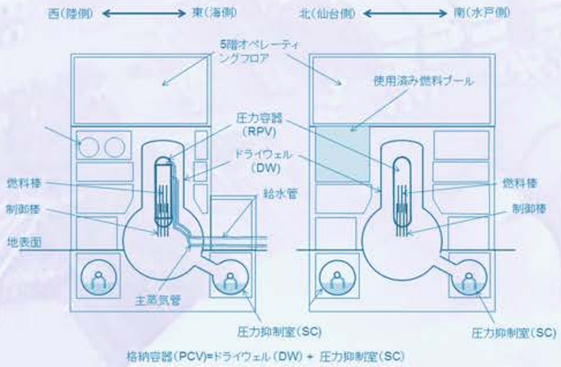
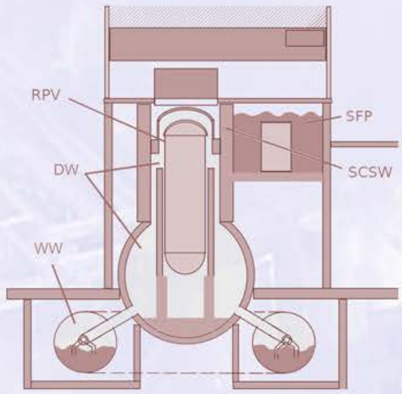
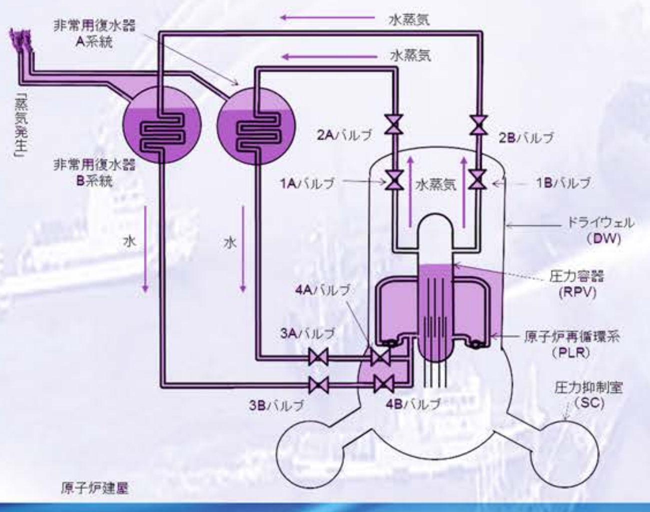
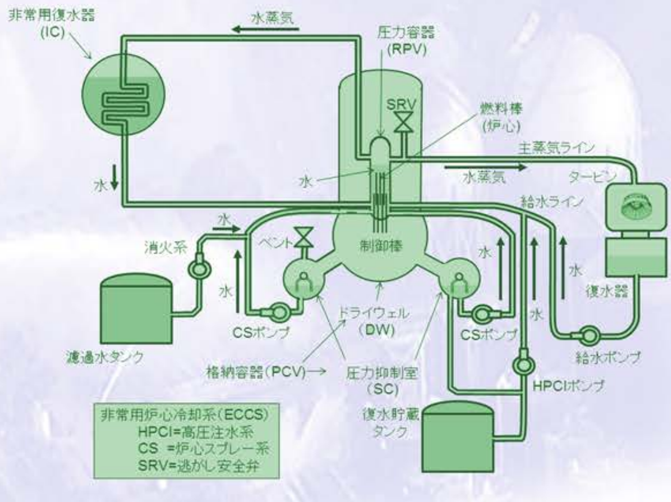
The Actual
Reason Why This Accident Could Not Have Been Avoided

-Understanding the core of the Fukushima Daiichi Power Plant accident-









About the Author

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He was born in Fukuoka in 1955. He graduated from the Department of Physics, The University of Tokyo in 1977 and received a Master of Science (MSc) degree and a Doctor of Science (DSc) degree in 1977 and 1984 respectively, both from The University of Tokyo.

He has been a physicist since he joined NTT Basic Research Laboratory in 1979. He also served as a visiting scholar at the University of Notre Dame, U.S.A., from 1984 to 1985, and as a guest scientist at IMRA Europe, France, from 1993 to 1998. Since he joined The 21st Century Public Policy Institute of Keidanren as an executive senior fellow in 1998, he has been investigating science, technology and innovation management and public policy on national innovation systems. In 2003, he was appointed as a professor of Doshisha University. He was also Deputy Director of ITEC (Institute for Technology, Enterprise and Competitiveness), Doshisha University. In April 2014, he will be a professor of Kyoto University (Graduate School, Shishu-Kan).

He founded fourventure companies, ArcZone K.K. (1998), Powdec K.K. (2001), ALGAN K.K. (2005), and CONNEXX SYSTEMS K.K. (2011) and is currently a board member of four.

Among his recent publications are "Innovation: Paradigm Disruption and Fields of Resonance" (NTT Publishing) in 2006, "Recovering from Success: Innovation And Technology Management in Japan" (Oxford University Press) in 2006, and "JR Fukuchiyama Line Incident: Rethinking Corporate Social Responsibility from Science" (NTT Publishing) in 2007.
In 2008-09, he served as a visiting fellow at Clare Hall, University of Cambridge.

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1. Introduction – Something was overlooked

An "Uncontrollable State"

It happened on Saturday, March 12, 2011. On that day, at 3:36pm, a hydrogen explosion occurred in Reactor No. 1 of the Fukushima Daiichi Nuclear Power Plant, which is managed by the Tokyo Electronic Power Company (TEPCO). At 7:04pm, seawater was injected into the No. 1 Reactor Pressure Vessel (RPV).

However, even in situations where all AC power was lost, the No. 2 (atomic) and No. 3 (plutonium-thermal) reactor vessels were kept in a "Controllable State", which was in a dimension of the state that all nuclear fuel rods were submerged into water, owing to the operation of Reactor Core Isolation Cooling System (RCIC).

During the night, if seawater would have been injected into the No. 2 and No. 3 reactors, these reactors would not have gone into an "Uncontrollable State".

However, "seawater injection" was not executed in reality. Due to this, by 5:00am on Sunday, March 13, Reactor No. 3 spiraled into an uncontrollable state (the state where a part of nuclear fuel rods was not soaked in water and was overheated). This led to a meltdown and later, at 8:41am, large amounts of highly concentrated radioactive substances (such as cesium and iodine, etc.) escaped the containment area when the vents were opened. Thus, more than 100,000 people living within a 30 km radius of the Fukushima Nuclear Power Plant facility and in Iidatemura (village), Fukushima-ken, fled for safety[1]. Had the seawater been injected earlier during the night of March 12 when the situation was still controllable, the damage caused by radiation from Reactor No. 3 could have been avoided.

Freshwater and seawater were injected into the No. 3 reactor vessel only on March 13 at 9:25am and 1:12pm. It is evident that it was just too late to change what had happened.

However, at that point of time, Reactor No. 2 was still in a completely controllable state. Even then, no decision was taken to inject seawater into Reactor No. 2.

On March 14, at 1:22pm, the RCIC in Reactor No. 2 stopped functioning. Around 5pm, Reactor No. 2 had also reached an uncontrollable and overheated state. However,

[1] Through the opening of the reactor vent, radioactive substances, such as cesium and iodine, escaped outside the facility. However, if we measure the output in terms of energy discharged by opening the vent, then the energy discharged from Reactor No. 3 was 1.7 times that of the energy discharged from Reactor No. 1.

seawater was not injected into the reactor vessel. At last, seawater was injected into Reactor No. 2 after7:54pm.

What took them so long in making the decision to inject seawater into the reactor vessels?

This first chapter aims to discuss in detail the reasons for the delay in order to answer this question. In our mission to solve this riddle, the results that we found were unlike any that we have heard from the mass media around the world.

It is not that they were late in making the decision; rather they intentionally delayed in making their decision. TEPCO intentionally refused to inject seawater into Reactors No. 2 and No. 3 while the situation was still controllable on March 12. The reason behind this can be easily explained. If you inject seawater into the reactor, it will become useless, in other words decommissioned. If that had happened, TEPCO would have incurred a huge monetary loss.

In fact, when this accident occurred on March 12, Naoto Kan (Prime Minister of Japan) had requested to inject seawater into the reactor pressure vessel. However, Takeguro, the acting representative for TEPCO, was completely against this suggestion when it was first made. Of course, he was not so arrogant as to dismiss Kan's advice altogether. By giving specious technological explanations, he softly denied the early necessity for seawater injection. The representatives of both the Nuclear and Industrial Safety Agency and the Nuclear Safety Commission acknowledged the negligence behind TEPCO's conduct.

However, under the current laws, any direct government intervention in TEPCO's affairs, like that of Prime Minister Kan's suggestion, was not authorized.

I would like to first give you a rundown of the evidence and assumptions this verification is founded upon. The detailed explanation follows from Section 1-2 onwards.

Where does the riddle begin?

After the accident, the mass media immediately started to focus its attention on blaming nuclear technology itself. Several reports from the media were, in fact, very valid arguments. They included statements like "It would take tens of thousands of years for the radioactive wastes generated from these nuclear reactors to naturally decompose and reach a completely harmless level", "One should never operate anything in practice, which produces a kind of waste that no human being can control", "It was a complete mistake on the part of Japan to build 54 of these nuclear reactors around the country, which is earthquake-prone", and "This earthquake is on the same level as the one which occurred during the Jougan era (869 AD), which also brought with it an enormous tsunami that hit roughly the same area as this recent one. Therefore, how can one possibly say that it was 'unforeseeable'?"

However, within these arguments, some very serious implications lurked in between the lines.

Each of these statements ambiguously assume that "As soon as the tsunami crashed into the facility, all power was lost, causing the three reactors to spiral out of control". However, these are nothing more than hypotheses and suppositions, which lack concrete supporting evidence. In other words, these statements cannot be deemed valid enough to argue and analyze the nuclear accident.

Although TEPCO was more than likely aware of this, they continued to just respond by repeating at each press conference that, "This was something that was just simply 'un-assumable". Surely, what they meant by "assumable" seemed to be the standard design construction guidelines enacted by the government (i.e., what they meant by "un-assumable" was that it was just something that was not listed in the standard design construction guidelines, and vice versa). The reason behind this response probably goes something like "As you can see, we have complied with all the standard guidelines to avoid the noted accidents and problems". When they claim this, what they actually imply is "It's not our fault, so we are not going to take the blame".

It would cause one to wonder if the engineers involved in the design process of this facility also shared this kind of unscientific logic. Many of the engineers whom I contacted told from their experience that this line of thought is flawed. Those who study science definitely understand that the government's guideline is unscientific in stating that "Nuclear reactors are absolutely safe; therefore, their safety should not be doubted." In order to properly maintain and operate a business, engineers have to take full consideration and care into the design of their workplace; but, in practice, they would surely acknowledge that few things of such design guidelines should not be adopted as is. We can describe the ethics behind engineering as that feeling, which causes one to set up a "Last Fortification" by accounting for measures to protect against the "un-assumable".

There was a "Last Fortification" in place to work when all power was lost

I came to know that what I had imagined was right on March 29, 2011. The equipment in place, which made up this "Last Fortification", was, in fact, installed on all the RPVs. It was a kind of equipment that could remain operational and cool down the core regardless of the loss of all power (or DC power supply) to the facility. For Reactor No. 1, this was called the Isolation Condenser (IC); for Reactors No. 2 and No. 3, it was called the RCIC.

IC was designed to continue to cool the core for approximately eight hours without electricity. The later evolved version, RCIC, was designed with an internal DC back-up power supply, which can support continuous cooling of the core for over 20 hours without AC power.

It was obvious that these emergency equipments should have been designed to automatically start functioning after earthquakes, as this past one, or in other emergency situations where staff could manually start them when needed. If they are not readily available for use when such emergencies occur, it would certainly lead to an "uncontrollable state" of nuclear reactors with devastating consequences. This "Last Fortification" was designed as a temporary means to prevent the situation from reaching an "uncontrollable level". During that time, measures would need to be immediately taken to get things back under control again. In the event that the cooling systems would not be functioning, the heat levels of the reactor vessels would "go beyond the boundary of life and death"[2], and without a doubt, would spiral out of control leading to an uncontrollable level.

However, in situations like the magnitude of this past earthquake when all the power supply was lost, we can see that it was certainly not a situation that could have been amended by repairing some damaged equipments in few hours. In reality, while they were using the prepared fresh water stored in these emergency tanks, they should have

[2] A "controllable state" refers to sufficient water levels around the core (in reactors), which are able to provide sufficient cooling, whereas an "uncontrollable state" refers to the water levels in the core being reduced to a level that can no longer provide sufficient cooling to the core. The time taken for reaching this "uncontrollable state" after failure of "Last Fortification" is roughly four hours. There are no means available to man to bring the core back to a "controllable state" once it falls into an "uncontrollable state". The "inner physical boundaries" represent "life", whereas the "outer physical boundaries" represent "death", herein.

also been preparing and gathering seawater as well, as that was the only available alternative after all of the fresh water was used up.

Even though the logic behind it is simple, it was ultimately ignored and not executed.

Why?

There are two possible explanations. The first is that the "Last Fortification" ultimately malfunctioned and stopped working. Or, for example, maybe it started to work and then somewhere along the way a hole, etc. opened up, which allowed water to leak out of the container. Both these conditions would have led to a situation where the reactor would lack proper cooling, causing the heat to spiral out of control.

The second possibility is that TEPCO's corporate executives intentionally avoided injecting seawater into the reactors. The reason for such a decision could be to avoid incurring a huge financial loss by having to decommission the nuclear reactor vessels.

On July 20, 2011 at the "Put an End to the Power Plants" [20110720] conference, Tanaka Mitsuhiko pointed out that "immediately after such a severe earthquake, the possibility of even a small- or medium-scale cooling system-related problem occurring in the reactor system plumbing was extremely high. This led us to hypothesize that due to the "deficiencies in the underlying technology", water could possibly leak and escape out of the tanks". If we had some evidence to support this hypothesis, it would validate the first possible reason mentioned in the previous paragraph.

In order to determine which of these possible reasons is accurate, I performed some research on public data from the following dates: [20110315], [20110404], and [20110412]. I then made a scatter-plot graph using this data, which encompassed a timeline of the water and pressure levels of the containment centers of RPVs. The end result was that the emergency cooling system in Reactor No. 1 functioned exactly for the eight hours that it was designed for. Although we are not exactly sure how long the cooling systems in Reactors No. 2 and No. 3 functioned, the data indicated that they functioned for over 20 and 70 hours respectively.

During the start of April (2011), I started writing an article that I later published in the Nikkei Electronic Magazine's May 16 monthly release and in the Nikkei Business: Online Magazine's May 13-01 edition. They were both released on Friday, May 13, 2011. The article talked more about assertions and information that support the second possible reason mentioned earlier. These assertions are noted as follows.

All the "Last Fortification" systems in these three reactors worked just as they were designed to by continuing to cool the atomic cores. However, while the reactors were in a controllable level, no immediate decision was made to inject seawater into the reactors. Thus, we can determine that TEPCO's corporate executives responsible for technology management had committed a serious act of negligence with regard to "duty of care".

The Sudden Change – May 15, 2011

Two shocking reactions followed this. The first one came from TEPCO who held an emergency press release two days later (Sunday, May 15, 2011). The outline of the press release is as follows:

TEPCO announced that ---

The data regarding the water levels of Unit 1 reactor measured by the workers was inaccurate, which means that the water levels had not been maintained as earlier *reported. In addition, on March 11 at 3:03pm, a part of the emergency cooling system had been functioning abnormally.*

After hypothesizing that the emergency cooling system had completely lost function and analyzing the data on hand, TEPCO came to the conclusion that Unit 1 reactor's water levels had already lowered enough to expose the head area of the fuel rods by around 6:00pm on May 11, and by 7:30pm the water levels had already completely lowered past the bottom area of the fuel rods leaving them completely exposed to overheating. Thus, TEPCO also concluded that the meltdown officially began around 7:30pm on May 11.

Perhaps this was not some kind of "reaction" to my article and might have been unrelated to the published article. However, even though it may have been just a coincidence, there is the possibility that this press conference was intentionally held three days later.

Either way, it was certainly a strange and unexpected press conference.

So, why exactly was the data measured by these workers "inaccurate"? TEPCO did not mention why it happened. They just reported that "we ultimately could not maintain the water levels inside the reactors".

Moreover, of the two emergency cooling condensers, only one intermittently worked. TEPCO undoubtedly has the details of the condenser, which worked when they analyzed, and then released the analyzed data the following day (May 24). If that was really the case, then why did they deliberately choose not to release the more accurate information in the first place? It is quite a curious matter indeed.

Were they trying to conceal something? Did they have some kind of ulterior motive? TEPCO continuously asserted, until the accident happened, that nuclear power generation is safe, and even after the accident they continued to say that everything was under control. Despite this, when questioned as to who should take responsibility for this accident, they pointed the blame at the earthquake and tsunami asserting that "nuclear power generation is unstable enough to spiral out of control when affected by earthquakes and tsunamis". Therefore, "the fault does not lie with the TEPCO management's negligence of actions because Reactor No. 1 immediately spiraled out of control right after the disaster occurred". It seems as though TEPCO was trying to cover up something by altering and creating fake information as "rewriting their scenario on purpose" so as to avoid disclosing information, which could, otherwise, potentially blame TEPCO's top management. Their purpose was just to dodge their responsibilities for the corporate management.

I expected the mass media to recognize that this may have been the case and to remain very skeptical about TEPCO's response and demand concrete evidence to prove the validity of what TEPCO was asserting. However, unfortunately, most of the mass media ended up accepting this as a "fact" instead of as a "hypothesis" and took upon the role to inform everyone within their reach that it indeed was such. The mass media had been starting to focus its attention on doubts related to TEPCO's "Let's look at this accident from a lighter approach" attitude. Up until that point, TEPCO remained very adamant about avoiding the use of the term "meltdown". Then, TEPCO held the press conference as stated above. It is not hard to imagine why the media mistakenly interpreted that "TEPCO was confessing the information, which they had hidden, and finally started telling the truth".

Further, on June 6, the Nuclear and Industrial Safety Agency (NISA) also held a press conference to discuss the results they had found. Their hypothesis was concurrent with TEPCO's assertion that the "instruments which measured the water levels had indeed given erroneous values" and that "the emergency cooling condenser system immediately came to a halt after the tsunami's impact". On top of that, they concluded that "the water levels in the machine, which housed the fuel rods, had already reached the head of the rods at roughly 4:40pm on the 11, and by roughly 6pm the nuclear reactor core had become completely exposed and damaged". This report indicated the high possibility that the nuclear reactor core had melted and fallen about 90 minutes earlier than what TEPCO had concluded. As far as I know, there were no third-party onlookers who doubted TEPCO's analysis report stating that "the actual measured data was wrong to begin with, which means that in actuality the water levels had not been maintained". There were no articles, blogs, or broadcasts to be found demanding for the management of TEPCO to take responsibility for its negligent actions.

Yasushi Hibino's Testimony

The second reaction came from a close friend, Dr. Yasushi Hibino.

Dr. Hibino is currently serving as Vice President of the Japan Advanced Institute of Science and Technology (JAIST). He was also a friend and college pal in whom Prime Minister Kan firmly believed. With that connection, Kan placed his trust in Hibino by nominating him as a Cabinet Secretariat Advisor towards the end of February 2011. He was officially instated on March 20, 2011, and was assured that he would begin assisting with the administrative affairs related to science and technology.

The earthquake and power plant catastrophe occurred right in the midst of this personnel gathering on March 12 and 13. Before he was officially instated, he was invited as a friend to visit the official government residence and offer personal advice and opinions on a number of matters. The following passage contains the contents of a personal letter that Hibino sent in response:

> *I believe that the reason for why this accident occurred is exactly as you have already surmised (Note: based on the aforementioned articles released in the Nikkei Electronics and Nikkei Business Online Magazines).*
>
> *In these articles, Prof. Yamaguchi indicates the existence of the ICs in Reactor No. 1 and the RCIC in Reactors No. 2 and No. 3.*
>
> *Given my long relationship with President Kan, I officially instated on 20 of March; however, before that, the Official Residence asked me to come for a visit on the night of March 12, the next day of the accident, where I stayed there in a tense situation until the following afternoon (13).*
>
> *By that time, the vents had already been opened in Reactor No.1 and seawater had been injected into the reactor. However, this was not carried out until after the hydrogen explosion occurred.*
>
> *By that time, Prime Minister Kan had started to get the feeling that the same thing might possibly happen to Reactors No. 2 and No. 3 as well. And Kan had frequently instructed TEPCO, NISA and Nuclear Safety Commission of Japan to forestall the situation. However, they, experts, stalled the opening of vents and seawater injection with the reason that the Unit 2 reactor and RCIC were still working.*
>
> *So, on the grounds that there was a working cooling system still in place, they chose to delay opening the vent and injecting seawater into the RPVs.*
>
> *Prime Minister Kan asserted that even if we were to say that the ICs had indeed been functioning as intended (as there was no heat coming out of the containment area), we can infer that the heat and pressure more than likely continued to gradually build up as it had nowhere to escape. Thus, Kan strongly*

maintained that this is exactly why they should have quickly opened up the vents and injected seawater into the reactors immediately to cool down the out of control reactors.

Agreeing with his (Kan's) assertions that the vents should have been immediately opened and seawater should also have been immediately injected into the reactors to cool them down, I questioned Takeguro, the representative of TEPCO, the heads of NISA and the Nuclear Safety Commission of Japan as to why they waited till the emergency back-up cooling systems stopped before taking any countermeasures.

This was their response: "As the vent can only be opened one time, we wanted to wait for the most opportune moment when the pressure and heat had built up to as high as it possibly could to release as much of the heat and pressure as possible in one go."

Unfortunately, I did not possess enough knowledge regarding thermodynamics at the time, so I ended up accepting that as a good enough reason to just let them carry on as they pleased. The following day, March 13, the emergency cooling system in Reactor No. 3 failed, leading to an "uncontrollable state".

However, after returning back to my university and doing some research, I learned that when the temperature of water exceeds the boiling point, a large amount of the latent heat from the hot steam becomes absorbed. When the surrounding pressure exceeds 21 atmospheres, water vapor (steam) and water both possess an equal amount of heat absorption properties.

In other words, TEPCO should have immediately opened up the vent and injected seawater into the reactors instead of waiting for the pressure and heat to build up before doing so. There is still enough time to take action before it is too late with regard to Reactor No. 2. I immediately called Prime Minister Kan and gave him the details regarding my proposal.

It was already late as the isolation cooling system had already stopped functioning.

I had doubts for quite some time as to why exactly TEPCO did not open the vents and inject seawater into the reactors while the RCICs for Unit 3 and Unit were still functional. I was able to completely understand why only after you clarified some points for me.

Now we can clearly see the complete and utter "negligence" of TEPCO's actions with regard to this disaster.

I immediately replied to Dr. Hibino hoping that he would be able to provide some more detailed information regarding the matter. By accepting my request, the more than willing Dr. Hibino testified regarding all the information and knowledge he had gathered and uncovered, including what he had learned while at the government residence.

The Structure of this Chapter

The next section, Chapter 1 (Section 2), takes another look at how exactly this accident happened. It aims to discuss and explain a simple mechanism within the nuclear reactor, which was in place at the time. It also explains how the "Last Fortification", ICs for Reactor No. 1, and RCIC for Reactors No. 2 and No. 3 were structured with the help of figures to help the reader get a better grasp of what I am trying to convey. Sections 1.3 and 1.4 analyze and break down the elements to show how Reactors No. 2

and No. 3 went into an uncontrollable state. Graphs were created using publicly available data, which after thorough analysis aim to determine exactly when the "Last Fortification" in each reactor stopped functioning, when the vents were opened, and when seawater was injected.

As previously mentioned, the public data contains information about how the reactors spiraled out of control and the "sudden change" in Reactor No. 1, which occurred on May 15. TEPCO's press release on the result of their computed simulation (model analysis) stated that "the water level indicator of Reactor No. 1 showed erroneous figures" and, in addition, that "IC was not in operation". I have summarized the "sudden change" and its related situations in Section 1.5.

Section 1.6 covers the information and records available related to Hibino's interview, his appearance at the government residence during the two-day period between March 12 and March 13, and the topics discussed there. These questions will be answered as elaborately as possible. Only the records for which we received permission from the speakers to use will be included in this section. Section 1.7 will discuss, compare and contrast this Fukushima No. 1 power plant accident with that of the JR Fukuchiyama line train accident, which occurred on April 25, 2005. Main topics include the clear negligence within the actions of the management of these firms with regard to these accidents, which the media failed to convey to the public. We can see a strong resemblance between those accidents in terms of the fundamental laws of corporate governance, in organizations and the mass media in a way that they still have not yet come to understand the laws related to this accident. By using these two examples as a base, I would like to demonstrate that as long as such organizations continue as monopolies or oligopolies, they will continue to lack fundamental innovative core competencies, which will ultimately lead to disasters such as these.

Section 1.8 encompasses what has been made clear in previous sections and what still needs to be clarified. Section 1.9, "Conclusion – Looking towards a New Sunrise", will pinpoint the innovations that the Japanese society needs to seek to provide a better and safer future. That is our vision. In discussing the relationship between the problems within this accident and those within the current Japanese industrialized society, which is "one cycle behind", we aim to show what kind of horizon the future holds in store.

2. How exactly did this accident happen?

What happened after the earthquake?

The "East Japan Large-scale Earthquake" was triggered by the earthquake that occurred off the eastern shore of the Tohoku region in the Pacific Ocean on March 11, 2011, at 2:46 pm. The Fukushima Daiichi Nuclear Power Plant lost access to all outside sources of electricity when the emergency electricity receiver tower collapsed due to the impact of the earthquake. The emergency power supply generators were then immediately turned on for temporary support. The reactors came to an emergency stop when the control rods were automatically inserted into the three still working reactors (from the oldest reactor (No. 1) to the more recent plutonium-thermal type reactor (No.3) or "reactor scram)". The other three reactors (No. 4–No. 6) were still in temporary "hibernation" at the time. The used-up fuel had just been removed out of the reactor and placed in a pool-like confined area with cool water.

However, 40 minutes later at 3:27pm, a 14-meter high tsunami crashed into the facility, completely submerging the emergency power supplies ("diesel power generators") and switchboards, which were installed at the base and underground areas of the reactor and turbine buildings, in water ("0–5.8 meters below sea level). However, as the No. 6 reactor was the only reactor designed with an air-based cooling system installed on the first floor as a third cooling system, it was able to avoid coming to an emergency stop [20110620, p. III-30][3]. Although Reactors No. 5 and No. 6 still had working supplies of electricity, by 3:42 pm Reactors No. 1 through No. 4 had completely lost all external access to electricity; thus, the Emergency Core Cooling System (ECCS) had also stopped functioning. Since all the switchboards were submerged except half of those installed in Reactor No. 2, specialists were unable to get them up and running again despite having arrived there with power source vehicles [20111028, p.109].

With the exception of the 3rd unit on the first floor of Reactor No. 6, by that point of time all other emergency back-up electricity systems had stopped functioning. There are two reasons for this occurrence.

The first reason is that the power plant facility was built in an area only 10 meters above sea level. In contrast, the Onagawa Nuclear Power Plant of the Tohoku Electric Power Company, Inc., which faced a higher tsunami attack, experienced only minor flooding in the basement areas. This was because its water inlet was at a slightly higher location in Reactor No. 2 (approx. 15 meters above sea level), which enabled it to retain access to electricity.

The second reason is that except the 3rd emergency power source of Reactor No. 6, all other emergency power supplies were built with a 2-unit design and installed in the basement. Had they been designed at a different location in a different method, they would have been able to avoid this loss of electricity. Actually, only one of the units in Reactor No. 6 survived the impact, and that too because it was an air-cooling type system that was located on the first floor.

Here, we continue to analyze and break down one single point over and over again. That point centers on the question whether the "Last Fortification", in other words the IC in Reactor No. 1 or the RCICs in Reactors No. 2 and No. 3, had actually worked at all even after all the back-up electricity systems had failed.

The structure of the emergency reactor cooling equipment

Before discussing the structure of the emergency reactor cooling equipment, I would first like to emphasize the mechanics behind the design of the Fukushima Daiichi Nuclear Power Plant Reactors No. 1 through No. 3. All these reactors were Boiling Water Reactors (BWR).

Figure 1.1 - The No. 1 reactor in the No.1 Fukushima Power Plant overall structure (Mark I). Reactors No. 2 and No. 3 were also designed using the Mark I model. However a Reactor Core Isolation Cooling System was used in place of the Isolation Condenser.

[3] According to Kenichi Ohmae's (1943–present) accident investigation report, one of the two emergency backup cooling units in the No. 2 and No. 4 reactors were actually air-cooling units installed on the first floor of each of the reactors [20111028, p. 105]. NISA also reported similar findings regarding effects on the "Damage of the internally installed electrical equipment and effects on safety equipment" [20111008, p. 105].

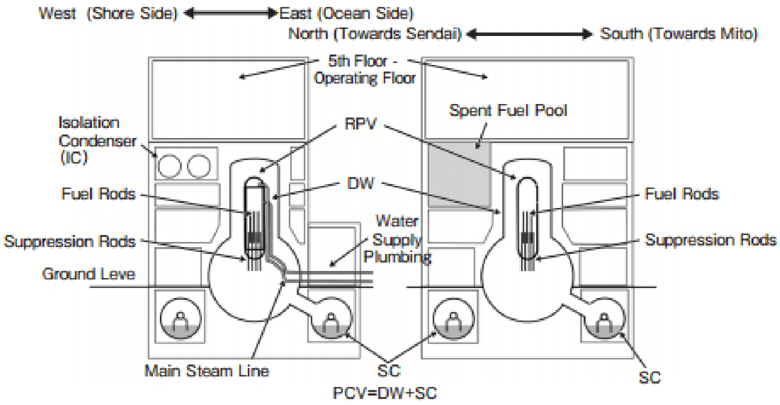


Figure 1.1 shows the basic design structure of these BWRs (these were designed based on the Mark I model). The Primary Containment Vessel (PCV) was in the shape of a flask Drywell (DW) and the donut-shaped Suppression Chambers (SC) hung down from the bottom of the DW. The PCV can withstand temperatures up to 140°C. Reactor No. 1 was designed to withstand 4.3 atmospheres, whereas Reactors No. 2 and No. 3 were designed to withstand pressure up to 3.8 atmospheres. The RPV, situated inside the PCV, was designed to withstand temperatures up to 300°C and pressure up to 83 atmospheres. This is where the fuel rods (i.e. atomic core) were located.

Figure 1.2 - *Plumbing layout of Reactor No. 1. Reactors No. 2 and No. 3 were also designed using the Mark I model.*

However, a Reactor Core Isolation Cooling System was used in place of the Isolation Condenser. Both used AC currents to function.

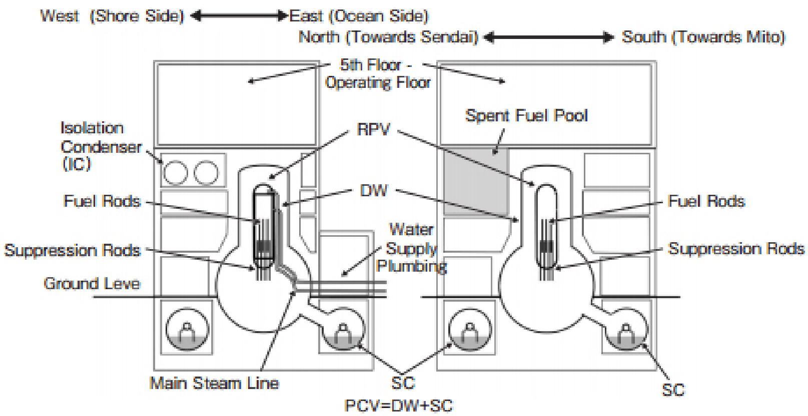


Figure 1.2 showsthe plumbing layout for Reactor No. 1's cooling system. You can see that the cores are completely submerged in water. That water turns into steam when it comes in contact with the heat from the core (generated from nuclear fission reactions). That steam is then channeled through the main steam pipeline and guided directly towards the turbines. The pressure of the steam then pushes the turbines and makes them revolve and turn, which is how electricity is generated. Afterwards, a condenser uses the surrounding seawater to cool down the hot steam and move it back through again. This is done by using a water supply pump and line, which are connected to the RPV.

If a problem were to occur within the RPV's cooling system and cause a malfunction and build up of pressure from the steam, or if the water pump were to fail, a consequent rise in temperature of the core would activate the High Pressure Coolant Injection System (HPCI) pump to immediately inject cooled water stored in the Condensate Storage Tank (CST) into the reactor to cool it down with the support of the Core Spray (CS) pump. This would then suck up all the water inside the SCs and pull it into the RPVs, and then spray this water into the reactor to cool it down.

If this system also were to fail, then when the pressure inside the RPV surpasses 75 atmospheres, the Safety Relief Valve (SRV), which is attached to the main steam line, would open to allow the steam to escape into the PCV. This system, which is composed of HPCI, CS, SRV, etc., has been termed as the Emergency Core Cooling System (ECCS).

If the Emergency Core Cooling System (ECCS) also were to fail, then what could be done?

In case the water supply pumps, CS pumps and HPCI pumps were to stop working or fail after a power failure and the ECCS also were not to work, then what could be done? Actually, the "Last Fortification" was prepared keeping such situations in mind. As previously mentioned, in the case of Reactor No. 1, this was called IC.

Let us take one more look at figure 1.2. The steam line starts from RPV, moves through the IC and then loops back into the RPV once more. If the ECCS were to stop working, the steam produced from the core's heat would be channeled through this line into the IC to be cooled and condensed back into water. This condensed water would then travel back into the RPV where it would be used again to cool down the core.

The important point to understand here is that this is a natural cooling system, which does not require electricity to function. The reactor heat is generated from disintegration caused by nuclear decay, which takes place within the core. On the other hand, the coolant water in the ICs is cold. The ICs were designed to be able to run for approximately eight hours without electricity after the cool water stored in the condensers is completely exhausted.

As previously mentioned, the No. 2 and No. 3 reactors were designed by using advanced versions of ICs, i.e. the RCIC, as their "Last Fortification". Even if all external access to power is lost, the steam generated from the core's heat can be rerouted to turn a special backup DC-powered turbine, and its electricity can continuously operate the pump for coolant water for over 20 hours.

So what would happen if all the stored water evaporates and the ICs in Reactor No. 1 and the RCICs in Reactor No. 2 and No. 3 fail?

The heat from the core would continue to boil and evaporate the remaining water in the RPV, creating steam and pressure that would continue to build up. When the pressure inside surpasses 75 atmospheres, the SRV would automatically open to allow the steam and pressure to escape out of the RPV into the PCV, where the pressure would start to build up again. As previously mentioned, the PCV in Reactor No. 1 can only withstand pressure up to 4.3 atmospheres and the No. 2 and No. 3 reactors can only withstand pressure up to 3.8 atmospheres. If the pressure inside these were allowed to continue building up well beyond their limits, it would cause the PCV to explode. The DW and SCs were prepared for the PCV to avoid problems such as these as they have respective vents and valves to allow for pressure release.

The vents were originally designed in a way that required manual opening. Workers were supposed to judge the situation and open them only in critical situations when it was absolutely unavoidable. However, because both steam and water, which would be released out of these vents, contain radioactive isotopes like tritium and oxygen 19 generated from the atomic core in the reactions, the surrounding residents would need to be first alerted of the seriousness of the situation so that they would have enough time to evacuate and relocate to a safer location[4].

Even with the support gained by opening the vents, if 25 tons of water (fresh or seawater) were not continuously injected into the reactors every hour, there would be no way to continue to control them. After the safety relief valves of the RPVs are opened, the pressure will start to decrease. When it lowers down to less than 6 atmospheres, a high volume of water can be injected through the FSS into the RPVs to cool them down. Then at last, workers can restore the reactors to a "controllable state".

However, if there is too much of a delay before the water is injected into the reactors, and eventually if the heads of the fuel rods are exposed above of water, evaporating the surrounding water, then it will be too late. At this time, the reactors heat up to reach the "uncontrollable state" and surely fall into thermal runaway, and then start to meltdown, or in other words "go beyond the bounds of life and death".

The one and only way to prevent the reactors from falling into an "uncontrollable state" (=outer physical boundaries) would be to open the vents to reduce the pressure within the PPV and then continuously inject over 25 tons of water into the PPVs every hour, before the "Last Fortification" (=ICs and RCIC) systems stop working (or in the worst case scenario, immediately after the systems stopped working). In case of this kind of accident, the only way to secure such large amounts of water is to use seawater from the nearby ocean.

Did the "Last Fortification" systems actually work at all?

With regard to publicly available information, taking a look at the primary information written by engineers who were working at the scene of the accident would be a good place to start. NISA has placed on their website a chronological timeline showing all the major events as primary information, which took place from the time immediately after the accident until the present based on a transmission they received from TEPCO [20111007]. The transmission contained a document entitled "Accident Occurrence Report Details", which was made up of various handwritten reports [20110300-01], etc., "Plant Related Parameters" made up of computer and handwritten reports as well as graph and chart data [20110300-02]. As altering handwritten data is an extremely difficult undertaking in comparison to computer data, we can expect it to be quite accurate and reliable. Additionally, the possibility of the latter "Plant Related Parameters" data having been altered or revised is also quite low, the reason being that there was a line in red at the top of the report stating, "As there will be changes and alterations made here by TEPCO, please use this as a reference for data confirmation. We plan to make the data publicly available before any alterations are made". Therefore, we can safely assume that the chances of any "arbitrary" changes made by TEPCO to this data are very low.

In addition, TEPCO also made two reports regarding Reactors No. 1 and No. 2 [20110300-03] and Reactors No. 3 and No. 4 [20110300-03] based on the entries

[4] In case of reactors in Europe, a special filter was installed onto the vent system, which could reduce the potency of the radioactive materials down to 1/100 of their original strength so as to minimize any harm to the surrounding environment that would arise by releasing them in the open.

recorded in the ”Shift Journal Logs” and “Daily Journal Logs” respectively. These reports, including the photos of writings on a whiteboard, were also disclosed as soon as they were received, which again implies that the probability of TEPCO having altered the data in some way is quite low. As such, this chapter has been based on this primary data that has been determined as the most consistent and reliable data available. Other data, such as TEPCO’s updates and press releases, and any secondary data, etc. will not be included as the source reliability is questionable. However, information and charts, which were difficult to interpret on whiteboard or owing to the handwriting, have been included as references (“Overall Operations Results” [20110300-05] and “Transient Phenomenon Recorder Equipment Data” [20110300-06]), which TEPCO released publicly.

In the second half of November 2011, both TEPCO [20111122] and NISA [20111125] disclosed information, which they had been holding on to for quite some time, about activity logs of the IC in reactor No. 1. Based on this activity data, I have created a chart to show how the situation developed on a near minute-to-minute basis by comparing with the above-mentioned primary data to see whether any contradiction would/would not be found, and decided to refer this data after thorough scrutiny.

I have also made some additional charts outlining the specific events thatoccurred within the reactors chronologically: “Atomic Core Water Levels”, “Reactor Pressure Vessels Pressure Levels”[5], and “Internal Drywell Pressure Levels”[6]. The “Atomic Core Water Levels” chart displays measurement logs gauging the distance between the head of the reactor core and the water level surface inside the reactor pressure vessel (unit: millimeters). If this value is positive (=correct), then it means that the core was completely submerged in water and that the temperature of the surrounding water had not yet exceeded the boiling point (when pressure is equal to 74 atmospheres, internal temperature equals 290°C). On the other hand, if the data is negative, it means that the water levels had not been properly managed, that the head of the fuel rods had already been partially (=if not completely) exposed, and eventually that they caused the internal temperatures to rise dramatically by “decay heat” leading to thermal runaway.

If something like this happens, man has no means to prevent the nuclear core from spiraling out of control and melting down. In other words, if the data shows “negative”, it obviously means that the core indefinitely fell into an “uncontrollable state”.

Based on these charts and figures, we can get a better idea of how exactly the “Last Fortification” functioned during the crisis, as well as the changes experienced in internal water and pressure levels in RPVs and PCVs. We can break down and analyze in detail the corresponding changes that took place in the No. 1, No. 2 and No. 3 reactors.

3. How exactly did Reactor No. 1 fall into an “uncontrollable state”?

[5] Units: 6.6 MPa or Megapascals is equal to about 66 atmospheres.

[6] Units: 600 kPa or Kilopascals is equal to about 6 atmospheres.

The mechanism for Reactor No. 1's Isolation Condenser

Let us first look at the structure of the IC in Reactor No. 1.

Figure 1.3 - Reactor No. 1 Isolation Condenser Mechanism

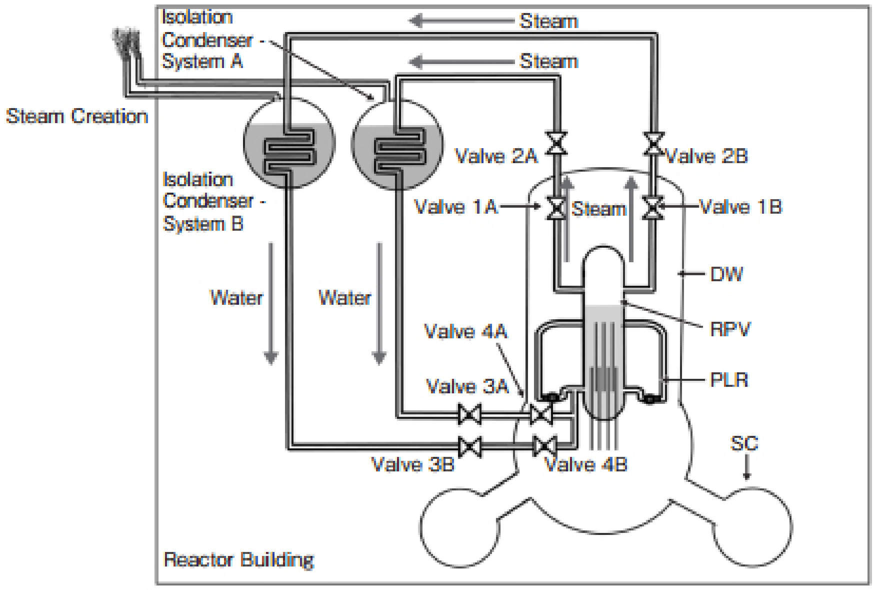


Figure 1.3 shows that the IC is made up of 2 parts: System A and System B. Roughly 2 meters above where the reactor water levels should be is where the steam exits the RPV, travels through the plumbing and then ends up in the condenser located on the 4 floor where it is then cooled and condensed back into water. This water is then rerouted back into the bottom area of the RPV through a mechanism called the Primary Loop Recirculation System (PLR). You can tell if the IC is properly working or not by physically taking a look at the outer area to see if steam is coming out or not.

In total, there are four valves for each of these systems. There are two valves on the input side of the condenser (for example, the valves for System A are labeled as 1A and 2A, which connect to the inner and outer of each of the PCVs), and two valves on the output side of the condenser (for example, for System A they are labeled as 3A and 4A, which also connect to the inner and outer sides of the PCVs). Normally, the 1A (1B), 2A (2B) and 4A (4B) valves remain open, while the 3A (3B) valves remain closed. These valves play a critical role in controlling how the IC functions. Although the entire "Motor drive" system functions automatically, the valves can be opened and closed manually as well (These were opened and closed manually after the emergency electricity supply was lost).

The Isolation Condenser was manually shut down twice

Precisely six minutes after the earthquake occurred at 2:52 pm, workers perceived that the pressure around the core was starting to rise. Both System A and System B were functioning automatically. Exactly 11 minutes later at 3:03 pm, the control room operators manually closed valves 3A and 3B. As the 3B valve could no longer be opened, IC System B could no longer be used. Valve 3A, on the other hand, was opened and closed about three times. The control room operator had adhered to standard procedure [20110523] by opening and closing the valve over and over again to maintain a pressure of 60–70 atmospheres and prevent the temperature inside the RPV from rising more than 55°C on an hourly basis. Actually, on November 20, 2011, NISA had conducted a hearing with TEPCO's officials regarding correspondence issues for reactor

No. 1, which were being taken during the time of the accident. The details of the hearing are as follows [20111120]:

> *Although access to outside electricity had been lost, we assumed that with the assistance of the diesel-powered generators started up and through carrying out the standard procedure "scram" countermeasures, we would have been able to handle the situation without major problem. Due to the impact of the earthquake, it took some time before workers could begin the recovery phase. They conducted a full-scale entire system check to see whether or not the control rods on each floor had been affected from the shaking or not and also checked the IC vent. By opening the vent on the IC, workers can confirm whether the internal pressure levels are falling or not. Then, because they were not able to maintain a reactor coolant temperature ratio of 55°C/h, they closed the System A and B vents when the IC system stopped working.*
>
> *Once the IC stopped, they decided to perform an inspection, and then made the necessary adjustments to System A in order to maintain an atomic core' pressure of somewhere between 6–7 MPa. They had also considered using System B in case System A did not work as planned. What is written in the operation handbook is not just the detailed operation of a single system, but an in-depth description of how to act in accordance with the situation.*
>
> *However, while the workers were in the process of manually opening and closing the vents, the tsunami emerged and crashed into the power plant facility, which lead to complete electricity loss at 3:37pm. Afterwards, we are unsure as to whether or not the IC started to function properly or not.*
>
> *At 6:18pm, workers were able to temporarily restore DC power. After performing a routine check, workers noticed that valves 2A and 3A indicated as being "closed", so they opened them to check and see whether steam was still being created or not. In other words, they were trying to confirm whether System A's condenser was properly routing cooled water to the core or not. However, it was here that the workers did something unexpected. At 6:25pm, seven minutes after opening valve 3A, they closed it once again.*

What led them to do this? Even NISA questioned, "Under what logic was the 3A valve closed? You just made a statement saying that the workers could not confirm whether steam was properly being created or not. Then why under such conditions did the workers feel the need to do so?" In response, those workers who had closed the 3A valve gave the following statement [20111120]:

> *Because we confirmed that steam was not being created, we assumed that the IC was not functioning at all. In such cases, one possibility for steam not having been created could have been that there was some stoppage in the PCVs isolation vents due to problems with the isolation signal. Another possible reason could have been that the water in the bottom area of the IC had completely depleted. Due to water supply plumbing, MOI3A would be left constantly open, which could lead to possible damage in the water coolant plumbing ultimately leading to steam escaping out of the facility, etc. For reasons such as these we decided to close the vent.*

Basically, after assuming that the steam was no longer coming out, we concluded that it was possible the IC had broken down. If that was the case, then if the vent was not closed it could lead to damage within the plumbing as well. However, the Plant Manager, Masao Yoshida, never once came to the conclusion that it was possible that the IC had simply just shut down and gone offline [20110908].

Approximately three hours after valve 3A was closed at 9:30 pm, the workers opened it once more. Regarding this, TEPCO stated that:

> *"The High Pressure Coolant Injection System pump was determined to have failed, however, because the diesel-powered Fire Suppression System pump was confirmed to be still functional, we felt confident that we still had sufficient means to continue cooling down the core by supplying coolant water into the IC. However, because the 3A vent indicator light had stopped blinking, we were not sure how much longer the Isolation Condenser would continue to function, so we decided to open the vent again" [20111122].*

Actually, the workers carrying out those operations had this response two days earlier:

> *"After opening the vent again, we left the central control room and were able to confirm that steam was indeed being created over the top of where the reactor was located, and we could hear it" [20111120].*

In case that steam was indeed being created, it means that although System A's IC had shut down for the three-hour period between 6:25 pm and 9:30 pm, it had somehow restarted itself and was functioning normally from 9:30 pm onwards. We can conclude from this that the IC was therefore able to continue to cool down reactor No. 1's core.

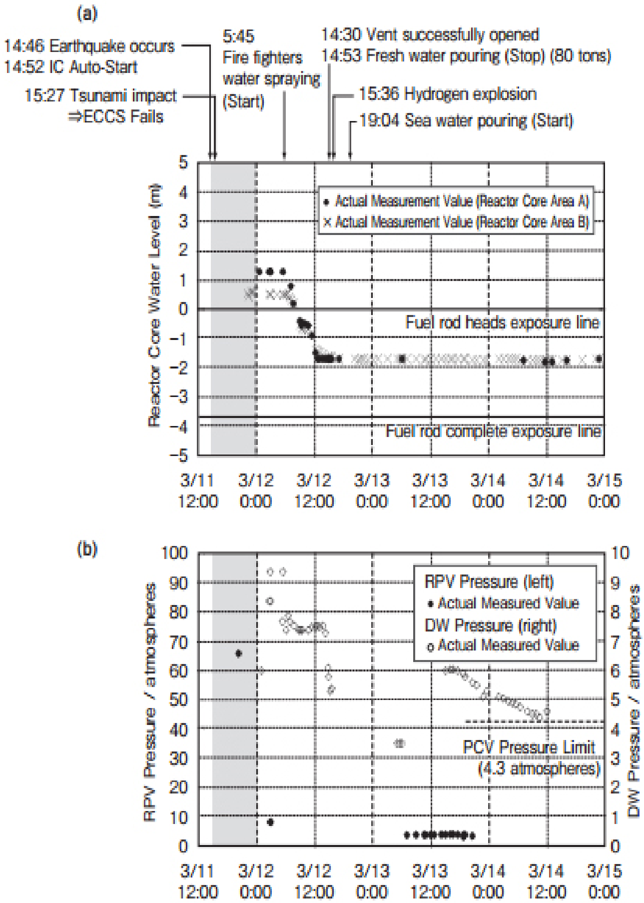
The reactor water levels remained stable until 7:00 pm (March 12)

Table 2 shows that at 22:11 pm (March 11), the reactor water levels had reached approximately 45 centimeters. If this holds true, then we can say that the No. 1 reactor was still in a "controllable state". This would then remain consistent with the statement that the control room operators gave; "at about 9:30 pm the control operators opened up valve 3A and left it open to allow the IC to continue working to maintain the necessary water levels". Starting from around 22:47 pm onwards, through support of System A's IC, the water levels started to rise and continued doing so until they reached 59 centimeters.

Mitsuhiko Tanaka stated in the "Let's Put an End to the Nuclear Power Plants" convention that "due to efforts to keep the isolation condenser up and running, we can assume that there were no large increases or build-ups in pressure around the reactor core from the time period between when the earthquake occurred until 9:30pm later that evening" [20110720, p.22]. By taking another look at Table No. 2, we can see that at 8:07 pm, the pressure in reactor No. 1's RPV had reached 66 atmospheres (max limit: 88 atmospheres as designed). Moreover, the pressure level was maintained to stay below 75 atmospheres with the support of the SRV. We can logically and safely assume that up until this point of time, there should have been no large or serious leaks coming out of the RPV.

I have inserted figure 1.4 into Table 2 to help you better understand this. Figure 1.4 is separated into parts (a) and (b). Part (a) shows the chronological time-based changes in the reactor water levels, and part (b) displays pressure changes over time inside the RPV and DW of PCV.

Figure 1.4 - Reactor Core Water Levels (a) and Pressure Levels (RPV and DW) (b) in Reactor No. 1 between 3/11 12:00 pm and 3/15 12:00 am. (The gray area represents the time when the IC functioned). However, we do know that IC function thereafter remained inconsistent.



We can see from this figure that the reactor water levels had been steadily maintained at a height of no less than 50 centimeters until approximately 6:30 am on March 12.

By looking at Table No. 1, which is based on the "Plant Related Parameters" data [20110330-01], we can see the "IC working" indication, which means that the IC was working until 3:28 pm on March 12. However, it is quite possible that this data, which was provided by the operators, could certainly have been inaccurate. This is because, even if we were able to clearly confirm that the IC had not been working as intended at 8:30 pm, or even 9:00 pm (March 11), there was the report of "IC working" indicator being on. Moreover, the water level had more than likely reached a critical level, meaning "negative", by around 7:55 am. Therefore, as the reliability of this "IC working" related data is questionable, it will not be discussed any further in this chapter.

Two Possibilities

Till how long was the IC, which had been operational at 9:30 pm (March 11), able to continue cooling down the reactor?

Looking at Figure 1.4 in detail, two possibilities emerge. First, there is a possibility that the IC stopped operating sometime between midnight and 00:30 am (March 12). This can be said because the pressure level rapidly increased in the PCV after 00:30 am (March 12), and went far beyond the pressure limit of its design, i.e. 4.3

atmospheres. Heat generated by the core would suddenly increase due to the stoppage of IC, increase the pressure level in the RPV rapidly, and might lead the vapor into the PCV by functioning of the SRV.

As shown in Figure 1.4 (b), the SRV had functioned because the pressure level in the RPV had decreased from 66 atmospheres at 8:07 pm (March 11) to 8 atmospheres at 2:45 am (March 12). Its pressure level became equal to that in the DW, 8.4 atmospheres. But there is an alternate possibility. The SRV did not open, the RPV was damaged and vapor had leaked into the PCV. The reasons to support this conjecture will be discussed later.

Second, there is a possibility that the IC stopped operating at approximately 6:30 am (March 12). The reason behind this was that the water level date in the reactor, measured by workers, showed that the level had restored 50 centimeters or more until approximately 6:30 am (March 12); but later on, it suddenly dropped. In fact, the IC was originally designed to be operational for about eight hours; thus, it is rational to think that the IC worked till around 6:30 am (March 12), considering its possible operating time.

In addition, not being a primary source, an interesting fact was revealed by a testimony of the persons concerned, which was broadcast by Tokyo Broadcasting System Television, Inc. (TBS) on September 11, 2011[7]. It was a comment that “the Control Panel signaled to close the valve of the IC.” That is why “the reactor heated the vessel without water in it until the valve was reopened at 6:18 pm.” The TV program continued as follows: “Then, according to the analysis by the Government, the fuel of core began to dissolve at approximately 6:00 pm, the melted fuels broke the RPV, and they came to a state of falling through the vessel.” In reality, this “analysis” was just drawn from a computer simulation by simply following the scenario that “If the IC could not function, we could conclude that the fuel dissolution would start at 18:00 pm (March 11) or so. This issue will be discussed in Section 1-5 in detail.

In either way, when we trust the “Plant-related Parameters” as they are, even though the IC suspended its operation, we can conclude that Reactor No. 1 restored its “controllable” dimension. As shown in Figure 4.1 (a), this is because the water level in the reactor was shown to be 50 centimeters or higher by 6:30 am (March 12).

Fresh water was poured, the vents were opened and then seawater was poured

As we can see from Figure 1.4 (a), about 15 hours after all power was lost at approximately 6:47am (March 12), the water level around the core started to reduce dramatically and, by around 8:00 am, the fuel rods were exposed. Yoshida, who had predicted a similar eventuality, acted quickly to try to fix the situation. TEPCO’s attached report of September 9, 2011 contained information regarding the “Influence and Damage Incurred by the Fukushima No. 1 Power Plant from the Tohoku Earthquake” [20110909]. According to this report, a little after midnight on March 12, onsite workers were given instructions to open the vents. They immediately did their best to prepare to inform the surrounding residents to evacuate the premises and flee to safety. At 5:44 am, the Prime Minister issued an evacuation order to areas within a 10-kilometer radius of the power plant facilities. Later, around 6:44 am, it was confirmed that residents had made suitable preparations to evacuate the area. At 6:50 am, the vents were manually opened. About an hour prior to this, at 5:46 am, fresh water had begun to be injected into the reactor.

[7] TEPCO claimed this TV program’s broadcast to be baseless and declared a protest note in September 13 to disclose that “While the Accident Investigation Committee continues the investigation, it is really regrettable that the TV program coverage concludes that the accident was caused by “human errors” based on presumptions and speculations without waiting for investigation into the truth.”

It seems that Yoshida had already determined that sometime in the early morning on March 12 (between 00:00 am and 6:00 am), seawater needed to be injected into the reactor.

Japan's Independent Institute Inc.'s President, Shigeharu Aoyama, gave his testimony regarding this. Having received permission from TEPCO, he visited the Fukushima No. 1 power plant and was then interviewed. He gave the following statements [20110617]:

> "The most important measures that were taken in this accident correspondence were, without a doubt, actions taken to cool down the core. Immediately after the earthquake, the Fire Suppression System (which was installed to take care of fire outbreaks), was used to start to pour fresh water into the reactor to cool it down. However, this system was only designed to last until all of the water in the tank had been depleted. According to some of the worker's journal logs that were received regarding events which happened in early morning on March 12, the plant manager, Yoshida, had reported to the TEPCO headquarters that "we need to start injecting seawater into the reactor instead of fresh water". At 12:02pm on March 12, the TEPCO headquarters also came to the understanding that injecting water into the reactor was now of highest priority. This meant that TEPCO was prepared to cool down the core and get the power plant back under control at any cost, even if it meant decommissioning the nuclear reactor."

If the information in Figure 1.4 holds true, then had they injected seawater (not fresh water) into the reactor by the time the reactor water levels had started to drop (around 6:47 am on 12), TEPCO would have been able to prevent reactor No. 1 from falling into an "uncontrollable state".

NISA released a report called the "Earthquake Damage Report (Period: March 11–September 30)" [20111101], which included information on how fresh water had been injected in the beginning followed by the injection of seawater towards the end, and then lastly how the vent was successfully opened. The following list contains some information from the report:

- The Fire Suppression System (pump) in the No. 1 reactor of TEPCO's Fukushima No. 1 Power Plant started injecting water into the reactor (5:46 am on March 12).
- All the 2,000 liters of fresh water stored in the fire engine had been completely sprayed into the reactor (6:30 am on March 12).
- TEPCO made the following report to the Nuclear and Industrial Safety Agency: "This report is to state that currently (8:30 am) the water levels in the reactor are starting to lower and are nearing the heads of the fuel rods (Water from the fire engine is currently being sprayed into the reactor)" (8:29 am on March 12).
- Workers evacuated the area after TEPCO gives the order to open the vent of reactor No. 1 (Afterwards, Team 1 manually opened the first vent 25% of the way. Team 2 is exposed to large doses of radiation on their way to open the second vent and as such decide to take a break) (9:04 am on March 12).
- TEPCO [orally] contacts the Nuclear and Industrial Safety Agency to report that "the first vent on No. 1 reactor has been opened" (9:30 am on March 12).
- Start opening vents. Workers in the central control room successfully open up the No.1 reactor's second vent (10:17 am on March 12).
- Having successfully opened the second vent, workers continue to work to do everything they could to supplement and support the situation (The Air Compressor was used) (around 2:00 pm on March 12).
- TEPCO confirmed that the pressure levels in the PCV in the No. 1 reactor had started to decline (2:30 pm on March 12).

- They finished injecting 80,000 liters of fresh water into the reactor (2:53 pm on March 12).
- The Fire Suppression System line located within the RPV is activated and starts to inject seawater into the reactor (7:04 pm on March 12).

In other words, 80 tons of fresh water had been injected into the reactor between 5:46 am and 2:53 pm on March 12. However, we know that from that point onwards, if 25 tons of water were not continuously injected into the reactor every hour, the fuel rods would start to disintegrate and melt down. There was approximately 80 tons of fresh water stored in isolated tanks prepared for cases such as these [20110613]. It would not even take four hours to spiral out of control once the core water levels depleted. TEPCO did not do anything for four hours between 2:53 pm and 7:04 pm to try and alleviate the situation. At 7:04 pm, TEPCO finally gave the order to inject seawater into the reactor, but by that time it was already too late.

Did the Reactor Pressure Vessel in Reactor No. 1 incur any damage during the early stages of this accident?

Let us take another look at the time flow of this accident. You might have noticed that there is something odd about the "vent" area here. By using compressed air, among other things, they were able to finally get the vent open at 2:30 pm on March 12. The Fire Suppression pump was ready to start injecting fresh water from the outside area into the reactor nine hours prior at 5:46 am. Originally, as long as the vents remain closed, the pressure which builds up in the RPV will not be able to escape, which also means that water cannot be injected from outside either. However, Reactor No. 1 was designed in such a way that water could be injected into the reactor from the outside without opening the vents. How is that possible?

More than likely, sometime between approximately 9:00 pm on March 11 and 12:00 am on March 12, the RPV probably incurred some kind of damage (cracks forming from excessive pressure build up, etc.) which could have led to steam leaking out of the RPV into the PCV. If that was truly the case, it means that the pressure in the RPV had lowered back down to eight atmospheres from 66 atmospheres, and that by injecting water into the reactor with the Fire Suppression System pump, it should have been no surprise that the situation was still under control (controllable state). Actually, at 12:57 am on March 12, the pressure inside the DW suddenly rose dramatically. The Japan Nuclear Energy Safety Organization had hypothesized that this was due to "steam having leaked out of the RPV into the PCV, which caused the pressure therein to rise"[8].

4. How did Reactors No. 2 and No. 3 reach an "Uncontrollable State"?

As previously mentioned, although Reactors No. 2 and No. 3 were also designed based on the Mark I model design, their "Last Fortification" differed from that of Reactor No.

[8] On December 9, 2011, the Japan Nuclear Energy Safety Organization (JNES) disclosed a report entitled "Reactor No. 1 Atomic Core Behavior Report - During the time while the Isolation Condenser was functioning" 1 [20111209]. According to this report, if we perform a calculator simulation of what happens when a 3-sq. centimeter crack forms inside the plumbing of the Primary Loop Recirculation System (Refer to figure 1.3), we accurately calculate and explain what would happen to reactor pressure and water levels over time during the period when the IC was functioning. In other words, this is an interpretation showing how, if a 3-sq. centimeter crack really had formed in the plumbing, seven tons of water would have leaked out of the tank on an hourly basis, which could lead to sharp drops in pressure and water levels.

1. Reactors No. 2 and No. 3 have an advanced version of Reactor No. 1's IC called the RCIC. This RCIC can continue to support to cool the reactor for an even longer period of time than the earlier model (IC) in Reactor No. 1 by implementing a turbine rotated by steam generated by heat of core, and by pumping water with its rotation.

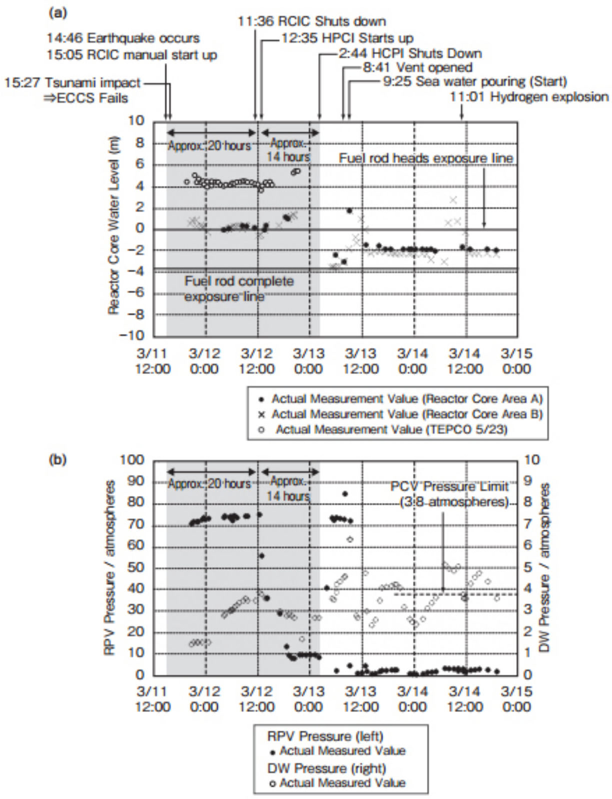
How long did the RCIC continue to function and at what point of time were the physical limits crossed to cause the core to fall into an "uncontrollable state"?

Let us briefly analyze Reactor No. 3, which first fell into an "uncontrollable state".

***The high pressure coolant injection system (HPCI) continued to function until approximately 2:00 pm on March 13.**

Table 2 contains plotted data with regard to time and the reactor water levels in Reactor No. 3, as well as the pressure levels in RPV and DW. They can also be viewed by looking at Figures 1.5 (a) and 1.5 (b).

Figure 1.5 - Reactor Core Water Levels (a) and Pressure Levels (RPV and DW) (b) in Reactor No. 3 between 3/11 12:00 pm and 3/15 12:00 am. (The gray area represents the time when the RCIC and HCPI functioned.)



By looking at Figure 1.5 (a), we can see that by March 12 the reactor water level loss had increased from 10 cm to 40 cm and by 6:30 pm on March 12, the water level loss had already exceeded 1 m.

On the other hand, TEPCO's May 23, 2011, report entitled "Analysis and Damage Incurred by the Fukushima No. 1 Power Plant and its Operation Records at the Occurrence Time of Tohoku Earthquake" [20110523] (Appendix 1, page 34 of the report), included relative accumulated data from March 11 and March 12. Table 2 shows how the 4-meter high actual measured data was included.

It is believed that the actual measured data taken immediately after the accident contained some errors and it was therefore adjusted by TEPCO based on logical hypotheses. This data is shown and represented by white circles plotted in Figure 1.5 (a). As no changes were made to the actual measurement after March 13, as far as the analysis in this chapter is concerned, the white circles represent all the data released until March 12, whereas the disclosed data from March 13 onwards has been incorporated into Table 2. This is the data we will use to discuss the events that have happened thus far.

As you can see by looking at Figures 1.5 (a) and (b), Reactor No. 3's RCIC was manually activated at 3:05 pm on March 11. NISA also released a report entitled "Reactor No. 1, No. 2 and No. 3 Cooling Systems and Substitute Water Cooling Countermeasures Report"[20111125], which stated that even after all AC electricity was lost due to the impact of the tsunami at 3:37 pm, the RCIC was still able to function through the support of DC batteries. Because of this, the reactor water levels maintained a steady height of 4 m and a pressure of around 74 atmospheres continuously inside the RPV. However, because the SRV was properly working to allow the steam from the RPV to escape into the PCV, the pressure levels in the DW started to rise as a result from 1.5 atmospheres to 3.5 atmospheres.

At 11:36 am on March 12, the RCIC in reactor No. 3 stopped working, which means that it had functioned for about 20 hours and 30 minutes. With the RCIC no longer working, the reactor water levels slowly started to fall and the pressure levels in the DW started to increase until it had exceeded 3.9 atmospheres (pressure limit for DW is only 3.8 atmospheres).

This is when the reactor experienced a stroke of good luck. At 12:35 pm, about an hour after the RCIC shut down, the DC generator was still operational (as it is a separate system aside from the RCIC) and started to divert electricity to the HPCI, which had just automatically started up.

The HPCI actually possesses 10 times the cooling power of the RCIC[9]. It very speedily cools down all the steam inside the RPV and condenses it into water, which causes the pressure to drastically decrease. By 7:00 pm on March 12, the pressure level inside the RPV had already decreased down to 10 atmospheres, and by 8:15 pm it had lowered down to 8 atmospheres. From that time until about 2:00 pm on March 13, the pressure levels inside the RPV remained stable between 8 and 9.7 atmospheres.

Reactor No. 3 could have been definitely saved

I would like to re-state and emphasize this matter one more time, because I strongly believe that Reactor No. 3, beyond a shadow of doubt, could have been saved.

Thanks to the efforts of the RCIC, proper cooling in Reactor No. 3 had been maintained, thereby keeping it in a "controllable state" between 3:05 pm on March 11 and 11:36 pm on March 12. Even after RCIC shut down, the HPCI continued to cool the core and kept it in a "controllable state". Had TEPCO opened the SRV around 8:00 pm on March 12, when the pressure in the RPV lowered back down to 8 atmospheres, the fire fighters would have been able to inject seawater into the reactor without having to open the vent. Workers on-site should have already understood this by that point of time as they

[9] The High Pressure Coolant Injection System (HPCI) is able to inject 960 tons of water into the reactor on an hourly basis, whereas the Reactor Core Isolation Cooling System (RCIC) is only able to channel 96 tons of water into the reactor per hour.

were performing measurements and calculations on the spot based on what was happening around them.

However, at 2:44 am on March 13, the HPCI also shut down[10], which led the reactor water levels to fall to 3.5 meters and pressure levels in the RPV to rise from 8 atmospheres to higher than 70 atmospheres.

Initially when the workers tried to open the vent on March 13 at 8:41 am, they experienced some difficulties. After 40 minutes, they finally managed to open the vent, which meant it was now possible to divert pressure out of the DW, and to inject water into the PCV, thereby allowing for seawater to start being injected into the RPV. At 9:25 am on March 13, TEPCO finally started injecting seawater into the reactor.

In other words, at 2:44 am on March 13, Reactor No. 3 had already fallen into an "uncontrollable state" (towards meltdown) and was then left unattended until 9:25 am (6 hours and 43 minutes later). Although they started to inject seawater into the reactor at 9:25 am, the core temperature levels had already skyrocketed as it was in the process of a meltdown. It was just too late.

It was not just the residents living in the Fukushima Prefecture who were (and still are) suffering, but also those who resided in the eastern parts of Japan.

If the vent had been opened by 3:00 am on March 13 (even though, as previously mentioned, there was no need to open it in the first place), only harmless steam would have been released outside the facility as the core had not yet started to meltdown. I say "harmless" because only trace amounts of radioactive substances[11] were hiding with the steam at that point of time. The threat they posed to the surrounding environment, even if they escaped, was negligible.

However, the vents were opened from 8:41 am onwards on March 13,; the core had already started to melt down (as over three hours had passed) and by now radioactive substances, such as Iodine 131, Cesium 134 and 137, etc. (produced by reactions from within the atomic core) had been released and were now beginning to dissolve in the coolant water. By opening the vents, these highly concentrated radioactive substances were able to escape outside the containment area, which led to this worst-case scenario.

Eventually, the Fukushima No. 1 power plant, which had now become the center of attention all over the world, became the source of highly concentrated radioactive substances, which polluted the surrounding environment and made this the most tragic accident in Japanese history.

Had TEPCO injected seawater into the reactor sometime on March 12, or at the latest by 2:44 am on March 13, they would have been able to completely prevent this from happening (as previously stated, there is evidence that if they had just done this in the first place, they would have been able to completely avoid opening the vent).

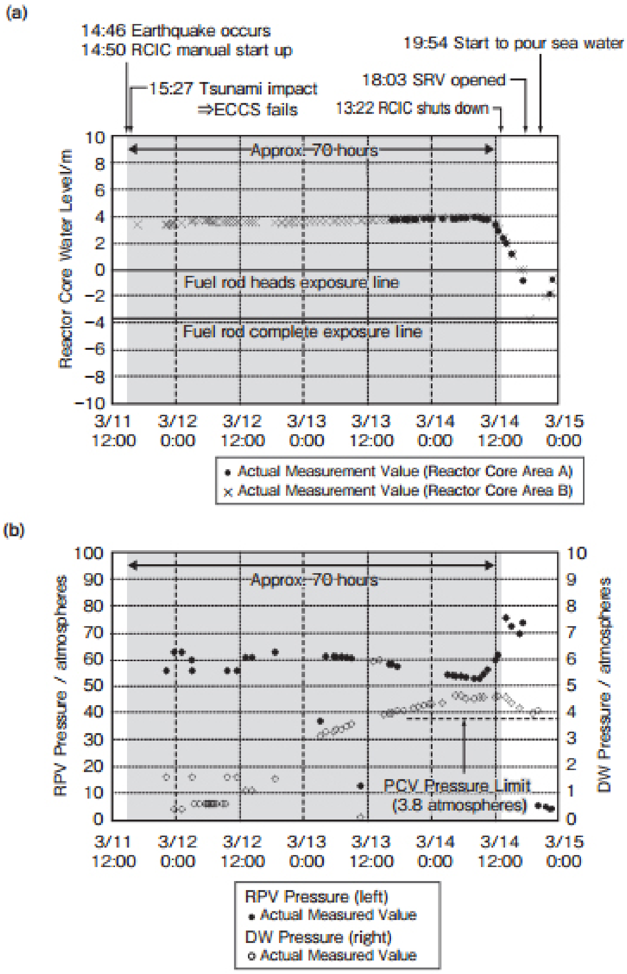
[10] The following contains a statement from the "Accident Investigation Report" given by the Accident Investigation Verification Committee (which was more than likely altered by the government) - "because the control room operators feared that the battery might run out soon, they stopped the HPCI without first seeking permission from the former Plant Manager Yoshida. Afterwards, neither the HPCI nor the RCIC would respond upon trying to restart them up again."[20111216].

[11] The composition in the water changed from the normal hydrogen and oxygen compounds to tritium and oxygen 19 due to influence from the reactor core. Still, the other impure substances, as well as trace amounts of Chromium 51, Manganese 54, Iron 59, Cobalt 58, Cobalt 60, etc. (from corrosion in the turbines and plumbing system) were found in the water.

The RCIC in Reactor No. 2 functioned until 1:00 pm on March 14

Data regarding the reactor water levels and pressure levels in the RPV and inside the DW for Reactor No. 2 can be seen on an hourly basis by looking at Figures 1.6 (a) and (b).

Figure 1.6 - Reactor Core Water Levels (a) and Pressure Levels (RPV and DW) (b) in Reactor No. 2 between 3/11, 12:00 pm and 3/15, 12:00 am. (The gray area represents the time when the RCIC functioned)



We can get a rough idea of what happened and when. For example, at 2:50 pm on March 11, we can see that RCIC in Reactor No. 2 was manually activated. According to NISA's "Reactors No. 1, No. 2 and No. 3 Cooling Systems and Substitute Water Cooling Countermeasures Report" [20111125], Reactor No. 2 had lost both AC and DC power alike, disabling use of HPCI. Strangely enough, due to one reason or another (still not known even now), the RCIC started up and continued to cool down the reactor.

Through support of the RCIC, the reactor water levels stayed at a little less than 4-meters and the pressure in the RPV did not surpass 63 atmospheres for more than two days. Because the SRV continued to work without fail, the pressure inside the DW rose from 1 atmosphere to 4.6 atmospheres surpassing its pressure limit of 3.8 atmospheres as the pressure from the RPV was continually being redirected into the PCV.

Around 1:22 pm on March 14, the RCIC finally came to a stop. According to the actual data measured at the time, the reactor water levels started to decrease, from which we can assume that the RCIC started to lose function a little more than 20 minutes prior at 1:00 pm the same day. This brings us to the conclusion that the No. 2 reactor functioned for roughly 69 hours (two days and 21 hours).

The pressure inside the RPV rose at an exceeding rate from 60 atmospheres to 74 atmospheres in just a short 2-hour period between 12:00 pm and 2:00 pm. Later, around 6:03 pm, the SRV was opened allowing the pressure levels to fall down to similar levels as that of the Fire Suppression System Pump (about 6–7 atmospheres). At 7:54 pm, approximately seven hours after the RCIC shut down, the Fire Suppression System was engaged and started dumping seawater into the reactor[12].

Reactor 2, beyond a shadow of doubt, could have also been saved.

Let us quickly recap everything that we have gathered concerning Reactor No. 2.

The reactor water levels in Reactor No. 2 stayed at a constant level just below 4-meters for approximately 70 hours between 2:50 pm on March 11 and 1:00 pm on March 14 through support of the RCIC. The core remained in a "controllable state" all throughout this period. Until 12:00 am on March 12, the pressure levels in the RPV had been maintained below 60 atmospheres and the pressure levels in the DW stayed around 1 atmosphere, thanks to the SRV. By opening the SRV, the pressure levels inside the RPV could be easily reduced to less than 6 atmospheres. Anytime thereafter, the SRV could be re-opened in the same way to reduce the RPV pressure levels below 6 atmospheres (Actually, the SRV was opened once at 6:03 pm on March 14). Through use of the SRV, the Fire Suppression System Pump could have been used to dump seawater any time without opening the vent in the first place. The workers on-site knew this as well, just as they had with regard to Reactor No. 3.

In other words, had TEPCO just opened the SRV and injected seawater into the reactor, Reactor No. 2 would not have surpassed its "physical limits" causing it to fall into an "uncontrollable state". Just as the TEPCO management had clearly been determined not to let Reactor No. 3 end up the same way as Reactor No. 1, things would have been different had they been similarly determined not to let the same thing happen to Reactor No. 2, even if that meant dumping seawater into the reactor. However, once again they intentionally chose not to do so. The radioactive contamination from Reactor No. 2 then followed.

However, on the night of March 14 after Reactor No. 2 fell into an uncontrollable state, there was a sudden change in TEPCO management's attitude.

TEPCO's then president, Shimizu Masataka, made a phone call to Banri Kaieda, Minister of Economy, Trade and Industry of Japan (former), appealing that "I would like to request for an evacuation as 'we are going to leave the out-of-control power plant alone'".

Many of those government-related officials and specialists both reluctantly made a decision. After coming to a conclusion, they reported to Prime Minister Kan at 3:00 am on March 15.

[12] A statement by Watanabe Tadashi (Atomic Energy Development and Organization Department at the meeting of the Atomic Energy Society of Japan) on September 19 - "Had water been continually injected into the reactor until 4:00 pm on March 14, the core would not have melted down". By taking a look at Figure 1.6 (a) or Table 2, we can see that the reactor water levels had been properly maintained as "positive" until 4:00 pm on March 14.

However, Kan was furious with TEPCO's actions, asserting questions like "Do you have any idea what will happen to Japan if you were to request for evacuation?" President Shimizu was summoned and TEPCO's appeal was dismissed. On March 15 at 5:35 am, Kan marched into TEPCO's headquarters and set up a kind of "forced collaboration" in respect to the accident correspondence TEPCO was handling at the time.

Haraguchi Kazuhiro's misunderstanding

Haraguchi Kazuhiro, a member of the House of Representatives, made a live appearance on TBS's "Morning Talk Show with Mino Monta!" program where he gave the following shocking statement: "The "Last Fortification" for Reactors No. 2 and No. 3 had been dismantled eight years ago". The following paragraph contains information that he had uploaded on his Facebook page [20110528].

> *I have read the records from the "2003 29 Nuclear Safety Commission – Incidental Conference" and the "2003 10 Nuclear Safety Commission – Regular Conference". The functionality of the Steam Condensing System in the Residual Heat Removal System was removed from the Fukushima No. 1 Power Plant. Koizumi was the Prime Minister at the time and the Minister of Economy, Trade and Industry was Hiranuma. I searched these records over and over again, but I was unable to find the reason why such an important function had been removed. Right after the earthquake, former Saga University President, Dr. Haruo Uehara, felt extremely puzzled after observing the situation. "How could things end up like this when they had a Steam Condensing System in place to protect against problems like this?*

On June 2, Haraguchi held a press conference where he emphasized that "Had TEPCO not removed this safety equipment, such a serious accident would never have happened" [20110602].

Actually, he had mistaken the Residual Heat Removal System for the RCIC. It was only a small mistake. The Residual Heat Removal System is a supplemental piece of equipment that functioned as a kind of a Low Pressure Injection System or Reactor Core Spray System. However, it was removed due to fears that in case a hole or break occurred in the plumbing, it would disable the RCIC. In addition, since it can only run on AC power, it could hardly be thought of as a kind of "Last Fortification" [20110606-01].

5. The "Sudden Change" on May 15

As previously mentioned, the reason why this accident happened in the first place was clearly due to the negligence of TEPCO's "Technology Management". It was 100%predictable that the IC in Reactor No. 1 would last only a few hours after it was activated at 2:52 pm on March 11. It was also 100% predictable that the RCIC in Reactors No. 2 and No. 3 would eventually stop working after they were manually activated at 2:50 pm and 3:05 pm the same day.

Either way, these "Last Fortification" systems were only able to simply prolong the amount of time before the reactors melted down. In addition, immediately after

Reactor No. 3's RCIC stopped functioning, the HPCI through a stroke of luck automatically started and provided an extra 14 hours of assistance before it shut down.

Beyond doubt, had TEPCO's top decision makers given the green signal to inject seawater into the reactor during this 14-hour period while the HPCI was working, TEPCO would never have lost control of the power plant, thus preventing this radioactive contamination disaster completely. And TEPCO would not have been held responsible for the "most tragic accident in Japanese history".

As stated earlier, these previous statements and analyses results were presented in the May edition of Nikkei Electronics Online Magazine [20110516] and the Nikkei Business Online Magazine [20110513-01] both released on the same day, Friday May 13. The results from this analysis, which are based on documents and materials received regarding the meetings which took place at the government residence on March 15 [20110315] and April 12, as well as publicly released data from NISA and Japan Nuclear Energy Safety Organization [20110412], have reached nearly the same conclusion (from a qualitative perspective) as any other analysis that has since been released.

***May 15 – TEPCO holds an emergency press conference**

Two days later on Sunday May 15, TEPCO held an emergency press conference [20110515]. They announced that "the 'fuel pellets' in Reactor No. 1 melted down earlier in comparison to the other reactors after the tsunami's impact. We have come to the conclusion that after the fuel pellets melted down they more than likely fell down into the bottom of the RPV".

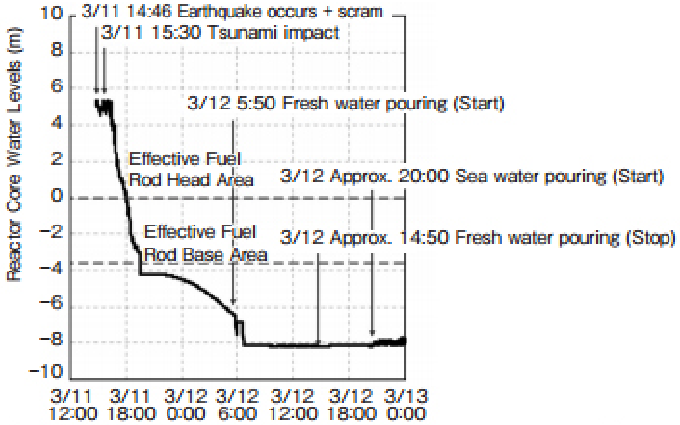
Reactor No.1 - Reactor Core Water Levels, Reactor Core Maximum Temperature

(analysis results)

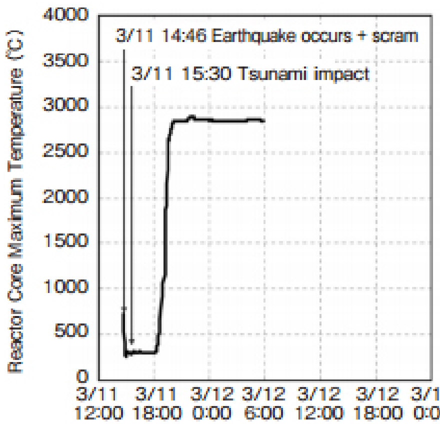
Hypothesis from main analysis: It is supposed that from around 3:30pm

(post-tsunami impact) onwards, the IC did not function.

Figure 1.7 - TEPCO press conference (May 15)



- Fuel head exposed about 3 hours after the scram (roughly 6:00pm)
- 4.5 hours later fuel rods become completely exposed



Reactor core water levels begin to lower exposing the heads of the fuels rods causing the temperature to rise leading to fuel rod melt down.

The recorded times, operations, etc., and other related data taken from the accident investigation report is subject to future changes.

Figure 1.7 shows the results TEPCO released that day regarding the reactor water levels in Reactor No. 1. At the bottom of the graph, you can see that the water levels "had already reached the "Effective Fuel Rod Head Area" about three hours after the scramming (around 6:00 pm on May 11), and by 7:30 pm (four and a half hours after the scramming) they had reached the 'Effective Fuel Rod Base Area' of the fuel rod". The fuel rods started to melt down immediately after the water levels reached the base of the fuel rods at 7:30 pm.

If you take a look under the title of this figure [1.7], you can see that ("Hypothesis from main analysis: It is supposed that from around 3:30 pm (post tsunami impact) onwards the IC did not function.") is written in small letters. In other words, this is a figure (calculator-based simulation) which shows nothing more than the timetable that TEPCO thinks the IC functioned and stopped working based on findings from their own analysis[13]. It does not mention whether the IC actually functioned or not, or whether the reactor core melted down or not. Therefore, I would like to make the reader aware that the hypotheses presented at this press conference were not based on facts or confirmed information. They were simply just best-guess calculations based on logical hypotheses.

[13] MAAP (Modular Accident Analysis Program) is a kind of classical thermodynamics software application. It can be purchased from Fauske company's official website (http://www. fauske.com/maap.html).

Misleading articles and information released by mass media

Every newspaper's headlines during the following two days (May 16 and 17) read "TEPCO tried to conceal the fact that the meltdown in Reactor No. 1 had actually started on May 11". The following are five major Japanese newspaper headlines and articles, which were released during those two days (Nikkei, Mainichi, Yomiuri, Sankei and Asahi).

TEPCO and NISA still have yet to release information related to reasons why cooling system shut down before tsunami impact.

The Isolation Condenser in Reactor No. 1 temporarily went offline before the tsunami impact (confirmed). There is a possibility that it was manually taken offline as well. The core is thought to have started melting down within just about 5 hours after the earthquake.

(The Nihon Keizai Shimbun Newspaper, May 17 2011, Evening Edition, Front Page)

TEPCO releases detailed data indicating that the cooling system in Reactor No. 1 had temporarily shut down.

We have confirmed, based on the data released by TEPCO (May 16), that the Isolation Condenser in Reactor No. 1 in the TEPCO Fukushima No. 1 Power Plant temporarily went offline before the tsunami impact. On May 15, TEPCO announced results from their own analysis, which were based on the assumption that the cooling system had gone offline due to the impact of the tsunami, stating that the reactor core started to melt down approximately 16 hours after the earthquake.

(Yomiuri Newspaper, May 17 2011, Morning Edition, Front Page)

16 hours later, Reactor No. 1's reactor core almost completely melts down, TEPCO finally discloses data for the first time.

On May 15 TEPCO, regarding the Fukushima No. 1 Power Plant accident, announced that based on their analysis results Reactor No. 1 core is thought to have melted down about 16 hours after the earthquake. TEPCO finally uncovered what happened to the core immediately following the earthquake.

(Mainichi Newspaper, May 16 2011, Morning Edition, Front Page)

Condenser in Reactor No. 1 manually shut down? TEPCO blames "Tsunami" for Fukushima Power Plant Accident.

The results TEPCO gave after the tsunami's impact on May 15 in regard to the condenser were found under an analysis, which used conditions that were not even possible to begin with. About five and a half hours after the tsunami's impact, the reactor core started to melt down and by the morning of the following day (March 12), it had completely melted down.

(Asahi Newspaper, May 17 2011, Morning Edition, Page 3)

Reactors No. 2 and No. 3 also complete melt down? Cooling unit in Reactor No.1 shuts down in just 10 minutes.

Goushi Hosono, Aide to the Prime Minister and Head of the Secretariat (Accident Correspondence Unification Headquarters) calls for TEPCO to reflect on the fact that they were not able to confirm whether or not the core in Reactor No. 1 had completely melted down or not. It is possible that the current situation for Reactors No. 2 and No. 3 is similar to that of Reactor No. 1, which asserts the possibility that these reactors too may experience a complete meltdown as well.

(Sankei Newspaper, May 17 2011, Morning Edition, Front Page)

We can see by looking at the headlines of these five major Japanese newspapers that at the TEPCO May 15 press conference, all of the mass media had basically conveyed the "hypothesis" that within just five and a half hours, one of the cores started to melt down as a "fact". On top of that, one article in Sankei Newspaper clearly stated and conveyed as a fact that even the "Prime Minister believes that Reactor No. 1 core started to melt down within just five and a half hours of the tsunami".

In other words, "If we were to just simply suppose that the IC did not function at all, then the reactor core fuel rods probably would have started to become exposed by 6:00 pm on March 11 after burning up all the surrounding cooled water. If this holds true, then the fuel rods would have started to melt down shortly after". This simple and classic model based on just a hypothesis turned into a frenzy of over-exaggerated headlines, which led to headlines like "TEPCO tried to hide information regarding the meltdown, which happened some time during the day of the earthquake on March 11" being mistaken as facts instead of being regarded as assumptions or hypotheses.

NISA confirms results from TEPCO's analysis

On June 6, NISA also presented a model (calculator simulation) they had made based on their own analysis [20110606-02], which had nearly identical results to those earlier released by TEPCO. NISA had used the same software TEPCO had used, as well as one other kind of software[14], in creating the model (Figure 1.7 (b)). They reached the conclusion that "At around 4:40 pm, two hours after the reactor water levels scrammed, the water levels had already reached the head of the effective fuel rod head area, and by around 6:00 pm (three hours later), the core started to incur structural damage. By around 8:00 pm, the RPV base area had become damaged as well. Afterwards, the melted fuel rods fell down to the bottom of the RPV". NISA hypothesized that the water levels had started to fall about one hour earlier than what TEPCO had previously guessed.

NISA's model hypothesized and supported TEPCO's assumption that the "original measured values were incorrect" and that information released relating to "after the earthquake, the IC went offline" was not far off from the actual facts.

After this analysis, NISA reported their assumption to the mass media that "the control room operator's data was, in fact, incorrect. We confirmed that the reactor water levels had actually not been maintained at all". Let us do a quick analysis of the mass media as they grab onto every new piece of information they can get their hands on.

Figure 1.8 shows the frequency of articles released among five of the largest circulating Japanese newspapers, which mentioned anything regarding either the "Isolation

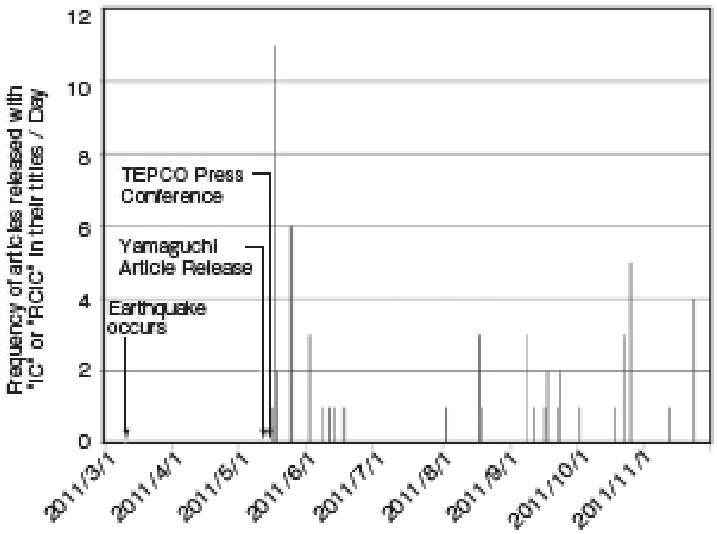
[14] The other software NISA used is called MELCOR, which is also a kind of classical thermo-dynamics calculation software. This software was created by Sandia National Laboratories (http://melcor.sandia.gov/).

Condenser" or the "Reactor Core Isolation Cooling System" working as "Last Fortification" between March 11 and November 11, 2011.

Figure 1.8 shows that by May 15 there had been almost no articles released regarding either the IC or RCIC. Not one journalist had seemed to be in the least bit interested in the fact that the "Last Fortification" worked without any sort of power source. As no questions were raised regarding the matter, we can assume that it was possibly because they simply did not understand what that meant. Actually, until May 14 TEPCO had continued to insist that "There was no way for us to predict that this kind of tsunami attack was going to happen. The power plant was certified as safe from a technical standpoint."

However, on May 15, their behavior suddenly changed when it was announced that "The Fukushima No. 1 Power Plant was actually not safe from a technical standpoint. The 'Last Fortification', which had been prepared in place for times where all AC power was completely lost to the facility, did not even work in the first place".

Figure 1.11 - A graph plotting frequency of articles released on the front pages of 5 of the largest circulating newspapers in Japan between 3/11 and 11/30. They all included something in the title related to "Isolation Condenser", "Reactor Coolant Isolation Condenser" and "automatically started and manually stopped".



By looking at figure 1.8, one reason comes to mind for why this might have happened.

In the event that the IC in Reactor No. 1 had functioned for just a little while (doing nothing more than simply prolonging a meltdown), just as I mentioned at the beginning, the TEPCO management clearly had plenty of time to deliberate and prevent such an accident from happening by giving the order to inject seawater into the reactor. Their negligence was the driving factor due to which this accident happened and as such it is their responsibility to take the blame for it as well.

Afterwards, TEPCO releases another set of analysis results

Shortly afterwards, TEPCO silently released another set of results [20110524] without trying to draw too much attention.

The results hypothesized that at 2:52 pm, the two Isolation Condenser Systems (A and B) had automatically engaged. At 3:03 pm, System B was manually taken offline. On the other hand, although System A had been functioning, it was unstable. It would occasionally stop and then start up again. For example, it was very unstable from 3:03 pm until 3:34 pm and thereafter it started functioning normally until it stopped again sometime around 6:18 pm. It started itself back up again around 6:25 pm and then stopped again around 9:30 pm. However, from that point onwards, it seemed to have been functioning normally.

Just like the first set of results, this set also suggested that the reactor core started to become exposed around 6:00 pm on March 11. However, this time they came to the conclusion that the reactor water levels probably reached the base of the fuel rods sometime around 11:30 pm on March 11 (four hours later than previously hypothesized).

Strangely enough, although TEPCO received both sets of results around the same time, at the May 15 press conference, TEPCO only stated that "It is quite possible that the Isolation Condenser did not even function at all". This would imply that none of the model analysis results they had released up until that point had been practical. It felt as though they were trying to put on some sort of "sensational and thrilling performance" where they were trying to keep the audience wondering what was going to happen next.

Which results were correct, the actual measurement values or the model analysis results?

Looking at Figures 1.9 (a) and (b), we can see how the reactor water levels, RPV and DW pressure levels in Reactor No. 1 changed over time. However, on top of the values shown in Figures 1.4 (a) and (b), these figures also contain the model analysis results from both TEPCO and NISA. As an additional reference, Figures 1.10 and 1.11 contain the information regarding Reactors No. 2 and No. 3 based on TEPCO's model analysis results compiled on top of their actual measurement data.

Let us look at Figure 1.9 (a) once more to investigate how the water levels were thought to have changed over time.

You can see that there are also three other curves in addition to the actual measurement results. The first curve is TEPCO's model No. 1 analysis results (Figure 1.7) disclosed at the press conference on May 15 [20110515]. As previously mentioned, this figure was created based on the assumption that the "Isolation Condenser did not function at all after the impact of the tsunami".

Figure 1.8 - Reactor Core Water Levels (a) and Pressure Levels (RPV and DW) (b) in Reactor No.1 between 3/11,12:00 pm and 3/15 12:00 am.

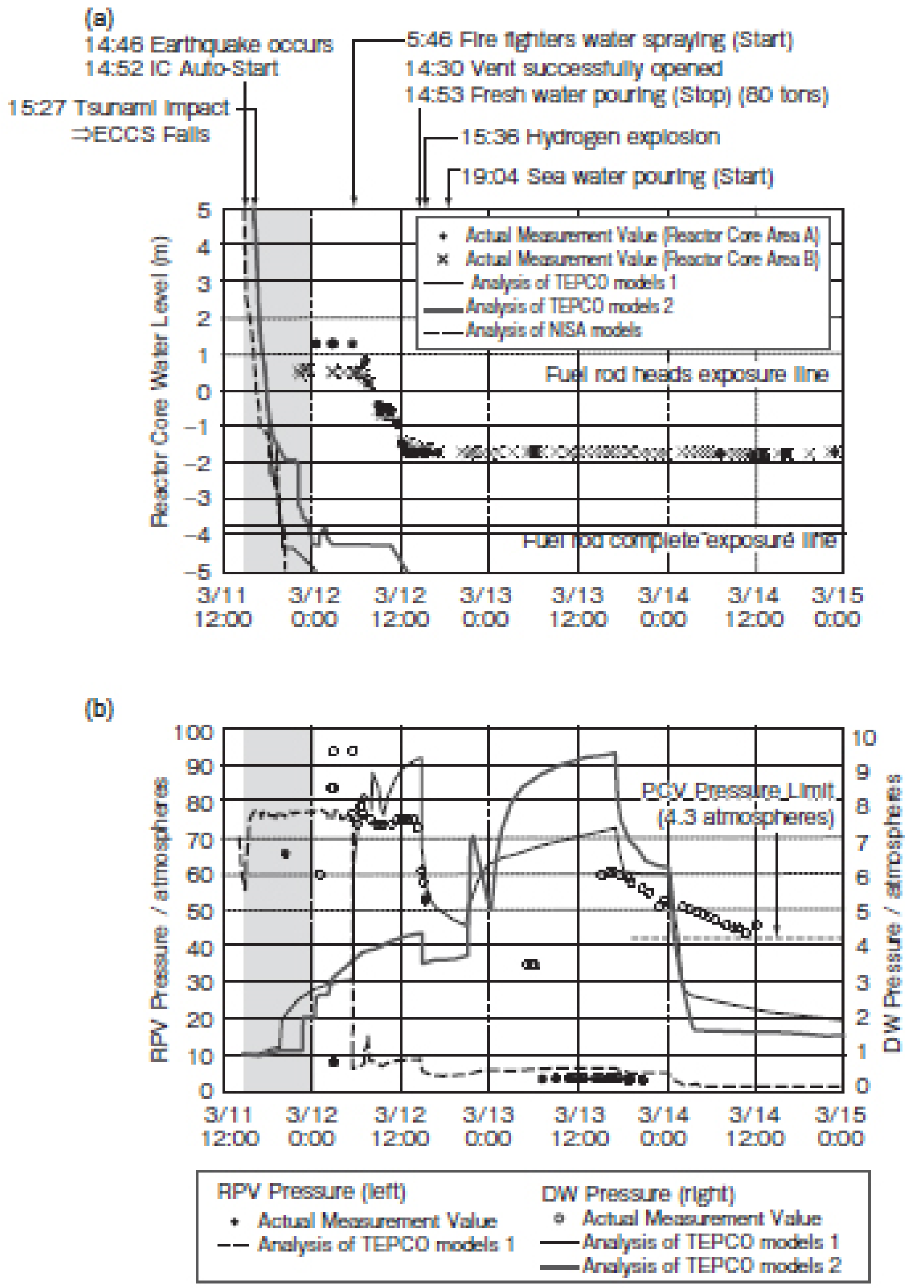
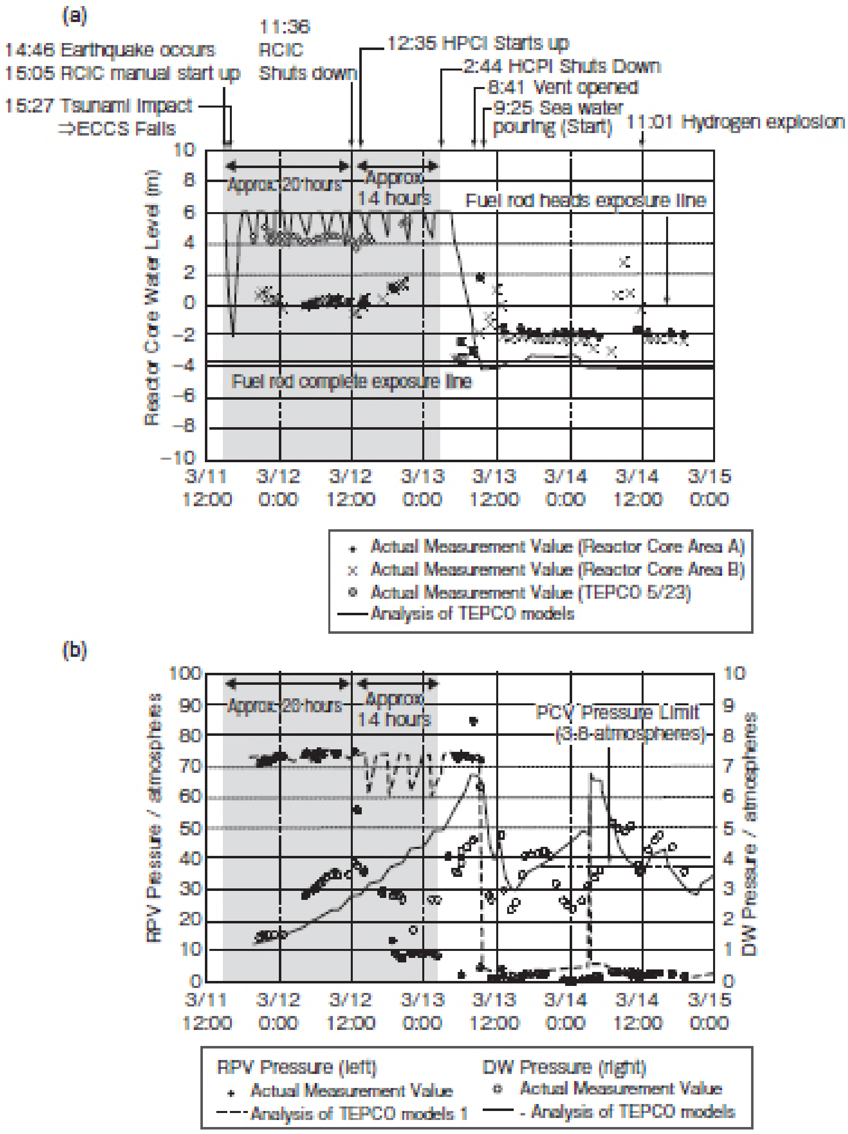


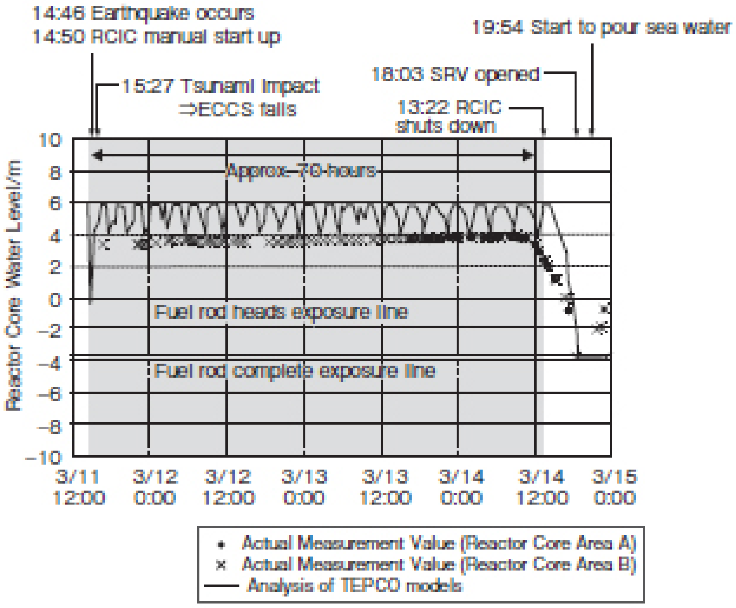
Figure 1.9 - Reactor Core Water Levels (a) and Pressure Levels (RPV and DW) (b) in Reactor No.3 between 3/11,12:00 pm and 3/15 12:00 am.



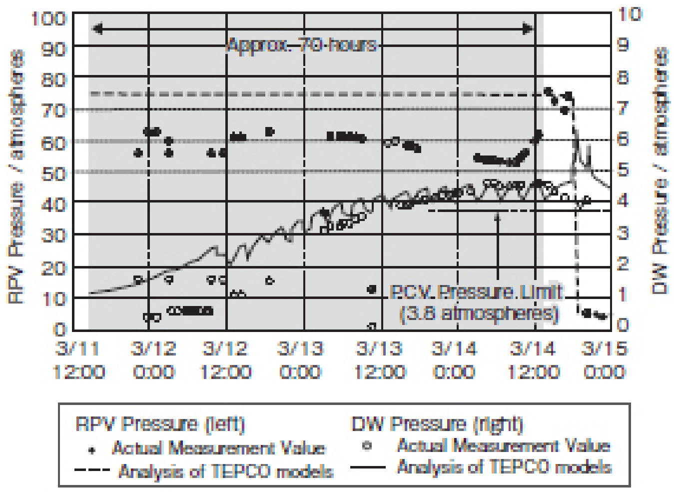
The second curve is based on TEPCO's model No. 2 analysis results presented in their report on September 9 entitled ""Influence and Damage Incurred by the Fukushima No. 1 Power Plant from the Tohoku Earthquake" [20110909] (refer to Graph 3-1-1 on page 1-12 of the report). In other words, this model analysis report was created based on the assumption that the IC did in fact function after the tsunami attack. The third curve is based on data from NISA's model analysis results.

Figure 1.10 - Reactor Core Water Levels (a) and Pressure Levels (RPV and DW) (b) in Reactor No. 2 between 3/11 12:00 pm and 3/15 12:00 am.

(a)



(b)



Let us take a look at this model by first ignoring the two curves based on TEPCO's model No. 1 analysis results (disclosed on May 15 [20110515]) and NISA's model analysis results (disclosed on June 6 [20110606-02]). The reason for this is that they both share the same illogical and impractical assumption that "the Isolation Condenser did not function after the impact of the tsunami", and are therefore not worth considering. Actually, as mentioned earlier, TEPCO [20111122] and NISA [20111125] both acknowledged the fact that System A in Reactor No. 1 IC did in fact function intermittently and that it continued to function normally from 9:30 pm onwards on March 11.

So, if we were to disregard TEPCO's model No. 1 analysis results and NISA's model analysis results, it would leave us with just two scenarios as the only possible conclusions: the "actual measurement results" (Scenario 1) and TEPCO's model No. 2 analysis results (Scenario 2).

Scenario 1: Time flow based on results from TEPCO's "actual measurement results" for Reactor No. 1

- March 11 - 2:52 pm: Isolation Condenser automatically engaged. Valves 3A and 3B both opened.
- 3:03 pm–3:37 pm: Valve 3A opened and closed repeatedly to control pressure levels. Valve 3B closed and left closed thereafter.
- 6:18 pm: Valves 2A and 3A opened. Steam creation confirmed.
- 6:25 pm: Valve 3A closed.
- 9:30 pm: Valve 3A opened. Steam creation confirmed.
- March 12 – Sometime between 12:00 am and around 6:30 am: Isolation Condenser went offline.
- 6:47 am: Reactor water levels start to fall.
- Around 8:00 am: Reactor water levels reach negative and danger levels. Core starts to meltdown.
- 7:04 pm: Begin to inject seawater into the reactor (11 hours with no cooling to core before seawater was injected).

Scenario 2: Time flow based on TEPCO's "model No. 2 analysis results" for Reactor No. 1

- March 11 – 2:52 pm: Isolation Condenser automatically engages. Valves 3A and 3B both opened.
- 3:03 pm–3:37 pm: Valve 3A opened and closed repeatedly to control pressure levels. Valve 3B closed and left closed thereafter.
- Around 6:00 pm: Reactor water levels reach negative and danger levels. Core starts to meltdown.
- 6:18 pm: Valves 3A and 3B opened. Steam creation confirmed.
- 6:25 pm: Valve 3A closed.
- 9:30 pm: Valve 3A closed. Steam creation confirmed.
- Around 11:30 pm: Reactor core fuel rods become completely exposed leading to complete meltdown.

So, which scenario is accurate? In Section 1.8, I will discuss more about questions such as "What can be concluded from this?" and "What still needs to be clarified?"

6. Yasushi Hibino's testimony

***After there was nothing left to be done, TEPCO was visited by Lady Luck**

If Scenario 2 was proved to be the more accurate of the two, then it would have been quite possible that the meltdown of Reactor No. 1 could not have been avoided. However, Reactors No. 2 and No. 3 were still in "controllable states" at the time seawater was being injected into Reactor No. 1. TEPCO, who was watching this terrible sight, had come to the firm resolution that they were not going to allow what happened to Reactor No. 1 happen to No. 2 and No. 3 reactors as well, even if that meant injecting seawater into them.

Any normal person who possessed even a smidgeon of good intentions would have undoubtedly done just that. TEPCO had just made a firm resolution the night after the accident on March 12 that they were prepared to inject seawater into the RPV in Reactors No. 2 and No. 3. But, even after witnessing that dreadful scene, they still wavered in making the decision to inject seawater into the reactors.

Why?

The reason must have been that they did not want to decommission No. 2 and No. 3 reactors as well by injecting seawater into them.

Did the top "Technology Management" at TEPCO even understand the basic rule that "When such a phenomenon crosses the 'physical limits', there is no means currently known to man to control such a monstrosity"?

If they really did not, then that would imply that TEPCO's management did not possess the basic core competencies required to manage such an endeavor. One would naturally think that the backbone of such an advanced and top-of-the-line company would comprise an exceptionally capable management team.

I could not help but want to solve the question as to why such a team did not exist at the heart of such a company.

The best way to solve that question would be to directly ask the management itself, i.e., the Plant Manager (Yoshida), the Representative Director and President (Shimizu) and Chairman (Tsunehisa Katsumata), as well as the Vice-President and CTO (Sakae Mutou, former and current), Nuclear Energy Division Headquarters) of TEPCO.

Based on an article released by the Kyodo News Service [20110413] on April 13, President Shimizu commented on "making the personal decision open the vents and inject seawater into the reactor shortly after". Shimizu stated that he realized he was going to eventually have to take responsibility for the ultimate decision made in the process, so he decided to just go through with it.

You would think that one of these people might be inclined to shed some light on the situation, but all of them flatly refused to provide time for an interview.

Plan B would have been to ask for the advice of the Prime Minister by inquiring from him personally. It is extremely important to try and find out exactly how responsible Prime Minister Kan was for this accident according to Japans' Nuclear Administration Governance laws. However, to my great misfortune, a government-based Accident Investigation Reporting and Consideration Committee stood in my way of getting any further information regarding the subject.

With regard to aircraft and railway accidents, the Japan Transport Safety Board of the Ministry of Land, Infrastructure, Transport and Tourism is the only official agency having the authority to seek out and obtain information on a level even higher than the police. As follows, with regard to this accident as well, on May 24 when the cabinet reached the decision to hold the "TEPCO Fukushima Power Plant Accident Investigation Reporting and Consideration Committee Meeting" (conducted by Committee Chairman Yotaro Hatamura), this committee was given authority to oversee all investigative activities related to this incident.

This meeting was closed to the public. Moreover, as the purpose of this meeting was not to decide who was responsible for letting it happen, they insisted that affidavits and testimonies, which took place in the meeting, would not be used to seek the responsible parties for this accident. On top of that, the public is not permitted to seek any information or results, which took place in the hearing from Prime Minister Kan himself, as he is bound under strict duty of confidentiality.

Just when it looked like there was nothing more that could be done, Lady Luck made an appearance.

As previously mentioned in Section 1.1, on November 4, 2011, Yasushi Hibino had personally contacted me to say that he was willing to meet me. The following is a verbatim account of the interview we had.

Prime Minister Kan's assertion to open the vent and inject seawater into the reactor during the early stages

—Dr. Hibino, would you please mind telling me about what you talked about when you visited Prime Minister Kan on March 12?

Hibino: Before the accident around the end of February, I had met with President Kan, who is actually an old college friend. As we were about to leave, he brought up a request stating that "I would like you to serve as my Cabinet Secretariat". As my last lecture at The Japan Advanced Institute Science and Technology (JAIST) was already scheduled on 18 March, I decided to accept his offer and told him that I could start any time after March 18 as that was the actual day I would be released. Then, not too long afterwards on March 11 the earthquake struck.

I noticed that I had received a voicemail from Prime Minister Kan at around 8:00 am earlier that day. I tried to call him back right after the earthquake, but the lines seemed to be experiencing some difficulty due to the earthquake. I was in Chuo University's Science and Technology Department at that time and ended up even staying there overnight as I was unable to return home. I took the first train back to my home in the suburbs of Tokyo the next day, March 12, at around 6:00 am.

I hadn't been able to sleep well the previous night as I was quite worn out. Later while I was taking a nap at home, I received a phone call from a secretary to Prime Minister Kan at around 3:00 pm requesting me to "Please come immediately". Exhausted and wanting to rest a little bit longer, I replied "Sorry, would you mind waiting a little bit longer? I can't come right now". The phone rang a second and even a third time. He wanted me to come regardless of whatever I was doing at the time. So, I finally told him that I would go and then called a taxi and made my way to the government residence.

Unfortunately, at that time, there was a huge traffic jam; so I didn't end up arriving until around 9:00 am (March 12). After being asked to wait for about 30 minutes, I was escorted to a room where only the Prime Minister was present. However, it had appeared that right up until I had arrived, the Prime Minister Kan had been conducting a long distance meeting between himself, the Chairman of Nuclear and Industrial Safety Agency (NISA), the Chairman of the Nuclear Safety Commission, a TEPCO Fellow (the former Vice-President) and a Contact Representative and Spokesperson for TEPCO, discussing the current situation.

—*Changing the subject to the hydrogen explosion which happened around 9:00 am on* March 12. By that time the RCICs in Reactors No. 2 and No. 3 were functioning without the support of AC power, which would imply that they still had not fallen into an "uncontrollable state", if I am not mistaken?

Hibino: That's correct. Basically, the ECCS had failed at that time. Even Prime Minister Kan was aware of TEPCO's failure to implement sufficient safety measures as tsunamis generally follow earthquakes and that it would only make sense to have protection in place against both. Because earthquakes and tsunamis both happen around the same time, it is of utmost importance to have proper measures implemented in place before they occur. Even someone with no knowledge of the subject can understand this. Even so, why had the emergency diesel-powered generator and the spare battery been foolishly placed in the basement?

This reminds me of the accident, which occurred in the Three Mile Island Nuclear Plant. The accident was the result of the steam flow getting cut and not being properly channeled to the electricity-generating equipment. This eventually resulted in cooling equipment function loss. This led me to wonder if "had they just gotten the proper steam flow up and going again, would that alone really have been enough to prevent this accident from happening?"

When I mentioned this to the Prime Minister, he insisted that I immediately call and contact the Fukushima No. 1 and No. 2 Power Plants and tell both of the Plant Managers this idea. So, I did just that.

While it logically made sense, right now it is just simply not possible. The reason being that even if you opened the main steam line and directed the flow of steam towards the turbine to make it turn, because the seawater pump was not working at the time, there would be no way to control the heat that was brought about by the steam.

The Prime Minister requested me to "call NISA, the Nuclear Safety Commission of Japan, and TEPCO one more time and listen to what they had to say. I cannot get any clear advice or suggestions from any of them. I am also afraid that I lack enough knowledge on the subject to really understand what they are talking about and that I might make a bad judgment call from misunderstanding what they are saying". The Director at NISA, NSC Committee Chairman, and the TEPCO Fellow had already left a little while ago, so I ended up getting in touch with NISA's Vice-Director, the Representative Committee Chairman at the NSC and TEPCO's Nuclear Safety and Quality Department Head. The Nuclear Safety and Quality Department Head informed me that "the RCIC is currently functioning properly".

The Prime Minister had also received the same explanation earlier before I had arrived. Even with the support of the RCIC, as there is no place for the steam to escape it would just continue to go round and round in a circle causing both the temperature and pressure to rise. Then, in order to prevent the temperature or pressure from increasing, they should immediately open the vent to let the pressure out and inject seawater into the reactor to control the core temperature. Prime Minister Kan called all three of these institutions and conveyed them the same.

I too was sure that this was the right course of action and upon asking the Director of Nuclear Safety and Quality Department at TEPCO and the Representative Committee Chairman at the NSC "what do you have to lose by injecting seawater into the reactor? How big could the risk of something go wrong possibly be?", they responded "theoretically, the risk should be zero".

—Which means that there were no risks of re-criticality involved in injecting seawater into the reactor?

Hibino: That's correct. They replied that there would be no risk at all. Their explanation was that no re-criticality or alternate nuclear reaction would occur as sodium ions were present in seawater, which when injected into the reactor, would cool it down. That is why I felt that if this logic really held true, then the vents should be opened and seawater injected as quickly as possible before the RCIC stops functioning.

Upon asking "Is there some reason for you not hurrying up and opening the vent and injecting seawater into the reactor?" the Director of Nuclear Safety and Quality Department at TEPCO responded "if we continue to wait for the pressure and temperature in the PCV to increase and build up as high as they possibly can, then we will be able to release a larger portion of the energy in one go. As the vent can only be opened once, we want to make it count by waiting as long as possible."

Although, I felt like something didn't sound quite right, I ended up backing off and left them to do things their own way. Upon doing some research the following day, I learned that when steam builds up to the point that it exceeds the critical pressure limits, water can only absorb heat at 1 gram per calorie, which means that the longer you wait the more water you will need to dump to cool down the core. Therefore, waiting to let the pressure accumulate and then release it in one go, was not a very good idea. This is exactly why they should have immediately opened the vents to allow this pressure to escape, and then immediately injected seawater into the reactor. The purpose of the RCIC is to earn extra time to get things back under control before the situation worsens. While the RCIC was functioning, had they just taken the opportunity to open the vent and inject seawater into the reactor that would have been the end of the story. Nothing would have happened and Reactor No. 3 would have been able to avoid a meltdown.

Even afterwards, I continued to feel that way. I had asked many people regarding the subject, but no one was able to give me a definite answer. Everyone just sat around silently without trying to attract too much attention. That was when I first heard about you, Dr. Yamaguchi, the first person I found who was clearly trying to assert exactly just this [20110516] [20110513-01].

—If I remember correctly, didn't you mention that Prime Minister Kan was also asserting exactly the same idea?

Hibino: Yes, that's correct. However, TEPCO gave evasive answers and wouldn't listen to what I was trying to tell them. Then, the following day on March 13, the situation at Reactor No. 3 started to worsen and also ended up falling into an "uncontrollable state". Had they just opened the vent and injected seawater into the reactor sometime the previous night (March 12), nothing would have happened. Afterwards, these three institutions all backed. Then, upon meeting with the Prime Minister, he and I shared the following statement, "This meant that TEPCO just really didn't like the idea of decommissioning the core".

—So, in the end TEPCO hesitated because they didn't want to decommission the core?

Hibino: In response to that question, let me first say one more thing. After the earthquake occurred, in April of this year (2011), NISA demanded that all power plants immediately set up emergency safety measures to protect against disasters such as this. During the first half of May, each power company reported its newly established procedures to be implemented to NISA, which evaluated them. You can actually view one of them on the internet[15]. These measures were supposed to be able to withstand the most severe of situations where, at the time when the RCIC stopped functioning, they would open the vent and inject seawater into the reactor before it started to meltdown.

In other words, this should not be a system, which just opens the vent and injects seawater into the reactor immediately once power is lost, but should be a system, which is considered to be durable to preserve in an emergency situation until the RCIC stops functioning. The RCIC will stop working sooner or later. Once the RCIC stops, the core will inevitably meltdown, which is why it is critical to have a system in place, which will be activated before the RCIC stops working. However, every single power company failed to understand that this was supposed to be a system, which could still function after everything else had failed. They had all designed their systems to start up after the RCIC failed, meaning that they failed to comprehend why they were doing this in the first place.

—I can imagine that the same kind of safety measures that NISA was pressing onto the other power companies could probably have been found in TEPCO's "Emergency Situation Handbook" as well, am I right?

Hibino: I believe that this "Safety Measures Manual" is actually what all power companies' manuals are based upon. However, no one knows for sure as the power companies have labeled their Emergency Situation Handbooks as "Classified Information" and by so doing refuse to disclose its contents.

—So, do you have any idea who could have written this handbook?

Hibino: After the Three Mile Island Power Plant accident, NISA instated a policy requiring all power companies to create a kind of Emergency Situation Handbook. After each company finished creating their respective handbook, they would submit it to NISA for inspection and approval. However, according to a broadcast by NHK, it was reported that the vents were not able to be immediately opened manually. Apparently, the engineers were so determined to get the vent open that they willingly went into the control room (which was now full of radioactive substances) to search and retrieve the blueprints, designs and handbooks related to the vent, and then vigorously researched them for nine straight hours in a drastic attempt to get the vent open. However, given the extremely high quantity of radioactive materials, they could only do this for 15 seconds at a time and then afterwards were forced to take a short break before starting again. I am sure that none of them could have imagined the situation would have turned out like this.

—Based on what you just told me, it sounds like there was quite a large possibility that it would have been fairly difficult to inject seawater into Reactor No. 1 before the IC shut down.

[15] Please refer to [20110506] under Attachment 2. In a "Cool Temperature Maintenance Failure" scenario, we can see that the recommended course of action was to "Allow the pressure in the Primary Containment Vessel to continue building up to the highest point possible and then open the vent". In addition, under the "Complete AC Power Loss" scenario, "12–36 hours after Atomic Core Shutdown" was recorded as well. We can actually see the same information written down when looking at any case dealing with Boiling Water Reactors.

Hibino: Yes, that's exactly right. The fuel rods had not yet melted down, which means that they basically only possessed about the same amount of radioactivity as the steam, which flows around inside the electricity-generating equipment of a normally functioning boiling water reactor, like the one TEPCO was using. Actually, even if the steam were to get directly into the area where the electricity is being generated under normal conditions, the amount of radioactive particles it would pick up would be negligible. That is exactly why before the reactor core temperatures spiral out of control that the vents need to be opened. That way we can minimize the damage and amount of radioactive materials released through the steam into the environment when the vent is opened.

—I completely agree with you. If the core temperature levels get out of control before the vent is opened, then by the time it is opened, the amount of radioactive substances will increase due to the meltdown occurring in the reactor core. However, the amount of radioactive materials that would get released into the environment if the vent was opened before the core got out of control would be so low that we could completely ignore it altogether. So, had TEPCO given the green light to inject seawater into the reactor some time on the 12 of March (2011), then the entirety of the damage (or at least the damage brought about by reactors No. 2 and No. 3) to the surrounding area in Fukushima, would never have happened.

Hibino: I truly believe that to be case.

This power plant accident is a direct result of mistakes made by TEPCO's "Technology Management".

Hibino: After those three individuals, previously mentioned, left the government residence just before I had arrived, I was able to have a one-on-one chat with the Prime Minister. Afterwards, I left and checked in at a nearby hotel. The next day, March 13, at 9:00 am, I returned once more to the government residence.

—I believe by about that time Reactor No. 3 had already gone into an "uncontrollable state" and was preparing for a meltdown, am I right?

Hibino: Yes, that's right. Right around the time the "countermeasures meeting" was going on, I was showed into the President's office shortly after a break at around 9:00 am. Goshi Hosono, [Aide to the Prime Minister] had brought and presented a simulation showing the possibility that "if something is not done quickly, in just a few hours the water levels are going to reach the base of the fuel rods ultimately leading to a meltdown". But, in the end, nothing was done; the vent was not opened and seawater was not injected.

—The executives at TEPCO thought it would be best to wait as long as possible, right? However, due to their delay in giving any calls to open the vent or inject seawater into the reactor, the end result was a meltdown. Only after the situation became uncontrollable, did they finally consent to opening the vent and injecting seawater into the reactor. Is that right?

Hibino: Yes, that's correct.

—Why on earth would they possibly do that?

Hibino: Why do you ask? I too have been searching for the exact same answer, and never found it either.

—Even though the Prime Minister had been calling for such measures to be taken, they still laid in wait. Did the Prime Minister lack the authority to just go up to the scene of the accident and give the order himself to the on-site workers to open the vent and inject seawater into the reactor?

Hibino: As a matter of fact, he did lack the authority to do so. Article 15 of the "Nuclear Disaster Special Measures Law"[16] and Article 64 of the "Atomic Energy Regulation Law" [17] state that "in the event that all power is lost and fears arise

[16] **Nuclear Disaster Special Measures Law – Article 15**

Section 1 - In situations where the Cabinet Minister in Charge, with regard to either of the following conditions listed below, can confirm that a nuclear emergency has emerged, he must immediately make a report to the Prime Minister and issue a suitable plan of action with respect to the following two conditions.

- **Condition 1** - Article 10 paragraph 1 states, in cases where abnormally high concentrated amounts of radioactive materials have been detected by, or through, any form of equipment and then a report has been given to the Cabinet Minister in Charge and it is determined that an even higher level of authority is needed in making a decision.
- **Condition 2** – In addition to the above stated, situations where the seriousness of the nuclear emergency has been determined to be so great that the government feels the need to intervene.

Section 2 - The Prime Minister, upon receiving the report (with regard to Section 1) that a nuclear emergency has occurred, should immediately prepare all necessary countermeasures (i.e., "Declare a State of Nuclear Emergency" (below)) in addition to the following items:

- **Item 1** – The determination of the area around the accident where emergency countermeasures should immediately be installed.
- **Item 2** – An outline of the situation of stated nuclear emergency should be provided.
- **Item 3** – As previously set forth in the previous two items, residents, visitors and organizations currently within the potential scope of accident influence should be informed immediately that a "State of Nuclear Emergency" has been declared.

Section 3 – Upon the Prime Minister declaring a "State of Nuclear Emergency", and with regard to Item 1, he should direct and inform all local authorities (Mayor, Governor, etc.) where to go so that they might lead evacuees to safety in accordance with the "Disaster Countermeasures Basic Act" stated in Article 28, Section 2 and Article 60, Section 1. He should also perform all other necessary procedures related to the scope of dealing with the accident's correspondence.

Section 4 – After declaring a "State of Nuclear Emergency", when the situation calms down to the point that the danger appears to be properly contained and will spread no further, the Prime Minister should immediately seek advice and council from the Nuclear Safety Commission. Following receiving their council, he should immediately call off the "Nuclear State of Emergency" to inform the masses of the situation's development.

[17] **Atomic Energy Regulation Law – Article 64**

Section 1 – All employees of stated power company (following applies to anyone with any sort of relationship to the said power company, i.e., consignees etc.) who discover, or have fears that the contained atomic core might have released radioactive substances, caused accidents, etc., or have been brought about due to side effects from the atomic core, should immediately report such incidents or fears to the proper authorities (i.e., the Ministerial Ordinance). Following such reports, emergency correspondence actions should be taken immediately.

Section 2 - In accordance with the previous section, such reports should also be relayed to the police and/or coastguard immediately.

that the reactor core may meltdown, then the right to decide what emergency actions are taken is reserved by that company's (TEPCO) decision makers. The Cabinet Minister in charge, Kaieda (former Minister of Economy, Trade and Industry), does have the right to order TEPCO to take the necessary actions to get the situation under control; Head of the Nuclear Emergency Response Headquarters, Prime Minister Kan also had the authority to give orders and instruction to the Cabinet Minister in charge.

In other words, the Prime Minister could indirectly order TEPCO to take the necessary emergency actions by giving the order to the Minister of Economy, Trade and Industry, who will then relay the order to TEPCO. However, as TEPCO has the authority to decide what measures are taken, neither of these two government officials had the authority to specifically say "We order you to open the vent and inject seawater into the PRV".

For this reason, there were many people who felt that the government instating this kind of a "forced cooperation", where Prime Minister Kan marched into the TEPCO headquarters to help with and oversee measures that were being taken, was in fact a breach of law.[18] Based on the current laws, the government in fact had no right to do so in the first place. Under the current law's jurisdiction, the only direct order the Prime Minister could give in regard to this situation were "Evacuation Orders", in other words, "orders and instructions to flee to a safe place out of harm's way and to evacuate indoor locations". Even so, on the 12 of March, the Prime Minister took a helicopter and flew to the accident scene where he then requested the Plant Director, Yoshida, to "Please open the vent!"

—When Prime Minister Kan took the helicopter and flew to the scene of the accident, the Chief Technology Officer (CTO) and Vice-President, Mutou was also there, wasn't he?

Hibino: Yes, he was. He was actually waiting for the Prime Minister to arrive. He together with Mr. Yoshida conducted the correspondence issues with Prime Minister Kan. By that time, Reactor No. 1 had already gone out of control and was melting down, but reactors No. 2 and No. 3 were still in a "controllable state".

—As Vice-President Mutou is a board member of and Head of the Nuclear Energy Division Headquarters, he has authority of matters related to internal controls and business governance. Therefore, he should also have had the authority to order them to open the vent and inject seawater into Reactors No. 2 and No. 3. In other words, it would not be an overstatement to say that this accident was a direct result of negligence on his part. Shortly afterwards, President Shimizu returned back to TEPCO

Section 3 – In the event that the before- mentioned case in Section 1 outbreaks, then the Minister of Education, Culture, Sports, Science and Technology, the Minister of Economy, Trade and Industry, and the Minister of Land, Infrastructure and Transport, have the authority to order the immediate halting of all operations with regard to the stated power plant's refining facilities, processing facilities, nuclear reactors, spent fuel storage facilities, reprocessing facilities, waste management facility and/or waste disposal facilities and immediately seek out and perform the necessary measures needed to alleviate the situation.

[18] On March 15 at 5:35 am, as soon as TEPCO appealed for an evacuation order, Prime Minister Kan immediately went to the TEPCO headquarters and set up a kind of "forced cooperation" accident correspondence.

on the 12 of March. The Representative Director ultimately could not escape accepting part of the responsibility for this accident.

7. Similarities between this accident and the JR Fukuchiyama line train accident

The Scientific Paradigm "Physical Limits" cannot be exceeded

Let's take a minute to digest everything we have learned so far.

On March 12 at 7:04 pm, TEPCO finally injected seawater into Reactor No.1.

At this point of time, the reactor water level in Reactor No. 3 was still above the 4-meter mark indicating that the situation was still in a "controllable state". In addition to that, the HPCI had been suppressing pressure levels in the RPV and DW to keep them both at acceptable levels of around 8 and less than 3 atmospheres respectively, which were less than the limited pressure levels as designed. Even if the pressure level inside the RPV started to rise, the SRV could be opened to let some steam out and then the Fire Suppression System pump could be used to keep the pressure levels from rising above 6–7 atmospheres. As such, the Fire Suppression System pump could have been easily used to inject seawater into the reactor at any time.

Figure 1.10 (b) shows the pressure level simulation provided by TEPCO. According to this figure, even with the HPCI engaged, the pressure levels in the RPV were still hovering above 60 atmospheres. However, even if we were to accept this to be true, since the pressure in the DW was low enough, the SRV could have been opened to let out excess pressure and then the Fire Suppression System pump could have been used to keep pressures down at an acceptable level. Thus, as seawater could have been dumped into the reactor without even having to bother opening the vent, they should have done that in the first place.

Just as this was possible with Reactor No. 3, it was also possible with Reactor No. 2, which would have kept the situation within the "inner physical boundaries". The fact that the reactor water levels were at a height of about 4meters implies that the core was receiving sufficient amount of cooling. The pressure levels inside the RPV and DW at the time were about 60 and less than 3 atmospheres respectively, which means that they were both well within their pressure limits and there was the opportunity to open the SRV and use the pump from the Fire Suppression System to hold the pressures down to a safe level just as in the case of Reactor No. 3. Therefore, as seawater could have been injected into the reactor without even having to bother opening the vent. I will have to say once again that that is what they should have done in the first place.

However, just as Hibino pointed out earlier, around 9:00 pm on March 12, TEPCO intentionally chose to delay dumping seawater into the reactor. Throughout the time this was going on, Prime Minister Kan had been constantly asserting and urging TEPCO to "Please inject the seawater into the reactor!" But TEPCO just would not listen to reason.

Are you asking "Why?" This is the same question that had both Prime Minister Kan and Hibino puzzled because the only conclusion they both could come to was "It must have been because TEPCO simply did not want to decommission the reactors". Basically, TEPCO's management lacked the basic core competencies necessary to understand what it would mean for this kind of technology to fall into an "uncontrollable state". In other words, this points to one single conclusion that they simply lacked the ability to comprehend that "all forms of technology in this day and age are founded upon scientific paradigms, which all share one rule in common: the 'physical boundaries' cannot be crossed".

I would like to add one more thing, and that is the "existence" of the reason and logic, which Hibino had earlier mentioned. That "existence" being the literal fact written in TEPCO's "Safety Measures Manual" is a clause which states that "in the event that the Reactor Core Isolation Cooling System fails, then, as the next step, open the vent and inject seawater into the reactor".

It was not until later that Hibino came to know that "The Reactor Core Cooling Isolation System (RCIC) will eventually fail. Once it fails the reactor core temperatures will skyrocket due to the lack of cooling. You have to do it before the system fails. However, every single power companies' response to that was 'we are preparing for a situation that will work once the RCIC stops'. I did not understand at all as to why they came up with such nonsense". In each of their accident correspondence manuals, there was a clause stating, "Avoiding the decommissioning of the core for as long as physically possible is the top priority". They too clearly lacked the fundamental core competencies that "Technology Management", needless to say, should have possessed.

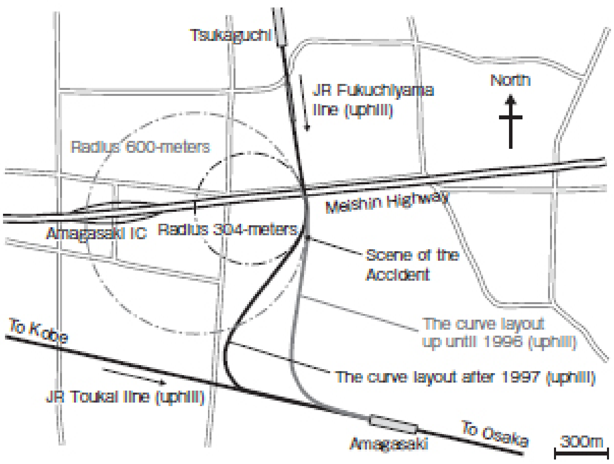
What are the essentials behind the JR Fukuchiyama line train accident?

I finally came to an understanding that the fundamental reason behind why this TEPCO power plant accident occurred bears a striking resemblance to the trigger, which led to the JR Fukuchiyama line train accident in 2005. This tragedy led to the deaths of over 107 people.

"In December 1996, when JR consciously and intentionally redesigned a railway track curve, which originally had a radius of 600-meters, with a curve with a radius of only 304-meters they overlooked the fact that they were also bringing down the maximum physical speed that the train could travel at before turning over." Using this excerpt from a book I wrote regarding this accident [20070605], I would like to show how their lack of a "scientific thinking" was the driving factor for this accident to have occurred.

Figure 1.12 - The curve where the JR Fukuchiyama line accident happened.

Curve radius was 600m until 1997. It was changed in 1997 to 304m.



Please take a look at Figure 1.12. By looking at this map, we can see that the radius of the curved part of the track on the JR Fukuchiyama line was 600 meters. In December 1996, when JR made a conscious decision to alter the angle of the track and change the radius to nearly half of what it had previously been, they did not even once perform a check or a calculation to see what the effects of the change would be on the dynamics of a moving train.

The "Overturn Speed Limit" is the speed limit, which shows us at what point a train will start to rock back and forth until it overturns. In the case of the Fukuchiyama line, it is not a derailing or derail-overturn accident as it did not miss cutting the curve, but rather the wheels started to come up off the tracks in a floating manner until the train fell over onto its side[19]. In this case, it was such a simple calculation that even a high school student using the most basic form of classical mechanics of physics, which he learns in school, could have figured out.

Figure 1.13 - Defining "overturn" through use of the figure below. D equals "danger level".

If D, the danger level, exceeds 1, then the train will sooner or later start to swing back and forth until it overturns.

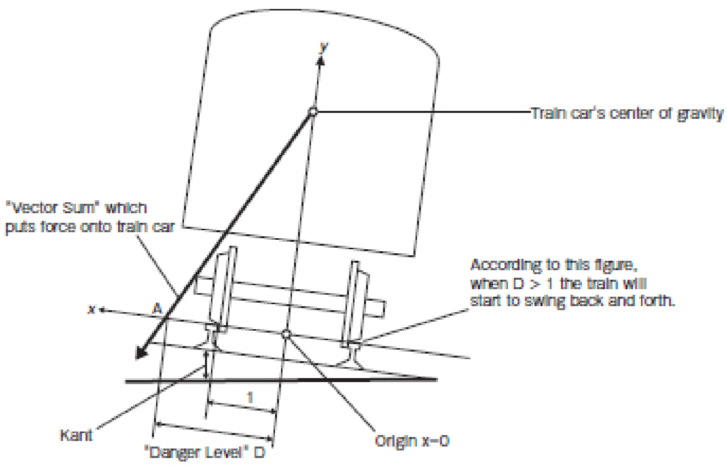


Figure 1.13 shows us the definition of what a "turnover" is. Please try to imagine for a second that there is a train heading down the track on this map towards the bottom on its way around the curve on the left.

There are two points on the x-axis where two of the train wheels are connected to the straight area of the track. And, at the point where the y-axis perpendicularly intersects the x-axis is the straight area of track where the train car's center of gravity is passed. Let us say that the distance between this intersection (starting point) and the point where the wheels touch the track equals 1. In addition, the vector-sum (which puts force on the train car), which comes from the train car's center of gravity, is the combined force of the perpendicular force of the center of gravity along with the centrifugal force put on the center of gravity as well as the resultant force of such, along the straight area of the track.

As shown in this figure, if point A (vector-sum and x-axis intersection) moves outside the area where the train wheels and the rail connect, then the inner right wheel of the train car will start to gradually be pulled upwards, causing it to detach from the rail. Let us define this situation as "overturning". If we make D the distance from the starting point to point A, then when D exceeds 1, the train will inevitably overturn. If

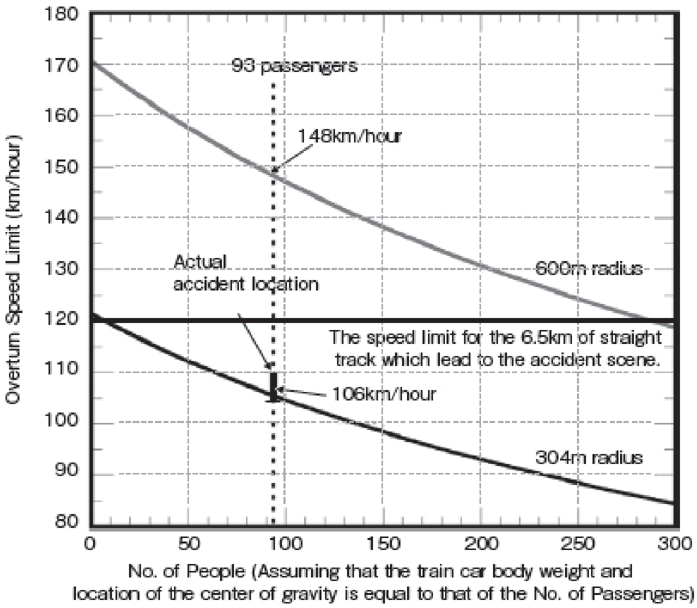
[19] As there are currently no laws or ordinance pertaining to "Overturning Accidents", these kinds of accidents have often been referred to as "Derailing accidents" in a court of law. However, from a physics standpoint, this kind of accident should be redefined as "Overturning".

D continues to remain lower than 1, then the train wheels will continue to receive enough strength (force) to "keep their feet firm in place" (wheels on the ground). In other words, as long as D does not exceed 1, it will not overturn. Therefore, we can define the "Overturning Speed Limit" as the speed which causes the value of D to equal 1.

It was inevitable that one day a train was going to fall over on the JR Fukuchiyama line

Figure 1.14 was created with the intent of displaying that when D starts to approach 1, what kind of effect it will have on a train car's maximum speed before turning over based on the number of passengers riding at the time. Let us use an easy example and assume that the total body weight and center of gravity of all the passengers riding the train are the same. As the number of passengers on the train increases, the maximum speed the train can travel at before overturning will decrease. This is because as the weight inside the train increases, the train car's center of gravity will start to shift and move upwards. In the case of an accident where 93 people are riding the train at once, if we set the radius of the curve to 600 meters, then the train would have to be traveling at a speed above 148 kph to overturn. However, if we set the radius of the curve to 304 meters, then the train would only have to be moving at a speed above 106 kph before it would start to overturn (this was the case in the actual accident).

Figure 1.14 - A function based on the number of passengers was used to determine the speed at which the train would overturn. I sought after the formula to find when D, Danger Level, equals 1 (based on the number of passengers)



Even if we were to say that the train was filled with 288 (over 3x the number of people riding at the time of the accident) people, the train would still have to exceed 120 kph before overturning if the radius of the curve was 600 meters. However, if one wanted to design a curve with a radius of 304 meters and still keep 120 kph as the "overturning" speed limit, they would have to limit the number of passengers riding at one particular point of time to no more than eight people. In summary, even if you were to completely fill the train with people, you would still have a zero percent chance of overturning when going around a curve with a radius of 600 meters at 120 kph, whereas if you were to go at the same speed around a curve with a radius of 304 meters, the chances of an overturn accident happening would be 100%, even if there are almost no passengers on the train.

The southbound train had just departed from Itami station and was heading down the straight line of track, and its speed limit was set to 120 kph (or 2 kilometers per minute). The distance from Itami station to the accident site was approximately 6.5 kilometers. The speed limit posted at the area just before the curve where the accident occurred was set at 70 kmh. The time it would take to reach the curved area of the track from Itami station, at the current speed, would be approximately 3 minutes (6.5 kph/2 kilometers per minute). Therefore, we can determine that in case of a curve with a radius of only 304 meters, if the driver were to lose consciousness sometime during this 3-minute period and the train were to enter the curve at the current speed (120 kph), the chances of an accident occurring would be 100%. Three minutes is more than enough time for a person to start experiencing physical problems or even lose consciousness.

In other words, it was 100% predictable that due to the change in size of the radius of this curve, sometime in the future an "overturning" accident, such as this one, was inevitably going to happen. If there had been some sensible engineer while designing this curve itself, he would have understood this, which means that he would never have gone through changing the curve radius from 600 meters to 304 meters in the first place. Even in the event that he was ordered to do so by his superiors, he would have at least had enough sense to make sure an "Automatic Train Stop" (ATS-P) device[20] was properly installed sometime during the process.

However, these managers who ignored this kind of critical scientific and technological way of thinking consciously made the decision to go through with the change without first taking time to consider what kind of consequences a change like that might lead to. JR's management did not understand the scientific truth that "'physical boundaries' exist within all kinds of technology".

The Fukushima Power Plant meltdown was inevitable

This destructive power plant accident (Table 1.1) was the same in this respect. It is quite possible that TEPCO had simply not planned for such a situation (where all power was lost, including emergency power) due to confidence in their safety measures, such as making safety manuals, under the assumption that the chances of a situation with complete power loss occurring were next to impossible.

However, from a nuclear engineer's point of view, that kind of thinking was not necessarily unscientific. The logic was that they did, in fact, have measures in place ("Last Fortification" or IC/RCIC), which could provide additional cooling even in situations where all power is lost. All the engineers working on the site at the time must have surely understood that because these "Last Fortification" systems were only designed to work for a limited number of hours, after they stopped working the situation would fall into an "uncontrollable state" if nothing else was done. The fact that the Plant Manager had sent a transmission to headquarters informing them of the

[20] There are two models currently available with regard to the Automatic Train Stop (ATS) device; an older model (ATS-S) and a newer model (ATS-P). The ATS-S is a device, which simply engages an emergency brake on the train in the event that the train ignores a stopping signal, starts moving at speeds above those regulated or in any other circumstance where the train seems to be functioning abnormally in a potentially dangerous way. The ATS-P, on the other hand, is a device which constantly regulates the train's speed on certain areas of the track. If the regulated speed is exceeded, then the emergency brake will automatically be engaged to slow the train down to below the regulated speed limit. At the time of the accident, only this older version, the ATS-S, was installed and it did not seem like they had any plans to upgrade to the ATS-P anytime soon either. Had there been an ATS-P system installed and working at the time, regardless of whether the driver lost consciousness or not, when the train approached the curve where the speed limit became from 120 kph to 70 kph, the device would have automatically engaged the emergency brake, thus slowing the train down. In other words, through the simple installation of this device, 107 lives could have been saved (in relation to this case).

dire need to inject seawater into the reactors as soon as possible is proof that they understood this.

However, TEPCO's management continued to ignore the suggestions from those who were at the accident site at the time. It was not until after Reactor No. 1 started to meltdown on the night of March 12 that they finally gave the order to inject seawater into the reactor. TEPCO's management did not even once make an attempt to understand what kind of consequences could be brought about from the physical truth: when technology falls into an "uncontrollable state", nothing can be done.

After all, every technology is bound to a certain specific scientific paradigm. Exceeding these established physicals boundaries results in "going beyond the bounds of life and death", i.e., transitioning from a "controllable state" to an "uncontrollable state". In summary, when these boundaries are crossed, trains overturn, planes crash, and nuclear reactor cores melt down.

An enterprise founded upon such technology has the responsibility to understand everything about it including where its physical boundaries lie, including their locations, characteristics, and structure, before trying to create a business out of it. An absolute priority should be given to safety by putting proper measures in place to minimize the risks involved and making sure those boundaries are never crossed regardless of the economic costs required to do so. That is what we refer to as "Technology Management". The fundamental reason why the JR Fukuchiyama line train accident and the TEPCO Fukushima Power Plant accident occurred is simply the absence and lack of "Technology Management".

Table 1.1. Comparison between the JR Fukuchiyama line train accident and the TEPCO Fukushima Power Plant accident

	JR Fukuchiyama line train accident	**TEPCO Fukushima Power Plant accident**
Technology: **Ethics of scientists and engineers**	Engineers calculated and defined the "Overturning Speed Limit", and designed the tracks with the curve radius of 600-meters in the first place.	Engineers installed IC and/or RCIC as "Last Fortification" to cool the reactors for about eight hours to several tens of hours. They knew that the nuclear reactors will inevitably fall into "uncontrollable state" once those equipments would stop working.
Technology Management: **Executive managers (CEO/ CTO)**	Executive managers gave an order to change the tracks with a curve of radius 600-meters to 304-meters without scientific grounds. They did not know or understand what physical boundaries are like.	Executive managers did not decide to inject seawater into the reactors intentionally. They did not know or understand what physical boundaries are like.

8. What has been made clear and what still needs to be made clear?

What has been clarified?

I would like to conclude this chapter by briefly recapping what we have learned from all of this.

(1) On March 11 at 3:27 pm, after the tsunami struck, all AC power sources, including emergency power in the power plant got disabled; the ECCS and IC in Reactor No. 1 and RCIC in Reactors No. 2 and No. 3 ("Last Fortification") started up and continued to cool the reactor cores without the support of AC electricity. The back-up DC-powered generator in Reactor No. 3 remained functional allowing use of HPCI after the RCIC went offline at 11:36 am on March 12. HPCI continued to cool down the core until 2:44 am on March 13.

(2) The reactors remained in a "controllable state" throughout the period these "Last Fortification" mechanisms were functioning. During this time, had TEPCO simply issued the order to inject seawater into the reactors, this accident could have been completely avoided. However, in order to use the Fire Suppression System pump, which is used to inject seawater, you must first lower the pressure in the RPV to below 6–7 atmospheres. The SRV can be opened to allow the steam to escape into the DW of the PCV, thereby allowing the pressure levels of the RPV to fall down to an acceptable level so that the pump can be used. The DWs pressure limits for Reactor No. 1 and Reactors No. 2 and No. 3 are 4.3 and 3.8 atmospheres, respectively. When the pressure in these DWs exceeds their pressure limits, the external vent can be opened to allow the release of steam outside the drywell in order to reduce the pressure levels. If the vent is opened in what is considered to be a "controllable state", the amount of radioactive substances, which will escape into the outside environment, will be insignificant, whereas if the vent is opened in what is considered to be an "uncontrollable state", an extremely dangerous amount of harmful radioactive substances, like Iodine 131, Cesium 134 and Cesium 137, will escape into the nearby area and wreak havoc on anything and everything they come into contact with. This is why it is absolutely critical that the vent is opened before the situation falls into an "uncontrollable state".

(3) Despite this, TEPCO continued to refuse and delay in making the decision to inject seawater into the reactors. The fact that seawater was not able to be injected into Reactor No. 1's core was quite the phenomenon. However, after they could not hold off any longer, they finally injected the seawater into Reactor No. 1 on the night of March 12. During that time, Reactors No. 2 and No. 3 were both still in "controllable states" with plenty of time left to make the decision to inject seawater into each of these reactors. However, TEPCO simply chose not to do so.

(4) At last, around 2:44 am on March 13, Reactor No. 3 too ended up falling into an "uncontrollable state" and was left unattended. TEPCO finally gave the green light to inject seawater into the reactor around 9:25 am, but it was too late. The heat from the core was no longer controllable. Even around this time, when Reactor No. 3 had completely entered into the meltdown stage and was being injected with seawater, the RCIC in Reactor No. 2 was still working, meaning that it was still in a "controllable state". However, two meltdowns were apparently not enough to make TEPCO reconsider giving the order to inject seawater into Reactor No. 2. Around 1:00 pm the following day (March 14), the RCIC in Reactor No. 2 also stopped functioning. Although,

TEPCO finally gave the order to inject seawater into the reactor about seven hours later around 7:54 pm, it was just too late. Just like in the case of Reactor No. 3, they had waited too long before injecting seawater into the reactor, which resulted in a meltdown in both cases.

(5) So, why did TEPCO repeatedly refuse to inject seawater into the reactors? One reason could have been due to the information and instructions regarding emergency and crisis correspondence and procedures written in their "Critical Emergency Correspondence Manual". However, one would expect that regardless of what was written in this manual, after seeing the first reactor meltdown the way it did, TEPCO's management would have been able to understand the dire need to immediately inject seawater into the remaining two reactors to prevent the same thing (a meltdown) from happening. However, due to TEPCO's negligence to understand the "physical limits" with regard to atomic reactors, Reactors No. 2 and No. 3 eventually fell into an "uncontrollable state" and melted down as a result.

(6) The fact that if seawater was not injected before the RCIC in Reactors No. 2 and No. 3 failed, they would ultimately melt down was 100% foreseeable. That is why the essentials of this accident do not lie in the technology itself, but rather in the "Technology Management". As such, it would also imply that the management of TEPCO has violated serious corporate criminal laws and therefore should take responsibility for their actions.

What still needs to be clarified?

The truth behind what really happened in Reactor No. 1 is yet to come to light. The two most probable scenarios are:

Scenario No. 1 – "The actual measurement data collected by the reactor water level measurement equipment in Reactor No. 1 was actually correct (even though TEPCO had later reported that it was faulty) and that the one remaining function, i.e., systemic, had indeed managed to continue cooling the core and maintained sufficient reactor water levels by itself until 8:00 am on March 12." This assumption has been discussed in detail in Section 1.3 of this chapter.

Scenario No. 2 – "The actual measurement data collected by the reactor water level measurement equipment in Reactor No. 1 was in fact incorrect". This assumption has been discussed in detail in Section 1.5 of this chapter.

Now, let us try and put everything together.

There are three problems with regard to Scenario No. 1.

First, it is impossible to have a reactor water level of negative 1.4 meters. In fact, this was the reason why both TEPCO and NISA had determined that all the actual measurement data received from the reactor water level measurement equipment must have been wrong.

The water which occupies and maintains the reactor core in Boiling Water Reactors (BWR), like those used in the Fukushima No. 1 Nuclear Power Plant, is supplied from a separate water storage tank. That tank was designed with a "Standard Water Level" post, which was in place to monitor changes in the water level surrounding the core. In addition to this, there was also a "Water Level Measurement" post to measure the amount of water vapor (steam) being pulled from the RPV, and monitor the changes in pressure [19781100]. We can find the reactor water level value (which was taken and calculated from the standard criteria water level) by dividing the change in pressure by the density of the water vapor (steam).

In other words, if the Standard Water Level post was to start descending downwards (due to water levels falling), then the water from the storage tank would automatically be channeled into the RPV to replenish the water levels. As this system relies on a fairly simple and primitive technology, and not a digital one, it actually has the ability to withstand rather harsh conditions. A concrete outer wall was built on the outside to help the water level measurement device to properly function at all times. Based on the positioning of where this water measurement equipment is located, if the temperature of the steam in the water post rises too high, then studies need to be conducted to find a suitable reason to explain why it happened. Despite this, many knowledgeable people on this subject have pointed out that “if the water in the storage tank were to run out, there is a possibility that the storage tank would not be able to continue supporting the Standard Water Level post in maintaining the required water levels”.

When I asked Tadaharu Ichiki, a former Toshiba engineer who has more than 30 years of experience in nuclear power plant designing, concerning the matter, this is what he had to say:

> “In the event that the water in the storage tank completely depleted, I believe that the chances of the Standard Water Level post descending as a result are quite low. The reason being that even if a hole formed in the storage tank, steam created from the core would end up leaking out through that hole and then the water pressure detection line would start to spray water into the tank from the bottom area acting like a fountain to preserve the water levels. This would also in turn prevent pressure changes from occurring as well. However, I believe it would be more practical to assume that such damage to the water storage tank would never happen in the first place”.

On May 12, TEPCO provided a handout entitled “Reactor Water Level Measurement Equipment Calibration (Fuel Rod Area)” [20110512]. According to the information in this handout, there was a possibility that the measurement data for Reactor No. 1 water levels had been off by 3–5 meters in the lower regions (downscaled). Actually, when they added a little bit of water to it, they could get the data to show that the reactor water level measurement equipment had actually been functioning properly. However, even if the water levels did eventually downscale somewhere between 3–5 meters, it would still be more practical to assume that the time table data, opposed to the water level data, had been erroneous instead. I am actually still waiting to have this verified by a third party agent (party with no relation with or financial interests tied to TEPCO).

The second issue with this theory has do with the activities related to workers regularly checking and observing the levels of radioactivity in the neighboring areas around Reactor No. 1 up until 5:50 pm on March 11. For example, if we were to take some of the data from the “Daily Activities Report Log” [20110300-03] of Reactors No. 2 and No. 3, it would look something like this:

> 5:50 pm - IC area evacuation - due to rising radioactivity levels indicated by the radioactivity measurement equipment monitors: 300 CPM

In addition, the following data was provided in the “Plant Related Parameters” [20110300-02] released on March 11:

11:49 pm - Transmission 9 for Chapter 15 - "Quantity of radioactive contaminants rising as of 11:00 pm"

"1FNorth1 ·2mSv /h South 0 ·5mSv /h"

This data suggested that it was possible that the reactor core might melt down sometime that day (March 11).

The third problem with this theory is that at the end of all this, there was simply just too much cooled water remaining inside the IC. According to TEPCO's "Reactor No. 1 Isolation Condenser Status Evaluation Report" [20111122], which was inspected on October 13, only 35% and 15% of the cooled water in Reactor No. 1's IC System A and System B, respectively, had been exhausted. This implies that System B had hardly worked at all and that System A had also only provided a limited amount of support during the crisis. However, we would need to have this data analyzed and verified by another third party (with no ties or relations to TEPCO or the concerned government parties) before we can validate this as factual.

Now let us take a look at some of the issues with Scenario No. 2. Even though "by 6:00 pm the water levels had reached the core and by 9:30 pm the core had started to disintegrate", after the valve 3A had been opened at 9:30 pm, there had been no abnormal signs when the steam creation function was being checked. This data also requires analysis and verification of a third party before it can be validated.

Processes which need to be carried out immediately

As previously discussed, this was the extent of the available data with regard to Reactor No. 1. As such, there is no data concrete enough to say that TEPCO's management is at fault for what happened in Reactor No. 1. Although there are loopholes in the logic of Scenario No. 2, it still holds more ground than Scenario No. 1.

However, with regard to Reactors No. 2 and No. 3, the facts pointing to "negligence on the part of TEPCO's management" being the reason for this accident are clear. Just as Prime Minister Kan and Hibino had asserted from the beginning, had TEPCO just injected the seawater into Reactors No. 2 and No. 3 while they were still in a "controllable state" by about 1:22 pm on March 14 and 2:44 am on March 13 respectively, over half of the damage and spread of radioactive substances could have been prevented and "controllable state" could have been preserved. Therefore, TEPCO management's negligence to inject seawater into these reactors shall be construed as criminal liability because evidently the majority of the responsibility for this accident lies with them. The Head of NISA and the Committee Chairman of the Nuclear Safety Commission of Japan are also to take joint responsibility as they just stood around with TEPCO and watched without deciding to just abandon the reactors by injecting seawater.

What we all need to do now is to take a moment to consider the pain and suffering brought about to the plant workers and surrounding residents as a result of negligence on the part of TEPCO's management. After doing so, surely we can only come to the sole conclusion that TEPCO's management must be tried in court for their negligence and that they should do every possible thing to compensate the affected victims to the best of their ability.

As previously mentioned, there are two sets of victims: the surrounding residents and the workers at TEPCO.

Over 100,000 Fukushima residents were forced to flee their homes. All their belongings and assets got destroyed in just a single day and they suffered a lot emotionally. TEPCO needs to understand that they destroyed not only these peoples' assets, but also their communities and as such it is TEPCO's responsibility to return that to them. There was no need in the first place for TEPCO to issue a "Damage Compensation Application" because what TEPCO did was not an accident, but was intentional. Therefore, they should be issuing "Reparations", in other words "indemnification for financial, physical, and mental damages being paid for the victim due to stated illegal actions committed by the guilty party". But it shall not be "compensation under 'legal actions' committed by the guilty party".

The plant workers were the second victims. TEPCO's employees, even though not guilty in this accident, had been punished for the actions of their Management. Every day they lived in constant fear and hid from societies' justice seeking hand. These workers, who had been working at TEPCO plant for years and doing their best to provide a stable supply of electricity to the surrounding area, probably feel like all their efforts over the years had been reduced to nothing due to one single event. The engineers working at Fukushima No. 1 Nuclear Power Plant at the time risked their lives in a desperate attempt to prevent the radioactive materials from spreading any further. Surely, these workers rightly deserve the authority to impeach the managers from their company and restore honor to their names as heroes instead of being seen as villains that society has made them out to be.

There is one more victim worth mentioning as well: every single working person here in Japan. The "Japanese Brand" incurred a severe amount of damage as a result of this accident . It is my personal belief that had these fundamental reasons for this accident not been brought to light, Japan in turn would not be able to recover from this. If we continue to let these victims silently suffer without any form of restitution and not pursue prosecution on the part of those "criminals" involved, it is our humanity which will end up suffering as a result.

This is why the problems of the residents of Fukushima are yours and mine as well. Allowing these "criminals" to get away with their actions would be an act of discrimination on the part of the victims. Japan should never let something like this ever happen again.

9. Conclusion - Looking towards a new sunrise

Shedding light on the current state and style of the Japanese management system

Since the occurrence of this disaster, there have been many articles, books and investigation reports published by various individuals and organizations with their personal views or their conclusions on this accident. I have included a list of 22 of those works and reports (Japanese) to be used as references:

Jun Sakurai, "New edition; Where is the risk for nuclear power plants? Accidents in the World and Fukushima nuclear power plant" [20110408]

Katsuto Uchihashi, "Nuclear power plants in Japan, where did we make the mistake?" [20110420]

Ikuro Anzai, "Fukushima nuclear power plant disaster" [20110509]

Takashi Hirose, “FUKUSHIMA Fukushima nuclear power plant meltdown.” [20110513-02]

Kunihiko Takeda, “Nuclear power plants cause massive destruction! The 2nd Fukushima exists all over Japan” [20110514]

Ryuuichi Hirokawa, “The uncontrollable nuclear power plant” [20110520]

Hiroaki Koide, "The lie of Nuclear Power Plants" [20110601]

Eisaku Sato, “The Truth About Fukushima Nuclear Power Plant” [20110623]

Hiromitsu Ino, Mr. Goto Masashi, Mr. Segawa Yoshiyuki, ‘Why did the Fukushima nuclear power plant accident happen?” [20110623]

Jun Sakurai, “Verify the Fukushima Daiichi nuclear power plant accident: How did we allow the man-made disaster to happen?” [20110708]

Hiroaki Koide, “We don’t need Nuclear Power” [20110716]

Katsuhiko Ishibashi (ed.) “Let’s put an end to nuclear power plants” [20110721]

Tetsunari Iida, “Electric power is sufficient even if there are no nuclear power plants” [20110820]

Yoshitaka Yamamoto, “Thoughts and learning over Fukushima nuclear power plant disaster” [20110825]

Ryou Asakawa, “The truth that is happening in Fukushima nuclear power plant” [20110901]

Hiroaki Koide, Mr. Shin’ichi Kurobe, “Nuclear Power and Radioactivity – Dangerous for Children” [20110916]

Hajimu Yamana, Mr. Satoshi Morimoto, Mr. Takeshi Nakano, “Japan still cannot stop a nuclear power plant.” [20111005]

Makoto Saito, “Economics of Nuclear Power Crisis” [20111020]

Kenichi Ohmae and others, “What can be learned from Fukushima nuclear power plant accident” [20111028]

Takashi Hirose, Mr. Shoujiro Akashi, Mr. Yukuo Yasuda, “Judging the ‘Crime’ of Fukushima nuclear disaster” [20111117]

Yuichi Kaido, “Nuclear Power Plant Litigations” [20111119]

TEPCO “Fukushima nuclear plant accident investigation report (Interim Report)” [20111202]

With the exception of one book from this list, all the other works and documents possess a common trait: they do not mention even once about how TEPCO deliberately chose not to inject seawater into the reactors while the “Last Fortification” systems were still operational. The one exception is a book written by Makoto Saitou entitled

"原発危機の経済学" [20111020]. Dr. Saitou mentioned in his book that "at the absolute latest, by the evening of 12th March, the TEPCO management should have been more than determined to open the vent and inject seawater into Reactors No. 2 and No. 3" [20111020, p.43]. In short, of more than 20 investigation report-related materials, only one made a reference to the "Mistakes on the part of TEPCO's Technology Management".

This is quite similar to the phenomenon encompassing how the JR Fukuchiyama line train accident happened as well. Masao Yamazaki, JR Board Member and President of the Railroad Headquarters, was summoned to court in Kobe, Japan, and questioned by Judge Shinichi Okada regarding the changes made to the railroad designs in December 1996. The judgment for whether or not he is guilty of "negligible homicide indirectly brought about through business activities" in regard to this case will be passed on January 11, 2012, by which time this book should have already been published and made available for sale.

As the trial date is nearing, some newspaper reporters had recently paid me a visit inquiring about some personal matters concerning this court case. They had told me how all the other knowledgeable persons on the subject were unanimous in stating that "we believe he is innocent of such crimes". I, on the other hand, have taken a firm stance in saying that they are indeed guilty. Those who think he is innocent argue that "eight years prior to the accident, when they were re-designing the curve, it would have been impossible for anyone to predict such a thing might happen. Thus, there are no grounds to say that their actions were negligible and could have been avoided."

When I am faced with the reality of these accidents, I strongly feel that "Japanese Society" is in jeopardy.

Here in Japan, top managers of almost any company are made up of people who started out as regular employees and then through hard work have been promoted over and over again until they arrived at the top where they are now. Japan is a kind of bottom-up society; as such, all employees work together as a single unit in meeting their goals and striving to grow. Therefore, it is the role of the management to understand how to adjust and shift the efforts of their employees to cope with current demands or problems. There is no real need to take a leadership role in traditional Japanese companies.

In other words, management mentality and traits are considered to rule the corporate management for all workers from the bottom to the top. As such, regardless of what consequences occur based on decisions (or negligence) made by the management, there is currently lack of sufficient corporate governance in place to compel these managers to take responsibility for the consequences of their actions.

The company management remains in hiding and pulls the strings, thereby determining the company's fate. As soon as a risk of any kind, problem or issue manifests itself, decisions are immediately carried out to limit the effects of the damage it may cause. In times like these, if a wrong decision is made, they should be willing and bold enough to take responsibility for the consequences of their actions. Although we have no idea what the future holds in store, decisions are constantly being made to cope with any changes that may occur to help keep the company afloat. This is what we refer to as "Management". For these managers to achieve this, they need to carry out their responsibilities and duties with full involvement as well as have a sense of responsibility for the consequences of their actions.

That is why when the JR management decided to cut the curve radius on the JR Fukuchiyama line by half, they were "creating the ideal conditions" for an accident to happen without any scientific examination. In the same respect, when the TEPCO management consciously made the decision not to open the vent and inject seawater into the reactors, the outcome of last March was "bound to happen". Both these accidents were results of companies having management teams who possessed no knowledge related to their respective technology's "physical limits/boundaries". People who lack such fundamental yet critical knowledge have no right to manage these companies in the first place. We now have a great and important opportunity to compel TEPCO's management to take responsibility for their negligence and put them on trial for criminal penalty. By doing so, we will be uniting ourselves to transform the Japanese society into one that can take responsibility for its wrongdoings.

Survival requires "breakthroughs"

Why were the same "Technology Management mistakes" repeated? It is because both JR West and TEPCO are monopolistic companies that do not see any need to innovate.

Currently, there is fierce competition in the global high-tech industry. In such an environment, if companies do not continuously seek breakthroughs, they will not survive. However, as JR West and TEPCO are both technically oligopolistic[21] and/or monopolistic enterprises, there is no real need for them to innovate to compete as there is no real competition threatening them.

In such situations, if one were to evaluate and compare them to other similar innovation-seeking enterprises, they would certainly come out in worse light by comparison. In relation to risk management, when it comes to giving demerits and downgrading in this world, there is a tendency for the focus to be more on "avoiding risk" instead of the more important aspect of "putting proper safety measures in place to minimize as much damage as possible in situations to prepare and protect against the 'unpredictable'". This leads to deterioration of the imaginative and creative abilities of humans.

In order to create an organization, which utilizes its employees' imaginative and creative abilities, the enterprise must participate and do business in a competitive environment (not monopolistic). By doing so, they put pressure on their workers, forcing them to utilize and develop their individual talents related to creativity and imagination. In case of TEPCO, the company should be divided into four parts: electricity production, electricity supply, electricity distribution, and corporate damages/compensation. After realizing that this accident was due to "Technology Management", the corporate damages/compensation company should have been ready to take responsibility for the situation without trying to place the blame elsewhere.

After TEPCO's deconstruction gets finalized, they need to immediately instate a Chief Science Officer (CSO) into the management team. It should be someone who understands the boundaries between a "controllable state" and an "uncontrollable state" and assumes the highest amount of authority and responsibility of things related therein. The CSO is different from the Chief Technology Officer (CTO) insofar as the CSO is not so much responsible for seeking continual improvement of the technology they use on a day-to-day basis, but rather for the "Grand Scheme" of knowledge from the perspective as a whole, as well as innovative activities.

Until such changes are made, it will be impossible for managers to effectively run monopolistic enterprises, such as power companies.

In actuality, after the management at TEPCO allowed two of their reactors to melt down (by waiting too long to inject water into the reactors), they finally seemed to understand that they had crossed the "physical boundaries". After coming to such a

[21] The total sale of JR West surpasses (unconsolidated) the cumulative sale of five major railway companies in the same service area: Kinki Nippon Railway Co., Ltd, Hankyu Corp., Hanshin Electric Railway Co., Ltd., Keihan Electric Railway Co., Ltd., and Nankai Electric Railway Co., Ltd. (Kintetsu, Hankyu, Hanshin, Keihan, and Nankai, in short).

realization, they decided to request an evacuation and leave the power plant as is without further consideration. One can only imagine what the attitude of TEPCO's management had been towards the decisions they made as they made it seem like the consequences of their actions had no hold over them.

It would be a crime in itself if we were to just leave the current management system of nuclear power companies unchanged as similar accidents would certainly happen again. Just as Hibino mentioned earlier, currently all the Safety Measures Manual, which NISA had ordered TEPCO (and all the other power companies as well) to create, have been created based on scenarios where "the vent would be opened and seawater injected only after the RCIC stopped functioning" [20110506].

That is just simply preposterous. That implies that the countermeasures that have been put in place now do not differ in the slightest from those already in place before this disaster struck. They are still making measures to "avoid decommissioning" their top priority as opposed to the safety of those within its area of influence. If no new countermeasures are put in place, identical nuclear accidents would occur again in other nuclear power plants also. Clearly, the nuclear reactor management system in Japan is one to be feared.

It would be no understatement to say that this accident has crippled Japan. Our management system and the way we conduct business affairs will never become adopted or used by other countries unless we start seeking for "breakthroughs". I guess Japanese companies should consider this accident as a "caution" or "wake-up call".

Of course, this is not just limited to electricity-producing companies. It applies to the agricultural and bio-industries as well. The Japanese system would end up creating a network of high-and-low structures by constructing seemingly closed village societies where all movement and transfer of information concerning their respective discipline remain controlled. The people working within these high- and low-end networks would end up being figuratively suffocated by such controls. Individuals who actually seek innovation only find it upon leaving these networks and village societies and then make their new home in the new enabling (horizontally networked) environment never to return back to their closed village societies. This is termed as Japan's "illness".

However, the world is taking these "large enterprises and conglomerations" and turning them into "synthesized horizontal networks dependent upon innovators" with the industry and employers being the ones who pull the strings.

This is why we must urge people to leave these suffocating societies and "wander about" figuratively, so that Japan as a whole can grow beyond its current state. Then, when problems related to cross-border problems manifest, we should seek to understand the fundamental reasons behind them, and properly find a lasting solution; by doing so we temper our "Grand Scheme Conceptual Abilities". In order to achieve this, we need to make science and technology "resonate" with our society and freely allow "cross-border knowledge" as we endeavor to construct new fields of learning as a means to solve these problems. This accident has provided Japan an unexpected opportunity to transform its narrow-minded thought process into a broader and "breakthrough-seeking" one.

Table -1 The following table is based upon TEPCO's Nuclear Disaster Countermeasures Report No.10. This report was created using public data reports, documents and transmissions received by TEPCO from the Fukushima No.1 Power Plant.

Source: http://www.nisa.meti.go.jp/earthquake/plant/plant_index.html http://www.nisa.meti.go.jp/earthquake/plant/1/plant-1-3.pdf

Date	Time Table	Fax Time Table	Time Reported	Classification	Reactor No.1	Reactor No.2	Reactor No.3
11	14:46:00				Earthquake manifests		
	15:27:00				Tsunami strikes power plant		
	15:42 1rst Report	16:00:00		Transmission 10	Complete AC power loss in reactors 1～5 DG flooded with seawater "Trip"		
	16:36:00	16:59:00		Transmission 15	Reactors No. 1 and No. 2 cooling equipment fails to dump water Water Levels Unknown		
	15:42:00	4/24 10:02		Transmission 10 Revised	Changed from reactors 1～5 to 1～3		
	16:36:00	4/8 17:36		Transmission 15	Same as above		
	16:45:00	16:55:00		Transmission 15	Water level surveillance restored Transmission 15 - cancelled	ECCS status: unknown water levels: unknown	
	17:07:00	17:12:00		Transmission 15 Report No.3	Reactor No. 1 Water level surveillance fails again, Water levels Unknown		
	16:36 2nd report	4/8 17:37		Transmission 10	Radioactivity levels normal in areas surrounding MP		
					(Large Time Gap In Time)		
		21:02:00	20:30 current	Plant Data	IC: Working HPCI(waiting on power restoration) Pressure, Water Levels, Everything Unknown	Beginning: RCIC Engages L8 "Trip", Fails to engage a second time due to complete power loss RCIC: Offline HPCI: Waiting on power restoration	RCIC: Working 7.1MPa +600mm
	Unknown	21:02:00		Transmission 15 Report No.5		Water Levels Unknown RCIC Function Unconfirmed Water Levels TAF May have already arrived Preparing request for evacuation	
	20:30:00	21:02:00		Parameter Data	IC: Working HPCI: Waiting on power Water / Pressure Levels Unknown 20:15 Onwards unable to confirm M/C Submerged	Beginning: RCIC Engages L8 "Trip", Fails to engage a second time due to complete power loss RCIC: Offline HPCI: Waiting on power restoration Electricity supply vehicle still en-route	RCIC: Working Reactor Pressure Vessel 7.1Mpa Water Levels +600mm (Wide) D/W 145kPa
	Unknown	21:15:00		Transmission 15 Report No.6	Under Evaluation	TAF expected to arrive around 21:40 Core Center starts to incur damage around 22:00 RPV incurs damage around 23:50	
		21:15:00	21:00 Current	Parameter Data	IC: Working HPCI: Waiting on power Water / Pressure Levels Unknown 20:15 Onwards unable to confirm	Beginning: RCIC Engages L8 "Trip", Fails to engage a second time due to complete power loss RCIC: Offline HPCI: Waiting on power restoration *(A system which can be used to dump water onto the core after the Fire Suppression System pump to lowers the pressure level)*	RCIC: Working Reactor Pressure Vessel 7.2MPa Water Levels +900 Wide D/W Pressure Levels 155 k Pa
	16:36	21:48:00		Report No.6 (Revised)	Under Evaluation	TAF expected to arrive around 21:40 Core Center starts to incur damage around 22:20	

						RPV incurs damage around 23:50	
	21:00:00 Revised	21:48:00		Parameter Data - Revised	IC: Working HPCI waiting on power Water / Pressure Levels Unknown	Beginning: RCIC Engages L8 "Trip"、Fails to engage a second time due to complete power loss RCIC: Offline HPCI: Waiting on power restoration *(A system which can be used to dump water onto the core after the Fire Suppression System pump to lowers the pressure level)*	RCIC: Working Reactor Pressure Vessel 7.2MPa Water Levels +900 Wide D/W Pressure Levels 155 k Pa
	(Blank)	22:11:00		Transmission 15 Report No.7	Water Levels TAF+450mm	Water Levels Confirmed TAF+3400mm	
	(Blank)	22:20:00		Transmission 15 Report No.8	Water Levels TAF+550mm	TAF+3400mm（L-2） 22：00	
		22:21:00	22:00 Current	Parameters	IC: Working 21:30 Pressure Release - Start ３A Valve Opened Fuel Head Area+550 20:07 Core Pressure: 6.6〜7.2MPa	TAF+3400mm	RCIC: Working Reactor Pressure Vessel 7.2MPa ＋350（Wide） Pressure Containment Vessel 155kPa
	23:49:00			Transmission 15 Report No.9	23:00 Radioactivity level in Turbine chamber starts to rise １F North 1.2mSv/h South 0.5m Sv/h		
		23:49:00		Parameters (Handwritten)	22:47 TAF+59cm Pressure Measurement Equipment Failure Unable to enter room 23:05 TAF+59 23:24 TAF+59 23:35 Waiting on alternate/emergency power (still unable to see indications instructions)	22:47 TAF+3400mm RCIC still unconfirmed 23:05 TAF+3400mm 23:20 TAF+3500mm 23:30 TAF+3500 6.3MPa D/W40kPa	22:58 Narrow +100 Wide +400 7.3MPa 23:19 Wide +200mm Narrow D・S RCIC: Working 7.38MPa 23:35 Wide +350mm Narrow ±0 7..32MPa
12	16:36??	0:57:00		Transmission 15 Report No.10	Reactor No.1 D/W Pressure level exceeds 600kPa (Data blotted out) Maximum Pressure Limit (by design): 427kPa Abnormal rising in Pressure Containment Vessel pressure levels		
		0:57:00	0:30 Current	Parameters	IC: Working 21:30 Reducing Pressure Valve 3A opened IC(A)？Side: Fire Suppression System Supplying Water Water Level: TAF+1300mm	Beginning: RCIC Engages L8 "Trip" (15:28) Fails to engage a second time due to complete power loss RCIC: Offline 6.3MPa TAF+3500mm D/W 40kPa	RCIC: Working 7.35MPa (Adjusting S/R Vent) -200mm Wide "Downscale" （Narrow） 155 k Pa（21:00 onwards）
		2:48:00		Transmission 15 Report No.11	2:30 D/W 0.84MPa TAF+130cm（System A） TAF+53cm（System B）		
	Transmission Time 3：33	3:34:00		Transmission 15 Report No.12	2:50 Core 0.8MPa D/W 0.84MPa TAF+130（System A） TAF+50cm （System B） Reached Isobar - Should we penetrate?	2：50 RCIC Pump in use Core: 5.6MPa Water Level: TAF+3600mm RCIC Pressure Release 6.0MPa Radiation analysis/evaluation (complete) from when vent was opened after core sustained damage	
	Transmission Time 4：01	4:02:00		Transmission 15 Report No.13	DW Vent Simulation using Reactor No.1 data	3：16 TAF+3700mm 60 k Pag	7.4MPa DW280 k Pa

		Transmission Time 04：36	4:15 Current	Parameter Data	Replenishing water levels given absolute priority. Parameter data will be organized thereafter IC: Working-21:30 Reducing Pressure Valve 3A open Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration) 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area:+1300mm （Fuel Rod Area: A） Fuel Rod Head Area: +500mm （Fuel Rod Area: B） DW840ｋPa	RCIC: Working （2:55 Pressure released on site 6MPa） Confirmed） HPCI（Waiting on power restoration） Center of Core: 5.6MPa （2:55） Water level measurement equipment functional Fuel Rod Head Area: +3700mm DW60ｋPa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.47MPa ±0（Wide） ±0（Narrow） DW285KPa
	Transmission time 04：30 (Traces of Fax time being erased discovered)		4:30 Current	Plant Data Revision	Supplement added to previous data Base rod area: radiation levels rising 80μSV Entry/Exit area: 8500nG and rising Internal radioactivity levels rising 150μSV		
	Transmission Time 4：55	4:57:00		Transmission 15 Report No.14	Radiation Levels Rising Central Control Room 150mSv/h （4：00） Primary Base Isolation Rod 0.08m Sv/h (4：03） MP Main Gate 0.59mSv/h （4：23） MP-8 0.23mSv/h（4：15） Victims from explosion (confirmed) contamination continues to spread		
		5/17 4:45		Transmission 15 Report No.15	Internal radiation levels rising, D/W Pressure levels decreasing (5:14) Radiation thought to have escaped facility 0.84→0.77MPa		
		5/17 4:46		Transmission 15 Report No.16	Radiation detected in charcoal near main gate 5:10 Current 2.5*10-4 Bq/cm3		
		FAX time 5:22	5:20 Current	Plant Data	**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC: Working 21:30 Reducing Pressure Vent 3A Open Fire Suppression System water supply function shut down on IC(A) side？ HPCI(waiting on power restoration) 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area: +1300mm （Fuel Rod Area: A） Fuel Rod Head Area: +500mm （Fuel Rod Area: B） DW840ｋPa	RCIC: Working （2:55 Pressure released on site 6MPa） Confirmed HPCI（Waiting on power restoration） Center of Core: 5.6MPa （2:55） Water level measurement equipment restored Fuel Rod Head Area: +3700mm DW60ｋPa RCIC water source switches from CST to S/C	RCIC: Working Pressure Levels: 7.4MPa (Adjusting S/R Vent) +100mm（Wide） +50mm（Narrow） DW300KPa
	5:25:00		5:25 Current	Plant Data	(Extension of previous information) Radiation levels increasing Base Isolation Rods rising to 14μSV		
	5:30:00		5:30 Current	Plant Data	**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC: Working 21:30 Reducing pressure - Valve 3A opened Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration) 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area:+1300mm （Fuel Rod Area: A）	RCIC: Working (2:55 Pressure released on site 6MPa Confirmed) HPCI（Waiting on power restoration） Core Center: 5.6MPa（2:55） Water level measurement equip. operational Fuel Rod Head Area: +3700mm DW60ｋPa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.43MPa(Adjusting S/R Vent) +200mm（Wide） +0mm（Wide） DW305KPa

					Fuel Rod Head Area: +500mm （Fuel Rod Area: B) DW　Door airtightness increased by closing doors causing power lost (Unconfirmed), Main gate area radiation levels increasing **1.59μSV** **Iodine Levels reach 2.5×10−4 Bq**		
			6:00 Current	Plant Data	**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC: Working　21:30 Reducing pressure -　　Valve 3A opened Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration) 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area:+1300mm （Fuel Rod Area: A） Fuel Rod Head Area: +500mm （Fuel Rod Area: B) DW　Door airtightness increased by closing doors causing power lost (Unconfirmed) **Isolation base primary entry area: rising to 20μSV**	RCIC: Working (2:55 Pressure released on site 6MPa Confirmed) HPCI（waiting on power restoration） Core Center5.6MPa（2:55） Water Level measurement equip. operational Fuel Rod Head Area: +3700mm DW60 k Pa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.43MPa (Adjusting S/R Vent) +200mm（Wide）（5:55) +0mm（Narrow） DW305KPa
			6:10 Current	Plant Data	**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC: Working　21:30 Reducing pressure　　　Valve 3A open Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration) 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area: +1300mm （Fuel Rod Area: A） Fuel Rod Head Area: +500mm （Fuel Rod Area: B) **DW 0.74MPa restoring power** **17 workers showed signs of face pollution**	RCIC: Working (2:55 Pressure released on site 6MPa）Confirmed） HPCI（Waiting on power restoration） Core Center: 5.6MPa（2:55） Water level measurement equip. operational Fuel Rod Head Area: +3700mm （6：00） DW60 k Pa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.25MPa (Adjusting S/R Vent) +200mm（Wide）（6:00) +0mm（Narrow） DW310KPa（6:00）
			6:40 Current	Plant Data	**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC: Working　21:30 Reducing Pressure　Valve 3A open Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration) 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area: +1300mm （Fuel Rod Area: A） Fuel Rod Head Area: +500mm （Fuel Rod Area: B) DW　0.79MPa　（6：30） 17 workers showed signs of face pollution **2000 liters dumping (complete)** **Isolation Base Entry area: rising to 50μSV**	RCIC: Working (2:55 Pressure released on site 6MPa Confirmed) HPCI（Waiting on power restoration） Core Center5.6MPa（2:55） Water measurement equip. operational Fuel Rod Head Area: +3700mm （6：30） DW60 k Pa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.49MPa (Adjusting S/R ent) (6:30) +350mm （Wide）(6:30)　+50mm （Narrow） DW320KPa（6:30）
			6:47 Current		**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC: Working　21:30 Reducing pressure -　　Valve 3A opened Fire Suppression System water supply function shut down on IC(A) side？ HPCI Waiting on power	RCIC: Working (2:55 Pressure released on site 6MPa Confirmed) HPCI（Waiting on power restoration） Core Center: 5.6MPa（2:55） Water level measurement equip. operational Fuel Rod Head Area: +3700mm	RCIC: Working Core Pressure: 7.49MPa (Adjusting S/R Vent) (6:30) +350mm（Wide）（6:30) +50mm（Narrow） DW320KPa（6:30）

					restoration) 0.8MPa (2:45waiting on control room repairs) Fuel Rod Head Area: +1300mm（Fuel Rod Area: A） Fuel Rod Head Area: +500mm（Fuel Rod Area: B) DW　0.77MPa　（6：47） 17 workers showed signs of face pollution 2000 liters dumping (complete) Isolation Base Entry Area: Rising to 50μSV **Fire Truck tank water sprayed onto core** **D/DFP Line pours water via CS System connection.** **Main gate area: Radiation levels rising 4.9μSV Iodine levels 2.8× 10-4 Bq**	（6：47） DW60ｋPa RCIC water source switches from CST to S/C	
			7:00 Current	Plant Data	**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC　Ｗｏｒｋｉｎｇ 21:30 Reducing pressure　Valve 3A opened Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration) 0.8MPa (2:45 main control room repairs) **Fuel Rod Head Area: +800～1000mm（Fuel Rod Area: A）** **Fuel Rod Head Area: +300mm（Fuel Rod Area: B）（7:00）** DW　Unclear　（7：00） 2000 liters dumping (complete) Isolation Base Entry area:　Ｒｉｓｉｎｇ　ｔｏ　50μSV Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection.	RCIC: Working (2:55 Pressure released on site 6MPa Confirmed) HPCI（Waiting on power restoration） Core Center: 5.6MPa（2:55） Water level measurement equip. operational Fuel Rod Head Area: +3600mm（7：00） DW60ｋPa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.39MPa (Adjusting S/R Vent) (6:30) +350mm（Wide）（7:00) +50mm（Narrow） DW330KPa（7:00）
			7:55 Current	Plant Data	**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC: Working 21:30 Reducing pressure　Valve 3A opened Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration) 0.8MPa (2:45 main control room repairs) **Fuel Rod Head Area:−100～+200mm（Fuel Rod Area: A）** **Fuel Rod Head Area:−100～+200mm（Fuel Rod Area: B）(7:30)** DW　0.755MPa　（7：40） 3000 liters dumping (complete) (5:55) Isolation Base Entry area:　Ｒｉｓｉｎｇ　ｔｏ　1.53mSV Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection. Main gate area: 5.3μSV（7:40）	RCIC: Working (2:55 Pressure released on site 6MPa Confirmed) HPCI（Waiting on power restoration） Core Center: 5.6MPa（2:55） Water level measurement equip. operational Fuel Rod Head Area: +3600mm（7：30） DW60ｋPa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.23MPa (Adjusting S/R Vent) (6:30) +380mm（Wide）（7:30) +50mm（Narrow） DW330KPa（7:30）
	7:59	8:00:00		Transmission 15 Report No.17	7:30: Radiation detected in area around power plant main entrance/ isolated base rod entry area through use of charcoal area●●●(Iodine?) detected. Cable being laid out to open DW vent		

	8:30	8:31:00		Transmission 15 Report No.18	Preparing to open vent... Scheduled to open around 9:00 Water levels being lowered to TAF area Fire suppression pump dumping water onto core…..		
	7:55 Current	8:31:00		Plant Data	IC: Working Valve 3A open Core: 0.8MPa TAF-100～+200 （AB same time）(7：30) D/W 0.755MPa ABS (7：40) 3000 liters dumping (complete) Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection.	RCIC: Working 2:55 Pressure released on site 6MPa PCV:5.6MPa 2：55:Site Confirmation TAF+3600 Water level equip. restored 7:30 current D/W60kPa - Working to restore electricity RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.23MPa (Adjusting S/R Vent) (6:30) TAF+380（Wide） +50 (Narrow) D/W 340kPa 7:30
		9:10:00	8:49 Current	Plant Data	IC: Working Valve 3A open Core: 0.8MPa(2:45) Fuel Rod Head Area: -400～-200mm(Fuel Rod Area: A) Fuel Rod Head Area: -550mm(Fuel Rod Area: B)(8:49) D/W 0.740MPa ABS (8:49) 5000 liters dumping (complete) Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection.	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa Confirmed) HPCI（Waiting on power restoration） Core Center: 5.6MPa（2:55） Water Level measurement equip. operational Fuel Rod Head Area: +3600mm（8:39） DW60ｋPa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.52MPa (Adjusting S/R Vent) (6:30) +400mm（Wide）（8:30) +60mm（Narrow） DW350KPa（8:30）
		9:23:00	9:15 Current	Plant Data	**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC: Working 21:30 Reducing Pressure Valve 3A open Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration) 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area: -800～-550mm（Fuel Rod Area: A） Fuel Rod Head Area: -650mm（Fuel Rod Area: B)（9:10） DW 0.740MPaabs（9:10） 6000 liters dumping completed (9:15) Isolation Base entry area: rising to 50μSV (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection.	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa Confirmed) HPCI（Waiting on power restoration） Core Center: 5.6MPa（2:55） Water Level measurement Equip. Operational Fuel Rod Head Area: +3600mm（9:10） DW60ｋPa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.46MPa (Adjusting S/R Vent) (8:00) +400mm（Wide）（9:00) +60mm（Narrow） DW360KPa（9:00）
		9:40:00	9:40 Current	Plant Data	**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC Working 21:30 Reducing Pressure Valve 3A open Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area: -450mm（Fuel Rod Area: A） Fuel Rod Head Area: -700mm（Fuel Rod Area: B)（9:20） DW 0.740MPaabs（9:20） 11000 liters poured (complete) (9:40) Isolation Base Rod Area: rising to 50μSV Fire Truck tank water sprayed	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa Confirmed) HPCI（Waiting on power restoration） Core Center: 5.6MPa（2:55） Water Level measurement equip. operational Fuel Rod Head Area: +3600mm（9:10） DW60ｋPa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.46MPa (Adjusting S/R Vent) (8:00) +400mm（Wide）（9:00) +60mm（Narrow） DW360KPa（9:00）

					onto core D/DFP Line pours water via CS System connection. Vent being opened to reduce pressure. MO Valve Opening...25%. side vent thought to have opened after remote control activation。		
	9:54:00	9:53:00		Transmission 15 Report No.19	Evaluation of explosion before vent opened Wind blowing toward ocean		
		10:32:00	10:04 Current	Plant Data	**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC Working 21:30 Reducing Pressure Valve 3A open Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area: -500mm（Fuel Rod Area: Fuel Rod Area: A） Fuel Rod Head Area: -700mm（Fuel Rod Area: B)（10:04） DW 0.745MPaabs（9:20） Main gate area: Iodine Levels 6.6×10-5 Bq/ｃｍ3 21000 liters poured onto core (complete) (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection. Vent being opened to reduce pressure. MO Valve Opening...25%. 10:17 S/C side vent thought to have opened after remote control activation。	RCIC: Working (2:55 Site: Releasing Pressure -６MPa Confirmed) HPCI（Waiting for power restoration） Core Center: 5.6MPa（2:55） Water Level measurement equip. operational Fuel Rod Head Area: +3600mm（9:30） DW60ｋPa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.46MPa (Adjusting S/R Vent) (9:30) +350mm（Wide）（9:30) +70mm（Narrow） DW350KPa（9:30）
			10:41 Current	Plant Data	**Replenishing water levels given absolute priority. Parameter data will be organized thereafter** IC: Working 21:30 Reducing Pressure Valve 3A open Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration 0.8MPa (2:4 main control room repairs) l Rod Head Area: -550mm（Fuel Rod Area: A） l Rod Head Area: -700mm（Fuel Rod Area: B)（10:38） DW 0.740MPaabs（10:41） Main gate area 385μSV(10:30) 21000 liters poured onto core (complete) (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection. Vent being opened to reduce pressure. MO Valve Opening...25%. 10:17 S/C side vent thought to have opened after remote control activation	RCIC: Working (2:55 Site: Releasing Pressure -６MPa Confirmed) HPCI（Waiting on power restoration） Core Center: 5.6MPa（2:55） Water Level measurement equip. operational Fuel Rod Head Area:+3800mm（10:41） DW60ｋPa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.46MPa (Adjusting S/R Vent) (9:30) +350mm（Wide）（9:30) +70mm（Narrow） DW350KPa（9:30）
		11:29:00	11:20 Current	Plant Data	IC: Working 21:30 Reducing Pressure Valve 3A open Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration	RCIC: Working (2:55 Site: Releasing Pressure -６MPa Confirmed) HPCI（Waiting on power restoration） Core Center: 5.6MPa（2:55） Water Level measurement	RCIC: Working Core Pressure: 7.36MPa (Adjusting S/R Vent) (9:30) +200mm（Wide）（11:20) +70mm（Narrow）

					0.8MPa (2:45 main control room repairs) Fuel Rod Head Area:-900mm（Fuel Rod Area: A） Fuel Rod Head Area:-800mm（Fuel Rod Area: B)（11：20） DW 0.750MPaabs（11:20） Main gate area 385μSV(10:30) 21000 liters poured onto core (complete) (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection. Vent being opened to reduce pressure. MO Valve Opening...25%. 10:17 S/C side vent thought to have opened after remote control activation	equip. operational Fuel Rod Head Area: +3600mm（11:20） DW60ｋPa RCIC water source switches from CST to S/C	DW350KPa（11:20）
	11:39:00	11:40:00		Transmission 15 Report No. 20	As vent opens, workers inside suffer explosion damage 106.30mSv		
			12:05 Current	Plant Data	IC: Working 21:30３A opened to release pressure Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration) 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area: -1500mm（Fuel Rod Area: A) Fuel Rod Head Area: -1400mm（Fuel Rod Area: B) (12:05） DW 0.750MPaabs（12:05） Main gate area 385μSV(10:30) **Iodine levels 8.9×10−3** 21000 liters poured onto core (complete) (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection. Vent being opened to reduce pressure. MO Valve Opening...25%. 10:17 S/C side vent thought to have opened after remote control activation	RCIC: Working (2:55 Site: Releasing Pressure -６MPa Confirmed) HPCI（Waiting on power restoration） Core Pressure: 5.6MPa（2:55） Water Level Measurement equip. operational Fuel Rod Head Area: +3600mm（11:30） DW60ｋPa RCIC water source switches from CST to S/C	RCIC: Working Core Pressure: 7.36MPa (Adjusting S/R Vent) (9:30) +200mm（Wide）（11:20） +70mm（Narrow） DW 350KPaabs（11:20） SC 750KPaabs
	12:20:00	12:22:00		Transmission 15 Report No.21	Worker clutching chest, unable to stand		
		12:56:00	12:35 Current	Plant Data	IC: Working, 21:30３A opened to release pressure Fire Suppression System water supply function shut down on IC(A) side？ HPCI (Waiting on power restoration) 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area: -1700mm (Fuel Rod Area: A) Fuel Rod Head Area: -1450mm（Fuel Rod Area: B) (12:35） DW 0.754MPaabs（12:30） Main gate area: Iodine levels 8.9×10-3 21000 liters poured onto core (complete) (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection. Vent being opened to reduce pressure. MO Valve Opening...25%. 10:17 S/C side vent thought to have opened after	RCIC: Working (2:55 Site: Releasing Pressure -６MPa Confirmed) HPCI（Waiting on power restoration） Core Center: 5.6MPa（2:55） Water Level measurement equip. operational Fuel Rod Head Area: +3600mm（11:30） DW60ｋPa RCIC water source switches from CST to S/C	HPCI Working 12:35 L2 activated 11：36 RCIC: "Trip" Core Pressure: 7.53MPa (Adjusting S/R Vent) (12:10) -550mm（Wide）（12:10) +90mm（Narrow） DW 390KPaabs（12:10） SC 800KPaabs

					remote control activation		
		13:14:00	12:55 Current	Plant Data	IC: Working, 21:30３A opened to release pressure Fire Suppression System water supply function shut down on IC(A) side？ HPCI(Waiting on power restoration) 0.8MPa (2:45 main control room repairs) Fuel Rod Head Area: -1700mm （Fuel Rod Area: A) Fuel Rod Head Area: -1450mm （Fuel Rod Area: B) (12:55) DW　0.75MPaabs（12:55） Main gate area: Iodine levels **8.9× 10−3** 21000 liters poured onto core (complete) (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection.　Vent being opened to reduce pressure.　MO Valve Opening...25%. 10:17 S/C side vent thought to have opened after remote control activation	RCIC: Working (2:55 Site: Releasing Pressure -６MPa） HPCI（Waiting on power restoration） Core Center: 6.1MPa（12:55） Water Level measurement equip: operational Fuel Rod Head Area:+3600mm （12:55） DW　110ｋPa　(12:55) RCIC water source switches from CST to S/C	HPCI: Working 12:35　L2 Activated 11：36　RCIC: "Trip" Pressure Levels" 5.6MPa (Adjusting S/R Vent) (12:45) -450mm（Wide）（12:45） +90mm（Narrow） DW　380KPaabs （12:45） SC　800KPaabs
	13:12:00	13:14:00		Transmission 15 Report No.22	IC: Working （21:30３A opened to release pressure System water supply function shut down on IC(A) hull side Core: 0.8MPa 2:45 main control room repairs TAF(A)-1700mm TAF(B)-1500mm(12:55) D/W 0.75MPa ABS 21000 liters poured onto core (complete) (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection Vent being opened to reduce pressure MO Valve Opening...25%. 10:17 S/C side vent thought to have opened after remote control activation	RCIC: Working (2:55 Site: Releasing Pressure -６MPa） HPCI（Waiting on power restoration） Core: 6.1MPa　12：55 TAF+3600mm: Stable D/W　110ｋPa RCIC water source switches from CST to S/C	HPCI: Working 12:35　L2 Activated 11：36　RCIC: "Trip" Core: 5.6MPa　12：45 (Adjusting S/R Vent) -450 Narrow +90 Wide D/W　380ｋPa S/C　800ｋPa
			13:38 Current	Plant Data	IC: Working （21:30３A opened to release pressure Fire Suppression System water supply function shut down on IC(A) hull side Core: 0.8MPa 2:45 main control room repairs TAF(A)-1700mm TAF(B)-1500mm(13:38) D/W 0.755MPa ABS　（13：38） 21000 liters poured onto core (complete) (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection Vent being opened to reduce pressure MO Valve Opening...25%. 10:17 S/C side vent thought to have opened after remote control activation Main gate area radiation levels	RCIC: Working (2:55 Site: Releasing Pressure -６MPa） HPCI（Waiting on power restoration） Core: 6.1MPa　12：55 TAF+3600mm: Stable　（12：38） D/W　110ｋPa　（12：55） RCIC water source switches from CST to S/C	HPCI: Working12:35　L2 Activated 11：36　RCIC: "Trip" Core: 4.0MPa　12：45 (Adjusting S/R Vent) ±0（Wide）（13:38) D/W　380ｋPa S/C Water Levels 800mm (13:38)

					decreasing		
		14:06 Transmission	13:50 Current	Plant Data	IC: Working （21:30 ３A opened to release pressure System water supply function shut down on IC(A) hull side Core: 0.8MPa 2:45 main control room repairs TAF(A)-1700mm TAF(B)-1500mm(13:38) D/W 0.755MPa ABS （13：38） 21000 liters poured onto core (complete) (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection Vent being opened to reduce pressure MO Valve Opening...25%. 10:17 S/C side vent thought to have opened after remote control activation Main gate area radiation levels decreasing	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa） HPCI（Waiting on power restoration） Core: 6.1MPa 12：55 TAF+3600mm: Stable （12：38） D/W 110ｋPa （12：55） RCIC water source switches from CST to S/C	HPCI: Working 12:35 L2 Activated 11：36 RCIC: "Trip" Core: 4.0MPa 12：45 (Adjusting S/R Vent) ±0（Wide）（13:38) D/W 380ｋPa S/C Water Levels 800mm (13:38)
			14:10 Current	Plant Data	IC: Working （21:30 ３A opened to release pressure System water supply function shut down on IC(A) hull side Core: 0.8MPa 2:45 main control room repairs TAF(A)-1700mm TAF(B)-1650mm(14:10) D/W 0.730MPa ABS （14：10） 21000 liters poured onto core (complete) (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection Vent being opened to reduce pressure MO Valve Opening...25%. 10:17 S/C side vent thought to have opened after remote control activation Main gate area radiation levels decreasing	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa） HPCI（Waiting on power restoration） Core: 6.1MPa 12：55 TAF+3600mm: Stable （14：10） D/W 110ｋPa （12：55） RCIC water source switches from CST to S/C	HPCI: Working 12:35 L2 Activated 11：36 RCIC: "Trip" Core: 3.63MPa 13:58 +420（Wide）（13:58) D/W 360ｋPa S/C Water Levels 850mm (13:58)
		14:50:00	14:41 Current	Plant Data	IC: Working （21:30 ３A opened to release pressure System water supply function shut down on IC(A) hull side Core: 0.8MPa 2:45 main control room repairs TAF(A)-1700mm TAF(B)-1650mm(14:41) D/W 0.610MPa ABS （14:41） 21000 liters poured onto core (complete) (9:40) Pouring continues Fire Truck tank water sprayed onto core D/DFP Line pours water via CS System connection Vent being opened to reduce pressure MO Valve Opening...25%. 10:17 S/C side vent thought to have opened after remote control activation	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa） HPCI（Waiting on power restoration） Core: 6.1MPa 12：55 TAF+3600mm: Stable （14:10） D/W 110ｋPa （12：55） RCIC water source switches from CST to S/C	HPCI: Working 12:35 L2 Activated 11：36 RCIC: "Trip" Core: 3.63MPa 13:58 +420（Wide）（13:58) D/W 360ｋPa S/C Water Levels 850mm (13:58)

			14:50 Current	Plant Data	IC: Working （21:30 3 A opened to release pressure System water supply function shut down on IC(A) hull side Core: 0.8MPa 2:45 main control room repairs TAF(A)-1700mm TAF(B)-1650mm(14:50) D/W 0.58MPa ABS　（14:50） 80 tons of water successfully dumped onto core (14:53) water pouring continues...	RCIC: Working (2:55 Site: Releasing Pressure - 6 MPa） HPCI（Waiting on power restoration） Core: 6.1MPa　12 : 55 Fuel Rod Core Area: +3600mm: Stable (14:50) D/W　110 k Pa　（12 : 55） RCIC water source switches from CST to S/C	HPCI: Working 12:35 L2 Activated 11 : 36　RCIC: "Trip" Core: 3.63MPa　13:58 +420（Wide）（13:58) D/W　360 k Pa S/C Water Levels 850mm (13:58)
		15:08:00	15:04 Current	Plant Data	IC: Working （21:30 3 A opened to release pressure System water supply function shut down on IC(A) hull side Core: 0.8MPa 2:45 main control room repairs TAF(A)-1700mm TAF(B)-1650mm(14:50) D/W 0.53MPa ABS　（14:50） 80 tons of water successfully dumped onto core (14:53) water pouring continues...	RCIC: Working (2:55 Site: Releasing Pressure - 6 MPa） HPCI（Waiting on power restoration） Core: 6.1MPa　12 : 55 Fuel Rod Head Area: +3600mm: Stable (14:50) D/W　110 k Pa　（12 : 55） RCIC water source switches from CST to S/C	HPCI: Working12:35 L2 Activated 11 : 36　RCIC: "Trip" Croe:3.63MPa　13:58 +420（Wide）（13:58) D/W　360 k Pa S/C Water Levels 850mm (13:58)
			15:14 Current	Plant Data	IC: Working （21:30 3 A opened to release pressure System water supply function shut down on IC(A) hull side Core: 0.8MPa 2:45 main control room repairs TAF(A)-1700mm TAF(B)-1650mm(15:14) D/W 0.53MPa ABS　（15:14） 80 tons of water successfully dumped onto core (14:53) water pouring continues...	RCIC: Working (2:55 Site: Releasing Pressure - 6 MPa） HPCI（Waiting on power restoration） Core: 6.1MPa　12 : 55 Fuel Rod Head Area: +3600mm: Stable (14:50) D/W　110 k Pa　（12 : 55） RCIC water source switches from CST to S/C	HPCI: Working 12:35 L2 Activated 11 : 36　RCIC: "Trip" Core: 3.63MPa　13:58 +420（Wide）（13:58) D/W　360 k Pa S/C Water Levels 850mm (13:58)
	15:18:00	15:21:00		Transmission 15 Report No.23	14:00 Air compressor receives electric current upon D/W Vent and air vent opening. 14:30 D/W Pressure Levels falling (confirmed) Radiation thought to have escaped facility. DW Pressure　0.75→0.58MPa 14 : 50 Currently SLC System repairs in progress … After preparations are completed SLC pump will be activated to continue dumping water onto core		
			15:28 Current	Plant Data	IC: Working （21:30: Reducing Pressure 3 A Valve Opened　System water supply function shut down on IC(A) hull side Core 0.8MPa 2:45 main control room repairs TAF(A)-1700mm TAF(B)-1650mm(15:28) D/W 0.54MPa ABS　（15:28） 14:30 Decision to open vent confirmed	RCIC: Working (2:55 Site: Releasing Pressure - 6 MPa） HPCI（Waiting on power restoration） Core 6.1MPa　12 : 55 Fuel Rod Head Area: +3600mm: Stable (14:50) D/W　110 k Pa　（12 : 55） RCIC water source switches from CST to S/C	HPCI: Working 12:35 Started up using L2 11 : 36　RCIC: "Trip" Core 3.63MPa　13:58 +420（Wide）（13:58) D/W　360 k Pa S/C Water Levels 850mm (13:58)
	16:27:00	16:28:00		Transmission 15 Report No.24	**15:36: Relatively strong shock felt on site,** following which 15:40: smoke coming out of reactor No.1 confirmed Due to MP4 exceeding 500μSv「Site Boundaries abnormal radiation levels increasing」 Several explosion victims discovered MP4　569μSv		

			17:00 Current	Plant Data	Deliberating methods to dump water onto core to restore water levels Core Pressure Levels: Unknown Fuel Rod Head Area: -1700mm (Fuel Rod Area: A) Fuel Rod Head Area: -1700mm(Fuel Rod Area: B) (17:00) D/W Unknown		HPCI: Working Core Pressure: 2.9MPa 17:00 +400（Wide）（17:00) D/W 300 k PaABS
	17:00:00	17:00:00		Report No.24 (Revised)	1015μSv (Revised)		
	17:59:00	18:00:00		Transmission 15 Report No.25	Explosion Victims transported to OFC		
			18:30 Current	Plant Data	Considering prioritizing dumping of water Pressure Levels: Unknown "Downscale"（Fuel Rod Area: A） "Downscale" (Fuel Rod Area: B) (18:30) D/W Unknown	RCIC: Working (2:55 Site: Releasing Pressure - 6 MPa） HPCI（Waiting on power restoration） Core: 6.3MPa 18：30 Fuel Rod Head Area: +3650mm: Stable (18:30） D/W 155 k Pa （18：30）	HPCI: Working Core Pressure: 1.35MPa 18:30 +1200（Wide）（18:30) D/W 280 k PaABS(18:30)
			19:00 Current	Plant Data	Considering prioritizing dumping of water Pressure Levels: Unknown "Downscale"（Fuel Rod Area: A） "Downscale" (Fuel Rod Area: B) (18:30) D/W Unknown	RCIC: Working (2:55 Site: Releasing Pressure - 6 MPa） HPCI（Waiting on power restoration） Core: 6.3MPa 18：30 Fuel Rod Head Area: +3650mm: Stable (18:30） D/W 155 k Pa （18：30）	HPCI: Working Core Pressure: 0.95MPa 19:00 +1050（Wide）（19:00) D/W 285 k PaABS(19:00) SC Water Levels 1480mm
			19:42 Current	Plant Data	Considering prioritizing dumping of water Pressure Levels: Unknown "Downscale"（Fuel Rod Area: A） "Downscale" (Fuel Rod Area: B) (19:42) D/W Unknown	RCIC: Working (2:55 Site: Releasing Pressure - 6 MPa） HPCI（Waiting on power restoration） Core: 6.3MPa 18：30 Fuel Rod Head Area: +3650mm: Stable (19:42） D/W 155 k Pa （18：30）	HPCI: Working Core Pressure: 0.82MPa 19:42 +1300（Wide）（19:42) D/W 280 k PaABS(19:42) SC Water Levels 1450mm
		20:30:00	20:15 Current	Plant Data	Considering prioritizing dumping of water Pressure Levels: Unknown "Downscale"（Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (20:08) D/W Unknown	RCIC: Working (2:55 Site: Releasing Pressure - 6 MPa） HPCI（Waiting on power restoration） Core: 6.3MPa 18：30 Fuel Rod Head Area: +3650mm: Stable (20:00） D/W 155 k Pa （18：30）	HPCI: Working Core Pressure Levels: 0.8MPa 20:15 +1450mm（Wide）（20:15) D/W 270 k PaABS(20:15) SC Water Levels: 1600mm
	20:38:00	20:40:00		Report No.26	20:20 Fire Suppression System used to start dumping seawater onto core. Boric acid dumped into valve pit and mixed with seawater then poured onto core.		
			21:00 Current	Plant Data	Considering prioritizing dumping of water Core Pressure Levels: 3.675kg/cm2 (21:00) "Downscale"（Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (21:00) D/W Unknown	RCIC: Working (2:55 Site: Releasing Pressure - 6 MPa） HPCI（Waiting on power restoration） Core: 6.3MPa 18：30 Fuel Rod Head Area: +3650mm: Stable (21:00） D/W 155 k Pa （18：30）	HPCI: Working Core Pressure Levels: 0.72MPa 21:00 Water Levels: Unknown, Complete Power Loss (20:31 +1350) D/W Unknown, Complete Power Loss SC Water Levels: 1600mm
			21:30 Current	Plant Data	Considering prioritizing dumping of water Core Pressure Levels:	RCIC: Working (2:55 Site: Releasing Pressure - 6 MPa）	HPCI: Working 1600rpm 21：30 Core Pressure: 0.97MPa

					3.675kg/cm2 (21:30) "Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (21:30) D/W Unknown	HPCI（Waiting on power restoration） Core: 6.3MPa 18：30 Fuel Rod Head Area: +3650mm: Stable (21:30） D/W 155 k Pa （18：30）	21:00 Water Levels: Unknown, Complete Power Less D/W Unknown Complete Power Loss SC Water Levels: 1600mm
			22:00 Current	Plant Data	Considering prioritizing dumping of water Core Pressure Levels: 3.625kg/cm2 (22:00) "Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (22:00) D/W Unknown	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa） HPCI（Waiting on power restoration） Core: 6.3MPa 18：30 Fuel Rod Head Area: +3650mm: Stable (22:00） D/W 155 k Pa （18：30）	HPCI: Working 1600rpm 22：00 Core Pressures: 0.97MPa 22:00 Water Levels: Unknown, Complete Power Loss D/W 170 k Pa 22：00 SC Water Levels: 1600mm 20：15
		23:45:00	23:00 Current	Plant Data	Considering prioritizing dumping of water Core Pressure Levels: 3.650kg/cm2 (23:00) "Downscale" （Fuel Rod Area: A） -1750mm (Fuel Rod Area: B) (23:00) D/W Unknown	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa） HPCI（Waiting on power restoration） Core: 6.3MPa 18：30 Fuel Rod Head Area: +3650mm: Stable (23:00） D/W 155 k Pa （18：30）	HPCI: Working 1600rpm 23：00 Core: 0.96MPa 23:00 Water Levels: Unknown, Complete Power Loss D/W 170 k Pa 22：00 SC Water Levels: 1600mm 20：15
13		0:33:00	0:00 Current	Plant Data	Considering prioritizing dumping of water Core Pressure Levels: 3.750kg/cm2 (0:00) "Downscale" （Fuel Rod Area: A） -1750mm (Fuel Rod Area: B) (0:00) D/W Unknown	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa） HPCI（Waiting on power restoration） Core: 6.3MPa 18：30 Fuel Rod Head Area: +3650mm: Stable (0:00） D/W 155 k Pa （18：30）	HPCI: Working 1600rpm 0：00 Core Pressure Levels: 0.97MPa 0:00 Water Levels: Unknown, Complete Power Loss D/W 270 k Pa 22：00 SC Water Levels: 1600mm 20：15
			1:00 Current	Plant Data	Considering prioritizing dumping of water Core Pressure Levels: 3.825kg/cm2 （1:00) "Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (1:00) D/W Unknown	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa） HPCI（Waiting on power restoration） Core:6.3MPa 18：30 Fuel Rod Head Area: +3650mm: Stable (1:00） D/W 155 k Pa （18：30）	HPCI: Working 1600rpm 1：00 Core Pressure Levels: 0.97MPa 1:00 Water Levels: Unknown - Complete Power Loss D/W 270 k Pa 22：00 SC Water Levels: 1600mm 20：15
			2:00 Current	Plant Data	Considering prioritizing dumping of water Core Pressure Levels: 3.825kg/cm2 （2:00) "Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (2:00) D/W Unknown	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa） HPCI（Waiting on power restoration） Core: 6.3MPa 18：30 Fuel Rod Head Area: +3650mm: Stable (2:00） D/W 155 k Pa （18：30）	HPCI: Working 1600rpm 2：00 Core Pressure Levels: 0.85MPa 2:00 Water Levels: Unknown - Complete Power D/W 270 k Pa 22：00 SC Water Levels 1600mm 20：15
			3:38 Current	Plant Data	Fire Suppression System pump dumping seawater Core Pressure Levels: 0.342MPa （3:00) "Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (3:00) D/W Unknown	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa） HPCI（Waiting on power restoration） Core: 3.71MPa 3：00 Fuel Rod Head Area: +3650mm: Stable (3:00） D/W 0.315MPa ABS （3：00）	HPCI : Offline 2:44 Low Core Pressure - RCIC Automatically engaged D/D FS pump（0.61MPa） Online, but water dump function failure Pressure Levels: 4.1MPa 3:44 Water Levels: Unknown Power Loss D/W 270 k Pa 22：00 SC Water Levels 1600mm 20：15
		5:31:00	5:00 Current	Plant Data	Fire Suppression System pump dumping seawater Core Pressure Levels: 0.35MPa （5:00) "Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (5:00)	RCIC: Working (2:55 Site: Releasing Pressure - ６MPa） HPCI（Waiting on power restoration） Core:6.14MPa 4：00 Fuel Rod Head Area: +3650mm:	HPCI : Offline 2:44 Pressure Levels: 7.38MPa 5:00 Adjusting SRV Water Levels -2000 (Fuel Rod Area:) Water Levels: -3500

					D/W Unknown	Stable (4:00) D/W 0.33MPa ABS (4：00)	(Wide) D/W 380 k Pa 5：00
	5:00:00	5:31:00		Plant Parameter Data	Fire Suppression System pump dumping seawater Core: 0.35MPa (5：00) (A)"Downscale" (B)-1700mm Core Center: 120 tons Seawater pouring rate: 20～50 tons/H	RCIC: Working Core 6.14MPa (4:00) Water Level Measurement Equipment Restoration +3650 DW 0.33MPa	HPCI: Offline（2：44） D/D Fire Suppression System : Online, but water dump function failure Core: 7.38MPa (5:00) Adjusting SRV -2000 Fuel Rod Area: -3500 Wide DW 360 k Pa
		6:11:00	5:30 Current	Plant Data	Fire Suppression System pump dumping seawater Core Pressure Levels: 0.35MPa（5:30) "Downscale"（Fuel Rod Area: A) -1700mm (Fuel Rod Area: B) (5:30) D/W Unknown	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration） Core: 6.14MPa 5：30 Fuel Rod Head Area +3650mm - Stable（5:30） D/W 0.33MPa ABS (5：30）	HPCI : Offline 2:44 RCIC: No response, confirmed (5:10) Pressure Levels: 7.27MPa 5:25 Adjusting SRV Water Levels: -2400 (Fuel Rod Area) Water Levels: -3500 (Wide) D/W 355 k Pa 5：25
			6:00 Current	Plant Data	Core Pressure Levels: 0.35MPa（6:00) "Downscale"（Fuel Rod Area: A) -1700mm (Fuel Rod Area: B) (6:00) D/W Unknown	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration） Core: 6.12MPa 6：00 Fuel Rod Head Area +3650mm - Stable（6:00） D/W 0.34MPa ABS (6：00）	HPCI : Offline 2:44 RCIC: No response, confirmed (5:10) Core Pressure Levels: 7.39MPa 6:00 Adjusting SRV Water Levels: -2600 (Fuel Rod Area) Water Levels: -3500 (Wide) D/W 390 k Pa 6：00
	No Record	6:31:00		Report No.27			HPCI: Offline, Unable to secure alternate clean water source 5:30 TAF expected to arrive. Securing clean water source and preparing vent
	No Record	Unreadable		Report No.28			HPCI : Offline RCIC: No response 5:10 Complete cooling function loss
	6:19:00	6:13:00		Report No.29			4:15 TAF Arrives
		7:06:00	7:00 Current	Plant Data	Core Pressure Levels: 0.355MPa（7:00) "Downscale"（Fuel Rod Area: A) -1700mm (Fuel Rod Area: B) (7:00) D/W Unknown	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration Core: 6.12MPa 7：00 Fuel Rod Head Area +3650mm - Stable（7:00） D/W 0.34MPa ABS (7：00）	HPCI : Offline 2:44 RCIC: No response, confirmed (5:10) Core Pressure Levels: 7.35MPa 6:50 Adjusting SRV Water Levels: -2850 (Fuel Rod Area) 6:50 Water Levels: -3400 (Wide) D/W 440 k Pa 6：50
	7:35:00	7:42:00		Report No.30			Evaluating explosion from when vent was opened
	7:56:00	7:59:00		Report No.31			7:39 PCV Spray begins 7:45 (Current) Water Levels: -3000 Core: 7.31MPa D/W 460 k Pa ABS S/P 440 k Pa
	8:46:00	8:47:00		Report No.32			8:41 Vent Opened
			9:10 Current	Plant Data	Core Pressure Levels: 0.358MPa（8:55) "Downscale"（Fuel Rod Area: A)	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power	HPCI : Offline 2:44 RCIC: No response, confirmed (5:10) Core Pressure Levels:

					-1700mm (Fuel Rod Area: B) (8：55) D/W Unknown	restoration Core: 6.08MPa 8:55 Fuel Rod Head Area +3700mm -Stable（8:55） D/W 0.36MPa ABS （8：55）	0.46MPa 9:10 Adjusting SRV Water Levels: +1800 (Fuel Rod Area) 9:10 Water Levels: O/S (Wide) D/W 637ｋPa 9：10 S/C 590ｋPa 9：10
	9:01:00	9:02:00		Report No.33			MP4 exceeds 500μSv MP4 882μSv
	No Record	9:19:00		Report No.34			9:08 Reactor No.3 SRV used to quickly reduce pressure Reactor Core Water Levels: -1800 Pressure Levels: 0.46MPa D/W 637ｋPa S/C 590kPa Fire Suppression Pump begins to dump water
	9:36:00	9:44:00		Report No.35			9:20 Vent opens and pressure levels decrease Fire Suppression Pump begins to dump water ●●●
			10:35 Current	Plant Data	Core Pressure Levels: 0.362MPa（10:35） "Downscale"（Fuel Rod Area: A） -1750mm (Fuel Rod Area: B) (9：55) D/W Unknown	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration Core: 1.283MPa 9:55 Fuel Rod Head Area +3700mm -Stable（10:35） D/W 0.01MPa ABS （10：35）	HPCI : Offline 2:44 RCIC: No response, confirmed (5:10) Core Pressure Levels: Measurement Errors (10:35) Water Level: -200 (Fuel Rod Area) 10：35 Water Level: -700 (Wide) D/W 280ｋPa 10：35 S/C 230ｋPa 10：35
			10:55 Current	Plant Data	Core Pressure Levels: 0.358MPa（10:55） "Downscale"（Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (10：55) D/W Unknown	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration Core Pressure Levels: Measurement Errors Battery Consumed 10:55 Fuel Rod Head Area +3700mm -Stable（10:55） D/W Measurement Errors（10：35）	HPCI : Offline 2:44 RCIC: No response, confirmed (5:10) Core Pressure Levels: 0.1MPa (10:55) Water Level: -900 (Fuel Rod Area) 10：55 Water Level: -1200 (Wide) D/W 270ｋPa 10：55 S/C 220ｋPa 10：55
			11:55 Current	Plant Data	0.364MPa（11:55） "Downscale"（Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (11：55) D/W Unknown	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration Core Pressure Levels: Measurement Errors Battery Consumed 11:55 Fuel Rod Head Area +3750mm -Stable（11:55） D/W Measurement Errors Battery Consumed （11：55）	HPCI : Offline 2:44 RCIC: No response, confirmed (5:10) **Fire Sup. pump – Dumping water** Core Pressure Levels: 0.12MPa (11:55) Water Level: +1000 (Fuel Rod Area) 11：55 Water Level: +1000 (Wide) D/W --ｋPa 11：55 Rerouting power... S/C --ｋPa 11：55 Rerouting power...
	12:18:00	12:19:00		Report No.36		Preparing to open Vent Explosion evaluation still in progress ●●●	
			12:40 Current	Plant Data	Core Pressure Levels: 0.3645MPa（12:40） "Downscale"（Fuel Rod Area: A）	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power	HPCI : Offline 2:44 RCIC: No response, confirmed (5:10) **Fire Sup. pump 0.61MPa**

					-1700mm (Fuel Rod Area: B) (11：55) D/W Unknown	restoration Core Pressure Levels: Measurement Errors Battery Consumed 12:40 Fuel Rod Head Area +3750mm - Stable（12:40） D/W Measurement Errors Battery Consumed （12：40）	– **Dumping water** Core Pressure Levels: 0.45MPa (12:40) Water Level: -1400 (Fuel Rod Area) 12：40 Water Level: ±0 (Wide) D/W 480ｋPa 12：40 S/C 480ｋPa 12：40
			13:00 Current	Plant Data	Core Pressure Levels: 0.3645MPa（12:40) "Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (13：00) D/W Unknown	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration Core Pressure Levels: Measurement Errors Battery Consumed 12:40 Fuel Rod Head Area +3750mm - Stable（13:00） D/W 0.595MPaABS （13：00） S/C 0.590MPaABS （13：00）	HPCI : Offline 2:44 RCIC: No response, confirmed (5:10) Fire Sup. pump 0.61MPa - Dumping water Core Pressure Levels: 0.19MPag (13:00) Water Level: -1400 (Fuel Rod Area) 13:00 Water Level: -2000 (Wide) D/W 300ｋPa 13：00 S/C 250ｋPa 13：00
	No Record	13:51:00		Report No.37			Preparing Fire Suppression pump to dump seawater onto core.
			14:10 Current	Plant Data	Core Pressure Level: 0.3713MPa（14:10) "Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (14：10) D/W Unknown	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration D/S Measurement Errors, Battery Consumed 12:40 Fuel Rod Head Area +3750mm - Stable (14：10） D/W 0.60MPaABS （14：10） S/C 0.60MPaABS （14：10）	HPCI : Offline 2:44 RCIC: No response, confirmed (5:10) Fire Sup. pump 0.61MPa - Dumping water Core Pressure Levels: 0.09MPag (13:00) Water Level: -1800 (Fuel Rod Area) 14:10 Water Level: -2200 (Wide) D/W 235ｋPa 14：10 S/C 185ｋPa 14：10
	14:23:00	14:36:00		Report No.37 (Revised)			DW→RPV
	14:23:00	14:24:00		Report No.38			MP4 exceeds 500μSv MP4 905μSv(13:50)
			15:00 Current	Plant Data	Core Pressure Level: 0.3735MPag（15:00) "Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (15：00) D/W 0.60MPaABS S/C 0.60MPaABS（15:00）	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration） D/S Measurement Errors, Battery Consumed 14:30 （A) Power Failure （B)Fuel Rod Head Area+3750mm Stable（15：00） D/W 0.395MPaABS （15：00） S/C 0.60MPaABS （14：10）	HPCI : Offline 2:44 RCIC: Unresponsive (5:10) Fire Sup. pump 0.61MPa - Dumping water Core Pressure Level: 0.08MPag (15:00) Water Level: -1600 (Fuel Rod Area) 14：10 Water Level: -2000 (Wide) D/W 260ｋPa 15：00 S/C 210ｋPa 15：00
	15:18:00	15:19:00		Report No.39		Evaluation of Explosion from Vent	
			16:00 Current	Plant Data	Core Pressure Level: 0.378MPag（16:00) "Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (16：00) D/W 0.605MPaABS S/C 0.600MPaABS（16:00）	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting for power restoration） D/S 5.85MPag 16：00 （A) Power Failure （B)Fuel Rod Head Area +3750mm Stable（16：00）	HPCI : Offline 2:44 RCIC: Unresponsive (5:10) Fire Sup. pump 0.61MPa - Dumping water Core Pressure Level: 0.18MPag (16:00) Water Level: -1500 (Fuel Rod Area) 16：00 Water Level: -2000 (Wide)

						D/W 0.400MPaABS （16：00） S/C Restoring measurement equipment (16:00)	D/W 350ｋPa 16：00 S/C 300ｋPa 16：00
			16:45 Current	Plant Data	Core Pressure Level: 0.378MPag（16:30） "Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (16：30) D/W 0.605MPaABS S/C 0.600MPaABS（16:30	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration） D/S 5.85MPag 16：30 （Fuel Rod Area: A） +3750mm（B)Fuel Rod Head Area +3800mm（16：30） D/W 0.400MPaABS （16：30） S/C Restoring measurement equipment (16:30)	HPCI : Offline 2:44 RCIC: Unresponsive (5:10) Fire Sup. pump 0.61MPa - Dumping water Core Pressure Level: 0.24MPag (16:30) Water Level: -1500 (Fuel Rod Area) 16：30 Water Level: -1900 (Wide) D/W 410ｋPa 16：30 S/C 360ｋPa 16：30
		18:05:00	17:30 Current	Plant Data	"Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (17：30) Core Pressure Level: 0.3713MPag（17:30) D/W 0.600MPaABS S/C 0.600MPaABS（17:30)	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration） Wide: O/S （Fuel Rod Area: A） +3750mm（B)Fuel Rod Head Area +3800mm （17：30） D/S 5.78MPag 17：30 D/W 0.41MPaABS （17：30） S/C Restoring measurement equipment(17:30)	Water Level: -1800 (Fuel Rod Area) 17：30 Water Level: -2100 (Wide) Core Pressure Level: 0.24MPag (17:30) D/W 415ｋPa 17：30 S/C 365ｋPa 17：30
			18:45 Current	Plant Data	"Downscale"（Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (18：45） Core Pressure Area: 0.3623MPag（18:45) D/W 0.590MPaABS S/C 0.585MPaABS（18:45)	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration） Wide: O/S （Fuel Rod Area: A） +3800mm（B)Fuel Rod Head Area 3750mm（18：45） D/S Connection Error Unconfirmed 18:00 onwards D/W 0.41MPaABS （18：45） S/C Restoring measurement equipment (18:45)	HPCI: Offline（2：44） RCIC: Unresponsive (5:10) Portable hose dumping water onto core through connection to Fire Suppression system (1MPa) D/D Fire Suppression Pump in use (0.61MPa) Water Level: -1800 (Fuel Rod Area) 18：45 Water Level: -2200 (Wide) Core Pressure Level: 0.25MPag (18:45) D/W 415ｋPa 18：45 S/C 375ｋPa 18：45
	19:10:00	19:16:00		Report No.40	（A)"Downscale" (B)-1700 18：45 Core: 0.3623MPag D/W 0.590MPa ABS S/C 0.585MPa ABS 18：45	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI: Waiting on power restoration Restoring Water Level measurement equip (A)+3800 (B) +3750 18:45 Core: SC Unconfirmed DW 0.410MPa	HPCI: Offline（2：44） RCIC: Unresponsive (5:10) Portable Fire Suppression pump dumping water (1MPa) （A) -1800 (B)-2200 18：45 Core: 0.25MPag D/W 420ｋPa ABS S/C 375kPa ABS
			19:30 Current	Plant Data	"Downscale" （Fuel Rod Area: A） -1700mm (Fuel Rod Area: B) (19：00） Core Pressure Level: 0.3578MPag (19：00） D/W 0.580MPaABS S/C 0.580MPaABS(19：00）	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration） Wide: A/B = O/S （Fuel Rod Area: A） +3800mm （Fuel Rod Area: B） +3800mm （19：00） D/S Connection Error Unconfirmed 18:00 onwards D/W 0.420MPaABS （18：45） S/C Restoring measurement equipment (18:45)	Fuel Rod Area: A -1800 19：30 Fuel Rod Area: B -2200 Core Pressure Level: 0.25MPag (19:30) D/W 425ｋPa 19：30 S/C 375ｋPa 19：30

		20:21:00	19:55 Current	Plant Data	"Downscale" （Fuel Rod Area: A）-1700mm (Fuel Rod Area: B)（19：30） Core Pressure Level: 0.3578MPag（19：30） D/W 0.575MPaABS S/C 0.570MPaABS(19：30）	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting for power restoration） Wide A/B = O/S （Fuel Rod Area: A) +3800mm （Fuel Rod Area: B) +3800mm （19：30） D/S Connection Error Unconfirmed 18:00 onwards （19：30） D/W 0.420MPaABS （18：45） S/C Restoring measurement equipment （19：30）	HPCI: Working 02：44 Fuel Rod Area: A -1800 19：55 Fuel Rod Area: B -2200 Core Pressure Level: 0.25MPag (19:55) D/W 425 k Pa 19：55 S/C 375 k Pa 19：55
			20:45:00	Plant Data	"Downscale" （Fuel Rod Area: A）-1700mm (Fuel Rod Area: B)（20：30） Core Pressure Level: 0.3422MPag（20：30） D/W 0.560MPaABS S/C 0.560MPaABS(20：30）	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting for power restoration） Wide A/B = O/S （Fuel Rod Area: A) +3800mm （Fuel Rod Area: B) +3800mm （20：30） D/S Connection Error Unconfirmed 18:00 onwards （20：30） D/W 0.420MPaABS （20：30） S/C Restoring measurement equipment (20:30)	HPCI: Offline 02：44 RCIC: Unresponsive (6:10) Portable Fire Suppression pump dumping water O/D: In use... Fuel Rod Area: A -1800 Fuel Rod Area: B -2200 20：45 Core Pressure Level: Unknown (20:45) D/W 410 k Pa 20：45 S/C 370 k Pa 20：45(20:45)
			21:40 Current	Plant Data	"Downscale"（Fuel Rod Area: A）-1700mm (Fuel Rod Area: B)（21：30） Core Pressure Level: 0.342MPag（21：30） D/W 0.550MPaABS S/C 0.550MPaABS(21：30）	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Working for power restoration） Wide A/B = O/S （Fuel Rod Area: A) +3800mm （Fuel Rod Area: B) +3800mm （21：00） D/S Connection Error Unconfirmed 18:00 onwards （20：30） D/W 0.425MPaABS （21：30） S/C Restoring measurement equipment (21:30)	HPCI: Offline 02：44 RCIC: Unresponsive (6:10) Portable Fire Suppression pump dumping water O/D: In use... Fuel Rod Area: A -1800 Fuel Rod Area: B -2200 21：40 Core Pressure Level: Unknown (21:40) D/W 320 k Pa 21：40 S/C 320 k Pa 21：40
			23:00 Current	Plant Data	"Downscale"（Fuel Rod Area: A）-1750mm (Fuel Rod Area: B)（22：45） Core Pressure Level: 0.333MPag（22：45） D/W 0.540MPaABS S/C 0.530MPaABS(22：45）	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting on power restoration） Wide A/B = O/S （Fuel Rod Area: A) +3850mm （Fuel Rod Area: B) +3900mm （22：30） D/S Connection Error Unconfirmed 18:00 onwards （22：30） D/W 0.430MPaABS （22：30） S/C Restoring measurement equipment (22:30)	HPCI: Offline 02：44 RCIC: Unresponsive (6:10) Portable Fire Suppression pump dumping water O/D: In use... Fuel Rod Area: A -1800 Fuel Rod Area: B -2250 23：00 Core Pressure Level: 0.089MPag (23:00) D/W 265 k Pa 23：00 S/C 275 k Pa 23：00
			23:30 Current	Plant Data	"Downscale"（Fuel Rod Area: A）-1750mm (Fuel Rod Area: B)（23：30） Core Pressure Level: 0.050MPag（23：30） Core Pressure Level: 0.324MPag（23：30） D/W 0.530MPaABS S/C 0.530MPaABS(23：30）	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting for power restoration） Wide A/B = O/S （Fuel Rod Area: A) +3850mm （Fuel Rod Area: B) +3900mm （23：30） D/S Connection Error Unconfirmed 18:00 onwards	HPCI: Offline 02：44 RCIC: Unresponsive (5:10) Portable Fire Suppression pump dumping water Fuel Rod Area: A -1800 Fuel Rod Area: B -2250 23：30 Core Pressure Level: 0.066MPag (23:30) Core Pressure Level: 0.068MPa (23:30)

						（22：30） D/W 0.435MPaABS （23：30） S/C Restoring measurement equipment (23:30)	D/W 250 k Pa 23：30 S/C 260 k Pa 23：30
			0:30 Current	Plant Data	"Downscale" （Fuel Rod Area: A）-1750mm (Fuel Rod Area: B)（23：30） Core Pressure Level: 0.050MPag（23：30） Core Pressure Level: 0.324MPag（23：30） D/W 0.530MPaABS S/C 0.530MPaABS(23：30)	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（Waiting for power restoration） Wide A/B = O/S （Fuel Rod Area: A) +3850mm （Fuel Rod Area: B) +3900mm （24：00） D/S Connection Error Unconfirmed 18:00 onwards（22：30） D/W 0.435MPaABS （24：00） S/C Restoring measurement equipment (24:00)	HPCI: Offline 02：44 RCIC: Unresponsive (5:10) Portable Fire Suppression pump dumping water Fuel Rod Area: A -1800 Fuel Rod Area: B -2250 24：30 Core Pressure Levels: 0.051MPag Core Pressure Levels: 0.051MPa (24:30) D/W 240 k Pa 24：30 S/C 255 k Pa 24：30
14	0:56:00	Unreadable		Report No.41	Fire Suppression System pump dumping seawater （A) "Downscale"（B)-1750mm 23：30 Core: 0.05MPa 0.324MPa D/W 0.530MPaABS S/C 0.530MPa	RCIC: Working 2:55 6MPa Wide（A/B)O/S Fuel Rod Area: A +3850 Fuel Rod Area: B +3900 23：30 Core: Unconfirmed D/W 0.435MPa ABS S/C Restoring measurement equipment	HPCI: Offline RCIC: Unresponsive Portable hose dumping water onto core through connection to Fire Suppression system (1MPa) Fuel Rod Area: A -1800 Fuel Rod Area: B -2250 23：30 Core: 0.066MPag 0.068MPag 23：30 D/W 250kPa S/C 260kPa D/DFP Offline 22：15
		2:55:00	2:00 Current	Plant Data	"Downscale"（Fuel Rod Area: A）-1700mm (Fuel Rod Area: B)（2：00） Core Pressure Level: 0.036MPag（2：00） Core Pressure Level: 0.315MPag（2：00） D/W 0.510MPaABS S/C 0.505MPaABS(2：00)	RCIC: Working (2:55 Pressure released on site 6MPa） HPCI（waiting on power restoration） Wide A/B = O/S （Fuel Rod Area: A) +3850mm （Fuel Rod Area: B) +3900mm （2：00） D/S Connection Error Unconfirmed 18:00 onwards（22：30） D/W 0.44MPaABS （2：00） S/C Restoring measurement equipment (2:00)	1:10 Portable hose dumping water onto core through connection to Fire Suppression stopped Fuel Rod Area: A -1800 Fuel Rod Area: B -2250 2：00 Core Pressure Level: 0.077MPag Core Pressure Level: 0.079MPa (2:00) D/W 265 k Pa 2：00 S/C 275 k Pa 2：00
	2:30:00	Unreadable		Report No.42	Fire Suppression System pump dumping seawater （A)"Downscale"（B)-1700mm 2：00 Core: 0.036MPa 0.315MPa D/W 0.510MPaABS S/C 0.505MPa	RCIC: Working Wide（A/B)：O/S Fuel Rod Area: A +3850 Fuel Rod Area: B +3900 2：00 Core: Unconfirmed D/W 0.44MPa ABS S/C Restoring measurement equipment	2:00 Because supply of seawater around core is too low, at 1:10 provisional pump used to draw seawater. After pump finishes collecting water it starts to pour sea water onto the core once more. Fuel Rod Area: A -1800 Fuel Rod Area: B -2250 2：00 Core: 0.066MPag 0.068MPag 2：00 D/W 265kPa S/C 275kPa D/DFP: Offline 22:15 Portable hose dumping water onto core through connection to Fire Suppression stopped 1:10
	2:30:00	2:38:00		Report No.42	Revised items Unknown		

				(Revised)			
		3:56:00	3:00 Current	Plant Data	"Downscale" （Fuel Rod Area: A）-1700mm (Fuel Rod Area: B) (3：00) Core Pressure Level: 0.029MPag (3：00) Core Pressure Level: 0.306MPag (3：00) D/W 0.505MPaABS S/C 0.500MPaABS(3：00)	RCIC: Working Wide: (A/B)：O/S Fuel Rod Area: A +3850 Fuel Rod Area: B +3900 3：00 Core: Unconfirmed D/W 0.44MPa ABS S/C Restoring measurement equipment	Fuel Rod Area: A -1850 Fuel Rod Area: B -2300 3：00 Core: 0.134MPag 0.134MPag 3：00 D/W 315kPa S/C 305kPa
	3:14:00	Unreadable		Report No.43	Fire Suppression System pump dumping seawater (A)"Downscale" (B)-1700mm 3：00 Core: 0.029MPag 0.306MPag D/W 0.505MPaABS S/C 0.500MPa	RCIC: Working Wide: (A/B)：O/S Fuel Rod Area: A +3850 Fuel Rod Area: B +3900 3：00 Core: 5.45MPa 5.45MPag (3:00) D/W Restoring S/C Restoring measurement equipment	Fuel Rod Area: A -1850 Fuel Rod Area: B -2300 3：00 Core: 0.134MPag 0.134MPag 3：00 D/W 315kPa S/C 305kPa
		4:37:00	4:00 Current	Plant Data	Drawing water…. Water dumping temporarily stopped. Fire Suppression System pump seawater dumping stopped. (A)"Downscale" (B)-1700mm 4：00 Core: 0.029MPag 0.304MPag D/W 0.495MPaABS S/C 0.490MPa	RCIC: Working Wide: (A/B)：O/S Fuel Rod Area: A +3850 Fuel Rod Area: B +3900 4：00 Core: 5.42MPag 5.42 MPag (4：00) D/W S/C Restoring measurement equipment (4:00)	3:20 Start dumping water again Fuel Rod Area: A -1800 Fuel Rod Area: B -2800 4：00 Core: 0.159MPag 0.159MPag 4：00 D/W 340kPa S/C 325kPa 4：00
	4:24:00	Unknown		Report No.44	Drawing water…. Water dumping temporarily stopped. Fire Suppression System pump seawater dumping stopped. (A)"Downscale" (B)-1700mm 4：00 Core: 0.029MPag 0.306MPag D/W 0.495MPaABS S/C 0.490MPa	RCIC: Working Wide: (A/B)：O/S Fuel Rod Area: A +3850 Fuel Rod Area: B +3900 4：00 Core: 5.42MPag 5.42 MPag (3:00) D/W Restoring S/C Restoring measurement equipment	3:20 Start dumping water again 2:20 951μSv (around main gate area) Fuel Rod Area: A -1800 Fuel Rod Area: B -2800 4：00 Core: 0.159MPag 0.159MPag 4：00 D/W 340kPa S/C 325kPa
		5:38:00	5:00 Current	Plant Data	Fire Suppression System pump dumping seawater (A)"Downscale" (B)-1700mm 4：45 Core: 0.034MPag 0.299MPag D/W 0.490MPaABS S/C 0.485MPa ABS	RCIC: Working Wide: (A/B)：O/S Fuel Rod Area: A +3850 Fuel Rod Area: B +3900 4：30 Core: 5.40 MPag 5.40 MPag (4:00) D/W Restoring S/C 467kPa ABS 4：30	3:20 Start dumping seawater again Fuel Rod Area: A -2000 Fuel Rod Area: B D/S 5：00 Core: 0.181MPag 0.181MPag 5：00 D/W 365kPa S/C 345kPa CAMS D/W 1.58E+2 CAMS S/C 3.78E+0
	5:03:00	5:04:00		Report No.45			Reactor No.3 ●●● (information concealed) CAMS measurement results: 1.4*10+2Sv/h Core Damage estimated at 25%
		Unreadable		Report No. (Revised)			Damage increases from 25→30%
	5:37:00	Unreadable		Report No.46	Fire Suppression System pump dumping seawater (A) "Downscale" (B)-1700mm 4：45 Core: 0.034MPag 0.299MPag D/W 0.490MPaABS S/C 0.485MPa ABS	RCIC: Working Wide: (A/B)：O/S Fuel Rod Area: A +3850 Fuel Rod Area: B +3900 4：30 Core: 5.40MPag 5.40 MPag (4:00) D/W Restoring S/C 467kPa ABS 4：30	MP-2 650μSv/h 2：40 3:20 seawater being dumped again Fuel Rod Area: A -2000 Fuel Rod Area: B D/S 5：00 Core: 0.181MPag 0.181MPag 5：00 D/W 365kPa S/C 345kPa

							CAMS D/W 1.58E+2 CAMS S/C 3.78E+0
			6:00 Current	Plant Data	Fire Suppression System pump dumping seawater (A)-1700 (B)-1700mm 5：30 Core: 0.027MPag 0.293MPag D/W 0.485MPaABS S/C 0.480MPa ABS	RCIC: Working Wide: (A/B)：O/S Fuel Rod Area: A +3900 Fuel Rod Area: B +3900 5：30 Core: 5.40MPag 5.40MPag (5:30) D/W Restoring S/C 467kPa ABS 5：30	Fuel Rod Area: A -2350 Fuel Rod Area: B D/S 6：00 Core: 0.181MPag 0.181MPag 6：00 D/W 425kPa S/C 400kPa CAMS D/W 1.66E+2 CAMS S/C 3.77E+0
			7:00 Current	Plant Data	Fire Suppression System pump dumping seawater (A)-1750 (B)-1750mm 6：30 Core: 0.032MPag 0.288MPag 6:30 D/W 0.475MPaABS S/C 0.470MPa ABS CAMS 1.62E+2 CAMS 2.66E+1	RCIC: Working Wide: (A/B)：O/S Fuel Rod Area: A +3900 Fuel Rod Area: B +3900 6：30 Core: 5.355MPag 5.355MPag (6:30) D/W Restoring S/C 455kPa ABS 6：30 CAMS 1.0E-3 CAMS 9.0E-3	3:20 seawater being dumped again Fuel Rod Area: A OS Fuel Rod Area: B -3000 7：00 Core: 0.338MPag 0.334MPag 7：00 D/W 520kPa S/C 500kPa CAMS D/W 1.67E+2 CAMS S/C 4.0E+0
	No Record	7:33:00		Report No.47	Fire Suppression System pump dumping seawater (A)-1700 (B)-1700mm 5：30 Core: 0.027MPag 0.293MPag D/W 0.485MPaABS S/C 0.480MPa ABS	RCIC: Working Wide: (A/B)：O/S Fuel Rod Area: A +3900 Fuel Rod Area: B +3900 5：30 Core: 5.40MPag 5.40 MPag (5:30) D/W Restoring S/C 467kPa ABS 5：30	4:00 Measurement results MP-2 exceeding 500μSv 820μSv ●●● Information Concealed Fuel Rod Area: A -2350 Fuel Rod Area: B D/S 6：00 Core: 0.181MPag 0.181MPag 6：00 D/W 425kPa S/C 400kPa CAMS D/W 1.66E+2 CAMS S/C 3.77E+0
	7:18:00	7:14:00		Report No.48	CAMS 1.64E+2Sv/h 55% Damaged		
	7:35:00	7:41:00		Report No.49	Fire Suppression System pump dumping seawater (A)-1750 (B)-1750mm 6：30 Core: 0.032MPag 0.288MPag D/W 0.475MPaABS S/C 0.470MPa ABS CAMS 1.62E+2 CAMS 2.66E+1	RCIC: Working Wide: (A/B)：O/S Fuel Rod Area: A +3900 Fuel Rod Area: B +3900 6：30 炉 5.355MPag 5.355 MPag (6:30) D/W Restoring S/C 455kPa ABS 6：30 CAMS 1.0E-3 CAMS 9.0E-3	CAMS 30% Damaged D/W 500kPa 3:20 seawater being dumped again Fuel Rod Area: A OS Fuel Rod Area: B -3000 7：00 Core: 0.338MPag 0.334MPag 7：00 D/W 520kPa S/C 500kPa CAMS D/W 1.67E+2 CAMS S/C 4.0E+0
	7:35:00	2011/4/27 12:00		Report No.49 (Revised)	P24 Confirmed Condition: Damaged		30%→35%
	7:53:00	7:54:00		Report No.50			6:10 460kPa Afterwards Report No.56 Revised
		8:19:00	8:00 Current	Plant Data	Fire Suppression System pump dumping seawater (A)-1750 (B)-1750mm 8：00 Core: 0.034MPag 0.284MPag 8：00 D/W 0.460MPaABS S/C 0.455MPaABS 8：00 CAMS 1.62E+2 CAMS 2.66E+1	RCIC: Working Wide: (A/B)：O/S Fuel Rod Area: A +3950 Fuel Rod Area: B +3950 8：00 Core: 5.310MPag 5.310 MPag (8：00) D/W 0.455MPaABS S/C 0.47MPaABS 8：00	Fire Suppression System pump starts dumping seawater again Fuel Rod Area: A -1000 Fuel Rod Area: B +650 8：00 Core: 0.31MPag 0.32MPag 8：00 D/W 500kPa S/C 480kPaABS 8：00 CAMS D/W 1.54E+2 CAMS S/C 4.4E+0

			9:05 Current	Plant Data	Fire Suppression System pump dumping seawater (A)-1800 (B)-1750mm 9：00 Core: 0.032MPag 0.275MPag 9：00 D/W 0.450MPaABS S/C 0.445MPa ABS 9：00 CAMS 1.41E+2 CAMS 2.65E+1	RCIC: Working Wide:（A/B)：O/S Fuel Rod Area: A +3900 Fuel Rod Area: B +3950 9： 00 Core: 5.310MPag 5.310MPag (9：00) D/W 0.460MPaABS S/C 0.478MPaABS 9：00	Fire Suppression System pump starts dumping seawater again Fuel Rod Area: A -1500 Fuel Rod Area: B +2800 9：05 Core: 0.304MPag 0.308MPag 9：05 D/W 490kPa S/C 475kPaABS 9：05 CAMS D/W 1.54E+2 CAMS S/C 4.4E+0
	9:34:00	9:35:00		Report No.51			MP-3 exceeds 500μSv
		10:35:00	10:00 Current	Plant Data	Fire Suppression System pump dumping seawater (A)-1800 (B)-1750mm 9：45 Core: 0.036MPag 0.275MPag D/W 0.450MPaABS S/C 0.445MPa ABS CAMS 1.41E+2 CAMS 2.65E+1	RCIC: Working Wide:（A/B)：O/S Fuel Rod Area: A +3800 Fuel Rod Area: B +3850 9： 45 Core: 5.468MPag 5.468MPag (9：45) D/W 0.460MPaABS S/C 0.467MPaABS 9：45 S/C 146.5℃ 9：00	Fire Suppression System pump starts dumping seawater again Fuel Rod Area: A -1500 Fuel Rod Area: B +800 10：05 Core: 0.327MPag 0.332MPag 10：05 D/W 510kPa S/C 495kPaABS CAMS D/W 1.54E+2 CAMS S/C 4.4E+0
	10:25:00	10:34:00		Report No.52	Fire Suppression System pump dumping seawater (A)-1800 (B)-1750mm 9：45 Core: 0.036MPag 0.275MPag D/W 0.450MPaABS S/C 0.445MPa ABS CAMS 1.41E+2 CAMS 2.65E+1	RCIC: Working Wide:（A/B)：O/S Fuel Rod Area: A +3800 Fuel Rod Area: B +3850 9： 45 Core: 5.468MPag 5.468MPag (9：45) D/W 0.460MPaABS S/C 0.467MPaABS 9：45 S/C 146.5℃ 9：00	Fire Suppression System pump starts dumping seawater again Fuel Rod Area: A -1500 Fuel Rod Area: B +800 10：05 Core: 0.327MPag 0.332MPag 10：05 D/W 380kPa S/C 390kPaABS 11：15 CAMS D/W 1.54E+2 CAMS S/C 4.4E+0
			11:15 Current	Plant Data	Fire Suppression System pump dumping seawater (A)-1800 (B)-1750mm 10： 30 Core: 0.034MPag 0.275MPag 10：30 D/W 0.440MPaABS S/C 0.435MPaABS 10：30 CAMS 1.41E+2 CAMS 2.65E+1	RCIC: Working Wide:（A/B)：O/S Fuel Rod Area: A +3800 Fuel Rod Area: B +3850 10：30 Core: 5.648MPag 5.648 MPag (10：30) D/W 0.460MPaABS S/C 0.481MPaABS 9：45 S/C 146.9℃ 10：30	Fire Suppression System pump starts dumping seawater again Fuel Rod Area: A -1500 Fuel Rod Area: B O/S 11：15 Core: 0.206MPag 0.215MPag 10：05 D/W 510kPa S/C 495kPaABS CAMS D/W 1.54E+2 CAMS S/C 4.4E+0
	11:21:00	11:20:00		Report No.54			**11:00 Explosion**
	11:30:00	11:26？		Report No.55			Fuel Rod Area: A -1800 Fuel Rod Area: B OS 11：25 Core: 0.185MPag 0.19MPag D/W 360kPa S/C 380kPaABS
		11:43:00	11:30 Current	Plant Data	Fire Suppression System pump dumping seawater (A)-1800 (B)-1750mm 10： 30 Core: 0.034MPag 0.275MPag 10：30 D/W 0.440MPaABS S/C 0.435MPaABS 10：30 CAMS 1.41E+2 CAMS 2.65E+1	RCIC: Working Wide（A/B)：O/S Fuel Rod Area: A +3800 Fuel Rod Area: B +3850 10：30 Core: 5.648MPag 5.648 MPag (10：30) D/W 0.460MPaABS S/C 0.481MPaABS 9：45 S/C 146.9℃ 10：30	Fire Suppression System pump starts dumping seawater again Fuel Rod Area: A -1800 Fuel Rod Area: B -2200 11：30 Core: 0.183MPag 0.191MPag 11： 30 D/W 360kPa S/C 360kPaABS 11：30

		12:10:00	12:00 Current	Plant Data	Fire Suppression System pump dumping seawater (A)-1800 (B)-1750mm 12：00 Core: 0.036MPag 0.275MPag 12：00 D/W 0.460MPaABS S/C 0.435MPaABS 12：00 CAMS 1.41E+2 CAMS 2.65E+1	RCIC: Working Wide（A/B)：O/S Fuel Rod Area: A +3400 Fuel Rod Area: B +3400 12：00 Core: 6.008MPag 56.008MPag (12：00) D/W 0.460MPaABS S/C 0.485MPaABS 12：00 S/C 147℃ 12：00	Fire Suppression System pump starts dumping seawater again Fuel Rod Area: A -1800 Fuel Rod Area: B -2200 11：55 Core: 0.183MPag 0.191MPag 11：55 D/W 360kPa S/C 380kPaABS 11：55
	11:47:00	12:15:00		Report No.56	Report No. 53 sent Report No. 50 contains errors		Casualties: 1 Missing: 6 MP Mobile Car 50μSv/h Neutron 0.01mSv/h
	12:21:00	12:22:00		Report No.57			Casualties: 6 Neutron information error
		13:22:00	13:00 Current	Plant Data	Fire Suppression System pump dumping seawater (A)-1800 (B)-1750mm 12：30 Core: 0.036MPag 0.275MPag D/W DS S/C DS CAMS 1.18E+2 CAMS 2.64E+1	RCIC: Working ？？ Wide（A/B)：+1400 +1400 Fuel Rod Area: A +2950 Fuel Rod Area: B +3000 12：30 Core: 6.188MPag 6.188MPag (12：30) D/W 0.465MPaABS S/C 0.486MPaABS 12：30 S/C 149.3℃ 12：30 CAMS 1.0E-3 CAMS 1.1E-2	Fire Suppression System pump dumping seawater Fuel Rod Area: A -1800 Fuel Rod Area: B -2200 13：00 Core: 0.247MPag 0.251MPag D/W 430kPa S/C 430kPaABS CAMS D/W Unconfirmed CAMS S/C Unconfirmed
	13:13:00	13:19:00		Report No.58		Descending water levels trend found, 15:30 TAF Expected arrival Fuel Rod Area: A +3400(12:00)→ +2950(12:30) Fuel Rod Area: B +3400(12:00)→ +3000 (12:30)	Fire Suppression System pump starts dumping seawater again Fuel Rod Area: A -1500 Fuel Rod Area: B +800 10：05 Core: 0.327MPag 0.332MPag 10：05 D/W 510kPa S/C 495kPaABS CAMS D/W 1.54E+2 CAMS S/C 4.4E+0
	13:38:00	13:53:00		Report No.59		Water levels fall, RCIC Assumed to have shut down. Fuel Rod Area: A +2950(12:30)→ +2400(13:24) Fuel Rod Area: B +3000(12:30)→ +2400(13:24)	
		13:54:00		Parameters	Fire Suppression System pump dumping seawater (A)-1800 (B)-1750mm 12：30 Core: 0.036MPag 0.275MPag D/W DS S/C DS CAMS 1.18E+2 CAMS 2.64E+1	RCIC: Working？？ Wide:（A/B)：+1400 +1400 Fuel Rod Area: A +2950 Fuel Rod Area: B +3000 12：30 Core: 6.188MPag 6.188MPag (12：30) D/W 0.465MPaABS S/C 0.486MPaABS 12：30 S/C 149.3℃ 12：30 CAMS 1.0E-3 CAMS 1.1E-2	Fire Suppression System pump dumping seawater Fuel Rod Area: A -1800 Fuel Rod Area: B -2200 13：00 Core: 0.247MPag 0.251MPag D/W 430kPa S/C 430kPaABS CAMS D/W Unconfirmed CAMS S/C Unconfirmed
		14:28:00	14:00 Current	Plant Data	Fire Suppression System pump dumping seawater (A)-1800 (B)-1750mm 12：30 Core: 0.036MPag 0.275MPag D/W DS S/C DS CAMS 1.18E+2 CAMS 2.64E+1	RCIC: Working Wide:（A/B)：+250 +250 Fuel Rod Area: A +2000 Fuel Rod Area: B +2000 14：00 Core: 7.583MPag～7.695MPag Hunting: (14：00) D/W 0.465MPaABS S/C Pressure Levels Unknown 14：00 S/C Water Temp. Unknown 14：00	Fire Suppression System pump dumping seawater Fuel Rod Area: A -1800 Fuel Rod Area: B -2200 14：00 Core: 0.278MPag 0.281MPag 14：00 D/W 460kPa S/C 450kPaABS 14：00 CAMS D/W Unconfirmed CAMS S/C

						CAMS 1.0E-3 CAMS 1.1E-2	Unconfirmed
		15:30:00	15:30 Current	Plant Data	Fire Suppression System pump dumping seawater （A)-1800 （B)-1750mm 15：00 Core: 0.041MPag 0.268MPag 15：00 D/W Unknown S/C Unknown 15：00 CAMS 9.48E+2 CAMS 2.62E+1	RCIC: Confirming status Wide（A/B)：-850 -850 Fuel Rod Area: A +1200 Fuel Rod Area: B +1200 15：00 Core: 7.268～7.515MPag (hunting) D/W 0.44MPaABS S/C Unknown 15：00 S/C 130℃ 15：00 CAMS 1.0E-3 CAMS 1.3E-2	Fire Suppression System pump status being confirmed Fuel Rod Area: A -1800 Fuel Rod Area: B -2200 15：00 Core: 0.295MPag 0.298MPag D/W 480kPa S/C 470kPaABS CAMS D/W Unconfirmed CAMS S/C Unconfirmed
	15:28:00	15:30:00		Report No.60		TAF Expected Arrival 16：30 Actual Measurement Results +1100 15:15	
				Parameters	Fire Suppression System pump dumping seawater （A)-1800 （B)-1750mm 15：00 Core: 0.041MPag 0.268MPag D/W DS S/C DS CAMS 9.48E+2 CAMS 2.62E+1	RCIC: Confirming status Wide（A/B)：-850 -850 Fuel Rod Area: A +1200 Fuel Rod Area: B +1200 15：00 Core: 7.268～7.515MPag (Hunting) D/W 0.44MPaABS S/C Unknown 15：00 S/C 130℃ 15：00 CAMS 1.0E-3 CAMS 1.3E-2	Fire Suppression System pump status being confirmed Fuel Rod Area: A -1800 Fuel Rod Area: B -2200 15：00 Core: 0.295MPag 0.298MPag D/W 480kPa S/C 470kPaABS CAMS D/W Unconfirmed CAMS S/C Unconfirmed
	16:37:00	16:38:00		Report No.61		●●●(Traces of data erasure found) 16:34 Start lowering pressure and dumping seawater. Reactor Core Water Levels: ±0 Fuel Rod Area Pressure Level: 6.99MPa PCV: 0.42MPa	
			17:00 Current	Plant Data	Fire Suppression System pump dumping seawater （A)-1800 （B)-1750mm 16：00 Core: 0.047MPag 0.270MPag D/W Unknown S/C Unknown CAMS 8.91E+2 CAMS 2.52E+1	RCIC: Confirming status Wide（A/B)： Unknown Fuel Rod Area: A -800 Fuel Rod Area: B Unknown 17：12 Core: 7.403MPag (17：12) D/W Unknown 17：12 S/C Unknown 17：12 S/C 130℃ 15：00	Fire Suppression System pump status being confirmed Fuel Rod Area: A -1800 Fuel Rod Area: B -2200 17：00 Core: 0.261MPag 0.261MPag 17：00 D/W 440kPa S/C 440kPaABS 17：00 CAMS D/W Unconfirmed 17：00 CAMS S/C Unconfirmed 17：00
	17:25:00	17:30:00		Report No.62		17:17 TAF Arrival	
		19:26:00	19:00 Current	Plant Data		RCIC: Confirming status 18:03 Atomic core pressure reduction - Start Vent opened Wide（A/B)： Unknown Fuel Rods Area: A D/S Fuel Rod Area: B Unknown 19：03 Core: 0.63MPag (19：03) D/W 0.40MPaABS 19：03 S/C Pressure unknown S/C Water temp. unknown	Fire Suppression System pump status being confirmed Fuel Rod Area: A -1900 Fuel Rod Area: B -2300 19：00 Core: 0.183MPag 0.183MPag 19：00 D/W 360kPa S/C DS 19：00 CAMS D/W Unconfirmed 19：00

						19：03	CAMS S/C Unconfirmed 19：00
	19:32:00	19:33:00		Report No.63		18:22 TAF-3700 Arrival Fuel Rods Completely Exposed	
		20:25:00	20:03 Current	Plant Data		RCIC: Confirming status 18:03 Atomic core pressure reduction - Start Vent opened Wide（A/B）: Fuel Rod Area: A D/S Fuel Rod Area: B Switching to Hunting Mode 20：03 Core 0.540MPag (20：03) D/W 0.410MPaABS S/C Pressure Levels Unknown 20：03 S/C Water Temp. Unknown 20：03	
	21:34:00	21:35:00		Report No.64		21:20 Fire suppression pump used to dump water, Safety Relief Valve (2) opened and water levels replenished (confirmed) Core Water Levels: -2000 21:30 Core Pressure: 0.495MPa D/W 0.475MPa	
	22:33:00	22:32:00		Report No.65		Water levels replenished, 22:14 Sustained core damage determined to be under 5%. **Tampered Data Found** Reactor Water Levels: -1800 22:14 Core Pressure: 0.405MPa D/W 0.480MPa CAMS D/W 5.36E0Sv/h CAMS W/W 3.83E-1	
	22:35:00	22:40？		Report No.66		Monitoring car around main gate, Exceeds 500μSv 21：37 3170μSv/h	
		23:15:00	23:00 Current	Plant Data		18:03 Reactor pressure levels falling (Confirmed) 19:57 Two Fire Suppression Pumps in use dumping water on to core Currently SRV2 vent open Fuel Rod Area: A/B -700 22:40 Core: 0.428MPag D/W 0.482MPaABS 22：40 S/C 0.35MPaABS S/C Testing ℃ CAMS 7.92E0 CAMS 7.35E-1	
	23:13:00	23:23？		Report No.67		3170→760 (Revision)	
				Plant Parameters	Fire Suppression System pump dumping seawater （A)-1700 （B)-1700mm 22：00 Core: 0.05MPag 0.24MPag D/W DS S/C DS CAMS 6.10E+1 CAMS 2.56E+1	18:03 Reactor pressure levels falling (Confirmed) 19:57 Two Fire Suppression Pumps in use dumping water on to core Currently SRV2 Vent remains open Fuel Rods Area: A/B -700 22:40 Core: 0.428MPag D/W 0.482MPaABS S/C 0.35MPaABS S/C Testing ℃ CAMS 7.92E0 CAMS 7.35E-1	Fire Suppression System pump status being confirmed Fuel Rod Area: A -1900 Fuel Rod Area: B -2300 22：45 Core 0.196MPag 0.196MPag D/W 370kPaABS S/C D/S CAMS D/W Unconfirmed CAMS S/C Unconfirmed
	23:39:00	Unknown		Report No. 68		22:50 D/W Pressure Limits Exceeded	

						640KPa D/W Vent opens	
				Report No. 69?			
15			0:00 Current	Plant Data		(Traces of data erasure found) Fuel Rod Area: A/B DS 23:54 Core: 0.653MPag 23：50 D/W 0.745MPaABS S/C 0.30MPaABS 23：54 S/C Testing ℃ 23：54	Fire Suppression System pump status being confirmed Fuel Rod Area: A -1850 Fuel Rod Area: B -2300 23：30 Core: 0.21MPag 0.21MPag D/W 380kPaABS S/C D/S 23：30 CAMS D/W Unconfirmed CAMS S/C Unconfirmed 23：30
		1:29:00	1:00 Current	Plant Data		Fire Suppression System pump dumping seawater Fuel Rod Area: A/B DS 0:45 Core 1.823MPag 0:45 D/W 0.72MPaABS 0：41 S/C 0.33MPaABS 0：41 S/C Testing ℃ 0：41	Fire Suppression System pump status being confirmed Fuel Rod Area: A -1900 Fuel Rod Area: B -2300 0：45 Core: 0.223MPag 0.223MPag 0：45 D/W 400kPaABS S/C D/S 0：45 CAMS D/W Unconfirmed CAMS S/C Unconfirmed 0：45
		3:57:00	3:00 Current	Plant Data		Fire Suppression System pump dumping seawater Fuel Rod Area: A/B DS 3： 00 Core: 0.653MPag 3：00 D/W 0.75MPaABS S/C 0.33MPaABS 3：00 S/C Testing ℃ 3：00	
	3:57:00	3:57:00		Report No. 70		3:00 D/W Pressure levels reduced to acceptable levels, Water levels still not replenished.●●●Information Concealed	
			3:00 Current	Plant Parameters	Fire Suppression System pump dumping seawater （A)-1700 （B)-1700mm 3：00 Core: 0.061MPag 0.223MPag D/W DS S/C DS CAMS 5.73E+1 CAMS 2.46E+1	Fire Suppression System pump dumping seawater Fuel Rod Area: A/B D/S 3:00 Core 0.653MPag D/W 0.75MPaABS S/C 0.33MPaABS S/C Temp: Nil CAMS 4.09E1 CAMS 6.00E0	Fire Suppression System pump being prepared to dump seawater Fuel Rod Area: A -1900 Fuel Rod Area: B -2300 3：00 Core: 0.242MPag 0.242MPag D/W 410kPaABS S/C D/S CAMS D/W Unconfirmed CAMS S/C Unconfirmed
	4:17:00	4:16:00		Report No. 70 (Revised)		3:00 Cannot reduce pressure	
	6:37:00	7:43:00		Report No. 70 (Revised)		**6：00〜6：10 Large crashing sound heard** **Core Water Levels:** D/S→-2800 Core Pressure Levels: 0.614MPa → Unknown D/W Pressure Levels: 0.73MPa → 0.73MPa S/P Pressure Levels: 0.27MPa → Unknown CAMS D/W 61.6→ Unknown CAMS S/P 4.89 →	

						Unknown	
	6:28:00	7:05:00	6:28 Current	Plant Data		Fire Suppression System pump dumping seawater Fuel Rod Area: A/B -2700 6:20 Core: 0.612MPag 6：20 D/W 0.73MPaABS S/C 0 MPaABS 6：20 S/C Temp: Nil	Fire Suppression System pump dumping seawater Fuel Rod Area: A -1800 Fuel Rod Area: B -2300 5：00 Core: 0.244MPag 0.244MPag 5：00 D/W 415kPaABS S/C D/S 5：00 CAMS D/W Unconfirmed CAMS S/C Unconfirmed
	6:37:00	7:42:00		Report No. 70 (Revised)		Countermeasure Headquarters moved to Fukushima power plant No.2; Facility Evacuated	
	7:00:00	7:21？		Report No.71		Some people stay behind to monitor situation	
	7:00:00	Unreadable		Report No.72		6：50 Exceeds 500µSv 583.7µSv (Near main gate area)	
	No Record	Unreadable		Report No.73		Confirm steam in upper part of reactor chamber	
	No Record	Unreadable		Report No.74			
	9:18:00	9:21:00		Report No. 75		8:25 Confirm white smoke from 5th floor of reactor chamber	
	9:56:00	9:59:00		Report No.76			
	9:56:00	9:59:00		Report No. 77		9：40 White smoke spreading	
	No Record	Unreadable		Report No.78			
	11:42:00		11:42 Current	Plant Data		Fire Suppression System Line continues to dump water Fuel Rod Area: A -1400 11:42 Core 0.315MPag 11：42 D/W 0.155MPaABS 11：42 S/C D/S S/C Temperature: Nil	
	11:45:00	11:46:00		Report No.79			
	16:22:00	16:33:00		Report No. 80 (Revised)	15：30 Core Damaged Sustained 43→70%	Core Damaged Sustained 14→33%	Main entrance exceeds 500µSv 531.6
	16:22:00	4/27 12:01		Report No. 80 (Revised)	55%	35%	
	21:56:00	3/16 0:14		Report No.81	Fire Suppression System line disengaged - stops pouring seawater （A)-1800 （B)-1800mm 18：43 Core 0.169MPag D/W DS S/C DS CAMS 6.89E+1 CAMS 2.33E+1	Fire Suppression System pump dumping seawater Fuel Rod Area: A -1200 18:43 Core 0.099MPag D/W 0.25MPaABS S/C D/S S/C Temperature: Nil CAMS 1.22E2 CAMS 4.40E0	Fire Suppression System pump dumping seawater 2：30 Start Fuel Rod Area: A -1900 Fuel Rod Area: B -2300 21：05 Core 0.17MPag 0.18MPag D/W 335kPaABS S/C D/S CAMS D/W Unconfirmed CAMS S/C Unconfirmed
	23:20:00	23:38:00				Main entrance exceeds 500µSv 4548µSv	

(1) "Trip" closing the vent part of the plumbing which supplies the steam to the turbine and then turning the power off on the turbine.

Table 2: Time line and changes in atomic reactors' water levels, pressure levels in RPV and (DW).

RPV= Reactor Pressure Vessel , DW = Drywell

Day	Time	Even	Reactor No.1				Reactor No.2							
			Water Level (A) mm	Water Level (B) mm	RPV Pressure Level	DW Pressure Level	Water Level (A)	Water Level (B)	RPV Pressure Level	DW Pressure Level	Water Level (A)	Water Level (B) mm	RPV Pressure Level	DW Pressure Level kPa
11	2011/3/11 14:46	Earthquake occurs. Reactor Core Scram (14:47)												
	2011/3/11 14:50	Reactor No. 2 manual start. Continues to function even after tsunami impact DC power was lost												
	2011/3/11 14:52	IC in Reactor No. 1 automatically initiated. Vents 3A/3B opened.												
	2011/3/11 15:03	After the IC in 3A was closed. It was opened and close to control the steam pressure levels until 15:37.									3B Vent closed and left			
	2011/3/11 15:05	Reactor No.3 manual start. DC power source continues to support RCIC even after tsunami impact.												
	2011/3/11 15:37	All power is lost due to tsunami impact (15:27)												
	2011/3/11 16:36			550				3400						
	2011/3/11 16:45													
	2011/3/11 18:18	Reactor No. 1 IC 2A, 3A vents opened. Steam creation confirmed.												
	2011/3/11 18:25	Reactor No. 1 IC 3A vents closed.												
	2011/3/11 20:07				6.6									
	2011/3/11 20:30											600	7.1	145
	2011/3/11 21:00											900	7.2	155
	2011/3/11 21:30	Reactor No. 1 IC 3A vents opened. Steam levels monitored and confirmed.												
	2011/3/11 21:48											900	7.2	155
	2011/3/11 22:00							3400				350	7.2	155
	2011/3/11 22:11			450				3400						
	2011/3/11 22:00			550				3400	5.6	161		350	7.2	155
	2011/3/11 22:47			590				3400						
	2011/3/11 22:58											400	7.3	155
	2011/3/11 23:05			590				3400						
	2011/3/11 23:19											200	7.38	
	2011/3/11 23:20							3500						
	2011/3/11 23:24			590										
	2011/3/11 23:30							3500	6.3	40				
	2011/3/11 23:35											350	7.32	
12	2011/3/12 0:57					600		3500	6.3	40				
	2011/3/12 0:30		1300									-200	7.35	155
	2011/3/12 2:30		1300	530		840								
	2011/3/12 2:45		1300	500	0.8	840								
	2011/3/12 2:50		1300	500	0.8	840		3600	6					
	2011/3/12 2:55							3700	5.6	161				
	2011/3/12 3:16							3700		60				
	2011/3/12 4:01												7.4	280
	2011/3/12 4:15			500				3700		60	0	0	7.47	285
	2011/3/12 5:14					770								
	2011/3/12 5:20		1300	500		941		3700		60	100	100	7.4	300
	2011/3/12 5:30			500				3700		60		200	7.43	305
	2011/3/12 5:55			500				3700		60		200	7.43	305
	2011/3/12 6:00			500		740		3700		60		200	7.25	310
	2011/3/12 6:30			550		790		3700		60		350	7.49	320
	2011/3/12 6:47			400		770		3600		60				
	2011/3/12 7:00		800	300				3600		60		350	7.39	330
	2011/3/12 7:30		200	200				3600		60		380		340
	2011/3/12 7:40					755								
	2011/3/12 8:30										400	80		350
	2011/3/12 8:36					740								
	2011/3/12 8:39							3600		60				
	2011/3/12 8:49		-400	-550		740								
	2011/3/12 9:00											400	7.46	360
	2011/3/12 9:10		-550	-650		740		3600		60				
	2011/3/12 9:20		-450	-700		740								
	2011/3/12 9:30							3600	5.6	161	350	350	7.46	350
	2011/3/12 10:04		-500	-700				3600						

	2011/3/12 10:38		-550	-700										
	2011/3/12 10:41					740		3600						
	2011/3/12 11:36	Reactor No. 3												
	2011/3/12 11:20		-900	-800		750		3600	5.6	161	200	200		350
								3600						

	2011/3/12 12:05		-1500	-1400		750								
	2011/3/12 12:10											-550	7.53	390
	2011/3/12 12:30					754								
	2011/3/12 12:35	Reactor No.3 HCPI	-1700	-1450										
	2011/3/12 12:45											-450	5.6	380
	2011/3/12 12:55		-1700	-1500		750		3600	6.1	110				
	2011/3/12 13:38		-1700	-1550		755		3600			0	0		360
	2011/3/12 13:58										420	420	3.63	360
	2011/3/12 14:10		-1700	-1650		730		3600	6.1	110				
	2011/3/12 14:30	Reactor No.1 Vent successfully opened.												
	2011/3/12 14:41		-1700	-1650		610								
	2011/3/12 14:50		-1700	-1650				3600						
	2011/3/12 14:50					580								
	2011/3/12 15:14		-1700	-1650		530								
	2011/3/12 15:28		-1700	-1650		540								
	2011/3/12 15:36	Reactor No.1 Explosion												
	2011/3/12 17:00		-1700	-1700								400	2.9	300
	2011/3/12 18:30							3550	6.3	155	1200	1200	1.35	280
	2011/3/12 19:00										1050	1050	0.95	285
	2011/3/12 19:04	Reactor No.1 Seawater dumping begins.												
	2011/3/12 19:42							3550				1300	0.82	280
	2011/3/12 20:00							3550						
	2011/3/12 20:08			-1700										
	2011/3/12 20:15											1450	0.8	270
	2011/3/12 20:31											1350		
	2011/3/12 21:00			-1750				3550						
	2011/3/12 21:30			-1700				3600					0.97	
	2011/3/12 22:00			-1700				3600					0.97	170
	2011/3/12 23:00			-1750				3600					0.96	
0:00	2011/3/13 0:00			-1750				3600					0.97	
	2011/3/13 1:00			-1700				3650					0.97	270
	2011/3/13 2:00							3650					0.85	270
	2011/3/13 2:44	Reactor No.3 HCPI shuts down.												
	2011/3/13 3:00			-1700				3650	3.71	315				
	2011/3/13 3:44												4.1	
	2011/3/13 4:00							3650	6.14	330				
	2011/3/13 5:00			-1700		350						-3500	7.38	360
	2011/3/13 5:25											-3500	7.27	355
	2011/3/13 5:30			-1700		350		3650	6.14	330		-3500		
	2011/3/13 6:00			-1700		350		3650	6.12	340		-3500	7.39	390
	2011/3/13 6:50											-3400	7.35	440
	2011/3/13 7:00			-1700	0.355			3650	6.12	340				
	2011/3/13 7:45											-3000	7.31	460
	2011/3/13 8:00							3650	6.1	350	-3000	-3000	8.5	465
	2011/3/13 8:41	Reactor No.3 vent												
	2011/3/13 8:55			-1700	0.358			3700	6.08	360				
	2011/3/13 9:08											-1800	0.46	637
	2011/3/13 9:10										1800	1800	7.24	637
	2011/3/13 9:25	Reactor No.3 Seawater dumping begins.												
	2011/3/13 10:35			-1750	0.362			3700	1.283	10		-700		280
	2011/3/13 10:55			-1700	0.358			3700				-1200	0.1	270
	2011/3/13 11:55			-1700	0.3645			3750				1000	0.12	
	2011/3/13 12:40				0.3645			3750				0	0.45	480
	2011/3/13 13:00			-1700				3750		595	-1400	-2000	0.19	300
	2011/3/13 14:10			-1700	0.3713			3750		600		-2200	0.08	235
	2011/3/13 15:00			-1700	0.3735	600		3750		395		-2000	0.09	260
	2011/3/13 16:00			-1700	0.378	605		3750	5.85	400	-1500	-2000	0.18	350
	2011/3/13 16:30			-1700	0.378	605	3750	3800	5.85	400		-1900	0.24	410

	2011/3/13 18:45			-1700	0.3623	590	3800	3750		410	-1800	-2200	0.25	420
	2011/3/13 19:00			-1700	0.3578	580	3800	3800						
	2011/3/13 19:30						3800	3800				-2200	0.25	425
	2011/3/13 19:55					575						-2200	0.25	425
	2011/3/13 20:30			-1750	0.3244	560	3800	3800		420				
	2011/3/13 20:45											-2200		410
	2011/3/13 21:00						3800	3800						
	2011/3/13 21:30			-1750	0.342	550				425				
	2011/3/13 21:40										-1800	-2200		320
	2011/3/13 22:30						3850	3900		430				
	2011/3/13 22:45			-1750	0.333	510								
	2011/3/13 23:00										-1800	-2250	0.089	265
	2011/3/13 23:30			-1750	0.3	530	3850	3900		435	-1800	-2250	0.062	250
14	2011/3/14 0:00						3850	3900		435				
	2011/3/14 0:30										-1800	-2250	0.051	240
	2011/3/14 2:00			-1700	0.315	510	3850	3900		440	-1800	-2250	0.077	265
	2011/3/14 3:00			-1700	0.306	505		3900	5.45		-1850	-2300	0.134	315
	2011/3/14 4:00			-1700	0.306	495	3850	3900	5.42		-1800	-2800	0.159	340
	2011/3/14 4:30						3850	3900	5.4	467				
	2011/3/14 4:45			-1700	0.299	490								
	2011/3/14 5:00										-2000		0.181	365
	2011/3/14 5:30			-1700	0.293	485	3900	3900	5.4	467				
	2011/3/13 6:00		-1700	-1700							-2350	-2350	0.225	425
	2011/3/14 6:30			-1750	0.288	475	3900	3900	5.355	455				
	2011/3/14 7:00		-1750									-3000	0.338	520
	2011/3/14 8:00			-1750	0.285	460	3950	3950	5.31	455		650	0.32	500
	2011/3/14 9:00			-1750	0.275	450	3900	3950	5.31	460				
	2011/3/14 9:05											2800	0.308	490
	2011/3/14 9:45			-1750	0.275	450	3800	3800	5.468	460				
	2011/3/14 10:05											800	0.327	510
	2011/3/14 10:05												0.215	
	2011/3/14 10:30			-1750	0.275	440	3800	3850	5.648					
	2011/3/14 11:01	Reactor No.3 Explosion												
	2011/3/14 11:15										-1600	-1600	0.309	380
	2011/3/14 11:25												0.185	360
	2011/3/14 11:30		-1800	-1750									0.19	360
	2011/3/14 11:55											-220	0.191	360
	2011/3/14 12:00			-1750	0.275	460	3400	3400	6.008	460				
	2011/3/14 12:30			-1750	0.275	DS	2950	3000	6.188	465				
	2011/3/14 13:00		-1800	-1750							-1800	-2200	0.247	430
	2011/3/14 13:22	Reactor No.2 RCIC shuts down.												
	2011/3/14 13:24						2400	2400						
	2011/3/14 14:00						2000	2000	7.583	460		-2200	0.261	460
	2011/3/14 15:00			-1750	0.268	DS	1200	1200	7.268	440		-2200	0.295	480
	2011/3/14 15:15							1100						
	2011/3/14 16:00		-1750	-1750	0.27	DS								
	2011/3/14 16:34							0	6.99	420				
	2011/3/14 17:00										-1800	-2200	0.261	440
	2011/3/14 17:12						-800		7.403					
	2011/3/14 17:17							0						
	2011/3/14 18:03	Reactor No.2 RSV opened.												
	2011/3/14 18:22							-3700						
	2011/3/14 19:00										-1900	-2300	0.183	360
	2011/3/14 19:03									400				
	2011/3/14 19:15			-1750	0.245									
	2011/3/14 19:54	Reactor No.2 Seawater dumping begins.												
	2011/3/14 20:03								0.54	410				
	2011/3/14 21:30							-2000	0.495	475				
	2011/3/14 22:00			-1700	0.24	DS								
	2011/3/14 22:14						-1800	-1800	0.405	480				
	2011/3/14 22:40		-1700	-1700			-700	-700	0.428	482				
	2011/3/14 22:45										-1900	-2300	0.196	370
	2011/3/14 22:50									640				

	2011/3/14 23:30										-1850	-2300	0.21	380
	2011/3/14 23:50								0.653					
	2011/3/14 23:54									745				
15	2011/3/15 0:41									720				
	2011/3/15 0:45								1.823		-1900	-2300	0.223	400
	2011/3/15 1:53								0.63	725				
	2011/3/15 3:00		-1700	-1700					0.653	750	-1900	-2300	0.242	410
	2011/3/15 5:00		-1750	-1750	0.216						-1800	-2300	0.244	415
	2011/3/15 6:00	Reactor No.2 Explosion												
	2011/3/15 6:20						-2700	-2700	0.612	730				
	2011/3/15 6:37							-2800		730				
	2011/3/15 11:30											-2300	0.248	420
	2011/3/15 11:42			-1700	0.185		-1400	400	0.315	155				
	2011/3/15 11:50											-2300	0.251	420
	2011/3/15 13:00		-1700	-1700	0.185				0.608	415	-1900			
	2011/3/15 15:25			-1750	0.166			-1950	0.113	275				
	2011/3/15 18:43		-1800	-1800	0.169	DS	-1200	-1200	0.099	250				
	2011/3/15 21:05										-1900	-2300	0.17	335

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