Report on the Investigation and Study of Unconfirmed/Unclear Matters

In the Fukushima Nuclear Accident

Progress Report No.2

August 6, 2014

Tokyo Electric Power Company, Inc.

TOKYO ELECTRIC POWER COMPANY

TEPCO

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Overview

1. Purpose of investigation and study of unconfirmed/unclear matters (from the first progress report)

Explaining what actually happened in the Fukushima Daiichi Nuclear Power Station accident will help improve the safety of power generating facilities in Japan and the rest of the world

As the operator of the nuclear power station and the main party responsible for the accident, we are fully committed to clarifying all aspects of the accident

Solving reactor decommissioning issues and accumulating information

Improvement in safety measures and heightened safety at Kashiwazaki-Kariwa Nuclear Power Station

2. Insights obtained from the second progress report

1. Causes of Unit 3 RCIC shutdown

The cause of the Unit 3 RCIC (Reactor Core Isolation Cooling system) was not specified according to the observations and actions of operators at the accident. We find the possible cause attributed to the system property through the further investigation

→We reflect the safety measures at Kashiwazaki-Kariwa NPS from the learned lessons to try to continue the water injection for core cooling as long as possible under a severe situation.

2. Evaluation of the operational state of HPCI at Unit 3 and its impact on the accident's progression

Core damage progression is re-analyzed with the updated condition which is more insufficient water injection for core cooling than previous analysis. The result infers the possibility that most of the fuel debris dropped onto containment vessel floor.

→We use the obtained information on fuel debris status for decommissioning strategy

3. Rise in reactor pressure following forced depressurization at Unit 2 and relationship between neutron detection and fuel melting

It is found that the timing to detect neutron is related to the onset of core melt as we improve the understanding of core damage progression at Unit-2 and 3. The reason to detect neutron near main gate had not been clear but the possible origin of the detected neutron is specified.

→We consider this event, which had not been expected before, for making accident response procedure

4. Improving the accuracy of evaluating the actual water flow rate injected into reactor from fire engines

The amount of injected water to the core by fire engine is still not clear although this is important factor to evaluate the accident progression. In this analysis, the actual water injection rate was estimated by calculating pressure loss of injection line.

→We will continue the study to estimate more consistent value and evaluate the affect on the accident progression.

We will continue to investigate the unsolved issues and contribute to further safety improvement and efficient decommissioning plan by evaluating present situation inside reactors

3. Report on progress made in investigating and studying unconfirmed/unclear matters

Verified the accident's details based on information obtained, as far as possible, through on-site verifications, records, interviews and data collection in combination with analysis techniques.

↓

Compiled and released in TEPCO's study reports
on the Fukushima Accident (December 2011, June 2012). Study is still ongoing.

↓

52 unconfirmed/unclear matters identified

Matters on which TEPCO has completed review

- Almost complete: **10**
  [Contents of the first progress report] *

Matters on which TEPCO has yet to complete review

- 10 high-priority issues
- 34 lower-priority issues

Review to continue Second time onwards

Reviewed with a flexible system and with the cooperation of external researchers

Analysis to begin with higher-priority matters

We will report on progress on a semi-annual basis,
and aim to produce conclusions on higher-priority matters within two years

*** We continue to study 2 matters from the previous results as a starting point**

4. Progress made in the study of ten high-priority issues

Issues covered by the present report	- Factors in the shutdown of the reactor core isolation cooling system at Unit 3	Unit 3-1
	- Evaluation of HPCI system operational state at Unit 3 and its impact on the accident's progression	Unit 3-5
	- Rise in reactor pressure following forced depressurization at Unit 2	Unit 2-7
	- Improving the accuracy of our estimate of the volume of cooling water injections from fire engines into the nuclear reactor	Shared-2
Issues under review (investigated by TEPCO)	- Study of safety relief valve operation after reactor core damage	Shared-1
	- Vent operation and rupture disk status at Unit 2	Unit 2-9
Issues under review (government R&D projects, etc.)	- Melted core's behavior in dropping to the lower plenum	Shared-6
	-Thermal stratification in the suppression pool at Unit 3	Unit 3-3
Issues on which review has yet to begin	- Release of radioactive materials from March 20 onwards	Shared-9
	- Identification of causes for the high-dose contamination of pipes in the reactor cooling water system at Unit 1	Unit 1-9

5. Ten issues on which review was virtually completed in the first progress report

- Tsunami arrival evaluation and the fact that the tsunami was a factor in causing the loss of cooling function	Shared-14
- Relationship between the earthquake and flooding in Unit 1's reactor building (R/B)	Unit 1-4
- Cooling water injected into the reactor from fire engines and leakage routes	Unit 1-9
- RCIC flow rate after loss of control power at Unit 2	Unit 2-1
- State of the RHR system after the tsunami's arrival at Unit 2	Unit 2-4
- Decrease behavior of PCV pressure temporarily decreased after RCIC shutdown at Unit 2	Unit 2-5
- State of HPCI operation estimated based on reactor water level behavior during HPCI operation at Unit 3	Unit 3-4
- Process of reactor core damage estimated based on reactor water level behavior after HPCI shutdown at Unit 3	Unit 3-5
- Possibility of rapid reactor depressurization due to ADS triggered at Unit 3	Unit 3-6
- Steep increase in reactor pressure following rapid depressurization at Unit 3, and its relationship to the process of reactor core damage	Unit 3-7

→ On the basis of past results, we will continue to review and reflect the results onto the second progress report. (Shared-2 Unit 3-5)

6. Activity for sharing the insights obtained from investigation and Discussion with researchers in the world

The Atomic Energy Society of Japan meetings / International meetings

We have given presentations on study results at academic or international meetings. Fortunately we received technical awards at some meetings. We will continue the study considering comments and other results obtained from these activities.

＜Presentation＞
AESJ meeting：2013 Spring, 2013 Fall, 2014 Spring meeting
International meeting：
NURETH (Nuclear Reactor Thermal Hydraulics) 10th meeting
NUTHOS (Nuclear Thermal Hydraulics, Operation and Safety) 9th meeting
International Workshop on Severe Accident Research, Tokyo Univ.

OECD/NEA BSAF project

We have shared our study results and accident information among the BSAF project members. Comparing simulation results of domestic and foreign researchers and exchanging opinions are helpful for us to study the unsolved issues

OECD/NEA：The Organization for Economic Co-operation and Development/The Nuclear Energy Agency
BSAF：“Benchmark Study of the Accident at the Fukushima Daiichi Nuclear Power Station” has been established to improve severe accident codes and analyze accident progression and current core status in detail for preparation of fuel debris removal, as a part of the R&D projects for the mid-to-long term response for decommissioning of the Fukushima Daiichi

Nuclear Regulation Authority, JAPAN The Committee on Accident Analysis

We explained our evaluation of tsunami arrival time and the cause of losing all power sources, which is mentioned in Interim report (DRAFT) made by NRA. We will continue the study reflecting the field investigations and analysis results performed by the Committee.

Niigata Prefecture Technical Committee

We have explained the issues regarding questions and interests from the governor or committee members for the discussion at Niigata Prefecture's technical committee on verification of Fukushima Daiichi accident and safety measures at Kashiwazaki-Kariwa Nuclear Power station.

We are continuing our investigation reflecting the discussions and opinions from various parties and researchers

Report on the Results of Examination and Review on Unconfirmed/Unclear Matters

Progress Report No.2

Matters studied

Overview of the second progress report

1. Causes for RCIC shutdown at Unit 3 [Report: attachment 3-5]

- The RCIC shutdown occurring in Unit 3 at 11:36 of March 12 was likely due to an electrical trip caused by high turbine exhaust gas pressure. We will take this into account in devising safety measures at Kashiwazaki-Kariwa.

2. Evaluation of the operational state of HPCI at Unit 3 and its impact on the accident's progression [Report: attachment 3]

- Sufficient cooling water injection into the reactor was no longer possible before the HPCI's manual shutdown. It is likely that, due to the zirconium-water reaction occurring as water level dropped, fuel had begun to melt before the water level reached the fuel's bottom.

3. Rise in reactor pressure following forced depressurization at Unit 2 [Report: attachment 2-7]

- It is possible that intermittent increases in nuclear pressure after forced depressurization at Unit 2 (issue list "Unit 2 - 7") may have been due to hydrogen and water vapor discharged while fuel was melting. In conjunction, the neutrons observed near the main gate may have been generated by the spontaneous fission of actinides discharged while fuel was melting at Units 2 and 3.

4. Improving the accuracy of our estimate of the volume of cooling water injected into the reactor from fire engines [Report: attachment 1-5]

* We evaluated the volume of cooling water injected from the fire engines into the reactor at Unit 1 based on pressure losses in the water injection route, and found that about 20% to 50% of water reached the reactor. Further review will be necessary, largely due to the uncertainty of discharge pressure from fire engines.

1. Causes of Unit 3 RCIC shutdown

(1) Overview

At Unit 3, DC power supply remained available after the tsunami's arrival, allowing continued cooling water injection from the RCIC system. We have confirmed that RCIC shutdown occurred at 11:36 of March 12.

Although operation continued for almost 20 hours,
the cause of the shutdown had remained unclear.

Based on verifications at the main control room (MCR) and in the field as well as on actual measures data and plant design information, we:

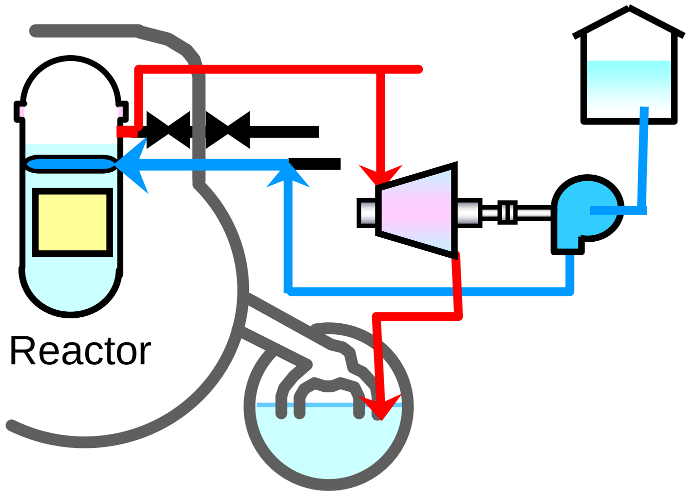
1) investigated the trip's causes
2) studied how trip conditions formed

- Causes of Unit 3 RCIC shutdown -

The RCIC shutdown occurring in Unit 3 at 11:36 of March 12 is likely to have been caused by an electric trip, due to high turbine exhaust pressure.

Reflected onto safety measures at the Kashiwazaki-Kariwa Nuclear Power Station

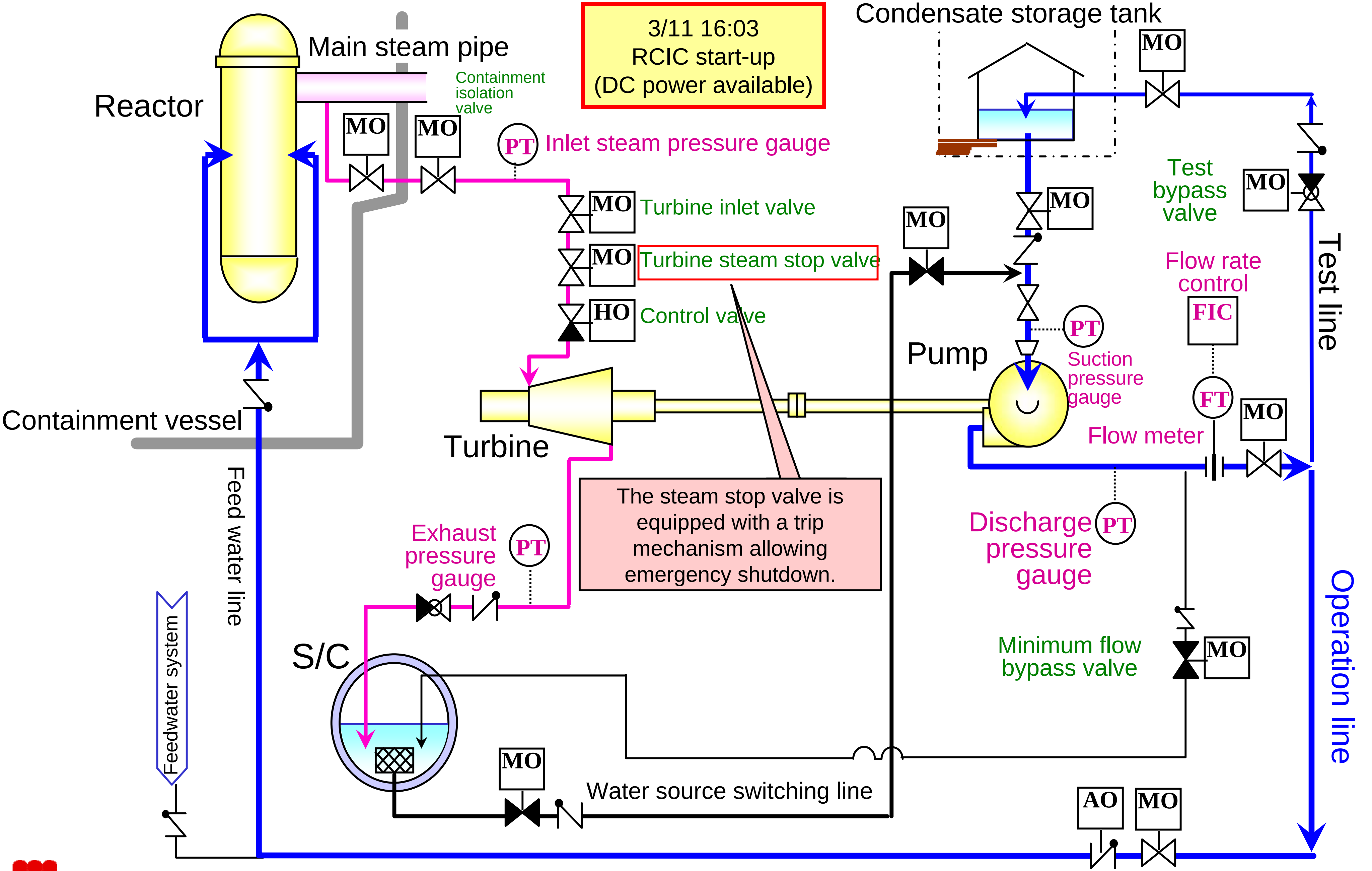
In addition to measures to bolster the HPCI system's functions, an operational procedure to release the turbine exhaust pressure interlock is being prepared as part of tsunami response procedures.



Reactor core isolation cooling system (RCIC)

As part of review aiming to voluntarily improve the power station's safety, this will be reflected onto Tsunami Accident Management procedures. (January 2012)

(2) Addendum - Overview of the RCIC system (operational state after the tsunami's arrival) -

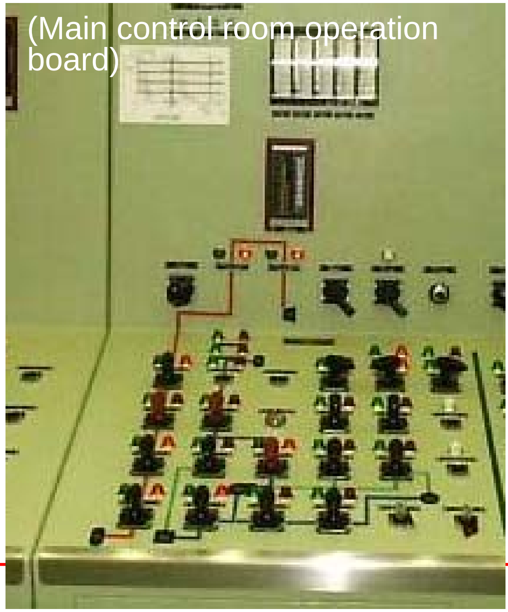


(3) Operations and conditions verified in the main control room and in the field

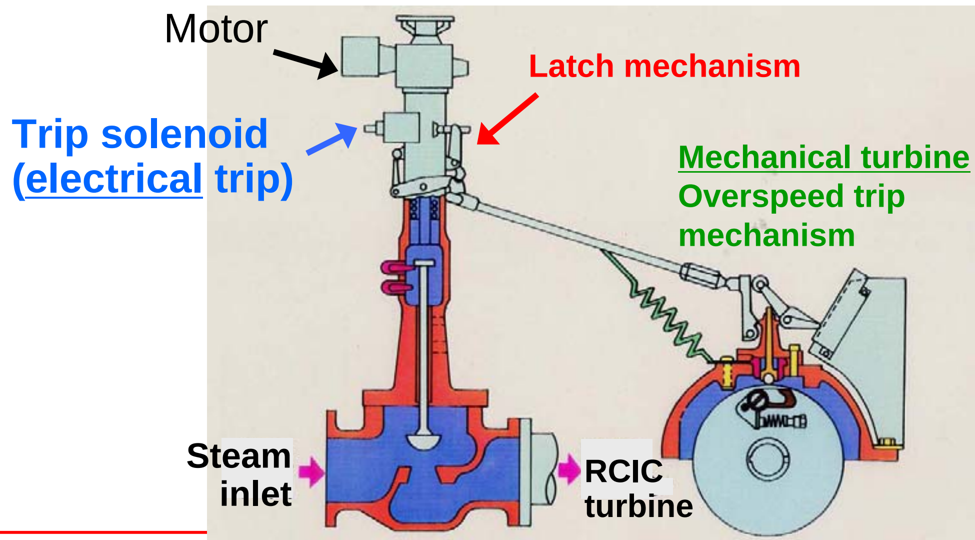
Based on the state of operations in the main control room and on conditions verified in the field, we believe that an electrical trip occurred.

Operations in the main control room and conditions found in the field

- We found that the **turbine's steam stop valve**, which has a trip mechanism, **was closed**, causing shutdown.
- After shutdown, the stop valve was reset from the main control room in order to switch to standby (**the mechanical turbine overspeed trip** that would have been necessary for in-field reset operations **was not triggered**).
- As of the shutdown of 3/12, the main control room allowed RCIC valve operation and monitoring of condition indicator lamps and meters, and **the DC power source required for triggering an electrical trip had been secured**.
- Restarting after reset operations was followed by another stop valve shutdown and trip (the cause of the trip may have been the same).



RCIC turbine steam stop valve



(4) Likelihood of trip conditions forming

None of the trip conditions required under electrical trip logic was confirmed.

Manual trip button → ✕
- We were unable to confirm that the manual trip button was pushed.

Reactor water level high (L-8) → ✕
- The measured value of the reactor's water level did not reach L-8 (reactor water level was being controlled by adjusting RCIC flow rate).

Attention!

Turbine exhaust pressure high (0.29 MPag) → ✕
- In conjunction with D/W and S/C pressure, exhaust pressure was also on the rise, but we did not find that it reached the trip set point.

Pump suction pressure low (- 0.0508MPag) → ✕
- It is possible that the water level in the condensate storage tank may have dropped; however, the HPCI system (having the same trip conditions) was activated immediately after the drop, employing the same condensate storage tank as a water source.

Turbine overspeed (electrical: rated value X 110% rpm) → ✕
- The RCIC control power source was functioning, and the steam regulating valve was under control; the occurrence of an overspeed trip is therefore unlikely.

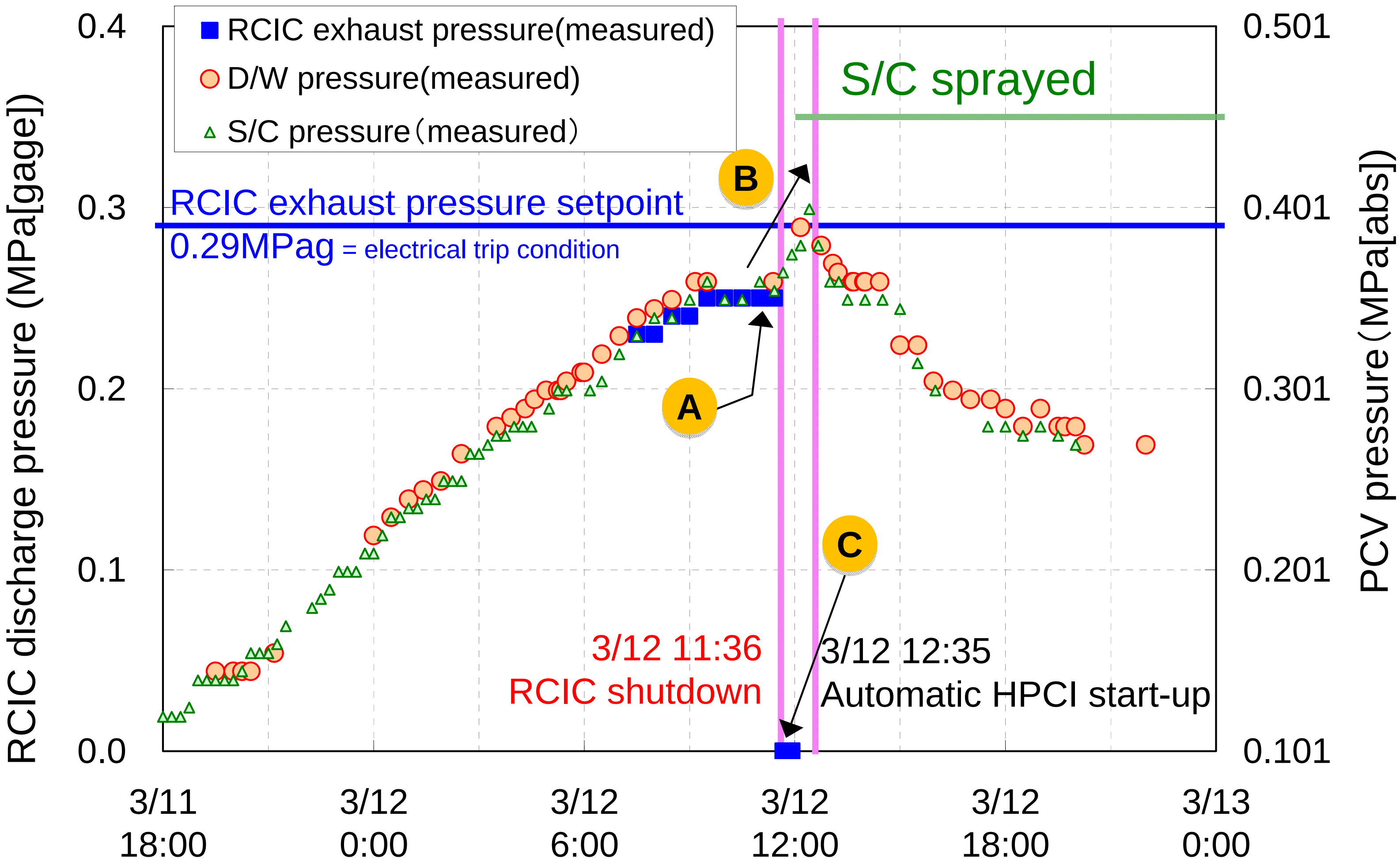
RCIC turbine pump room temperature (93℃)
Steam pipe flow rate high (±120.7kPa)
Steam pipe pressure low (0.344 MPa)
Turbine exhaust diaphragm pressure high (69 kPa)

→ OR → RCIC automatic isolation signal → ✕

- There is no verifiable record that the RCIC isolation valve was shut (condition indicator lamp).
- The PCV's external isolation valve was shut at about 11:00 of March 13 (verified based on condition indicator lamp).

(5) Turbine exhaust pressure readings

Out of electrical trip conditions, turbine exhaust pressure and S/C pressure <u>were both on the rise</u>, getting close to the trip set point.



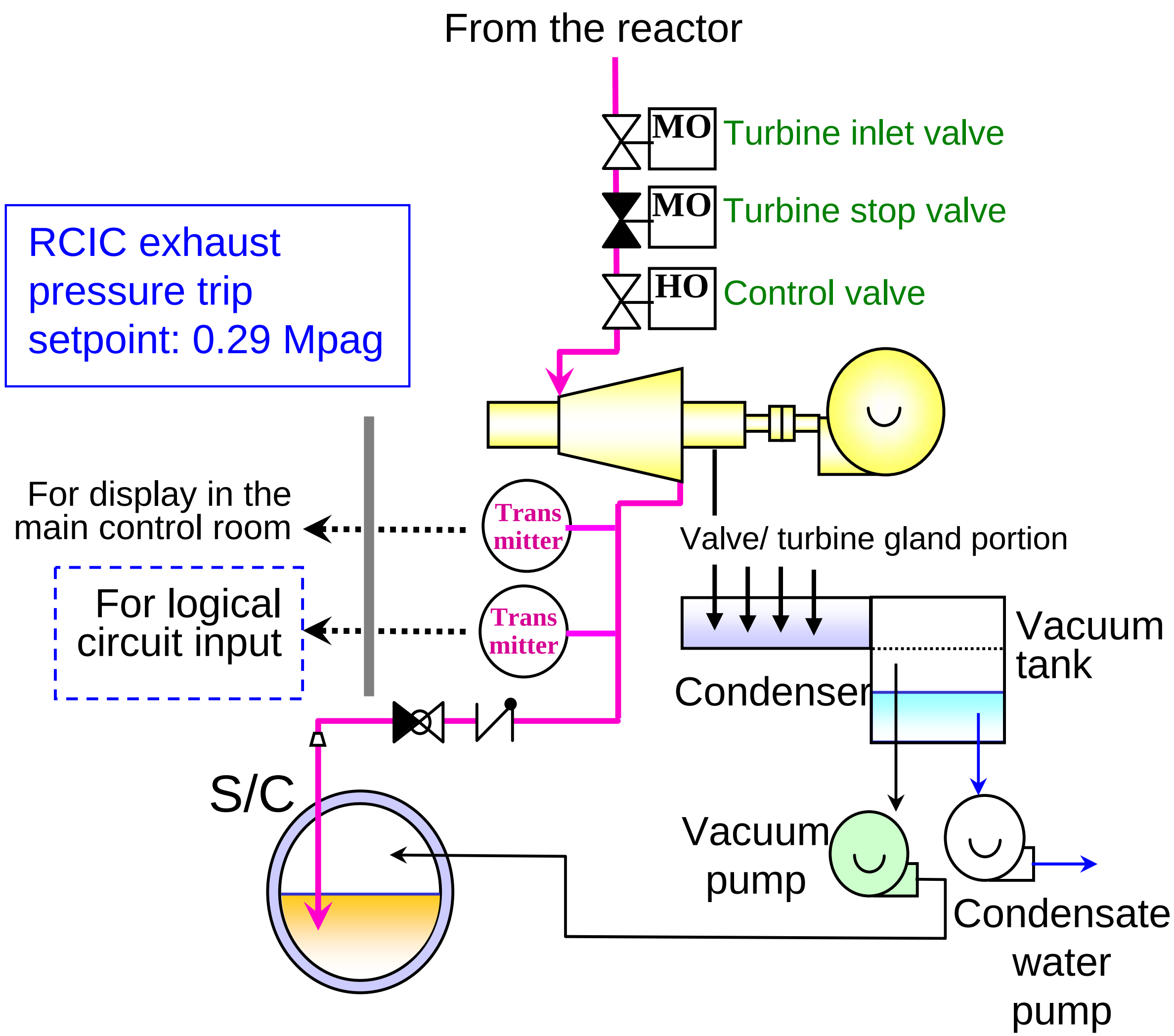
A At 11:25 - immediately preceding shutdown - the exhaust pressure reading was 0.25 MPag.
At this time, it had not reached the setpoint.
:

B S/C pressure rose steeply from 11:25 to 12:00.

C We do not have an exact record of exhaust pressure at the time of the shutdown (11:36). After the shutdown, exhaust pressure was back to 0 due to isolation from S/C.

(6) Likelihood of trip caused by exhaust pressure high trip

Trip due to high exhaust pressure is possible although there is no direct record



- S/C pressure at shutdown was about 0.25 MPag, which would have caused exhaust pressure to exceed the trip set point if we take into account the pressure drop in exhaust pipes (0.05 MPa according to trial run data).

→ Different pressure gauges are employed for display in the main control room and for logical circuit input; it is possible that, when S/C pressure rose at 11:36, the latter may have reached the trip set point.

- Another trip occurred again as steam began to flow following start-up, in spite of successful reset operation. This sequence of events can be explained based on the above (trip conditions were momentarily cleared upon exhaust pressure reaching 0).

(7) Likelihood of trip conditions forming

Likelihood of exhaust trip forming while other conditions are not convincing

Manual trip button → ✕
- We were unable to confirm that the manual trip button was pushed.

Reactor water level high (L-8) → ✕
- The measured value of the reactor's water level did not reach L-8 (reactor water level was being controlled by adjusting RCIC flow rate).

Turbine exhaust pressure high (0.29 MPag) → △
- Based on the increase of D/W and S/C pressure and on differences in exhaust pressure readings, it is possible that the trip setpoint may have been reached.

Pump suction pressure low (-0.0508MPag) → ✕
- It is possible that the water level in the condensate storage tank may have dropped; however, the HPCI system (having the same trip conditions) was activated immediately after the drop, employing the same condensate storage tank as a water source.

Turbine overspeed (electrical: rated value ×110% rpm) → ✕
- The RCIC control power source was functioning, and the steam regulating valve was under control; the occurrence of an overspeed trip is therefore unlikely.

RCIC turbine pump room temperature (93°C)
Steam pipe flow rate high (±120.7kPa)
Steam pipe pressure low (0.344 MPa)
Turbine exhaust diaphragm pressure high (69 kPa)

→ OR → RCIC automatic isolation signal → ✕
- There is no verifiable record that the RCIC isolation valve was shut (condition indicator lamp).
- The PCV's external isolation valve was shut at about 11:00 of March 13 (verified based on condition indicator lamp).

(8) Incorporation into safety measures

Incorporation into safety measures at the Kashiwazaki-Kariwa Nuclear Power Station

In addition to measures for bolstering the function of the water injection under high reactor pressure,
an operational procedure is being prepared to release the interlock for high turbine exhaust pressure

- In the response procedures for Tsunami Accident Management, which assume a station black out, an operational procedure is being prepared to release the interlock for high turbine exhaust pressure in order to prioritize the continuation of RCIC operation even while S/C pressure is on the rise.

(The procedure will be based on the notion that RCIC equipment will not be damaged immediately even if turbine exhaust pressure exceeds the trip set point, thus putting continued RCIC operation before equipment damage risks.)

- In addition, we take measures to bolster the function of the HPCI system.
- Bolster DC power source facilities (increased capacity and installation in high places)
- Additional installation of alternate water injection system (HPAC)
- Prepare procedures for RCIC manual start-up in the field during AC and DC power source loss

- Points for future review -

Next, we will consider the operational state of the RCIC system at Unit 2 (loss of DC power source) and the causes of its shutdown

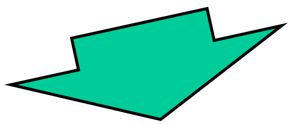
(1) Overview

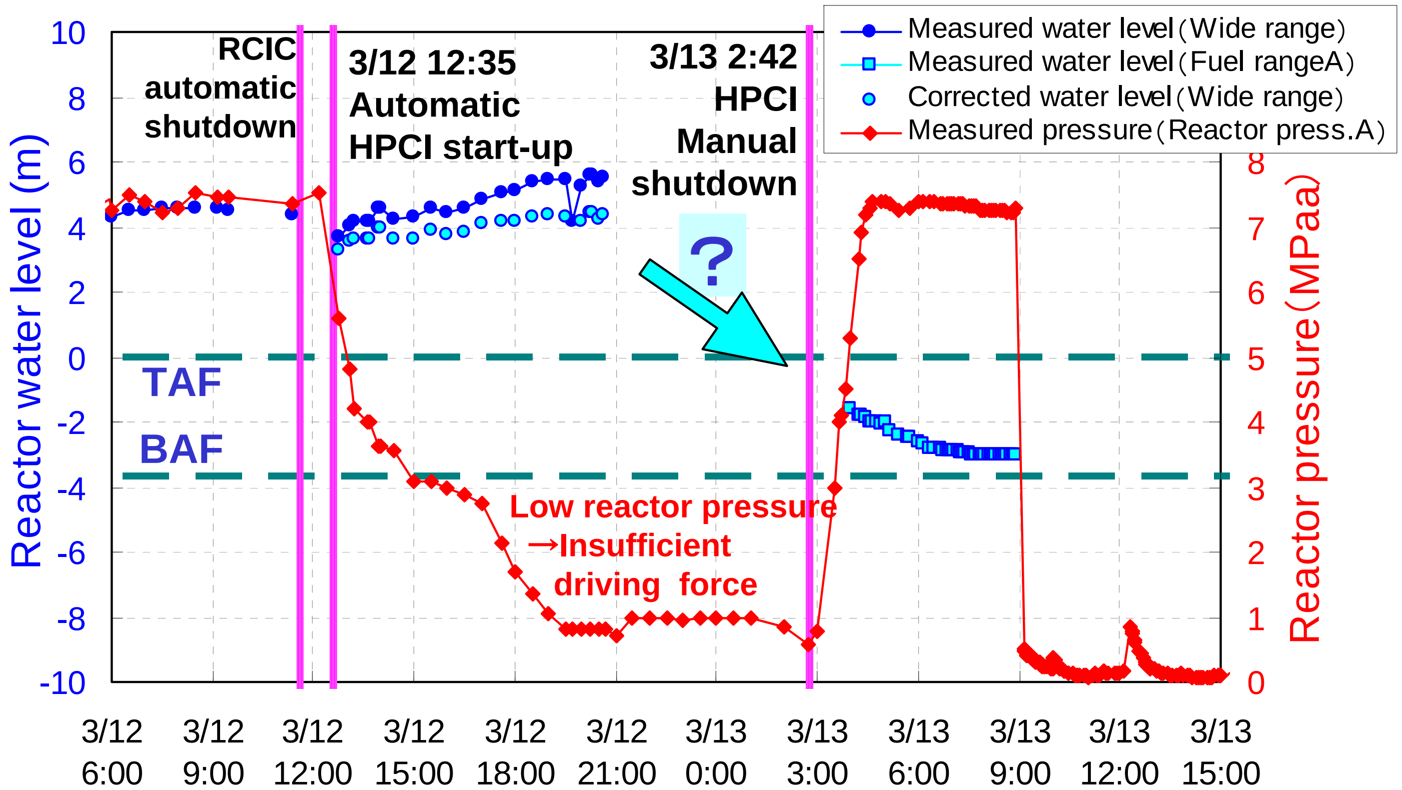
In our first report, we found that cooling water injections preceding manual HPCI shutdown may have been insufficient.

Based on this result, we evaluated the process leading up to melting from decreased water level and fuel exposure.

Conduct MAAP analysis, taking into account HPCI operational state

Process leading up to fuel melting and evaluation of its impact on the accident's developments





- Result analysis -

Process leading up to fuel melting	Developments following fuel melting
A zirconium-water reaction caused as the water level dropped resulted in fuel melting before the **water level reached the fuel's bottom.**	While uncertainty in the model and in the quantity of cooling water injected from fire engines makes the results of analysis somewhat unreliable, **the RPV did rupture, causing the majority of fuel to drop into the PCV.**

(2) Changes in reactor water level reflecting state of HPCI operation

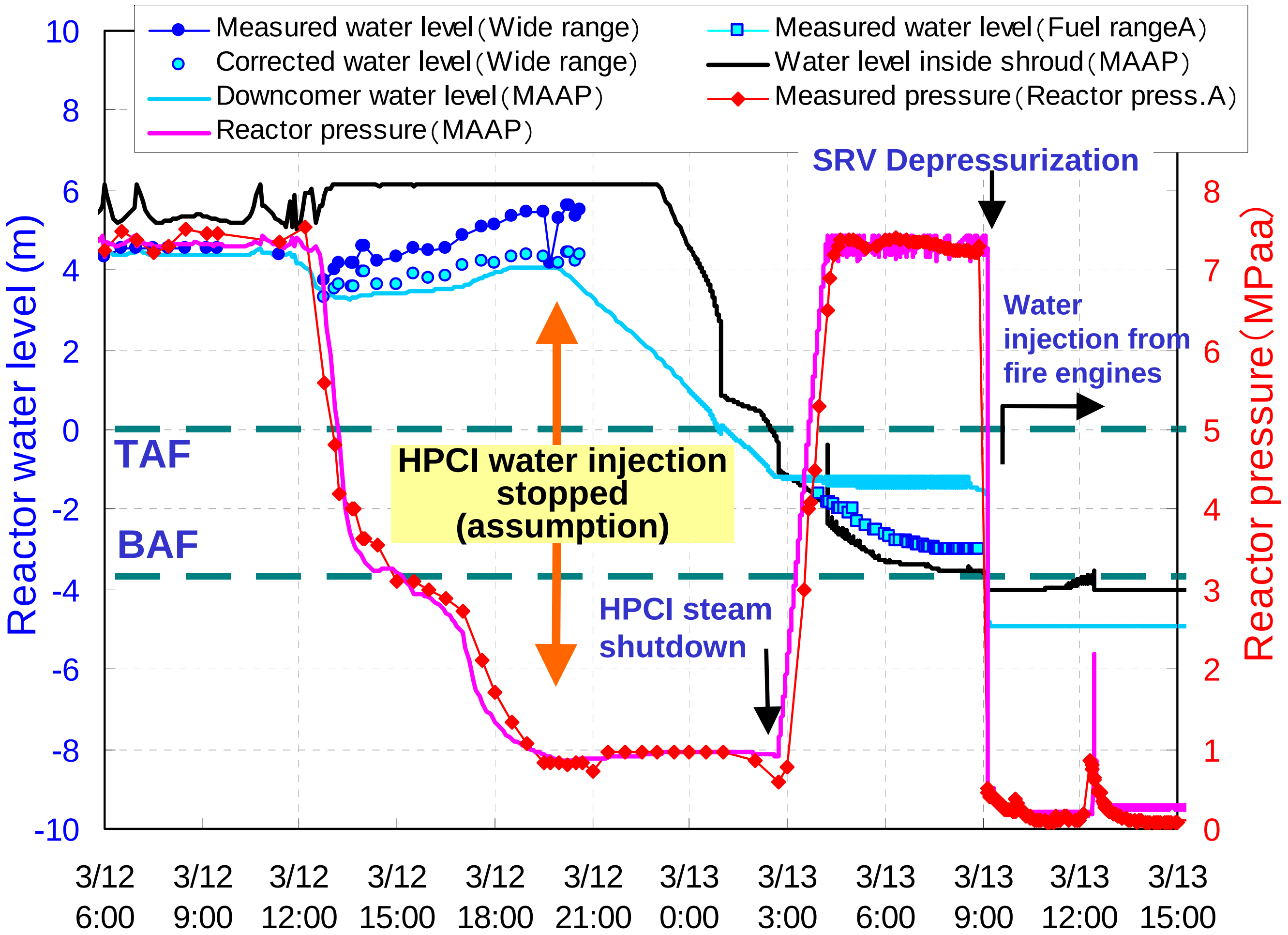
We conducted MAAP analysis, taking into account HPCI operational state.
We assumed that no cooling water was injected into the reactor after 20:00 on March 12.

- Conditions for analysis -

✓At 20:00 on March 12, reactor pressure fell below HPCI design condition 1MPag to about 0.8 MPag. We assumed that no cooling water was injected into the reactor after that time.

✓As for the state of HPCI operation, steam supply to the turbine continued, but we estimate that virtually all of the discharge flow rate went back from the test line to CST.

✓After the HPCI's manual shutdown, reactor pressure began to rise due to steam supply being cut off.



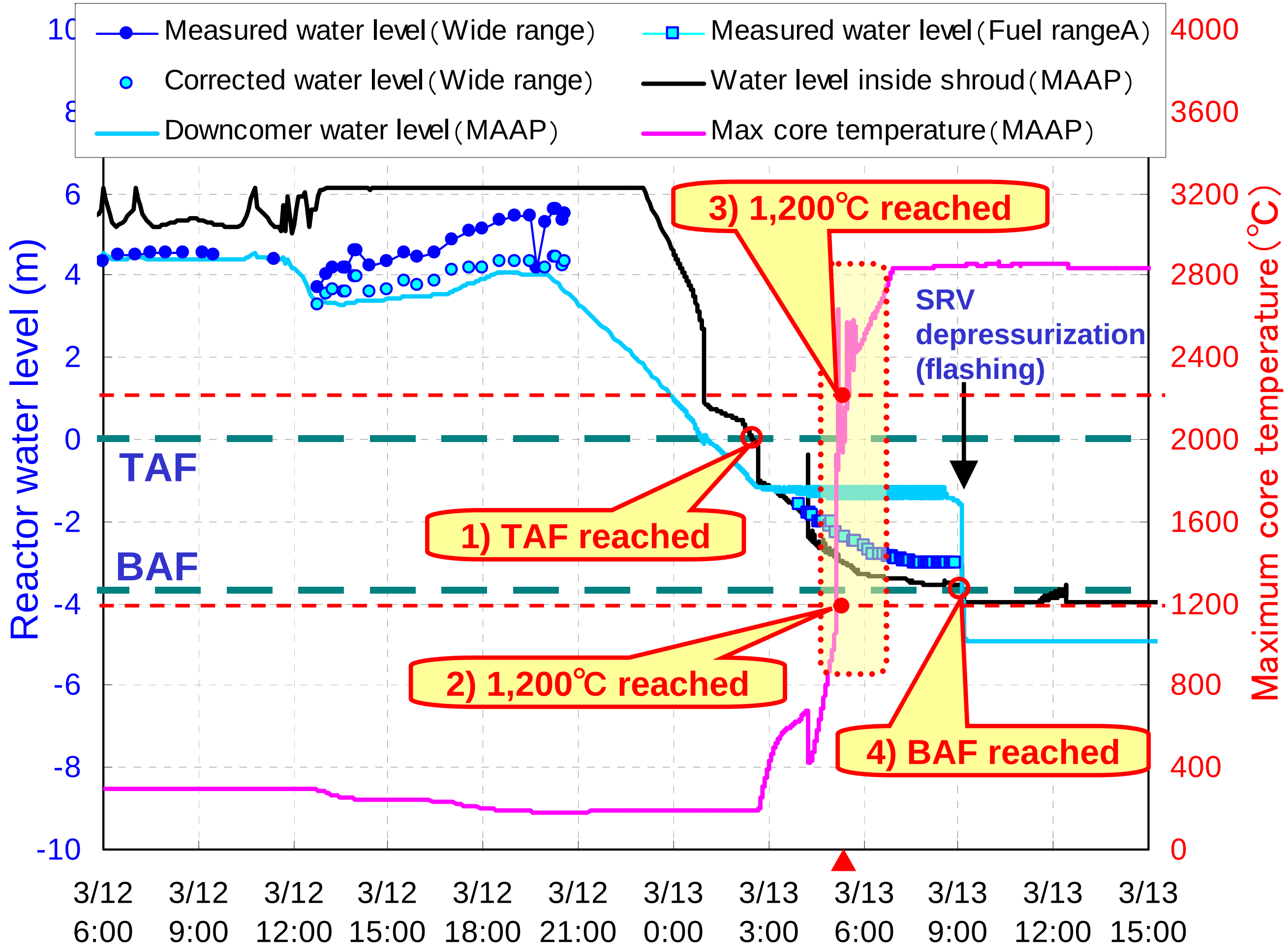
(3) Process of fuel melting reflecting the state of HPCI operating status

Fuel began melting before the water level reached the fuel's bottom.
We estimate that it was the heat from the zirconium-water reaction caused as the water level dropped to cause the fuel to melt.

- Result analysis -

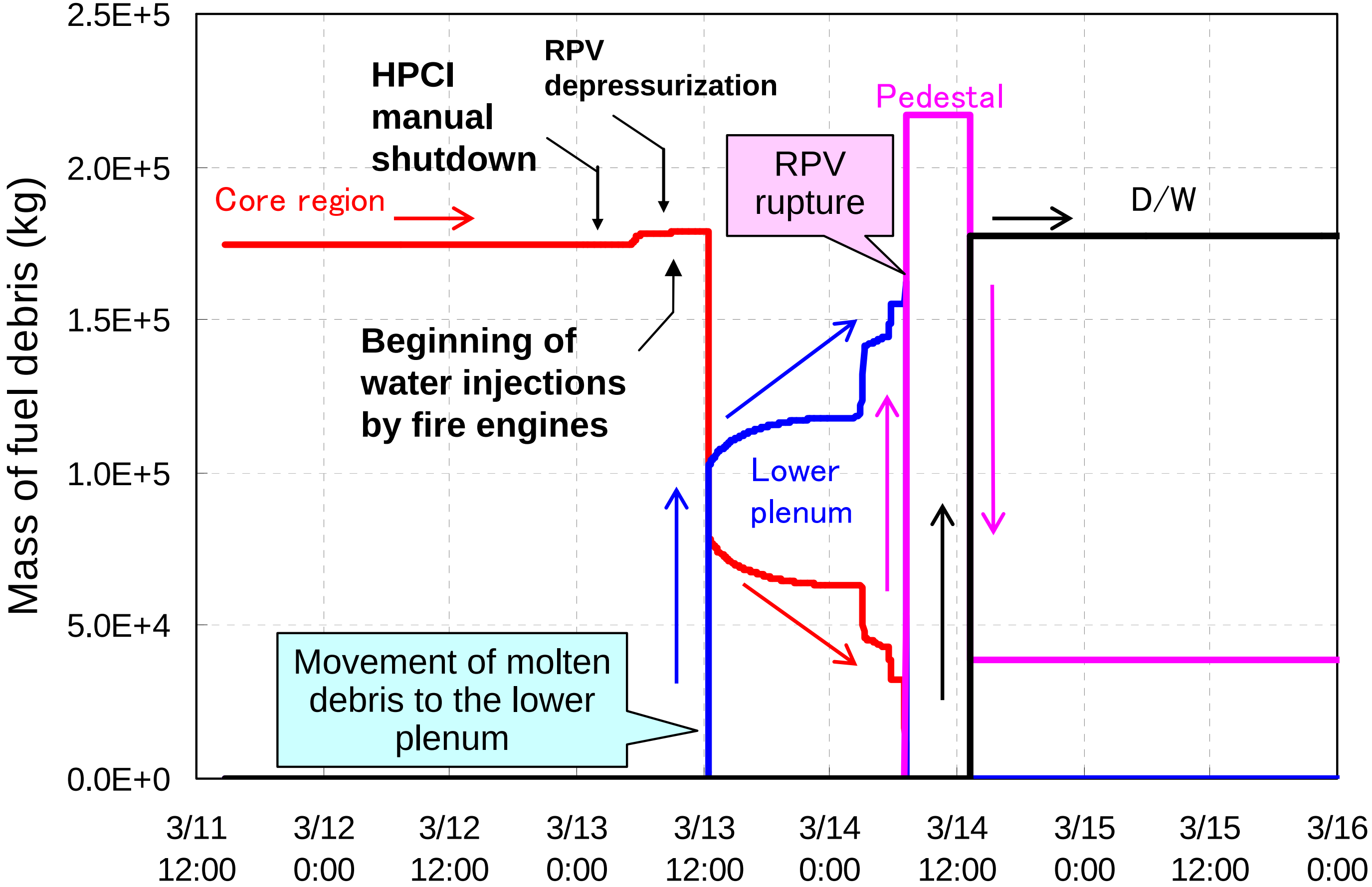
1) TAF reached	About 2:30 on 3/13
2) Maximum core temperature 1,200℃ reached	About 5:10 on 3/13
3) Maximum core temperature 2200℃ reached	(Fuel melting) About 5:30 on 3/13
4) BAF reached	About 9:10 on 3/13

We have made progress in our understanding of the accident's developments leading up to fuel melting.



(4) Developments following fuel melting

By taking into account the state of HPCI operation, simulation result shows that the majority of fuel fell dropped



✓The water injections made starting on September 1, 2011 from the core spray system caused a decrease in RPV temperature. Therefore, we believe there may be fuel debris in the core as well.

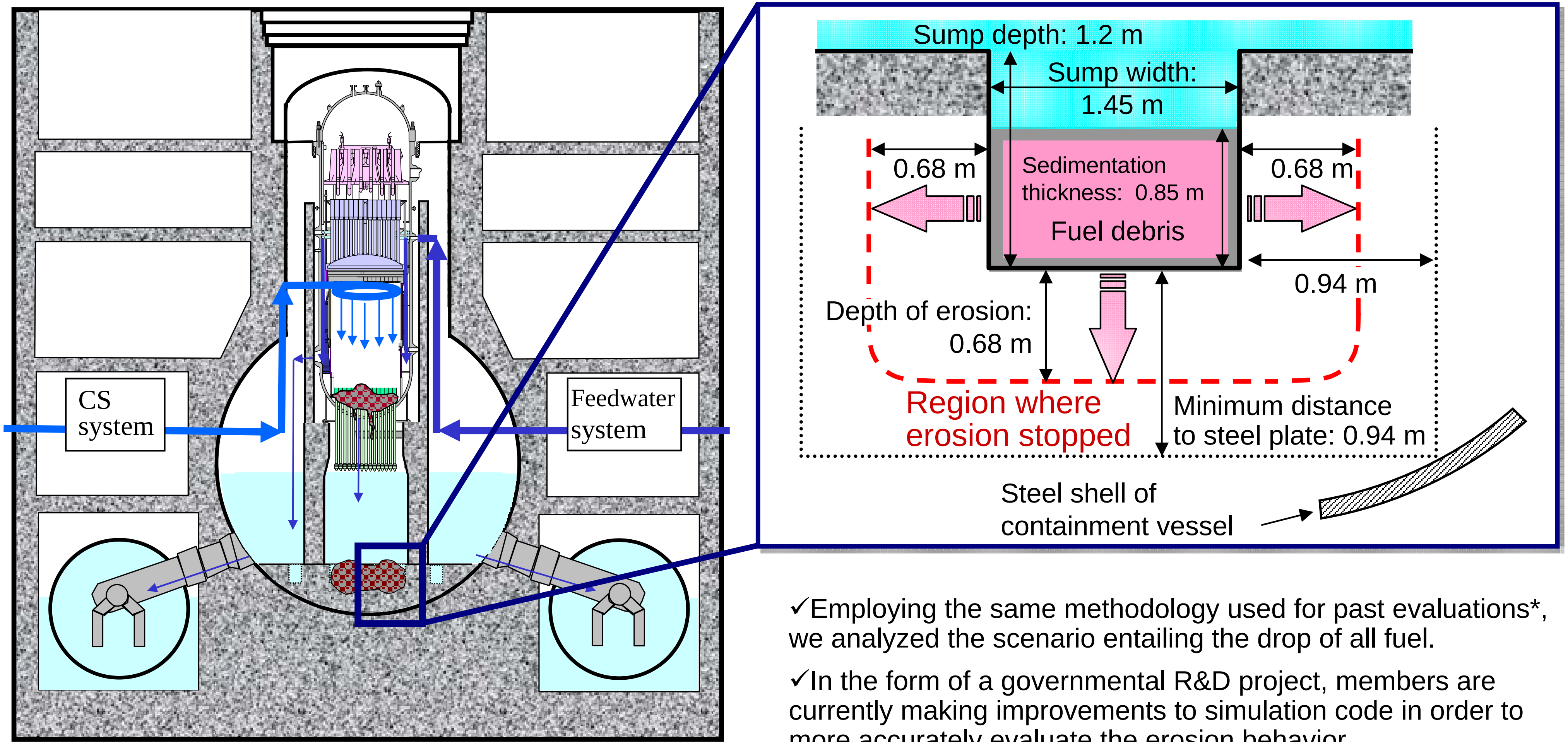
✓Whether the RPV is ruptured is largely determined by the volume of cooling water injected from fire engines; model and analysis conditions entail considerable uncertainty.

✓Simulation resulted in Debris on the PCV of 100%, but there are issues with the MAAP model (in MAAP, RPV rupture case tends to result in entire debris' dropping).

Developments since fuel melting remain largely unclear (molten core's behavior in dropping to the lower plenum, damage to pressure vessels, MCCI, etc.). We will need to study model improvements and input conditions.

(5) Evaluation of MCCI impact

We estimated the degree of concrete erosion by MCCI.
While our analysis entails some degree of uncertainty,
erosion was limited to within the reactor containment vessel.



* This image is for reference purposes, and is not quantitatively accurate in terms of the actual size of fuel debris, etc.

✓Employing the same methodology used for past evaluations*, we analyzed the scenario entailing the drop of all fuel.

✓In the form of a governmental R&D project, members are currently making improvements to simulation code in order to more accurately evaluate the erosion behavior.

(* past evaluation) "Core Conditions at Units 1 to 3 of the Fukushima Daiichi Nuclear Power Station" (November 30, 2011)

3-1. Increase in reactor pressure following forced depressurization at Unit 2

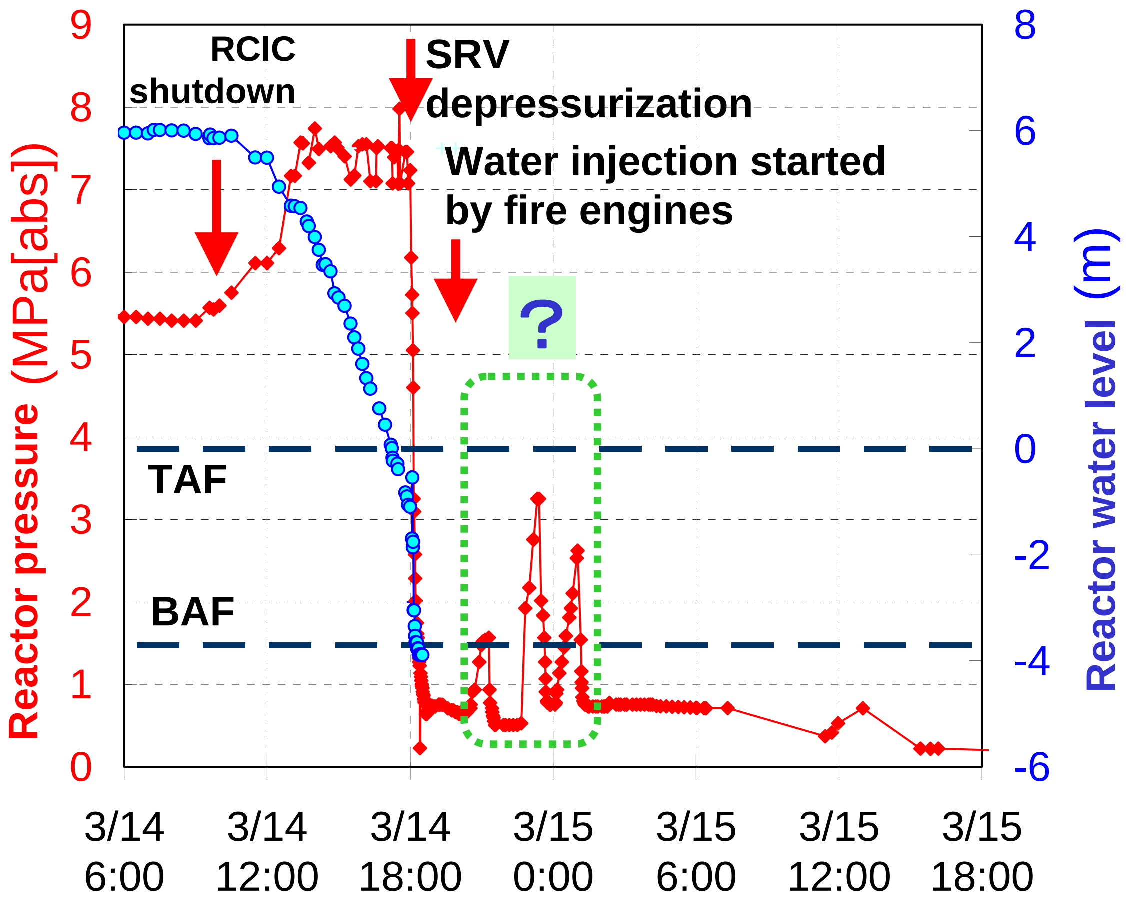
(1) Background

We have found that reactor pressure and PCV pressure increased following reactor depressurization by forced SRV opening.

We have not been able to explain the process from fuel exposure to melting that occurred after RPV depressurization.

Operators tried to open SRVs because of the re-pressurization, but rises and drops in reactor pressure may not necessarily have been caused by closing and opening of the SRV.

Evaluate the process of fuel melting and factors causing reactor pressure to rise



We estimate a scenario where, after reactor depressurization, the steam generated by cooling water injection from fire engines caused a zirconium-water reaction, in turn causing reactor pressure to rise and lead to fuel melting.

(2) Process leading up to fuel melting

We estimate a scenario where, after reactor depressurization, the steam generated by cooling water injection from fire engines caused a zirconium-water reaction, in turn causing reactor pressure to rise and lead to fuel melting.

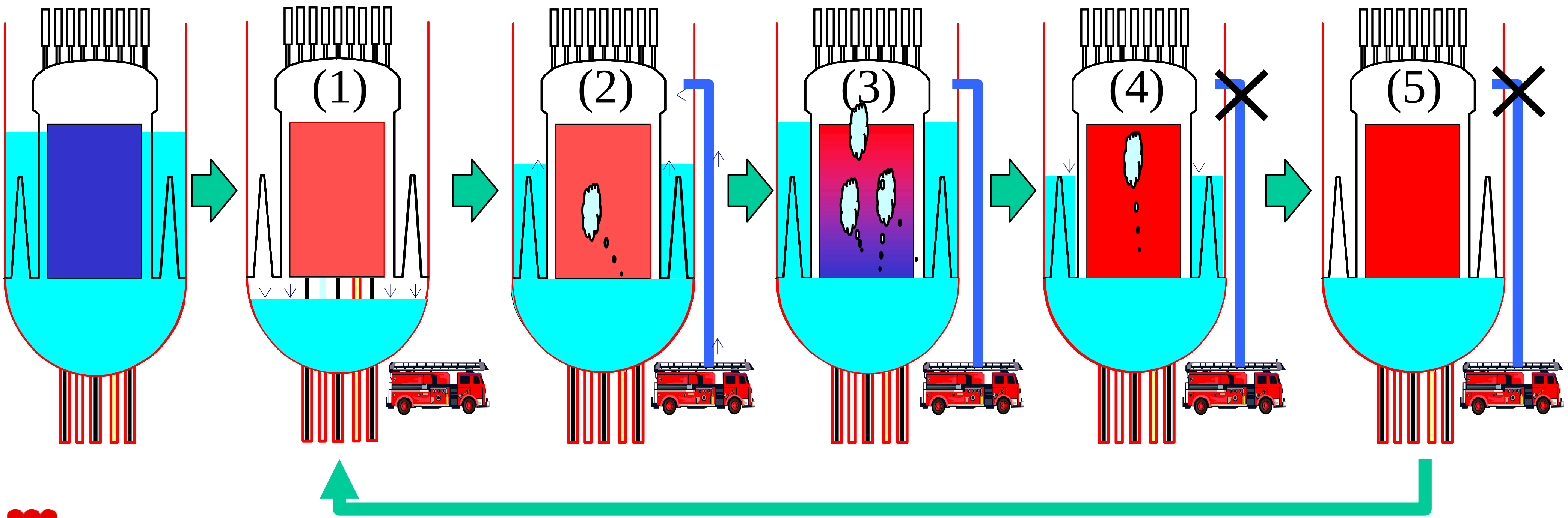
(1) On the reactor's forced depressurization, flashing caused the water level to drop steeply, completely exposing the core.

(2) Water level was restored by water injections from fire engines.

(3) Steam generation caused a zirconium-water reaction, in turn generating hydrogen and large amounts of heat, and causing reactor pressure to rise.

(4) Cooling water injections from fire engines were suspended due to the rise in reactor pressure.

(5) The suspension of cooling water injections brought steam generation under control, letting pressure drop.



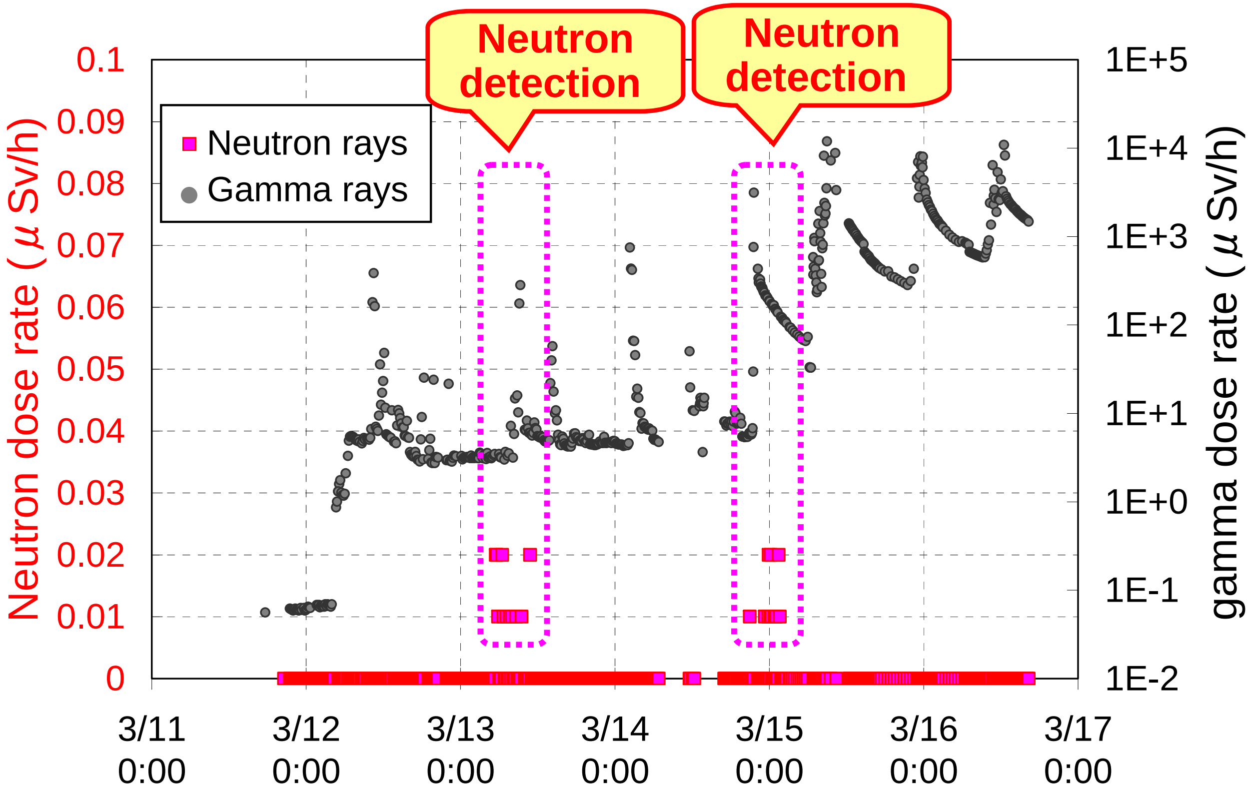
3-2. Relationship between neutron detection and fuel melting

(1) Overview

In the morning of March 13 and in the night of March 14,
small amounts of neutrons were detected near the main gate.
The reason for neutron detection was unclear.

The timing of neutron detection and the increase in the gamma dose rate are not correlated.

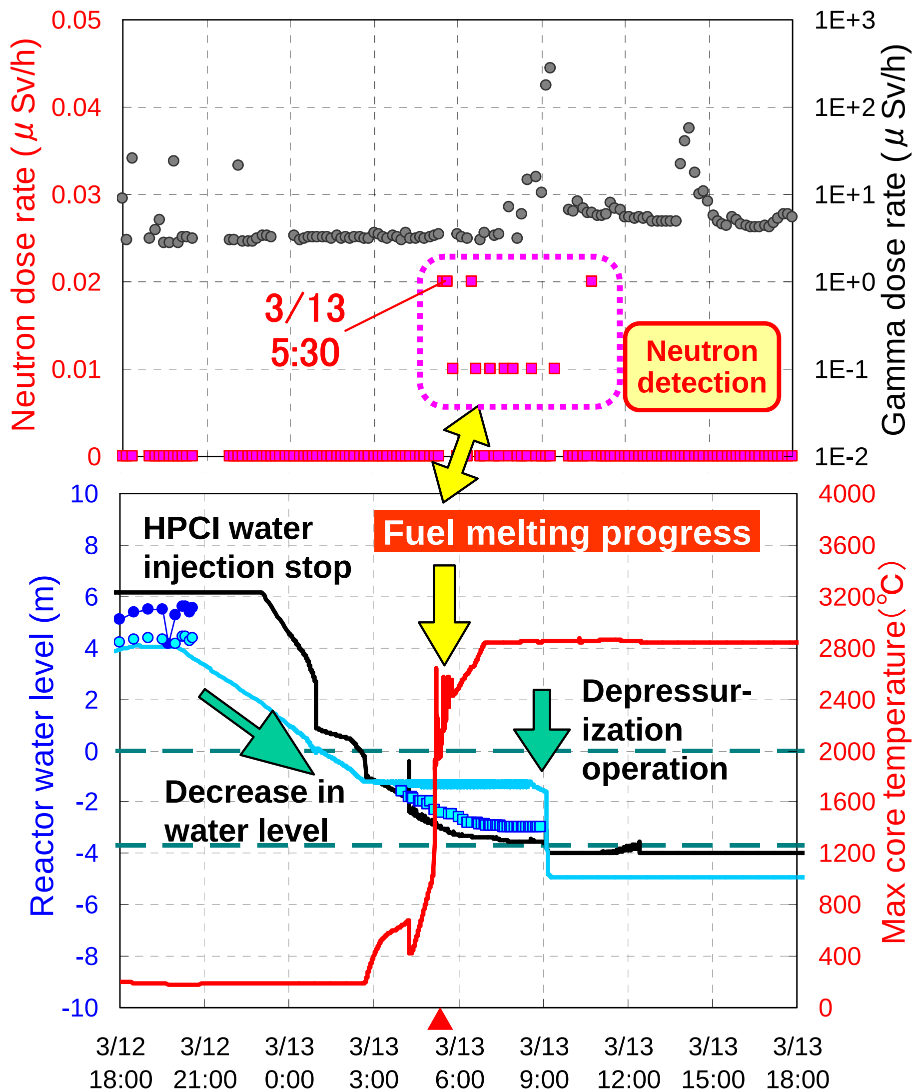
Study the relationship between neutron detection timing and accident behavior, and on the origin of measured neutrons



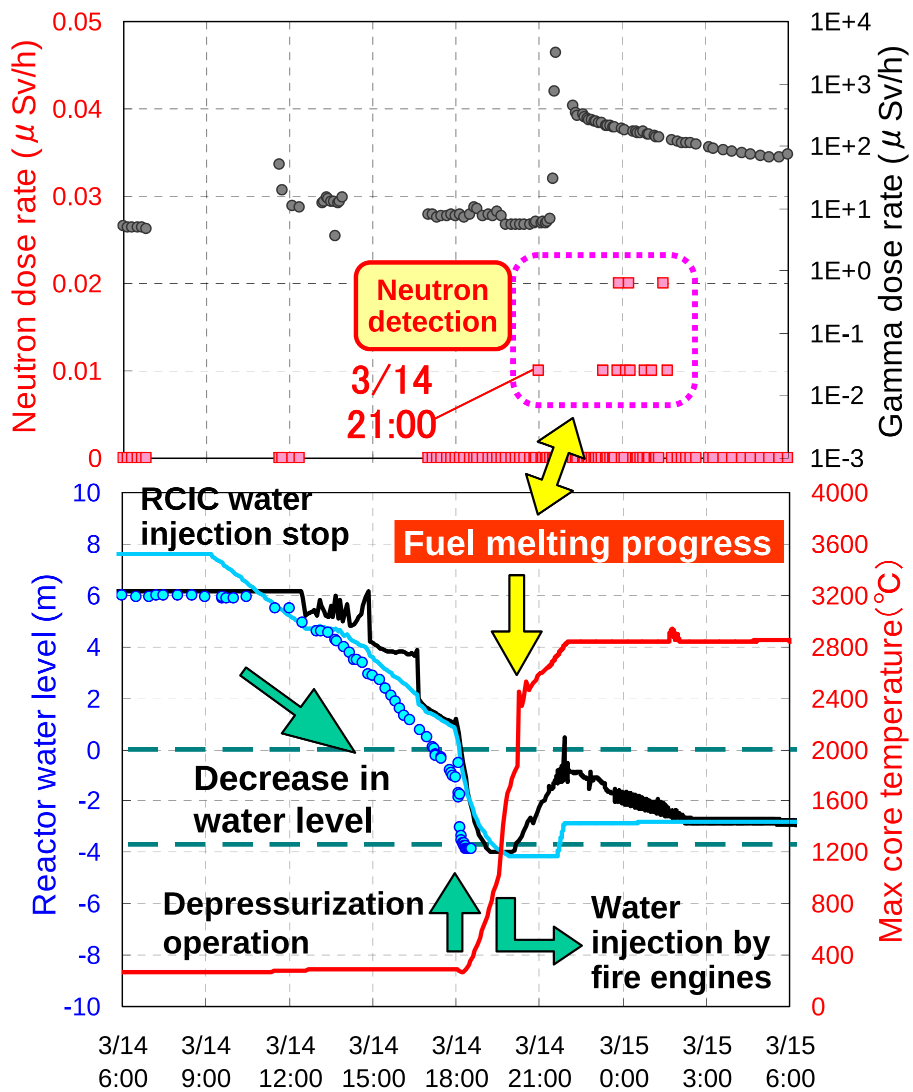
The neutrons detected in the morning of March 13 and in the night of March 14
were released in the course of fuel melting at Units 3 and 2, respectively.
Neutrons may have been generated by the spontaneous fission of released actinides.

(2) Timing of neutron detection

The timing of neutron detection on the morning of March 13 coincides with that of fuel melting at Unit 3.

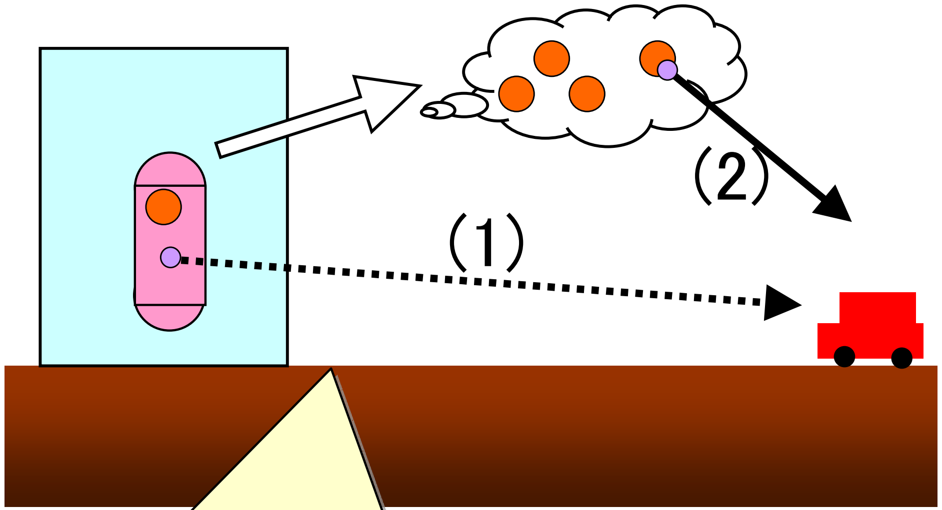


The timing of neutron detection in the night of March 14 coincides with that of fuel melting at Unit 2.



(3) Origin of measured neutrons

The neutrons observed near the main gate may have been generated by the spontaneous fission of released actinides in the course of fuel melting at Units 2 and 3.



The concentration in soil sampled in the Fukushima Daiichi site was similar to that preceding the accident. However, based on the detection of actinides with relatively short half-life, such as Cm-242 and Cm-244, we believe these may have been originated in the Fukushima Daiichi accident.

On Route (1); Neutrons inside the reactor were measured directly.

✕ Unlikely due to shielding

On Route (2)-1; Delayed neutrons deriving from the decay of discharged fission products (Br-87, etc.) were measured.

✕ Given their short half-life, by this time delayed neutron precursors had become sufficiently attenuated.

On route (2)-2; Neutrons deriving from the spontaneous fission of discharged actinides (Cm-242, etc.) were measured.

○
- The timing coincided with that of fuel melting.
- Possible given the detection of actinides in sampled soil thought to come from the Fukushima Daiichi accident.

(We also estimate Xe gas detected in PCV gas to have derived from spontaneous fission by Cm etc.)

(1) Overview

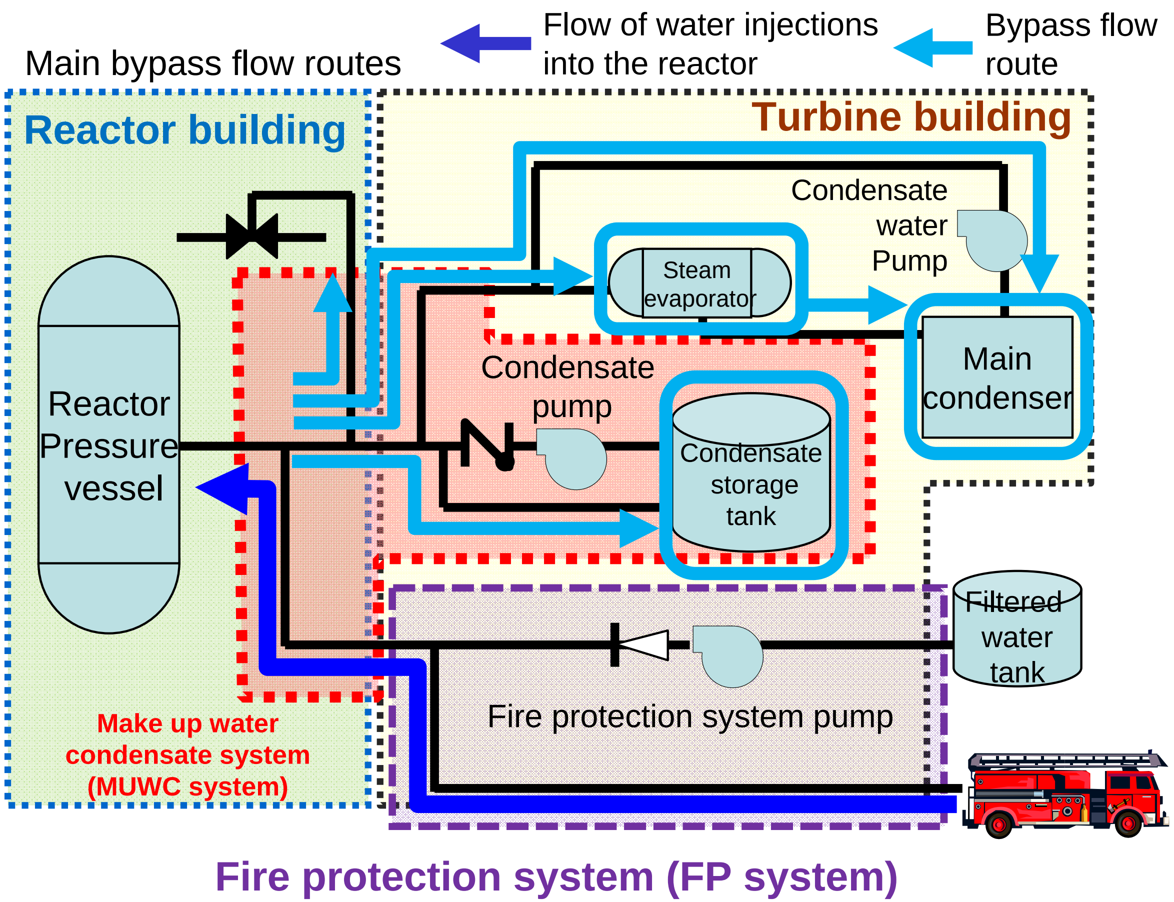
We believe that if all water from fire engines had reached its destination, it would have been possible to cool the reactor down.

It is possible that cooling water injections partially flowed into other systems.
We will proceed to evaluate the volume of water injections from the fire engines - an important input in assessing how the accident unfolded.

In order to evaluate the quantity of water injected from fire engines into the reactor, we **evaluated the volume of water injections into Unit 1's reactor based on pressure losses in the routes of water injections.**

20% to 50% of cooling water may have been injected into the reactor.

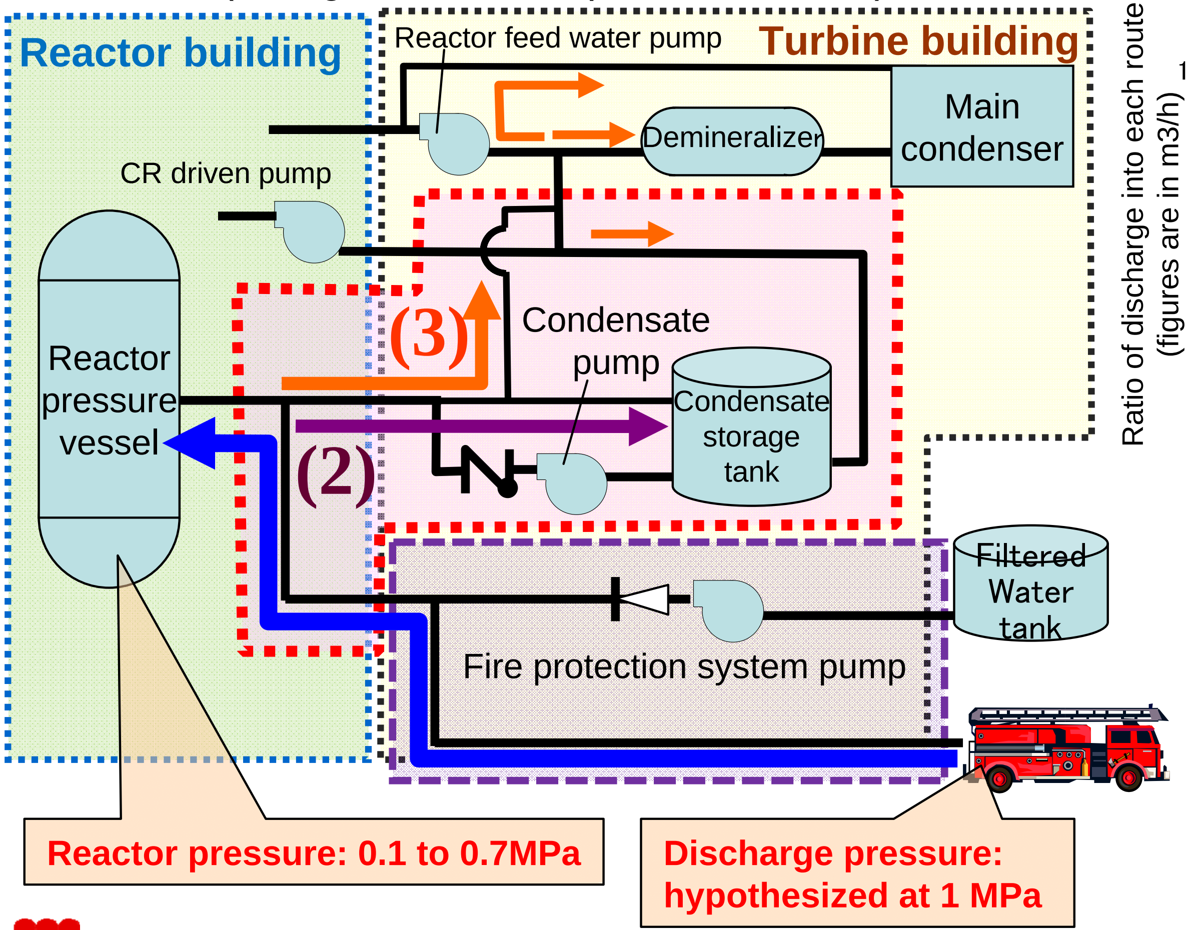
Note, however, that records of discharge pressure and flow rate, etc. from fire engines are few, and leave many aspects unclear; therefore, we will need to continue our review by conducting sensitivity analysis and comparison with plant response.



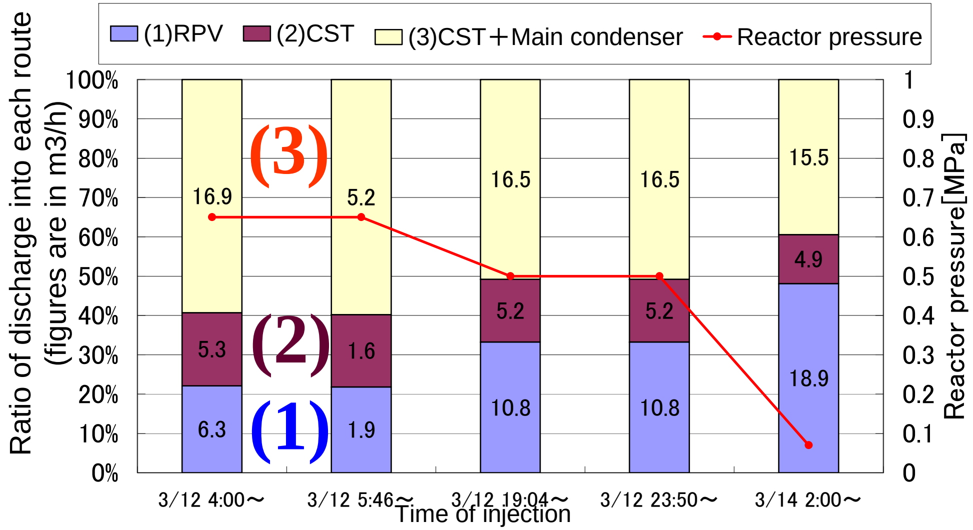
(2) Evaluation results

If we assume fire engine discharge pressure to have been constant at 1MPa,
then about 20% to 50% of water injected reached the reactor.
Note, however, that records of discharge pressure and flow rate, etc. from fire engines are few, and leave many aspects unclear, thus requiring further study.

Unit-1 Main bypass routes
(taking into account pressure losses)



Reactor pressure and ratio of discharge into each route



- At times, fire engine discharge pressure fell below 1 MPa.
- No D/W pressure response while water injection from fire engines were suspended

→ These results may overestimate the volume of water injected into the reactor.

Terminology (for reference)

●Actinides
Collective denomination of 15 elements on the periodic table, from Actinium (atomic number 89) to Lawrentium (103). Irradiated reactor fuel contains actinides such as Plutonium (atomic number 94), generated through repeated neutron absorption and beta decay by Uranium and other nuclear materials.

●BAF Bottom of Active Fuel
Bottom pellet level in fuel assemblies

●Condensate storage tank
Tank used for temporary storage of water to be used at the plant

●Delayed neutrons
Neutrons discharged following beta decay from certain nuclear fission products
(neutrons discharged directly through nuclear fission are called " prompt neutrons")

●D/W Dry Well
Space inside the reactor containment vessel, excluding the suppression chamber

●HPAC High Pressure Alternate Cooling System
Alternate water injection system. Serves as back-up for the reactor core isolation cooling system.

●HPCI High Pressure Coolant Injection system

●Interlock
System to allow or forbid facility operation upon detecting required conditions in order to prevent issues due to mistaken operation.

●Lower plenum
Part located below the core in reactor pressure vessels

●L-8
Signal indicating high reactor water level

●MAAP analysis Modular Accident Analysis Program
Analysis employing MAAP, a severe accident analysis code

●MCCI Molten Core Concrete Interaction
Reaction whereby a molten core fallen into the PCV reacts with concrete, resulting in decomposition and erosion

●PCV Primary Containment Vessel

●Pedestal
Space located below reactor pressure vessels inside the PCV

●Pipe pressure loss
Energy lost by a fluid when passing through pipes

●RCIC Reactor Core Isolation Cooling System

●RPV Reactor Pressure Vessel

●S/C Suppression Chamber

●Spontaneous nuclear fission
Nuclear fission occurring naturally (i.e. not caused by the absorption of neutrons, protons, gamma rays or beta rays)

●SRV Safety Relief Valve

●TAF Top of Active Fuel
Top pellet level in fuel assemblies

●Trip
Stoppage of pumps, turbines or other equipment

●Zirconium-water reaction
Heating reaction whereby high-temperature zirconium (used for cladding, etc.) reacts with water vapor, generating hydrogen; the heat thus generated accelerates the core's rise in temperature.