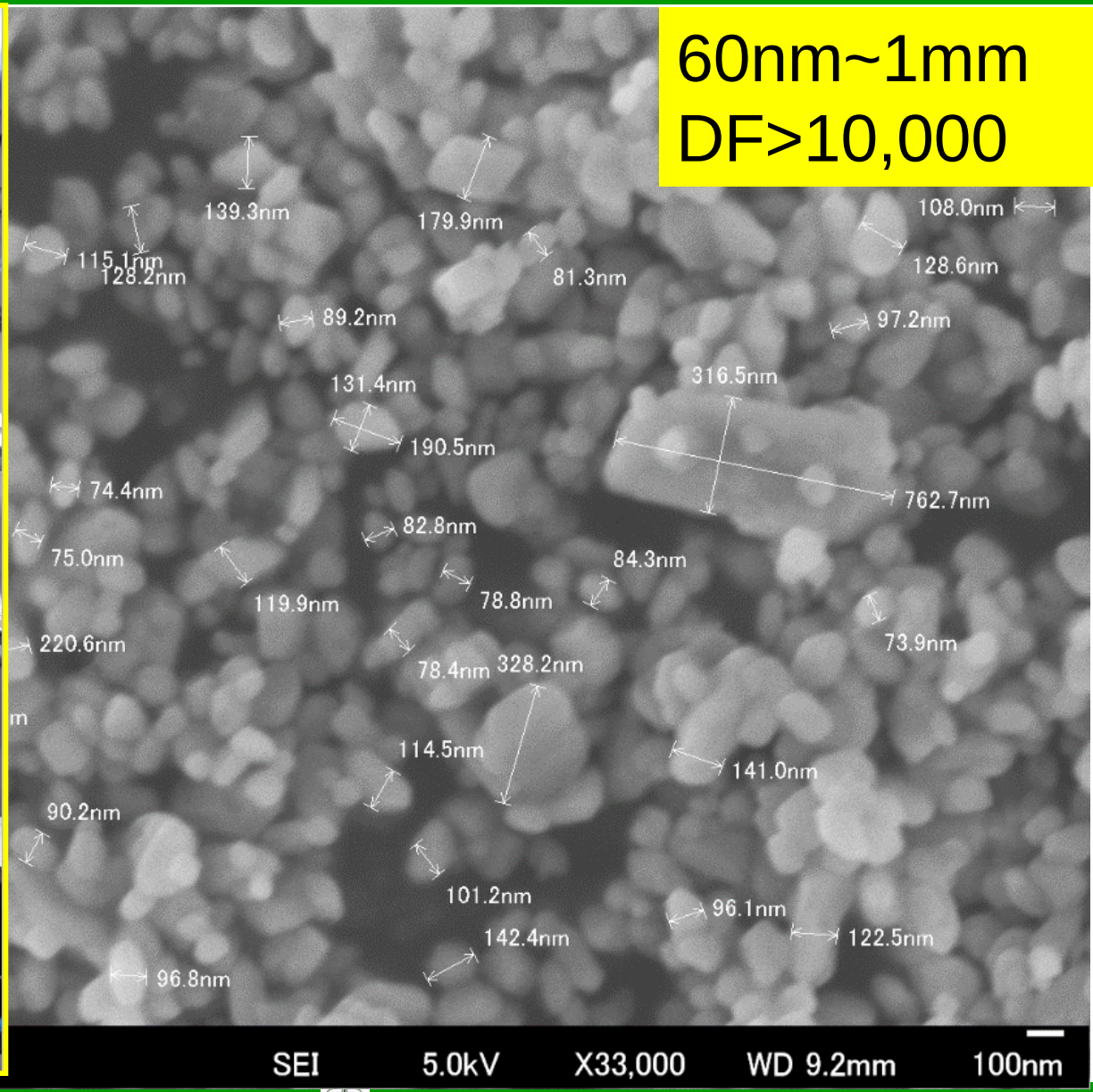
FP release protection

Aerosol Filters

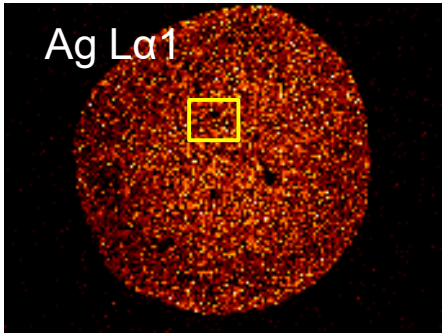


Metal Fiber Filter Trapped nanometer size Powder

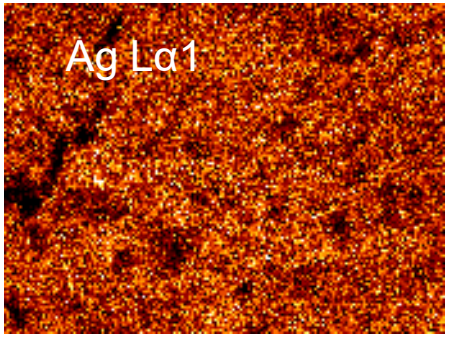
Trapped nano powder of BaSO4



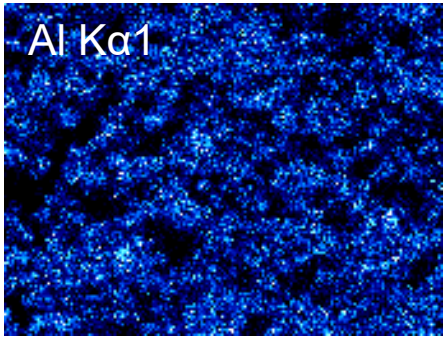
Iodine Absorbed Analysis Result in a AgX Particle



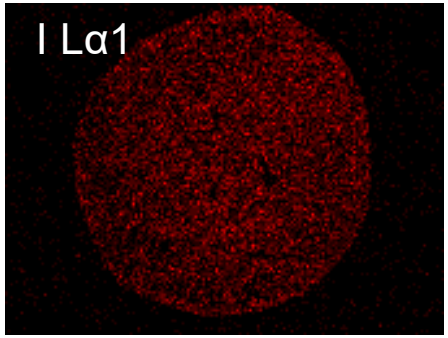
1mm



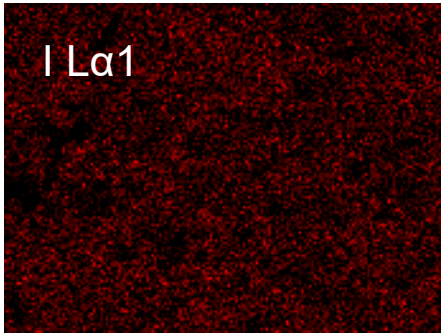
20μm



20μm

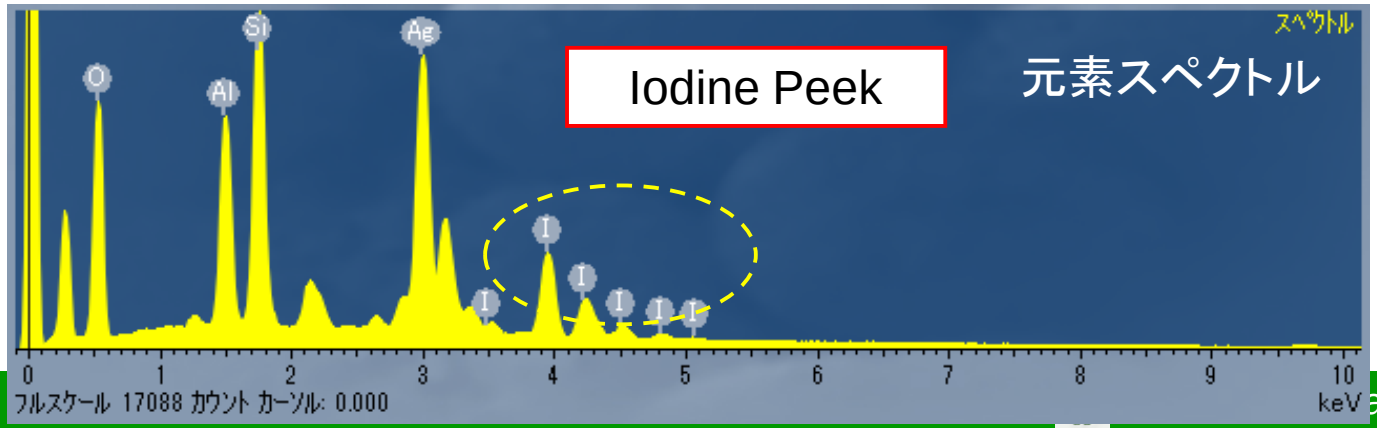


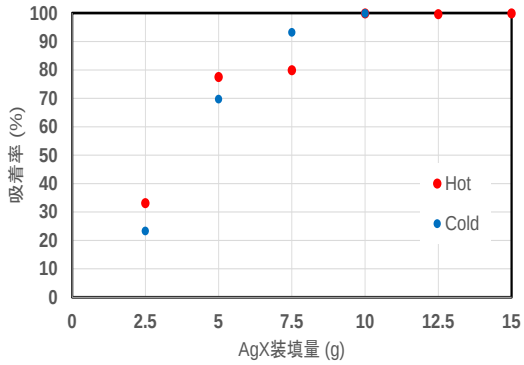
1mm



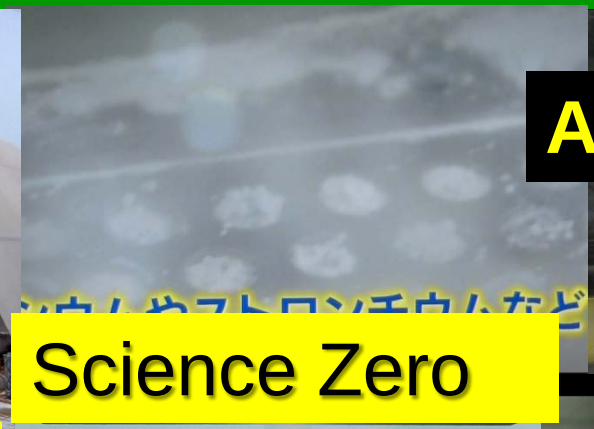
20μm

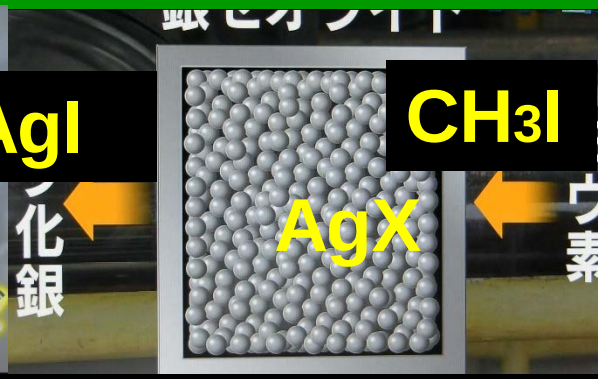
Iodine was captured even at the center of a AgX particle





The study results were introduced by NHK ETV





Science Zero

Super Engineer Education Project

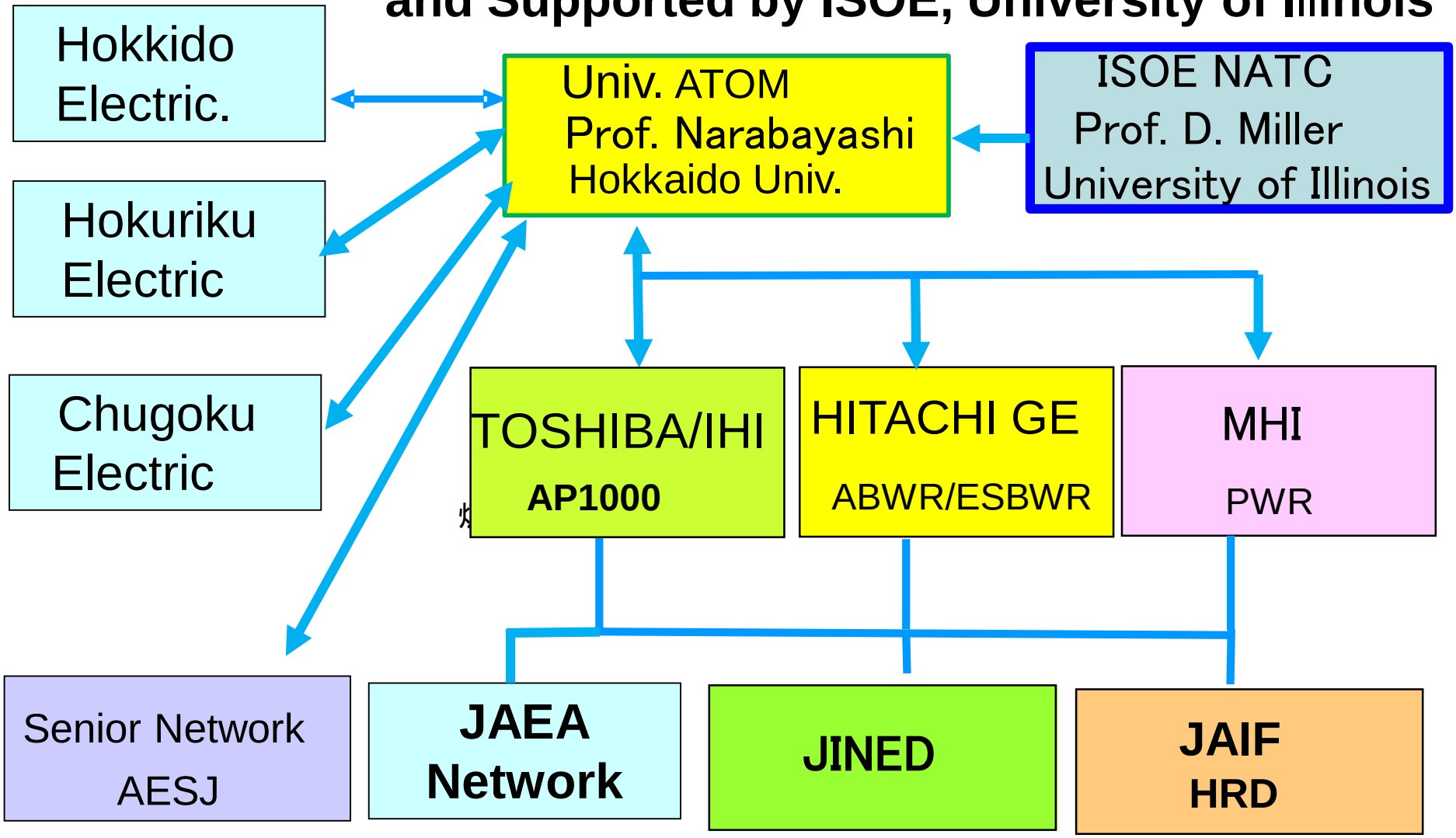
MEXT Project for Nuclear Human Resource Development

Super Engineer Education Project to Achieve Highest Safety at Hokkaido University

*MEXT: Minister of Education, Culture, Sports, Science and Technology

Framework of the Project

■ **Collaboration of Universities, Electric Power Co., Vendors and Supported by ISOE, University of Illinois**



Number of Students Trained in this Project

Students	Major	Number of Students			TOTAL
		FY 2015	FY 2016	FY 2017	
BS 1	All students in Hokkaido	—	50	50	**100**
BS 2	Civil, Natural Resource, Environment, Electronic	100	100	100	**300**
BS 3	Nuclear, Mechanical Engineering	120	120	120	**360**
MS 1,2	Nuclear, Plasma, Radiation, Mechanical	0	70	70	**140**
NPP Training	19 ATOM Universities	13	13	13	**39**
Vendor R&D	19 ATOM Universities	13	13	13	**39**
ISOE/Illinois	Excellent Students	5	5	5	**15**
TOTAL		**251**	**371**	**371**	**993**

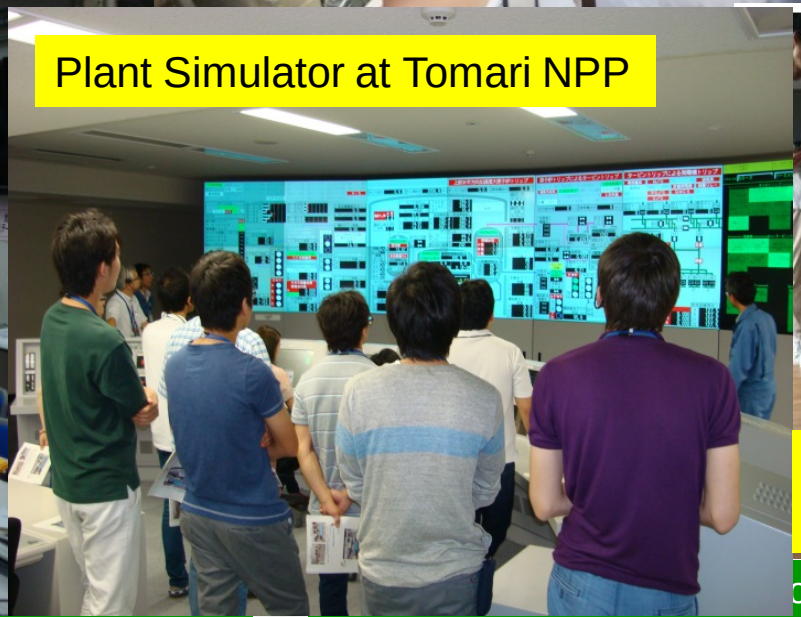
Students Training Programs for Super Engineer

Lecture on severe accident at Hokkaido Univ.

2Pd Filtered Containment venting system test

Emergency training at Tomari NPP

Plant Simulator at Tomari NPP



Robotics Contest

Training at Hitachi GE･JAEA and Discussion With Senior Network

Lecture on Safety Measures at Hitachi GE

Presentation of Company activities of Hitachi GE

At the Electronics Museum of Tepco

JAEA

JRR3

Training Shika NPP and offsite center

Lecture on safety measures for Shika NPP

Lecture on the purpose of offsite center

Training using plant simulator at Shika NPP

Trench to confirm no active fault at Shika NPP

Training at ISOE Symposium and NPPs

ISOE Symposium attendances with the 5 students to be super Engineer in Future

Five Students joined the NRC Region III RPM Meeting to learn operational topics

Five students Visited DC Cook NPP

Visit Dresden NPP

Isolation Condenser

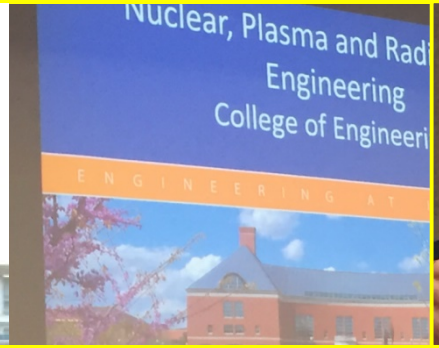
Steam pipe heater to protect frozen

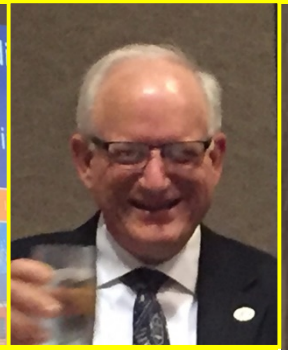
Hand wheel to operate RWCU valves

Hokkaido University Doctoral Commencement

Congratulations to Dr. Shinichi Kawamura ! Sep. 26, 2016

Prof. James Stubbins Memorial Lecture for John Palms Award





Held at the Hokkaido University on July 31, 2017

Congratulations Dr. Shinichi Kawamura for the John Palms Outstanding Innovation Award, Jan. 9, 2017.

Conclusion

- From the Lessons of Fukushima-Daiichi Accidents, Japanese NPP has installed safety measures, and Sendai 1 and 2 restarted in 2015. Ikata restarted in 2016. Kashiwazaki-Kariwa(ABWR) passed to restart in 2017. Four PWRs will restart in 2018.
- Development of Filtered Venting System (FCVS) with silver zeolite has finished. Installation has started.
- Development of a high efficiency multi-nuclide aerosol filters for radiation protection has achieved high DF at Hokkaido University as a MEXT project in Japan.
- Nuclear education is very important to encourage students to be super engineers for future Nuclear Energy. The Project is funded by MEXT, Japan.
- Super Engineer Education Project has succeeded by the support of ISOE NATC. Thank you, Dr. D. Miller.