

Chapter 2: TEPCO and its governance

Toshihiro Okuyama

=====

Introduction: What exactly did TEPCO reflect on?

1. Criminal investigation and trials reveal TEPCO management's deferral of tsunami preparedness measures
2. The politics behind putting off tsunami preparedness
3. In a business judgement where human lives are at stake, don't ignore the technical judgement of engineers without valid reason
4. Diversify responses to preparedness and reduce risk substantially
5. Avoid succumbing to unspoken pressure and speak up upon noticing anything of concern
6. TEPCO's political and economic clout
7. TEPCO's reform still only midway

Summary

=====

Introduction: What exactly did TEPCO reflect on?

What lessons did Japanese nuclear operators, including Tokyo Electric Power Company, Inc. (TEPCO), learn or not learn from the Fukushima nuclear disaster? And what kind of change and/or improvement has or has not been achieved following the disaster? In order to prevent the recurrence of a disaster caused by an accident like the one at the TEPCO's Fukushima Daiichi Nuclear Power Station, are there any problems that currently remain or exist? These are the subjects of this chapter.

Focusing on TEPCO as an organization, we took a bird's eye view of the whole situation, paying particular attention to the facts surrounding the accident, especially facts newly revealed in the last five years. We extracted three lessons and evaluated the current situation in response to them. We reviewed the work from various reports published in the first four years after the accident, records of TEPCO's internal video conferences during the disaster, transcripts of interviews and interrogations to key witnesses, as well as the TEPCO's "Fukushima Nuclear Accident Summary and Nuclear Safety Reform Plan". We examined whether, in the ten years following the accident, TEPCO had been able to respond to the lessons and recommendations put forward therein. We gathered and scrutinised the latest knowledge on the Fukushima accident and TEPCO, including the views of concerned parties and related court records, from the perspective of asking if lessons and recommendations have been missed or not.

In the first four years following the accident, various problems and issues regarding TEPCO's organization were pointed out.

The Independent Accident Investigation Report of February 2012 introduced the view that the government's system of "privately administered national policy", in which the national policy of promoting the peaceful use of nuclear energy is carried out by private nuclear power operators, had negative consequences. The policy created a system that allowed the electric power companies to make excuses along the lines of "we kept the standards the government told us", "we can't help it", and "it's not our fault". As a result, the soundness or the governance of the nuclear power operators as private companies was damaged.¹ It also pointed out that "TEPCO's crisis management capabilities,

¹ Independent Investigation Commission on the Fukushima Daiichi Nuclear Accident. (2012). *Fukushima genpatsu jiko*

decision-making, and weak governance have made the public wonder whether such companies should be allowed to generate nuclear power.”² A report by the National Diet of Japan's Accident Investigation Commission in July 2012 described TEPCO's governance as “bureaucratic, lacking autonomy and a sense of responsibility,”³ denouncing “the manipulative management culture at TEPCO, which worked very closely with and had a large influence on the government regulatory agencies but, in the end, shirked their responsibility by passing accountability to the government agencies.”⁴

Many reports took issue with TEPCO's safety culture, namely, the corporate culture, corporate mores or corporate fabric of the company, and above all, its poor internal communications and employee's general tendency of obeying superiors or authorities without questioning or challenging them. The final report of the Government Accident Investigation in July 2012 suggested there were problems with TEPCO's safety culture, saying “its workforce was vertically-segmented, and even in dealing with this accident a perspective of carrying out the necessary tasks based on a comprehensive overview of the situation was lacking; and the organizational information sharing system was not in place as can be seen in important steps relating to the handling of the accident being carried out without seeking direction from senior staff.”⁵ The August 2012 report of the Nuclear Power Operators' Association (INPO) in the United States emphasized the importance of “cultivating a questioning attitude and challenging assumptions” as a principle of safety culture, pointing out that, had TEPCO had such a safety culture, it may have benefitted in dealing with the tsunami and maintaining core cooling at the time of the accident.⁶ Regarding this, the US Academy of Sciences Research Council stated in a 2014 report that “the lack of a strong safety culture was an important contributing factor to the Fukushima Daiichi accident.”⁷

According to the National Diet of Japan's Accident Report, there was “distortion of risk management at TEPCO.”⁸ The final report of the Atomic Energy Society of Japan's Accident Investigation of

dokuritsu kenshō inkai: chōsa, kenshō hōkoku sho [Independent Investigation Commission on the Fukushima Daiichi Nuclear Accident: Report on the Inquiry and Investigation]. Tokyo: Rebuild Japan Initiative Foundation. (In Japanese.) p.320

² Independent Investigation Commission on the Fukushima Daiichi Nuclear Accident. (2012). *Fukushima genpatsu jiko dokuritsu kenshō inkai: chōsa, kenshō hōkoku sho* [Independent Investigation Commission on the Fukushima Daiichi Nuclear Accident: Report on the Inquiry and Investigation]. Tokyo: Rebuild Japan Initiative Foundation. (In Japanese.) p.388

³ The National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission. (2012). *Tōkyō denryoku fukushima genshiryoku hatsudensho jiko chōsa iin kaihōkokusho* [The official report of the Fukushima Nuclear Accident Independent Investigation Commission]. Report, July 5. Tokyo: Diet. (In Japanese.) p.525
https://warp.da.ndl.go.jp/info:ndljp/pid/3856371/naaic.go.jp/wp-content/uploads/2012/08/NAIIC_Eng_Chapter5_web.pdf#page=30

⁴ The National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission. (2012). *Tōkyō denryoku fukushima genshiryoku hatsudensho jiko chōsa iin kaihōkokusho* [The official report of the Fukushima Nuclear Accident Independent Investigation Commission]. Report, July 5. Tokyo: Diet. (In Japanese.) p.256
https://warp.da.ndl.go.jp/info:ndljp/pid/3856371/naaic.go.jp/wp-content/uploads/2012/08/NAIIC_Eng_Chapter3_web.pdf#page=7

⁵ Cabinet Office, Government of Japan. (2012). *Seifu jiko chō saishū hōkokusho* [Final Report of Investigation Committee on the Accident at Fukushima Nuclear Power Stations of Tokyo Electric Power Company]. Report, June 23. Tokyo: Cabinet. (In Japanese.) p.428
<https://www.cas.go.jp/jp/seisaku/icanps/eng/07VIfinal.pdf#page=81>

⁶ Institute of Nuclear Power Operations. (2012). Special Report INPO 11-005, *Lessons Learned from the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station*. August 1. Atlanta: INPO. Retrieved May 8, 2020 from <https://www.nrc.gov/docs/ML1221/ML12219A131.pdf#page=40> p.34

⁷ National Research Council. (2014). *Lessons Learned from the Fukushima Nuclear Accident for Improving Safety of U.S. Nuclear Plants*. Washington, DC: The National Academies Press. pp.232-237

⁸ The National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission. (2012). *Tōkyō denryoku fukushima genshiryoku hatsudensho jiko chōsa iinkai hōkokusho* [The official report of the Fukushima

March 2014 states that “TEPCO cannot complain about criticism that it failed to face the risks identified by new knowledge about tsunamis and severe accidents and postponed required safety measures,” pointing out TEPCO's lack of comprehensive management ability.⁹

The most important source of TEPCO's response to these lessons and recommendations lies in TEPCO's “Fukushima Nuclear Accident Summary & Nuclear Safety Reform Plan”¹⁰ (the Anegawa Plan) compiled in March 2013, after TEPCO had been put virtually under governmental control with the majority of its capital in government hands.

In June 2012 of the previous year, TEPCO released an accident investigation report under the former management team, including chairman Tsunehisa Katsumata, that concluded that TEPCO's employees “never imagined a massive earthquake and tsunami such as this one, and actually they could not possibly have imagined it.”¹¹ On the other hand, Takafumi Anegawa, who was called back within TEPCO from the electric vehicle department to his old post at the nuclear division after the accident and became the head of the nuclear asset management department at the end of the year, thought “It would be impossible for us to generate nuclear power again if this were the extent of our remorse,” and started working voluntarily to create a supplementary version of the report, which eventually became officially recognized by the company.¹²

According to a former senior official of the Ministry of Economy, Trade and Industry (METI) who knows TEPCO well, there were disgruntled voices within TEPCO arguing that the Great East Japan Earthquake was a “natural disaster” with nearly twenty thousand dead or missing, and questioning “Why is it just our company that has to shoulder such burdens among other victims?” Whenever he heard such remarks, the former METI official testified that he often felt doubts, thinking that “perhaps this organization needs to be legally scrapped and restarted from scratch.”¹³ In the midst of this, there was fierce opposition from the Corporate Affairs and Corporate Planning departments within TEPCO because officially recognizing Anegawa's team by the company and TEPCO itself acknowledging that there was an aspect of a man-made disaster in the Fukushima nuclear accident would amount to “selling out” the former management including former TEPCO chairman Katsumata, who were possible defendants of lawsuits. Regardless of this opposition, Anegawa and others worked together to release the Summary and Reform Plan¹⁴.

Despite a few ups and downs, this is how the issues that TEPCO's organization faced and the lessons to be learned seemed to be exhausted in the first four years after the accident, and TEPCO appeared

Nuclear Accident Independent Investigation Commission]. Report, July 5. Tokyo: Diet. (In Japanese) p.525
https://warp.da.ndl.go.jp/info:ndljp/pid/3856371/naic.go.jp/wp-content/uploads/2012/08/NAIIC_Eng_Chapter5_web.pdf#page=30

⁹ Atomic Energy Society of Japan. (2014). *Fukushima Dai ichi genshiryoku hatsudensho jiko ni kansuru chōsa inkai* [Final Report on the Accident at Fukushima Daiichi Nuclear Power Plant]. Report, March 26. Tokyo: AESJ. (In Japanese.) pp.355-356, or AESJ. (2015). *The Fukushima Daiichi Nuclear Accident: Final Report of the AESJ*. p.472.

¹⁰ Tokyo Electric Power Company. (2013). *Fukushima genshiryoku jiko no sōkatsuoyobi anzen kaikaku puran* [Fukushima Nuclear Accident Summary and Safety Reform Plan]. Report, March 29. Retrieved May 13 from
https://www.tepco.co.jp/cc/press/betu13_j/images/130329j0401.pdf (In Japanese.)

https://www4.tepco.co.jp/en/press/corp-com/release/betu13_e/images/130329e0801.pdf (In English.)

¹¹ Tokyo Electric Power Company, Inc. (2012). *Fukushima Nuclear Accident Analysis Report (Final Report)*. Tokyo Electric Power Company. p.33

https://www.tepco.co.jp/en/press/corp-com/release/betu12_e/images/120620e0104.pdf#page=57

¹² Okuyama, T. (2014). Intabyū genpatsu wo tsuzukeru shikaku tōkyō denryoku jōmu: genshiryoku gijutsusha toppu Anegawa Takafumi san [Interview: The credentials to continue nuclear power plants, Anegawa Takafumi, top nuclear engineer and TEPCO official]. *Asahi Shimbun*. March 29. Retrieved May 26, 2020 from
<https://judiciary.asahi.com/fukabori/2014041000001.html> (In Japanese.)

¹³ Interview with a former METI official, February 27, 2020.

¹⁴ Interview with a former METI official, February 27, 2020.

to be moving to respond to them under its new management team. What is the reality, however? Have the lessons really been taken completely on board, and is TEPCO really answering those lessons? What progress is being made in responding to the lessons learned? And, in the first place, was anything missing from the lessons and recommendations gleaned in the first four years, and if something was missing, what should the response to that be? These will be examined below.

1. Criminal investigation and trials reveal TEPCO management's deferral of tsunami preparedness measures

New facts, which were virtually bypassed in TEPCO's self-examinations, including the Anegawa Plan, concerning the most crucial question of why TEPCO failed to prepare for a tsunami, came to light during the criminal trial process from 2017.

Prior to the accident, TEPCO's tsunami evaluation group recognized the need for tsunami countermeasures.

The civil engineering survey group in charge of tsunami evaluation at TEPCO's Nuclear Asset Management Department was aware of the need to drastically strengthen tsunami countermeasures at Fukushima Daiichi by 2008 at the latest in order to comply with government regulations based on the Seismic Design Regulatory Guide newly formulated in 2006 in light of lessons from the Great Hanshin Earthquake in 1995. However, upper corporate management did not share this awareness. In 2008, upper management rejected the proposal made by the group and postponed looking into measures. Nevertheless, the civil engineering survey group maintained the view that it was necessary to take some measures to comply with the regulations, and in 2009 proposed to establish a cross-sectional team to consider and implement measures internally. Given the decision to postpone the previous year, however, this proposal was also not accepted within the company.

The details of these facts were discovered by the Tokyo District Public Prosecutors' criminal investigation from 2012 to 2013, but they were not disclosed to the general public at that time. They became known to the public for the first time from 2017 to 2019 when the interrogations of TEPCO engineers as witnesses were conducted publicly in criminal trials and when the prosecutor's criminal investigation records were submitted to both criminal and civil courts, which included a lawsuit against Katsumata and other former directors of TEPCO brought by TEPCO's shareholders. The details of these facts are not described in the various accident reports or the Anegawa Plan. Therefore, no related lessons or countermeasures can be found anywhere.

Let us first confirm the facts.

Rejected the civil engineering survey group's recommendations in 2008

In September 2006, the Seismic Design Regulatory Guide applied to the safety examination of nuclear power plants were revised by the government, and NISA, the national regulatory body, asked each power utility to carry out "seismic back checks" to confirm the conformity of existing nuclear power plants. This included a requirement to confirm tsunami safety, bearing in mind that as an earthquake-related phenomenon, "tsunami which could be reasonably postulated to hit in a very low probability in the service period of the facilities".

In response, the civil engineering group (later reorganized into the civil engineering survey group on July 1, 2008) at TEPCO, which belongs to the Niigata-Chuetsu-Oki Earthquake Restoration Management Center in the nuclear asset management department at head office, examined how to

deal with a tsunami.

In their research, the question arose as to whether the “long-term evaluation of seismic activity from off the Sanriku Coast to off the Boso Peninsula” (long-term evaluation) published by the government's Headquarters for Earthquake Research Promotion (Earthquake Headquarters) at the end of July 2002, should be incorporated into the tsunami height design assumptions for Fukushima Daiichi and Fukushima Daini Nuclear Power Stations. Previously, the Tsunami Assessment Methodology compiled by the Japan Society of Civil Engineers in February 2002 had been used to calculate estimated tsunami heights for the Fukushima nuclear power plants on the assumption that no major tsunami earthquake would occur off Fukushima Prefecture. The Earthquake Headquarters long-term evaluation pointed out that a magnitude-8 class tsunami earthquake could occur anywhere along the Japan Trench from off Sanriku to off Boso, including off the coast of Fukushima Prefecture. If this was followed, it was likely that conventional tsunami height design assumptions would be considered inadequate. The policy of adopting the view of long-term evaluation was taken around December 2007 inside the civil engineering group.

In the spring of 2008, Tokyo Electric Power Services Co., Ltd. (TEPSCO), which was commissioned by the nuclear asset management department, calculated the tsunami height based on the long-term evaluation of the Earthquake Headquarters, the result being that a tsunami up to 15.7 meters could hit, which exceeded the site height of 10 meters at the Fukushima Daiichi Nuclear Power Station.

The civil engineering group recognized that it was necessary to significantly raise their tsunami height design assumptions and implement countermeasures to match it. They started to study plans such as constructing a breakwater off the coast and building a seawall on site.

However, Masao Yoshida, general manager and head of the nuclear asset management department that oversaw the civil engineering group, and Kazuhiko Yamashita, No. 2 in the same department and head of the Niigata-Chuetsu-Oki Earthquake Restoration Management Center, had different perceptions to the civil engineers.

Yamashita made the following statement at a hearing by the Tokyo District Prosecutor.

“I felt a strong sense of discomfort with the 15.7 meter figure, and thought that it would be unrealistic to implement countermeasures for such a water level, and I was somewhat opposed to it. Yoshida was at least not in favour of taking measures for that water level.”¹⁵

Yoshida responded to an interview by the Government Accident Investigation as follows regarding the long-term evaluation by Earthquake Headquarters.

“Academics can say it's possible as much as they like, but when you ask if that's at the level of properly designing things, it isn't.”¹⁶

At a meeting on July 31, 2008, Sakae Muto, then Deputy Chief Nuclear Officer and No. 2 of the Nuclear Power and Plant Siting Division, who was the boss of General Manager Yoshida and others,

¹⁵ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 349.

¹⁶ Investigation Committee on the Accident at the Fukushima Nuclear Power Stations of Tokyo Electric Power Company, Government of Japan. (2011). *Chōshu kekka-sho* [report of hearing results]. November 30. Tokyo: GOJ. Retrieved May 26, 2020 from

http://warp.da.ndl.go.jp/info:ndljp/pid/10317644/www.cas.go.jp/jp/genpatsujiko/hearing_koukai/348_349_koukai.pdf#page=13 (In Japanese.) p.13

decided to ask the JSCE to carry out research on long-term evaluation and keep the tsunami height design assumptions as they were until the results were in hand.

Regarding that meeting, Makoto Takao, then manager of the civil engineering survey group reorganized from the civil engineering group, later testified in a court as follows.

“Given the situation up until the meeting, I hadn't expected that kind of conclusion, so to put it simply, I think it was a situation where I lost heart.”

The conclusion of the management differed from the engineering judgment of Takao and others in the field. Takao repeatedly used the words “I lost heart” in court.

“We had been looking into various options, so to have those things put on hold for a while, that was what was happening, so I felt like I'd lost heart.”¹⁷

His subordinate Toshimichi Kaneto testified as follows.

“I thought that engineering some countermeasures was necessary. This later led to asking the JSCE to conduct research, but even if the research was carried out, I was pretty sure they would still say a tsunami of a certain scale would occur. Because technically speaking, there was no material to overturn what the Earthquake Headquarters was saying, I thought that was what would happen and I believed we would build some countermeasures sometime though it might be delayed a little.”

Although it was not accepted by Deputy Chief Nuclear Officer Muto and the management of TEPCO, the engineering judgment of the civil engineering survey group remained the same. Toshiaki Sakai, the group manager, saw Muto's decision as “buying time”.¹⁸

In 2009, the recommendation to establish a cross-sectional body was rejected

The ensuing examination of tsunami countermeasures did not proceed smoothly. The following summer, the civil engineering survey group proposed the creation of a system within the nuclear asset management department.

Takao, manager of the civil engineering survey group, testified as follows.

“I thought we needed some kind of body headed by someone who knew more about the overall safety of the plant to organically link and look at what each individual group was doing, not each group working on their own.”¹⁹

Kaneto testifies as follows.

“We all [at the Civil Engineering Survey Group] had a common understanding that we would have to take countermeasures sometime, but the understanding of [other] groups actually implementing the countermeasures was probably a little more ambivalent (...) they didn't have such a strong conviction, so I thought it would be difficult to make progress.”²⁰

¹⁷ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 297-1, Witness Interrogation Report (2018, April 10). 5th Trial. pp.110-111

¹⁸ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 298-1, Witness Interrogation Record (2018, April 24). 8th Trial. pp.95-96

¹⁹ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 297-2, Witness Interrogation Report, (2018, April 11). 6th Trial. pp.32-33

²⁰ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 299-1, Witness Interrogation Report. p.100

The civil engineering survey group headed by Sakai, to which Takao and Kaneto belonged, was in charge of the tsunami assessment for the nuclear power plants, but they were not familiar with reactor plants themselves. They were not particularly familiar with matters such as what it would be like at the reactor plant if a tsunami exceeded the site height at Fukushima Daiichi. Although the civil engineering survey group was able to come up with ideas for measures related to “civil engineering” such as seawalls and breakwaters, the group was not skilled in fields other than civil engineering. Each group in the nuclear asset management department would have to autonomously come up with ideas for measures in a broader context.

According to Sakai's testimony, after receiving suggestions from his subordinates, when he consulted with the manager of the Component Seismic Design Group in the nuclear asset management department in July 2009, he was told that:

“Sakai-san, do you think you can show the manufacturers, who are so busy right now, an issue with an undetermined tsunami water level and ask them to think about it?”

Upon hearing this, Sakai thought the following. “In fact, you’re right.”

At the end of July of the previous year, The Nuclear Power and Plant Siting Division decided to request that the Japan Society of Civil Engineering conduct a study on estimated tsunami heights at the discretion of Deputy Chief Nuclear Manager Muto. Therefore, the civil engineering survey group, including Sakai, were obliged to follow this study and could not self-determine the tsunami height level. Although Sakai's group recognized the necessity of taking measures, they had no choice but to agree with the manager of the seismic resistance group as the reality was that “unless the water level is clarified, proper measures cannot be taken.”

Sakai later testified about this conversation as follows.

“I thought it was tough, that it wasn’t anyone’s fault, or partly my fault, because it would be difficult to move forward if the civil engineering survey didn’t establish a water level.”²¹

In this instance, it can be said that the study on tsunami countermeasures led TEPCO to get tangled in their own net due to the decision made the previous year to postpone.

2. The politics behind putting off tsunami preparedness

TEPCO still claims its “pre-accident tsunami countermeasures were appropriate”

In this way, the proposal of the civil engineering survey group regarding the tsunami countermeasures for the Fukushima nuclear power plants within TEPCO was repeatedly rejected from the summer of 2008 to the summer of 2009. The greatest reason for this was the considerable gap that existed between the engineers in the civil engineering survey group and other engineers. Their areas of specialization were completely different, and there was a difference in the degree of awareness of the premises underpinning the necessity for tsunami countermeasures. This difference in perception was not resolved and the gap between the two went unfilled, then along came March 2011.

The following internal circumstances at TEPCO, for example, form a backdrop to this. For example, it was not easy for the engineers in the civil engineering survey group to get the chance to meet and discuss with their superiors such as the head of the nuclear asset management

²¹ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 298-1, Witness Interrogation Report, (2018, April 24). 8th Trial. p.117

department.²² Sakai, the group manager, encouraged his subordinates to take up smoking to be able to interact with superiors and other engineers outside the group in the smoking room.²³ It appears that the engineers of the civil engineering survey group had only two chances to discuss the risk of a tsunami with Muto.

TEPCO also had a corporate culture averse to the widespread dissemination of important knowledge and proposals within the company before carrying out *nemawashi* (informal consensus building).

Take, for example, the episode where at an internal meeting on March 7, 2008, Takao, a manager of the civil engineering group, explained first and foremost to the engineers in charge of construction and component seismic design that the tsunami height expected at the Fukushima Daiichi Nuclear Power Station would be around 12 to 13 meters.²⁴ This story spread through the nuclear asset management department reaching Yoshida's ears, and Yoshida inquired of group manager Sakai, "That's considerably higher than previous numbers". Sakai seemed to have taken this as a sign of disfavor, and on March 10, he warned his subordinate, Takao, "Let's do it properly and explain it to the manager at a slightly earlier stage."²⁵

When proposing a cross-sectional examination body within the nuclear asset management department on July 1, 2009, Sakai cautioned Kaneto, a subordinate, regarding "things that tend to happen at TEPCO."²⁶

"Your way of working is kind of immature. Of course everyone's going to oppose it if you just shove it right out there."

"You've got to lay the groundwork beforehand. If you don't take it to the meeting after you've already got about 80% of the relevant departments on your side, they'll say, we weren't told, that's how things end up in Japan."²⁷

This kind of decision-making style, which emphasizes communication in the smoking room and prior informal "nemawashi" negotiations, may delay or incompletely share a common cognitive approach via formal routes. It also has the effect of obfuscating responsibility within the organization. In this way, it is not logical judgment based on objective facts or scientific grounds that leads decisions, but rather a distorted judgment that reads the atmosphere of the place, excessively reflecting the opinion of people in high positions or with strong voices.

This may be due to circumstances in TEPCO's nuclear power division where engineers who specialize in nuclear reactor plants often take on important jobs, whereas civil engineers do not, and there is a difference in their power relations, such as their ability to voice opinions internally. The engineers in a position to make decisions were not specialized in tsunami evaluation or civil engineering. For example, Yoshida, who was the head of the nuclear equipment management department, later said, "I'm not familiar with this field originally" "I have never worked on creating the (design) conditions until now, so I don't understand it" "I'm almost an amateur."²⁸

²² Sakai testifies that "the TEPCO managers are very busy. On a daily basis, people are lining up to speak with them." In TEPCO Shareholder Lawsuit. (n.d.). Plaintiff's Exhibit 298-1, Toshiaki Sakai Witness Interrogation Report. p.9.

²³ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 298-3.

²⁴ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 298-3, No.29, TEPCO's internal document dated March 7, 2008.

²⁵ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 298-1, Toshiaki Sakai Witness Interrogation Report. p.43

²⁶ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 298-3, No.106, email from Sakai dated July 1, 2009.

²⁷ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 298-1, Toshiaki Sakai Witness Interrogation Transcript. p.116

²⁸ Investigation Committee on the Accident at the Fukushima Nuclear Power Stations of Tokyo Electric Power Company, Government of Japan. (2011). *Chōshu kekka-sho* [report of hearing results]. November 30. Tokyo: GOJ. Retrieved July 30, 2020 from

From 2008 to 2009, despite the civil engineering survey group having more tsunami expertise and experience than management and the nuclear engineers inside TEPCO, the technical judgments of the civil engineering survey group were repeatedly overturned regarding tsunami countermeasures for the Fukushima Daiichi Nuclear Power Station. No scientific basis was provided for this overthrow. Yamashita, head of the Niigata-Chuetsu-Oki Earthquake Restoration Management Center and No. 2 in the nuclear asset management department, admitted to the Tokyo District Prosecutor that there were no particular scientific grounds.²⁹ One could say that amateurs overturned the experts' engineering judgment.

This story is reminiscent of the famous episode on the eve of the Space Shuttle Challenger explosion on January 28, 1986. At a meeting between rocket manufacturer Morton Thiokol and the Aerospace Agency (NASA), field engineers at the company opposed the launch the next day, which was expected to be cold, due to concerns over the properties of the rubber O-ring sealant. Vice President Bob Lund, who was in charge of engineering, also expressed the same opinion to NASA. In response, senior vice president Jerry Mason overturned the decision of his vice president in charge of engineering, saying to him, "we have to make a management decision" and asking him to take off his engineering hat and put on his management hat.^{30 31}

This case is almost always taken up in engineering ethics textbooks as a prime example of the guiding norm for engineers that when a person's life may be harmed or a large loss may be incurred, engineers should not acquiesce to management decisions, but resist unjustifiable management decisions.

It can be said that from 2008 to 2010 engineers in TEPCO's civil engineering survey group faced the same dilemma as Morton Thiokol's rocket engineers.

As a general theory, management judgments are made comprehensively by weighing various factors. The judgments regarding nuclear safety are also made comprehensively by taking into account a wide range of factors such as opinions of engineers in other fields, costs, and influence on local area and administration. As a result, it is possible that a decision different from the technical judgment of the civil engineering research group is reached, which should not be the sole reason for criticism. However, in making such a comprehensive decision, the decision-maker must fully understand the content of key technical decisions and weigh objectively without distortion. If an amateur who has no tacit knowledge of the technology is going to make a decision, the decision-maker should not rely on his/her intuition. In particular, when the decision is different from technical judgments, it is necessary to pay more attention than in other cases. TEPCO's decision making at the end of July 2008 does not seem to meet the requirements essential for making comprehensive judgments.

However, TEPCO continues to insist that tsunami countermeasures before the Fukushima accident were "appropriate and taken in light of the scientific and professional knowledge at each juncture"³²,

<http://warp.da.ndl.go.jp/info:ndljp/pid/10317644/www.cas.go.jp/jp/genpatsujiko/hearing_koukai/348_349_koukai.pdf#page=4> (In Japanese.) p.4, 6, 13.

²⁹ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 349, Affidavit by Kazuhiko Yamashita, (January 28, 2013). Tokyo District Public Prosecutor.

³⁰ Presidential Commission on the Space Shuttle Challenger Accident. (1986). *Report of the Presidential Commission on the space shuttle Challenger accident*. Last accessed May 12, 2020 at https://spaceflight.nasa.gov/outreach/SignificantIncidents/assets/rogers_commission_report.pdf#page=99

³¹ Okuyama, T. (2004). *Naibu kokuhatsu no chikara - Kôeki tsûhônsha hogohô wa nani o mamoru no ka* [The power of whistleblowing: what does the Whistleblower Protection Act protect?]. Tokyo: Gendaijin Bunsha. (In Japanese.) pp.190-193

³² TEPCO Shareholder Lawsuit. (2017, February 24). TEPCO auxiliary intervenor, preparatory document no.21.

“our actions were reasonable”³³.

3. In a business judgement where human lives are at stake, don't ignore the technical judgement of engineers without valid reason

Management tried to overturn technical assessments even in accident response

The case where TEPCO management overturned on-site engineering assessment can also be seen in its response to the situation in the immediate wake of the Fukushima nuclear accident.

Around 7:25 pm on March 12, 2011, Ichiro Takekuro, a former TEPCO vice president and Chief Nuclear Officer then fellow, instructed Masao Yoshida, site superintendent of the Fukushima Daiichi nuclear power plant, to stop the injection of seawater into Unit 1 where core meltdown was ongoing. At the time, there was ongoing debate in the Prime Minister's Office between Prime Minister Naoto Kan and Haruki Madarame, Chairman of the Nuclear Safety Commission, about possible adverse effects on the core if seawater was injected. According to TEPCO, Takekuro judged that “future coordination with necessary government organizations would be impeded even further if field work proceeded without the approval of the Prime Minister, as the PM is the chief of the Nuclear Disaster Response Headquarters.”³⁴ President Masataka Shimizu of TEPCO supported Takekuro to do so.³⁵

His judgement to give priority to consideration for the government over safety was quite unreasonable. In the end, aggravation of the situation was avoided because site superintendent Yoshida did not obediently obey him, but this episode graphically demonstrates the adverse effect of management judgments taken after rejecting onsite engineering assessments.

This is not the only such case.

On the evening of March 14, 2011, a conflict of opinion occurred concerning Unit 2, which had lost all its cooling function, as to whether priority should be given to starting water injection after depressurizing the reactor pressure vessel or venting the containment vessel. Yoshida said that he asked head office's opinion, telling them that Haruki Madarame, chairman of the government's Nuclear Safety Commission, had sent him a “suggestion” that water should be injected into the reactor pressure vessel before venting the containment vessel. It was the assessment of the onsite engineers at Fukushima Daiichi that priority should be given to venting the containment vessel, and engineers at the nuclear reactor safety engineering group at head office agreed with them. However, at 4:22 pm, President Masataka Shimizu of TEPCO interrupted the discussion and said,

“Yoshida-san. This is Shimizu. Please follow Chairman Madarame's method.”

Yoshida said, in a somewhat taken aback manner, “I have received the head office President's instruction, technically speaking...,” and spoke to the screen, “Executive General Manager Muto, is this alright?” However, there was no reply.³⁶ Muto, who was also executive vice president and chief nuclear officer, was traveling by helicopter from Fukushima to Tokyo at the time, so he was not

³³ Fukushima Evacuee Lawsuit. (2019, September 5). Group 1 preliminary appeal, preparatory document no.5 submitted by TEPCO Holdings' legal attorney. Retrieved from https://8b1b4cba-02ec-489e-99fb-71f4eee99d09.filesusr.com/ugd/8b6c85_d42489c05d60407c9ba883b92714106f.pdf#page=17 (In Japanese.) p.16

³⁴ Tokyo Electric Power Company, Inc. (2012). *Fukushima Nuclear Accident Analysis Report (Final Report)*. p.133 https://www.tepco.co.jp/en/press/corp-com/release/betu12_e/images/120620e0104.pdf#page=200

³⁵ Answer by Masataka Shimizu in a NAIIC meeting, June 8, 2012.

<https://warp.da.ndl.go.jp/info:ndljp/pid/3856371/naic.go.jp/wp-content/uploads/2012/08/18th-report.pdf#page=6>

³⁶ Asahi Shimbun. (2012). *Kenshō Tōden Terebi Kaigi* [Investigation: TEPCO's Televised Meeting]. Asahi Shimbun. (In Japanese.) pp.301-303

available by videoconference.

Unlike site superintendent Yoshida, who majored in nuclear engineering at the Tokyo Institute of Technology, and Chief Nuclear Officer Muto, a graduate of the University of Tokyo's Department of Nuclear Engineering and familiar with nuclear fuel and safety analysis, President Shimizu graduated from Keio University's Faculty of Economics and had never specialized in nuclear engineering. It was this President Shimizu who overturned the onsite engineering assessment and decided to give priority to depressurizing and injecting water into the pressure vessel.

TEPCO did not mention the fact that President Shimizu overturned the vent-prioritizing engineering judgement for Unit 2 in this way either in its 2012 Accident Investigation Report or the Anegawa Plan summary.³⁷ However, the Anegawa Plan clarified that “The field commander is given the ultimate responsibility for responding to the situation, and the people around him (even those from higher-ranking organizations or in higher-ranking positions) are assigned roles in which they work to support the field commander.”³⁸ According to TEPCO, this system has been adopted into its drills.³⁹

TEPCO's interference in the wording of the public statement on long-term evaluation by the government's Earthquake Headquarters

The history of TEPCO's attempted interference in the long-term evaluation of the nation's Earthquake Headquarters, something that should be compiled from a purely scientific point of view, shares similar problems to the case where TEPCO management overturned its onsite engineering assessment.

From 2010, the earthquake research committee of the government's Earthquake Headquarters had been examining the results of research on the underground traces of past tsunami in the Pacific Coasts of Miyagi Prefecture and Fukushima Prefecture, discussions taking place towards including them in the Long-term Evaluation of Seismic Activity from off the Sanriku Coast to off the Boso Peninsula (Second Edition) to be announced in the following spring of 2011.

According to the e-mail from Takao of the civil engineering survey group to TEPCO Executive Vice President and Chief Nuclear Officer Muto on February 22, 2011, an examiner at NISA told him, “It depends on how and what the Earthquake Headquarters announces, but if NISA finds to be not able to withstand, there's a possibility that it will issue some instruction to the operators.” In response to this e-mail, Muto instructed Takao on the afternoon of February 26, “This may have a huge impact depending on how the discussions go, so I'm asking you to pay consideration to communicating with NISA on every level and sharing information.”⁴⁰

Five days later, on March 3, a meeting was held between officers from the Ministry of Education's Earthquake Headquarters Secretariat and electric power company engineers like Takao from TEPCO. Officers of the Ministry of Education distributed a draft of the long-term evaluation with a description along the lines of “It is necessary to keep in mind that a huge tsunami (...) has hit multiple times along the coast from central southern Miyagi to central Fukushima”. According to TEPCO records, the

³⁷ Tokyo Electric Power Company, Inc.'s Fukushima Nuclear Accident Analysis Report 2012, p. 163, Appendix-2, pp. 73–74, pp. 79–80 has an explanation on the change of decisions but nothing on Mr. Shimizu. Retrieved from https://www.tepco.co.jp/en/press/corp-com/release/betu12_e/images/120620e0104.pdf#page=233, https://www.tepco.co.jp/en/press/corp-com/release/betu12_e/images/120620e0101.pdf#page=96, https://www.tepco.co.jp/en/press/corp-com/release/betu12_e/images/120620e0101.pdf#page=100

³⁸ Tokyo Electric Power Company. (2013). Fukushima Nuclear Accident Summary & Nuclear Safety Reform Plan. Retrieved from https://www4.tepco.co.jp/en/press/corp-com/release/betu13_e/images/130329e0801.pdf#page=93

³⁹ Answers to questions asked by Asia Pacific Initiative from TEPCO Holdings Inc., 2020, July 2.

⁴⁰ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 297-4, Witness Makoto Takao, No.1.

TEPCO side said, “We don’t intend to deny the science, but some people with rose-colored glasses sometimes quote part of the text of the Earthquake Headquarters and use it to their own advantage”, requesting the Ministry of Education to “please pay attention to the wording of the text so that it won’t be misused”, and “we would like you to change the wording because it can be read as if the Jogan Earthquake style earthquakes have occurred repeatedly.”⁴¹

In response to this, the Ministry of Education started to revise its long-term evaluation draft. The revised draft of March 8 was changed, as if in line with TEPCO's intention, to “There is insufficient data to ascertain as to whether the Jogan Earthquake style earthquakes have repeatedly occurred as a natural earthquake⁴²” being added.⁴³

The wording used in the long-term prediction of earthquakes and its official government documents should be determined purely on scientific grounds. Above all, there is a trade-off between how rigorously to express the degree of uncertainty in individual long-term projections and the reader's comprehension, and it is a delicate issue that requires the comprehensive judgement of scientists based on the latest and best knowledge. It would be acceptable if the revision were in response to various opinions requested under an open procedure, clearly expressing one's own position. However, the attempt of TEPCO, a stakeholder, to change the wording of a public statement on the long-term evaluation by the Earthquake Headquarters in a closed room cannot help but be taken as an interference that injects something other than science into a scientific matter. It is similar to the case of the Space Shuttle Challenger accident where management forced a change in engineering assessments and perverted scientific judgment. MEXT (Ministry of Education, Culture, Sports, Science, and Technology), who were going to accept the revision positively, and TEPCO should both reflect on this, but in reality, they do not.

Regarding this situation, TEPCO still maintains the view that “our company only stated that the statements should correctly reflect the current situation.”⁴⁴ In other words, TEPCO has not learned anything.

4. Diversify responses to preparedness and reduce risk substantially

Prior to the Fukushima accident, no Japanese electric power company or nuclear regulatory organization substantially and adequately adopted the approach of calculating the probabilistic risk of accidents and using that as an evaluation axis for taking safety measures to reduce that risk. A deterministic stance where it would be good enough to meet a predetermined standard formed the mainstream. TEPCO, therefore, recognized that the Fukushima Daiichi Nuclear Power Station had a relatively high risk of losing both AC and DC power supply due to a tsunami leading to a major

⁴¹ Investigation Committee on the Accident at the Fukushima Nuclear Power Stations of Tokyo Electric Power Company. (2011, August 18). *Chōshu kekka-sho* [report of hearing results]. Retrieved from http://warp.da.ndl.go.jp/info:ndljp/pid/10317644/www.cas.go.jp/jp/genpatsujiko/hearing_koukai/348_349_koukai.pdf#page=13 (In Japanese.) p.13

⁴² *Sanriku oki kara Bōsō oki ni kakete no jishin katsudō no chōki hyōka no heisei 23 nen sangatsu yoka jiten deno shusei soan ni tsuite* [Draft amendments to “long-term evaluation of seismic activity from the coasts of Sanriku to Bōsō” as of March 8, 2011]. (In Japanese.) The document was disclosed by the MEXT to the author in February 2020 on the basis of the application of the Law Concerning Access to Information held by Administrative Organs.

⁴³ Hashimoto, M., Shimazaki, K., & Sagitani, T. (2015). *2011-nen 3 tsuki 3-nichi no jishinchōsakenkyūsuishinhonbu jimukyoku to denryoku jigyō-sha ni yoru Nihon kaikō no chōki hyōka ni kansuru jōhō kōkan-kai no ikisatsu to mondaiten* [Background and problems of information exchange on the long-term evaluation of the Japan Trench between the Secretariat of the Earthquake Research Promotion Headquarters and electric power companies on March 3, 2011]. *Monograph of the Seismological Society of Japan*, 3, 34–45. Retrieved from <https://www.zisin.jp/publications/pdf/monograph2015.pdf#page=37> (In Japanese.) p.37

⁴⁴ Answers to questions asked by Asia Pacific Initiative from TEPCO Holdings Inc., 2020, July 2.

accident, but did not try considering measures across departments and in fact, did not take any effective measures. As a result, the Fukushima Daiichi Nuclear Power Station had inadequate diversity in the location of power supply equipment, no effective preparation for emergency aid equipment or support from outside, and no manual or training to deal with a loss of both AC and DC power supply incident, which caused the accident to expand and spread.

The probability of a beyond-design-basis tsunami was anticipated to be at a level that could not be ignored in engineering terms

As of December 2004, TEPCO recognized that the probability of Units 1 to 4 at the Fukushima Daiichi Nuclear Power Station being hit by a tsunami exceeding the site height was slightly lower than once every 100,000 years.⁴⁵ It is said that a common yardstick for the frequency of event occurrence that can be generally ignored in nuclear safety design is once or less in a million years,⁴⁶ but the value was close to an order of magnitude higher than that.

On the other hand, according to a report on the results of probabilistic risk assessment released to the general public by electric power companies including TEPCO in May 2002 in line with the requests from the regulatory authority, the frequency of total containment damage at Fukushima Daiichi Nuclear Power Station No. 1 was 1.0 times per 100 million years and 1.2 times for Unit 2.⁴⁷ Similarly, according to a report released by TEPCO in March 2004, the total containment damage frequency for Unit 3 was 1.3 times and that for Unit 4 was 1.5 times⁴⁸. As a side note, in a ranking table comparing the core damage frequency values of 29 boiling water reactors nationwide, the worst four were Units 1 to 4 at the Fukushima Daiichi Nuclear Power Station.⁴⁹

There was a serious problem with this “1.0 to 1.5 times per 100 million years” containment vessel damage frequency of Units 1 to 4 at the Fukushima Daiichi. That is, the value was calculated without taking into consideration external events such as tsunami and earthquakes. The evaluation was limited to internal events such as loss of coolant accidents. In the earthquake-prone country of Japan, unrealistically understated values and underestimated probabilities were publically announced. The probability of a tsunami exceeding the site height with a high possibility of linking directly to core damage, in turn leading to containment failure was an order of magnitude higher than announced.

According to TEPCO data dated May 25, 2006, albeit a trial calculation for Unit 5, the probability of a tsunami with a height of 10 meters was once every tens of thousands of years, and the probability

⁴⁵ Tokyo Electric Power Services CO.,Ltd. (2004). *Kisetsu pranto ni taisuru tsunami hazard kaiseki itaku houkokusho* [Report on Tsunami Hazard Analysis for Existing Plants] (In Japanese.) pp.4-45. The document was disclosed by Nuclear regulation authority to the author in July 2020 on the basis of the application of the Law Concerning Access to Information held by Administrative Organs.

⁴⁶ Tokyo Electric Power Company. (2013). *Fukushima genshiryoku jiko no sōkatsuoyobi anzen kaikaku puran* [Fukushima Nuclear Accident Summary and Safety Reform Plan]. Report, March 29. Retrieved May 13 from https://www.tepco.co.jp/cc/press/betu13_j/images/130329j0401.pdf (In Japanese.) p.18
https://www4.tepco.co.jp/en/press/corp-com/release/betu13_e/images/130329e0801.pdf#page=21

⁴⁷ Tokyo Electric Power Company. (2002). *Akushidento manejimento seibi yūkōsei hyōka hōkoku-sho* [Accident Management Maintenance Effectiveness Evaluation Report]. (In Japanese.) pp.35-36

⁴⁸ Tokyo Electric Power Company. (2004). *Akushidento manejimento seibi-go kakuritsuronteki anzen hyōka hōkoku-sho* [Probabilistic Safety Assessment Report following Accident Management Improvement]. (In Japanese.) pp.20-21

⁴⁹ Ministry of Economy, Trade and Industry, Nuclear and Industrial Safety Agency. (2004, October 18). *Keisui-gata genshiryokuhatsudenjo ni okeru `akushidentomanejimento seibi-go Katashi-ritsu-ron-teki anzen hyōka' ni kansuru hyōka ni tsuite* [Concerning the evaluation of "probabilistic safety assessment following improvement of accident management" in light water nuclear power plants]. Retrieved from <https://warp.da.ndl.go.jp/info:ndljp/pid/1368617/www.meti.go.jp/press/0005696/0/041018accident.pdf#page=10> (In Japanese.)

of a tsunami exceeding the tsunami height design assumption of 6 meters was once in thousands of years.^{50 51} In June 2007, a member of TEPCO's management team recognized that the probability of a tsunami exceeding design assumption was "expected to not reach a negligible level in engineering terms."⁵²

According to the tsunami hazard curve (a graph showing the relationship between the water level of the tsunami and the probability of exceeding it) shown by Managing Director Muto, when the civil engineering research group recommended the installation of breakwaters and seawalls in the summer of 2008, the probability that the tsunami would exceed the estimated height of 5.4 to 5.7 meters at that time was approximately once per 1,000 years, and the probability that it would exceed 10 meters, which was equivalent to the site height of Units 1 to 4, was once per tens of thousands of years.⁵³ The probability of exceeding 13 meters, which was equivalent to the site height of Units 5 and 6, was once every several hundred thousand years. Compared to "1.0 to 1.5 times per 100 million years," these were extremely high probabilities.

On July 23, 2008, TEPCO's Takao held a liaison meeting with Tohoku Electric Power Company, which has nuclear facilities on the Pacific coast of eastern Japan, the Japan Atomic Power Company, and tsunami-related staff at the Japan Atomic Energy Agency. At the meeting, it was explained that the yearly probability of a tsunami exceeding the conventional expected tsunami height would be one thousandth (frequency is once every few hundred years), and the probability of a tsunami height of more than 10 meters would be one 100,000th (frequency is once every few tens of thousands years), in accordance with the view from the Earthquake Headquarters. Takao added that, "Since the earthquake hazard is one 100,000th, we are proceeding to internally coordinate on the assumption that the Earthquake Headquarter's tsunami prediction should also be considered."⁵⁴ In the seismic guidelines revised in 2006, the regulatory authority requires considering active faults, whose activity cannot be denied since the late Pleistocene (126,000 years ago), in the design. Similarly, the statement expressed that even if a tsunami exceeding height assumptions were to occur only once per approximately 100,000 years, it would be included in the design assumptions.⁵⁵

The frequency of tsunami hazards referenced in these studies by TEPCO's Takao of the civil engineering research group was based on the results of a survey of seismologists, tsunami researchers, and TEPCO's civil engineering engineers. The survey quantified epistemological certainty through establishing an average value of the frequencies by weighing and combining different views, with an emphasis on the opinions of seismologists.

⁵⁰ TEPCO Shareholder Lawsuit. Defendant's Exhibit B116.

⁵¹ The National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission. (2012). *Tōkyō denryoku fukushima genshiryoku hatsudensho jiko chōsa iin kaihōkokusho* [The official report of the Fukushima Nuclear Accident Independent Investigation Commission]. Report, July 5. Tokyo: Diet. (In Japanese.) p.93 https://warp.da.ndl.go.jp/info:ndljp/pid/3856371/naaic.go.jp/wp-content/uploads/2012/08/NAIIC_Eng_Chapter1_web.pdf#page=32

⁵² TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 488.

⁵³ TEPCO Shareholder Lawsuit. Plaintiff's Exhibit 297- 4, document no.112, "Tsunami Hazard Curve (Fukushima Daiichi Unit 6)."

⁵⁴ TEPCO Shareholder Lawsuit, (2008, July 23), Plaintiff's Exhibit 297-4, document no.115, "Meetings of four companies information liaison meeting regarding tsunami", Japan Atomic Power; TEPCO Shareholder Lawsuit, Plaintiff's Exhibit 297-1, Takao Witness Interrogation Record in Criminal Procedure, pp. 102, 103.

⁵⁵ Kaneto, one of Takao's subordinates, said in his testimony at the criminal trial, "The probability of a tsunami exceeding 10 meters, or the probability of the water level of a tsunami exceeding that level, was set at 10 to the minus 5th power, and that number, 10 to the minus 5th power, was used as a reference for earthquake hazard in the formulation of the reference seismic motion. The reference result was about 10 to the minus 5th power, so the probability of the earthquake and the tsunami event we are considering now have about the same level of annual exceedance. TEPCO Shareholder Lawsuit, Plaintiff's Exhibit 299-1, p.58.

TEPCO engineers possibly were aware by the end of 2010 that the probability of a tsunami exceeding the site height of 10 meters at the Fukushima Daiichi Nuclear Power Station Unit 4 was slightly lower than once in 10,000 years.⁵⁶

This figure is almost four orders of magnitude higher than the publicly released frequency of containment damage of “1.0 to 1.53 times in 100 million years” due to internal events. It is nearly two orders of magnitude higher than the “once in a million years” that is generally considered to be the frequency of events that can be ignored in nuclear safety design. In addition, it is an order of magnitude larger than the containment failure frequency of “approximately once in 100,000 years,” which was a rough performance goal from the regulator for nuclear power plants.

TEPCO at the time in 2011 had a tsunami height design assumption of 5.7 to 6.1 meters for the Fukushima Daiichi Nuclear Power Station, but if it exceeded that even by one meter, it would lose its ability to remove heat from the reactor system, and if it exceeded the site height of 10-13 meters by just one meter for a certain period of time, the design was such that both AC and DC power supply would be lost and the reactor could not be controlled. This was recognized as a natural premise among some engineers in the nuclear asset management department.^{57 58} Nuclear circles refer to a “cliff edge” when things worsen little by little before the cliff’s edge, but deteriorate suddenly and almost topsy-turvily the moment the edge of the cliff is breached. A six-meter high tsunami was the first cliff edge and a ten-meter high tsunami height was the second cliff edge. It was known in advance there was a high probability close to one in one that the core and containment would be damaged if the tsunami crossed the second cliff edge.

It is thought that in order to reduce the probability of core damage, this “one in one” had to be reduced to “one in ten” or “one in a hundred”, which was possible without too much cost. In other words, in order to maintain the minimum safety equipment even if the tsunami exceeded expectations, there are some feasible options such as making building doors and pipe penetrations watertight, lifting air intake and exhaust ports to higher positions, making important rooms inside the buildings watertight, installing independent power sources at higher locations, preparing portable power supplies that can be carried by staff and replacing various pumps, preparing manuals of them, and training personnel

⁵⁶ Judgment in the first criminal trial in which former TEPCO chairman Katsumata and others were indicted for professional negligence resulting in deaths and injuries, Tokyo District Court Criminal Division 4, September 19, 2019, p.34.

⁵⁷ General Manager of TEPCO Nuclear Power & Plant Siting Division Matsumoto Junichi said the following in a press briefing on May 15, 2012:

"Obviously, you should consider the possibility that when water inundates the ground of the site the water will enter through the opening and flood the power supply, causing loss of function. (...) It is just common sense."

"Apparently, the result was the complete loss of power due to the tsunami reaching above ground-level."

"Obviously, when water inundates the ground of the site the water will enter through the opening and flood the power supply, causing loss of function. This is common knowledge for nuclear power operators or engineers like myself. (...) We all know as nuclear engineers that when you lose power you can no longer cool down the reactor, and that if water floods into the site you will lose the function of your power supply."

Nico Nico News. (May 15, 2012) *Tôkyô denryoku kisha kaiken* [TEPCO press conference]. [Video]. Retrieved June 15, 2020 from <https://live.nicovideo.jp/watch/lv92597723> (In Japanese.)

⁵⁸ "Since the indefinite continuation of a tsunami at the height of ground level plus 1 meter would lead to the indefinite entry of seawater into station buildings from their openings, the result unsurprisingly pointed to the loss of functionality for many of the electrical facilities and motor-driven facilities," in TEPCO, 2012, p.38.

https://www.tepco.co.jp/en/press/corp-com/release/betu12_e/images/120620e0104.pdf#page=62

to use them in an emergency.^{59 60}

They could easily derive ideas if thought through not only by the civil engineering survey group, but also by gathering the wisdom of engineers in electrical, mechanical, architectural and nuclear engineering departments within TEPCO.

In fact, in the material prepared by the Nuclear Facilities Management Department for the "Imperial Conference" held at TEPCO on February 16, 2008 with the President and CEO, Katsumata, stated measures to be examined that accompanied the document "Change in tsunami height assumption," included "improvement of waterproofness of building", "improvement of sealability of penetrations and doors", and "preservation of pump motor spare parts" for "maintaining function of emergency seawater pump."⁶¹ From December 2008 to September 2009, Japan Nuclear Power Company, another company in the same industry that TEPCO has invested in and dispatched engineers for, has actually implemented construction work such as waterproofing the building doors. Another nuclear operator voluntarily purchased a spare part of the seawater pump motor in 2008 and installed it in the power plant. These measures were prepared at a cost of tens of millions to billions of yen, not of tens of billions of yen.⁶²

By combining such methods in multiple and various ways, it was possible to reduce “one in one” to “one in tens” and eliminate the cliff edge. In other words, even if an unexpected tsunami occurred, it would be possible in most cases to stop before core damage, and it was not impossible to sufficiently reduce the probability of tsunami-induced core damage to low enough levels.

⁵⁹ "if we had taken the initiative to consider necessary measures and had implemented countermeasures such as waterproofing battery rooms or preparing back-up power sources, we might have mitigated to a certain extent the impact of the Tohoku-Chihou-Taiheiyo-Okai Earthquake and Tsunami and might have prevented the worst-case situation in which a large amount of radioactive materials were released." in TEPCO, 2013, p.18.

https://www4.tepco.co.jp/en/press/corp-com/release/betu13_e/images/130329e0801.pdf#page=21

⁶⁰ In a request for compensation from TEPCO and the government by people who fled Fukushima Prefecture during the Fukushima Daiichi Nuclear Disaster, on March 17, 2017, Maebashi District Court approved partial compensation and noted in its reasoning that "several concrete actions could have been taken to avoid this disaster, including (i) raising the air supply louvers to raise the lowest point of the opening, (ii) installing the switchgear and air-cooled emergency DGs on the upper floors of the building, and (iii) installing the switchgear and air-cooled emergency DGs (together with a power truck) on higher ground and laying permanent underground cables to connect them to the cooling system. Had either option (i) or (iii) been secured then cooling functions would not have been lost and the accident would not have occurred.

https://www.courts.go.jp/app/hanrei_jp/detail4?id=86691.

https://www.courts.go.jp/app/files/hanrei_jp/691/086691_hanrei.pdf#page=174.

⁶¹ TEPCO Shareholder Lawsuit, (2006, February 16), Plaintiff's Exhibit 298-3, document no. 20, TEPCO internal document, "Launch of seismic safety assessment based on Ss," TEPCO Nuclear Equipment Management Department Chuetsu-oki, Niigata Prefecture Earthquake Countermeasure Center.

⁶² The Japan Nuclear Power Company's (JNPC) technical review document (approval date: December 2, 2008) attached to the investigation report (regarding making a copy of the file titled JNPC document 5 concerning tsunamis) (created by Yukie Yasuhara, Tokyo District Public Prosecutor's Office, dated July 10, 2018) of the TEPCO shareholder lawsuit plaintiff's exhibit 466 (plaintiff's exhibit A265 in the criminal trial) states with regards to the Tokai Daini Power Station and Tsuruga Power Station Units 1/2 that functional equipment related to reactor shutdown, cooling, or confinement (hereinafter referred to as "safety functional equipment") will be lost in the event of extreme flooding onsite (Tokai: Tsunami, Tsuruga: Tsunami, flood overflow). To prevent this, measures will be taken to stop tides reaching buildings that house safety functional equipment. In addition, measures to prevent tides along the boundaries of controlled areas (excluding those where there is no risk of pollution) will be implemented. With regards to the construction of tsunami prevention measures for the buildings, waterproof doors, tide shutters and dams are listed. According to the Japan Nuclear Power Company's written approval on December 3, 2008, which was attached to the investigation report, the cost for the above measures was estimated to be 186.32 million yen at the three power plants. Of these, the construction period for Tokai Daini was from December 8th, 2008 to September 30th, 2009. In fact, the completion notice was submitted by Shimizu Corporation on the same day, and it was found that the cost of building the tsunami prevention measures at the power plant totalled 33 million yen.

Nevertheless, TEPCO took no such measures and did not try to eliminate this cliff edge. Cost effective measures to reduce probabilistic risk were not considered and thought through seriously. It can be said that the reality was that TEPCO turned away from the magnitude of the probability of core damage taking into consideration the tsunami and did not try to implement measures to reduce the value.

With regard to these circumstances, TEPCO said, “As for the probabilistic safety assessment against tsunami, it had not been established as a concrete assessment method because it was still under research and development as of March 11, 2011.”⁶³

However, the probabilistic evaluation of tsunami height (creating a tsunami hazard curve) was repeatedly attempted, and some of the results were shown to senior management, such as Managing Director Muto, who is in charge of business judgment, and regulatory authorities. If a TEPCO employee who knows the existence of a cliff edge has a stochastic risk that is orders of magnitude greater than the risk of internal phenomena, it can be easily read from the tsunami hazard curve. Nevertheless, if the results were disregarded as “still in the process of research and development,” and the civil engineering survey group rejected the “in-house adjustment that the tsunami predicted by Earthquake Headquarters should be taken into account,” it can be said that Muto, among other TEPCO senior executives, promoted an attitude of neglecting risk. The whole picture of these circumstances has finally been clarified by the evidence submitted to criminal and civil trials, and it is hard to say that TEPCO faced the facts and learned enough from them.

A lack of diversity caused the accident and delays in external support enlarged it

For these reasons, the Fukushima Daiichi Nuclear Power Station had the following weaknesses.

Namely, the locations of key power supply facilities at the Fukushima Daiichi Nuclear Power Station, such as an emergency diesel generator (AC power supply in the station), an emergency high-voltage switchboard, and a DC power supply panel, were located on the ground floor or underground. Nothing was located above the 2nd floor.

Plurality was prepared at each facility, “multiplicity” being secured in that respect. Units 2, 4, and 6 had air-cooled, not water-cooled, emergency diesel generators installed on the first floor above ground, not underground. Whether or not they were intentionally installed that way, they provided a certain degree of diversity. However, it wasn't enough.

All of the emergency generators for units 1, 3 and 5 were placed underground. All of the emergency high voltage switchboards for units 2, 3, 4, and 5 were placed underground. And all of the DC power sources for units 1, 2, and 4 were at the bottom of the basement floor. As a result, these facilities ceased to function as a whole due to the single cause of inundation of the basement floor by the tsunami, both AC power and DC power supply being lost immediately at Units 1, 2 and 4, resulting in a total power outage after the tsunami hit the Station.⁶⁴

The single factor of a tsunami caused the entire dysfunction of Units 1, 2 and 4 to occur because of a lack of “diversity” in the location of the power supply equipment.

⁶³ Answers to questions asked by Asia Pacific Initiative from TEPCO Holdings Inc., 2020, July 2.

⁶⁴ Tokyo Electric Power Company. (2012). Attachment 7-4 “Damage Status at Fukushima Daiichi Nuclear Power Station (After Tsunami).” In *Fukushima Nuclear Accident Analysis Report*. Retrieved from https://www.tepco.co.jp/en/press/corp-com/release/betu12_e/images/120620e0106.pdf#page=323 p.323

In addition, there were only three fire engines, which were used for alternative water injection into the reactors at Fukushima Daiichi, and there were no spare parts for the batteries required for reactor control. There were also no spare seawater pumps that could be used after the tsunami, although there were some spare parts for the pumps.

There were no procedures and no training in preparation for the loss of both AC and DC power sources. No external support was planned enough. For this reason, in order to procure the portable 12 volt batteries required for nuclear reactor control at the Fukushima Daiichi, employees of the site had to take batteries from their own cars or travel around hardware stores in Iwaki city 30 to 70 km away from the plants to buy them, creating a delay until the morning of March 13, the third day after the earthquake. In order to take seawater from the Pacific Ocean to the reactors, four large fire trucks came from TEPCO's own thermal power plants in the Tokyo metropolitan area and arrived at the Fukushima Daiichi Nuclear Power Station on the morning of March 14, the fourth day of the disaster. It was on the night of March 14th that a sufficient amount of 12 volt batteries ordered by head office from Toshiba were delivered to the Fukushima Daiichi Nuclear Power Station. This delay caused fatal damage to Units 2, 3, and 4.

In this way, a lack of diversity in the arrangement of key power supply facilities caused the loss of both AC and DC power supplies, and the lack of ready spare emergency equipment such as batteries, as well as the delay in support from outside, contributed to enlarging the accident.

Prepare versatile external support and ensure diversity in response

The lesson of not only increasing the amount but also diversifying the type of safety equipment in order to reduce the probabilistic risk of an accident was firmly recognized by the Japanese nuclear community in the wake of Fukushima Daiichi accident, including TEPCO and nuclear regulatory organizations.

“We will shift from the conventional securing of reliability through redundancy to ensuring reliability with an emphasis on diversity and positional dispersion to reinforce defense in depth,” says the Anegawa Plan⁶⁵.

However, looking at the current state of nuclear power plants in Japan, the situation seems to be limited to ensuring diversity required by regulations in order to comply with the new regulatory standards set in 2013, rather than seek to vigorously reduce probabilistic risks.

TEPCO's Kashiwazaki-Kariwa Nuclear Power Station significantly increased the number of fire engines deployed after the Fukushima accident, currently having 42 fire trucks. When asked if this was a rational safety measure, a TEPCO executive answered, “I think it is extremely irrational.” He intended to deploy fire engines, but didn't think they needed more than 40. He went on to say that given demands from the regulatory side, they decided to acquiesce because it didn't cost much and safety would not decrease.⁶⁶

Certainly “the more, the better”, but personnel and funds are and will be required in order to maintain and manage them so that they can be operated at any time. If a high effect in reducing risk can be

⁶⁵ Tokyo Electric Power Company. (2013). *Fukushima genshiryoku jiko no sōkatsuoyobi anzen kaikaku puran* [Fukushima Nuclear Accident Summary and Safety Reform Plan]. Report, March 29. Retrieved May 13 from https://www.tepco.co.jp/cc/press/betu13_j/images/130329j0401.pdf (In Japanese.) p.55
https://www4.tepco.co.jp/en/press/corp-com/release/betu13_e/images/130329e0801.pdf#page=63

⁶⁶ Interview with TEPCO executive, November 27, 2019

expected by doing so, then personnel and funding should not be spared, but looking at the Kashiwazaki-Kariwa Nuclear Power Station site and aerial photographs of it, we see that these fire engines are parked together in two specific locations inside the Station premises. TEPCO explained, “The equipment is dispersed on high ground within the power station in order to avoid the risk of not being able to use it at the same time due to an earthquake or tsunami.”⁶⁷ However, when you enter the site, you are greeted by the sight of some ten similar-looking red fire trucks all lined up. Even though there is multiplicity, there is insufficient diversity and incomplete dispersion. No matter how vast the site may be, deploying 42 fire trucks in one site diminishes the marginal utility to near zero.

In this regard, TEPCO seeks to justify the current situation on the grounds that regulators have approved TEPCO’s way as follows. “To prevent fire engines [outside the reactor building] and safety equipment inside the reactor building from being damaged simultaneously by common factors (of a single cause), fire engines are dispersed and separated from the reactor building by a distance of 100 meters or more, so conformity to the new regulatory requirements has been confirmed by the Nuclear Regulation Authority’s review. Therefore, we believe that a complete loss of function will not occur as the result of a single cause.”⁶⁸

Kansai Electric Power Company, Inc. (KEPCO) has also installed air-cooled diesel generator cars and water injection pumps according to the new regulatory requirements at its Takahama nuclear power plant. Looking at the site and aerial photographs, they are located only tens of meters away from the reactor building. According to documents submitted by KEPCO to the regulator, the water injection pump for Unit 4 is at the back of the Unit 3 reactor building, and the water injection pump for Unit 3 is at the back of the Unit 4 reactor building. KEPCO’s explanation is that this meets the “100 meters distance from the reactor building” requirement⁶⁹, an arrangement that has gone unchallenged. Although not as many as the Kashiwazaki-Kariwa Nuclear Power Station, even at the Takahama nuclear power plant, two generator cars of the same type are lined up next to each other. If you are going to the effort of creating multiplicity, diversifying locations and types of equipment contributes to greater safety rather than arranging power sources for the same kind of equipment in the same place, but this is not the case.

Regarding this, the public relations group of the Nuclear Power Division of KEPCO explained that “Based on the regulatory standards, power supply vehicles and fire pumps are located 100 meters or more away from the reactor building of the target unit, with another set stored and distributed 100 meters from the reactor building (...) Furthermore, we are developing initiatives not limited to the regulatory framework to improve safety, such as voluntary deployment of equipment with power supply and cooling functions.” As for the reason for defining “target units” for individual power supply vehicles and pumps, KEPCO believes that “it is possible to carry out more and more training and quickly conclude an accident without causing disorder.”⁷⁰

It is not uncommon to see emergency vehicles such as large-capacity pump cars and power supply

⁶⁷ Tokyo Electric Power Company. (n.d.). *Fukushima daiichi genshiryoku hatsudensho no jiko-ji no kyōkun to kadai wa?* [What are the lessons and challenges from the Fukushima Daiichi NPS accident?]. Retrieved from https://www.tepco.co.jp/kk-np/safety/images/how_image1.pdf (In Japanese.)

⁶⁸ Answers to questions asked by Asia Pacific Initiative from TEPCO Holdings Inc., 2020, July 2.

⁶⁹ Kansai Electric Power Company. (2013, December 20). *Shiryō 3–5 “Takahama 3-gō-ro oyobi 4-gō-ro kahangata jūdai jiko-tō taisho setsubi hokan basho oyobi akusesurūto ni tsuite”* [Documents 3–5, Takahama Units 3/4: portable equipment for severe accidents– storage locations and access routes]. Retrieved from <https://warp.ndl.go.jp/info:ndljp/pid/10249547/www.nsr.go.jp/data/000034987.pdf#page=3> (In Japanese.)

⁷⁰ Kansai Electric Power Company, Nuclear Power Business Headquarters, Community Headquarters, Public Relations Group. (2020, May 15). Answers to inquiries regarding the arrangement of emergency response equipment at Kansai Electric Power’s nuclear power plant.

cars without license plates on the premises of nuclear power plants. It means that no one can drive the vehicles on public roads outside the plants. Support for other power plants is not taken into serious consideration at all. The administrative executive of one of electric power companies says it is obliged to have as many pump cars and power supply cars as required by law on the premises of the power plant, and it is not possible to send them to other power plants for support, even if they are part of the same company. Although we think it would be preferable to allow large capacity pump cars and power supply cars to be interchanged between power plants to enhance defense in depth, they say it is not possible, citing regulations as the reason. In addition, KEPCO expresses that “If by any chance there is a need to accommodate another power plant, although it is not clearly defined by regulatory standards, on occasion it is also possible to carry necessary materials and equipment to other power plants by using a truck or tow truck, among other means, as a response.”⁷¹ However, this would require time and effort to prepare the towing vehicle in an emergency, and in reality it would be difficult without formulating a routine procedure and training.

From these examples, it can be said that, even after the Fukushima accident in Japan, the location of equipment for emergency response is not well dispersed, but rather concentrated, and the demand for ensuring diversity is thought lightly. It can also be said that they are less than fully remorseful about Fukushima Daiichi, where functions were lost across the board due to a single cause because TEPCO did not diversify the location of safety equipment. The centralized placement of safety equipment in an identical location increases the probabilistic risk that they would simultaneously be damaged and cease functioning. Efforts to reduce any such risk do not appear to have been fully undertaken.

Dispersing the locations of water injection pumps and generator cars should not be too expensive. Nevertheless, the reason such measures are not put in place is apparently because of the approach that complying with regulatory requirements is enough.

In the United States, in accordance with the regulatory requirements of the U.S. government’s Nuclear Regulatory Commission (NRC) based on the lessons learned from the Fukushima Accident, National SAFER Response Center warehouses located in two locations, east and west, were set up in June 2014 and are jointly operated by nuclear power companies, storing five sets each of emergency aid equipment such as low-pressure pumps, medium-pressure pumps, high-pressure pumps, water purification equipment, gas turbine generators, air compressors, floodlights, etc. , all of which can be deployed at any time to arrive at any nuclear power plant in the United States within 24 hours. In line with this, the power supply and hose connection ports have been standardized to the same size and shape in order to enable the same equipment to be used at nuclear power plants across the United States⁷². Such a measure, known as “FLEX strategy”, is an attempt to diversify and multi-layer the location of safety equipment.

In contrast, it seems that both Japan's regulators and private sectors pride themselves that Japan has a safer system than the United States by installing more than enough fire engines and power supply vehicles on the premises of nuclear power plants.

Belatedly from 2016, using the US FLEX strategy as a point of reference, the decision was taken even in Japan to create a shared database of power supplies, pumps and other equipment owned by each electric power company. Additionally, attempts are being made to ready attachments for connection ports so that portable water injection equipment and power supply vehicles can be used

⁷¹ Ibid.

⁷² Okuyama, T. (2016, March 30). *Nichibei de kon'nani chigau genpatsu jikonotaiō, Fukushima no kyōkun* [Lessons of Fukushima: The radically different responses to a nuclear emergency in Japan and the U.S.]. *Journal of Law and Economy Asahi Judiciary*. Retrieved from <https://judiciary.asahi.com/fukabori/2016032400001.html> (In Japanese.)

by other stations and companies. The Federation of Electric Power Companies also requested the Japan Atomic Power Company to open a Nuclear Emergency Assistance Center in Fukui Prefecture in March 2016, equipped with robots, wireless heavy equipment, and drones, ready to be dispatched to any nuclear power plants in Japan at any time, which it has done. However, unlike the US FLEX strategy, the center is not equipped with pumps or generators, and the interchange of materials and equipment between electric power companies is carried out on a voluntary basis without endorsement or inspection by the regulatory authorities. For these reasons, the effectiveness and sustainability of this measure is questionable. In other words, despite being a party to the Fukushima accident, Japan's response is three years behind that of the US, and the details are incomplete, leaving us in doubt.

5. Avoid succumbing to unspoken pressure and speak up upon noticing anything of concern

TEPCO has a top-down and inward-looking corporate culture of obeying superiors or authorities without questioning or challenging them, but of being passively resistant. So say a considerable number of stakeholders in a position to observe TEPCO management up close.

Japanese government's Atomic Energy Commission in the Cabinet Office pointed out the following as "Fundamental Issues Ingrained in Nuclear Energy-related Organizations" in its Base Policy for Nuclear Energy dated July 20, 2017⁷³.

"The unique mindset and groupthink in Japan, the pressure to conform tacitly or forcibly to the opinion of the majority, and the tendency to maintain the status quo are all very strong, and they can be a problem."

According to the Atomic Energy Commission, this tendency affected the safety of nuclear power.

"As a result of the sub-optimization of information sharing in terms of the contents and scope, truly needed information does not get appropriately shared. It is, therefore, necessary to create a culture in which people can exchange a variety of opinions based on solid grounds, regardless of their standing inside or outside the organization."

This is what was proposed by the Atomic Energy Commission, which the Cabinet resolved to respect in its meeting⁷⁴.

Yoshiaki Oka, chairman of the Japan Atomic Energy Commission, commented, "The painful lesson the Fukushima nuclear power plant accident has shown us is that it is especially necessary for objections to be voiced based on specific grounds as part of people's jobs."

"The Japanese are not good at expressing objections. Ignoring objections and focusing on apparent efficiency in the short-term perspective will lead to failure in the medium to long term. (...) Japanese people are bad at sharing evidence-based objections, but I strongly feel that efforts to overcome this weakness of national character are essential, not only for safety and an awareness of the various issues that stem from that, but also for nuclear personnel in their utilization of nuclear power."⁷⁵

⁷³ Japan Atomic Energy Commission. (July 20, 2017). *Basic Policy for Nuclear Energy*. Retrieved from http://www.aec.go.jp/jicst/NC/about/kettei/kettei170720_e.pdf#page=6 (In Japanese.)

⁷⁴ Japan Atomic Energy Commission. (n.d.). *Genshiryoku riyō ni kansuru kihon-teki kangaekata* [Basic Policy for Nuclear Energy]. Retrieved from <http://www.aec.go.jp/jicst/NC/sitemap/bunya22.htm#kakugi> (In Japanese.)

⁷⁵ Japan Atomic Energy Commission. (June 30, 2017). *Iin kara hitokoto* [A word from the committee]. *Atomic Energy Commission Mail Magazine*, no.224. Retrieved from <http://www.aec.go.jp/jicst/NC/melmaga/2017-0224.html> (In Japanese.)

Both the Atomic Energy Commission and Chairman Oka point out that these “Fundamental Issues Ingrained in Nuclear Energy-related Organizations” come from “characteristics of Japanese organization and citizens.” However, it would be a leap in logic to describe TEPCO's organizational climate and culture as “corporate characteristics unique to Japan.” Many large companies and organizations in Europe, the United States and China share the same tendency, and conversely, many Japanese companies do not, or only to a limited extent.

It would, nevertheless, be correct to say that TEPCO has a highly concentrated form of the “characteristics of Japanese organization and citizens” pointed out by the Atomic Energy Commission, and as a result, faces fundamental problems that continue to exist in nuclear-related organizations.

TEPCO's Anegawa Plan summary also addressed the issue of corporate culture.

According to the Plan, prior to the Fukushima accident, in response to reviews and audits by external trade associations such as the World Association of Nuclear Power Operators (WANO) and its in-house Nuclear Quality Management Department, there were TEPCO employees who focused efforts on “not getting any indicated items to deal with in the first place, rather than trying to make improvements by using the indicated items.” There was an absence of any attitude of deepening discussions on safety through audits and seriously accepting external suggestions.⁷⁶ Regarding its response to regulation by NISA, TEPCO had a tendency to “think that it was sufficient to follow the directives of the safety inspectors, or, in other words, to just satisfy regulatory requirements” and “to perform an operation according to the stipulations specified in the manual.”⁷⁷ A TEPCO executive looking back said, “they tried to stick to their own patch and if something went wrong, they would all make an excuse in unison, ‘that's not my role’, creating a group that ‘didn't think themselves’ emerging.”⁷⁸

Taking this situation into account, the Anegawa Plan summary concludes “despite the fact that TEPCO's safety culture was definitely not in a good state, this fact was overlooked(...) The decline of our safety culture went unnoticed with there not being ample activities for improving the situation.” It pointed out the cause of the Fukushima nuclear accident as follows. “The nuclear power scandals were not considered to be an indication of the deterioration of the safety culture, but due to there not being ample communication skills and problem-solving techniques. Therefore, the measures were not ample to methodically improve safety awareness.”⁷⁹

After expressing regret for its past conduct in this manner, TEPCO pledged under the Anegawa Plan that it would create output in the form of sharing current situational understanding and deciding on measures to improve by practicing in their meetings at the start and end of each day a stance of managers and subordinates questioning (challenging) each other, ““Is this all right?” “Is it better to

⁷⁶ Tokyo Electric Power Company. (2013). *Fukushima genshiryoku jiko no sōkatsu oyobi anzen kaikaku puran* [Fukushima Nuclear Accident Summary and Safety Reform Plan]. Retrieved May 13, 2020 from https://www.tepco.co.jp/cc/press/betu13_j/images/130329j0401.pdf (In Japanese.) p.41

https://www4.tepco.co.jp/en/press/corp-com/release/betu13_e/images/130329e0801.pdf#page=44

⁷⁷ Tokyo Electric Power Company. (2013). *Fukushima genshiryoku jiko no sōkatsu oyobi anzen kaikaku puran* [Fukushima Nuclear Accident Summary and Safety Reform Plan]. Retrieved May 13, 2020 from https://www.tepco.co.jp/cc/press/betu13_j/images/130329j0401.pdf (In Japanese.) pp.41-42

https://www4.tepco.co.jp/en/press/corp-com/release/betu13_e/images/130329e0801.pdf#page=48

⁷⁸ Interview with TEPCO executive, November 27, 2019

⁷⁹ Tokyo Electric Power Company. (2013). *Fukushima genshiryoku jiko no sōkatsu oyobi anzen kaikaku puran* [Fukushima Nuclear Accident Summary and Safety Reform Plan]. Retrieved May 13, 2020 from https://www.tepco.co.jp/cc/press/betu13_j/images/130329j0401.pdf (In Japanese.) p.50

https://www4.tepco.co.jp/en/press/corp-com/release/betu13_e/images/130329e0801.pdf#page=58

do this?”⁸⁰

In particular, the Anegawa Plan demanded middle managers at the department general manager level and group manager level “not underestimate their line responsibilities (division of duties and authority) and actively put forth their opinions”.

“If a nuclear power leader underemphasize safety or appears to take an attitude toward excessively delaying a conclusion, middle management must speak up. They must understand the situation and provide the materials necessary for making a determination to management at an appropriate time without having excessive trust in the intentions of superiors or remaining silent out of fear of making waves.”⁸¹

This passage can be said to be express remorse for the fact that prior to the Fukushima accident, middle management did indeed read the innuendos, swallow their supervisors’ opinions wholesale, anticipate their superiors’ wishes and maintain silence so as not to rock the boat, which caused the requisite materials for making judgments that were not shared with management and results that were unduly delayed.

There is no doubt that the Anegawa Plan was a reflection of sincere thoughts and efforts to identify problems in the company's corporate disposition.

Nevertheless, there is no mention of the truth behind how the tsunami countermeasures were postponed, nor any probing analysis on the history of the Fukushima nuclear power plant accident and its enlargement, the deterioration in the safety culture, and the relationship between this management culture and corporate disposition.

Take, for example, the case of internal communication failure on March 11, 2011 regarding whether or not the isolation condenser (IC) in Unit 1 of the Fukushima Daiichi was operating. It was nothing but a tragic lack of communication that involved “the practice of mutually questioning and challenging each other”.

From the late afternoon to the evening on the day of the earthquake, the reactor core in Unit 1 at Fukushima Daiichi actually started to melt, but TEPCO did not notice it and mistakenly thought cooling was continuing.

A tsunami struck Fukushima Daiichi around 3:36 pm on March 11, 2011, and shortly thereafter, all power including DC power supplies were lost at Unit 1. At that time, in Unit 1, all cooling devices including the isolation condenser (IC) stopped, and after the loss of all power, it was impossible to restart the cooling device by remote control from the main control room of Unit 1. The operator (main unit operator), who was in charge of operating the IC, and his supervisor, the deputy engineer, were aware of the fact that the IC had stopped. However, the shift supervisor and deputy manager, who were both in the same main control room, were not made aware of this fact. The shift supervisor strongly suspected that the IC might have stopped, but this perception was not transmitted to the site’s

⁸⁰ Tokyo Electric Power Company. (2013). *Fukushima genshiryoku jiko no sōkatsu oyobi anzen kaikaku puran* [Fukushima Nuclear Accident Summary and Safety Reform Plan]. Retrieved May 13, 2020 from https://www.tepco.co.jp/cc/press/betu13_j/images/130329j0401.pdf (In Japanese.) pp.64-65

https://www4.tepco.co.jp/en/press/corp-com/release/betu13_e/images/130329e0801.pdf#page=73

⁸¹ Tokyo Electric Power Company. (2013). *Fukushima genshiryoku jiko no sōkatsu oyobi anzen kaikaku puran* [Fukushima Nuclear Accident Summary and Safety Reform Plan]. Retrieved May 13, 2020 from https://www.tepco.co.jp/cc/press/betu13_j/images/130329j0401.pdf (In Japanese.) p.68

https://www4.tepco.co.jp/en/press/corp-com/release/betu13_e/images/130329e0801.pdf#page=77

Emergency Response Center (ERC) at the seismic isolated building in Fukushima Daiichi. As a result, site superintendent Yoshida, who was in the site's ERC, Akio Komori, Acting Chief of ERC in TEPCO's Emergency Response Center (ERC) in Tokyo headquarters, the government, and the press, all believed the IC was operating in Unit 1 and the cooling continuing. This misunderstanding of the IC operating status led to a "series of delays" in dealing with the accident. It can be said that human error caused the accident to spread.

However, the reason why such a thing happened is not yet clear. In particular, the details related to the fact that the information on IC outages was not shared in the main control room are only mentioned fragmentarily in the appendix to the TEPCO Accident Investigation Report and the main part of the report contains no mention. Nor is there any mention in the Anegawa Plan summary.

A TEPCO executive involved in compiling the Anegawa Plan noted the following "lesson" after stating the reason for the misunderstanding over the state of IC operation in Unit 1 as, "It wasn't a question of corporate culture. It was a question of information transmission techniques during an emergency."

"None of us had any training in how to reliably share information between people in an emergency like that. Right now, they're saying the principle of three-way communication should be used. The person who mentions an abnormality in an important machine must confirm whether or not the person they want to convey the message to has heard. For example, the shift supervisor has to repeat back, 'the IC has stopped, right?' On hearing that, the operator has to say, 'Yes, that's right.' Keep saying it until you know it's been conveyed."⁸²

However, it is clear that it is not possible to explain the misunderstanding over Unit 1's cooling by methodological problems alone.

In an interview with former Professor Emeritus Professor Hajimu Yamana of Kyoto University, Chairman of the Nuclear Damage Compensation and Decommissioning Facilitation Organization, when asked if he thought TEPCO's corporate culture or corporate mores had affected the course of the accident, he replied, "Of course I think so".

"Everyone is just looking up. Yes, instructions from the top were widespread, but there were some places where details were missing. At the very least, the details didn't make it to the top. It's all about the gap between the top and bottom."⁸³

Yamana said he believes that there is still a need to investigate the human error involved with the accident in the immediate aftermath of the tsunami, which hit Fukushima Daiichi on March 11, 2011⁸⁴. "The story of the ICs is typical, but there are some things that aren't clear. I think further interviews will be needed once the traces of the onsite hardware emerge."⁸⁵

Kazuhiko Toyama, an external director of TEPCO Holdings from 2017 to 2020, also points out problems in TEPCO's management climate and corporate mores. Toyama, who once worked on reforming Japan Airlines (JAL), says that a characteristic common to both JAL and TEPCO was "a fierce inertia for maintaining the status quo".

⁸² Interview with TEPCO executive, November 27, 2019

⁸³ Interview with Hajimu Yamana, December 11, 2019.

⁸⁴ Interview with Hajimu Yamana, December 11, 2019.

⁸⁵ Interview with Hajimu Yamana, December 11, 2019.

“Deciding on a new direction takes enormous energy to build a bottom-up consensus. It is very difficult. Everyone from a section head to the CEO has the right of veto. The problem at Fukushima was probably that they couldn't change what needed to change, and I think it was difficult in terms of the very nature of the organization. It's the same disease that organizations with a lot of Tokyo University graduates have.”⁸⁶

One of the former senior officials of the Ministry of Economy, Trade and Industry (METI) who is familiar with the ins and outs of TEPCO, while acknowledging in an interview that “I can't say for certain if it was a factor leading to the accident”, cited “the lack of a ‘culture to challenge’ and a condescending outlook as TEPCO’s corporate disposition.”⁸⁷ “There’s a mix of cultures that are inward-looking, passive resistant, and top-down. It's a problem found specifically at the power utilities.”⁸⁸

On the evening of March 11, 2011, all cooling devices including the isolation condenser (IC) shut down, and the reactor heat went completely untreated, but the even more frightening reality was that neither the shift supervisor, the site superintendent or head office knew the facts. There were multiple employees who knew the situation, so at least one of them should have made senior management aware of it, even if that meant yelling at the boss or grabbing him by the shirt. The reason this didn’t occur cannot be attributed solely to “a question of information transmission techniques during an emergency”. If that is so, then what was it? What was the real reason? TEPCO has to make this clear. It is no exaggeration to say that this is one of the greatest unsolved mysteries of the Fukushima Daiichi nuclear accident. TEPCO still doesn't take the question seriously.

6. TEPCO's political and economic clout

Electric power companies and the Federation of Electric Power Companies they have formed, and especially TEPCO, have or had traditionally wielded substantial political and economic influence that can have a wide-ranging impact on politics, the economy and society. TEPCO puts much effort into “lobbying” people involved in important decision-making in national politics and society, using a dedicated team for the purpose of explaining their thoughts, the background to issues, persuading, and building consensus, thereby exercising political and economic power. The influence of TEPCO and KEPCO extended even to the point of contacts with the underworld. This is considered to be a factor in the formation of the TEPCO corporate culture and structure described above.

According to Toyama, electric power companies in each region, including TEPCO, have been guaranteed an income for many years without being exposed to competition or the fear of bankruptcy, thanks to a quasi “National Polity” of regional monopoly, vertical integration, and the fully distributed cost method with a fair rate of return. Thanks to vertical integration, where power generation, transmission and distribution, and retail are all handled by one company, and a regional monopoly that guarantees the position of being the sole electricity seller in each region, electric power companies did not have to kowtow to their customers to get them to buy their electricity. And, on the other hand, they were in the dominant position of buying things from most of industry. Under the fully distributed cost method, almost all costs could be passed on to the electricity bill, so there was no need to lower purchase prices and they also had huge budgets. They were the “ultimate buyer” and “at the top of the purchasing hierarchy”. Additionally, they joined related organizations in donating to various fields, hiring both retired bureaucrats and the offspring of influential people. As

⁸⁶ Interview with Kazuhiko Toyama, March 18, 2020.

⁸⁷ Interview with a former METI official, February 27, 2020.

⁸⁸ Interview with a former METI official, February 27, 2020.

a result, the electric power companies in the past reigned in both the central and regional economic worlds. Although there is close public oversight of the government, including how the budget is spent, there was no such oversight for the electric power companies. A power company was once a “huge power with no governance” and a “monster”. Toyama concludes this was the consequence of “just how politically powerful” the power companies were⁸⁹.

Power utilities, including TEPCO, have not publicly made political contributions since 1974. This is because it “is not appropriate for companies operating in the public interest”. However, funds are provided in obfuscated ways. For example, they cooperate through donations in the name of individual executives and senior management, the purchase of tickets for parties held by politicians,⁹⁰ and “outsourced research funds” to organizations related to politicians even if they are not specifically political organizations⁹¹.

According to Chimori Naito, a vice-president and political liaison officer at Kansai Electric Power from 1962 to 1987, “Political contributions were made by TEPCO, KEPCO, and Chubu Electric in that order, KEPCO paying around 500 million yen a year when I was there. I think the construction of nuclear power plants accelerated this a fair bit. We gave to every prefectural and town council. Putting nuclear power in a region required power beyond reason.”⁹²

500 million yen was equivalent to several million dollars or more than 10 million dollars.

He said he handed out directly 20 million yen a year to former prime ministers at the two traditional times a year, and between two to seven million yen a time to other leading politicians.⁹³

Regarding the reason for such payments to politicians, Naito said, “Because Japan is a bureaucratic state, having a very friendly relationship with the Prime Minister makes it possible to communicate with other administrative agencies very smoothly.” As an example of the authority that an administrative body holds for an electric power company, he said, “(the assessment) of electricity charges is the most important thing (...) and then the construction of power plants.”⁹⁴

“The government holds the permits. Whether it's building a power plant or inspecting it, it's a matter of MITI's permission, so we can't get on their wrong side.”

⁸⁹ Interview with Kazuhiko Toyama, March 18, 2020.

⁹⁰ The Asahi Shimbun Special Press Department. (2014). *Genpatsu riken o ou* [Pursuing nuclear interests]. Asahi Shimbun Publishing. (In Japanese.) pp.162-175

⁹¹ In response to Takeuchi's interview, Miyoji Iwano, who worked as the official secretary to former Prime Minister Takeo Miki, looked back on the funding provided by the utilities (which got treated as non-political), stating “TEPCO granted financial aid in the form of a research sponsorship. However, the amount was ultimately much higher than other political contributions. (...) KEPCO and Chuden also granted aid in the same manner.” In Iwano, M. (2017). *Miki Takeo Hisho Kaikoroku* [Takeo Miki's Secretary Memoirs]. Tokyo: Yoshida Shoten. (In Japanese.)

⁹² Murayama, O. (2020, February 21). *Kansaidenryoku moto fuku shachō Naitō Chimori no shōgen Kansaidenryoku shunō kara rekidai shushō e no seiji kenkin to genpatsu kensetsu rasshu no kankei wa?* [Testimony of Former Vice President of KEPCO, Chimori Naito: What is the relationship between the rush to build nuclear power plants and political contributions from KEPCO executives to successive Prime Ministers?] *Journal of Law and Economy Asahi Judiciary*. Retrieved from <https://judiciary.asahi.com/jiken/2020021900001.html> (In Japanese.)

⁹³ The Asahi Shimbun Special Press Department. (2014). *Genpatsu riken o ou* [Pursuing nuclear interests]. Asahi Shimbun Publishing. (In Japanese.) pp.222-223

⁹⁴ Murayama, O. (2020, February 21). “*Kansaidenryoku moto fuku shachō Naitō Chimori no shōgen Kansaidenryoku shunō kara rekidai shushō e no seiji kenkin to genpatsu kensetsu rasshu no kankei wa?* [Testimony of Former Vice President of KEPCO, Chimori Naito: What is the relationship between the rush to build nuclear power plants and political contributions from KEPCO executives to successive Prime Ministers?]” *Journal of Law and Economy Asahi Judiciary*. Retrieved from <https://judiciary.asahi.com/jiken/2020021900001.html> (In Japanese.)

“Take, for example, the assessment of the fully distributed cost of electricity charges. This takes time. Assessments in Tokyo ran all night for almost a week. There were issues like how much labor costs were allowed and the spring union negotiations. It wasn’t just a matter of numbers. (...) You negotiated directly with the bureaucracy, but whenever there was some trouble, you would say, ‘It’s the opinion of statesman so-and-so’.”

Regarding the role of political officers in electric power companies, Naito said the following.

“You know, there are always various regulations and various people who oppose you in any business. You can’t go into business unless you manage to convince or contain them. So, to put it extremely, you spend every waking moment trying to get as many people as possible in political, government, and financial circles who understand the way of your company.”⁹⁵

In TEPCO, politics were dealt with by the Corporate Affairs Department and relations with the bureaucratic sector were up to the Corporate Planning department, which before the Fukushima accident was considered an elite course within the company, all the TEPCO presidents from 1971 to 2008 being from one or the other. They all participated enthusiastically in cross industrial business circle activities, producing the chairman of Keidanren (Japan Federation of Economic Organizations) and the representative secretary of the Keizai Doyukai (Japan Association of Corporate Executives).

Against this backdrop of such economic and political power, the electric power industry, led by TEPCO, actively lobbied to achieve its goals. According to Toyama, since government had the power of life and death over the electric power companies including TEPCO, the government/ruling party was their “customer”, and actual electricity users were on the other side of Kasumigaseki (Japan’s Whitehall) and Nagatacho (Japan’s Downing Street). According to a former senior METI official, the reality was that “lobbying rather than management determined actual profits and defined the business”⁹⁶, and therefore the electric power industry took on an “inward structure and lobbying priority”.⁹⁷

TEPCO was the most enthusiastic lobbyist in Japan, reaching out to government officials and politicians to persuade them to engage in specific policies and decisions.

Political scientist Ryunoshin Kamikawa points out that TEPCO’s “inconceivably absolute power as a private company” lay behind the Fukushima nuclear accident.

“Although it was pointed out numerous times that there could be a large earthquake, a big tsunami, the loss of all AC power supplies, or a severe accident, why was it possible to ignore those warnings? It was because of the political and economic powers that allowed TEPCO to suppress the regulatory authorities, suppress opposition to nuclear power plants and create a “safety myth” for nuclear power plants.”⁹⁸

The corporate culture and mores of electric power companies like TEPCO cannot be separated from this kind of “monster bully” towards outsiders.

⁹⁵ Murayama, O. (2020, March 1). *Kansaidenryoku moto fuku shachō Naitō Chimori no shōgen kansaidenryoku moto fuku shachō ga katatta Nakasone, Fukuda-ra moto shushō e no ‘bonkure’ wa kanpōyaku* [Testimony of Former Vice President of KEPCO, Chimori Naito: “Bonkure” for former prime ministers is medicine]. *Journal of Law and Economy Asahi Judiciary*. Retrieved from <https://judiciary.asahi.com/jiken/2020022100004.html> (In Japanese.)

⁹⁶ Interview with a former METI official, February 27, 2020.

⁹⁷ Interview with a former METI official, February 27, 2020.

⁹⁸ Kamikawa, R. (2018). *Denryoku to seiji jō: Nihon no genshiryoku seisaku zenshi* [Electric power and Politics: Japan’s History of Nuclear Policy]. Tokyo: Keiso Shobo Publishing. (In Japanese.) p.206

The structure of moral hazard that is indifferent to risk

It cannot be overlooked that not only the fully distributed cost method and regional monopoly, but also the nuclear damage compensation system itself has a structure that lowers sensitivity to the risk of accident.

Article 16 of the Act on Compensation for Nuclear Damage assumes in advance “necessary assistance” to nuclear power operators from the government. The amount of assistance will commensurately ease the pain of the accident for the power company. Putting this into reverse terms, incentives for a nuclear power operator to invest money in reducing the risk of accidents are correspondingly reduced.

In an extreme sense, even if a nuclear accident occurs, the country will take care of it anyway, so it would be an irrational business judgement to invest a huge amount of money to prevent an accident that may or may not occur. This is a so-called moral hazard in which the insured's motivation to avoid an accident covered by insurance is diminished. As a result, electric power company managers are less motivated to avoid accidents and less sensitive to accident risks.

In fact, TEPCO did not go bankrupt even when it caused a nuclear accident, and accident damages were covered by public funds. The Nuclear Damage Compensation and Decommissioning Support Organization redeems government bonds issued by the government and delivers the funds to TEPCO, which TEPCO records as “extraordinary profit” every year. In other words, TEPCO had paid a total of 9,542.6 billion yen in compensation by July 22, 2020⁹⁹, and in order to cover this sum, a cumulative total of 9,378.9 billion yen was received from the Support Organization from November 8, 2011 to July 22, 2020¹⁰⁰. TEPCO, however, does not recognize this as a liability in its accounting book. TEPCO is said to be obliged to return more than 9 trillion yen by paying the burden to the Support Organization in the future, but even if that is the case, if it is successful in maintaining to a substantial degree its regional monopoly and the fully distributed cost method, it can cover this by passing the cost on to electricity bills.

In Japan in the late 1990s and early 20th century after the burst of the economic bubble in the early 90s, bankrupt financial institutions rescued with public funds were placed under government control, and former managers were asked to hand over their private property. On top of that, the responsibility of former management teams was pursued in both civil and criminal terms. In the eight years from 1995 to 2003, 134 current and former executives and employees of 37 financial institutions were arrested, 15 being given prison sentences¹⁰¹. This was implemented as a national policy to maintain the discipline of self-responsibility and prevent moral hazard.

In contrast, TEPCO has escaped such handling. The former management team of TEPCO was not required by the company to put up their private property, and neither were they sued nor accused by the company. 3 members of the former management team were prosecuted but not arrested. It can be said that the former management team of TEPCO set a precedent that this was enough even if a nuclear power plant accident had taken place.

In September 2019, it came to light that the chairman, president, and former nuclear power business

⁹⁹ TEPCO Holdings Co. Ltd. (2020). *Baishō-kin no oshiharai jōkyō* [Payment status of compensation]. Retrieved from https://www.tepco.co.jp/fukushima_hq/compensation/results/ (In Japanese.)

¹⁰⁰ TEPCO Holdings Co. Ltd. (2020). *Genshiryoku songai baishō hai-ro-tō shien kikō kara no shikin no kōfu ni tsuite* [concerning grants from organizations supporting decommissioning and compensating nuclear damage]. Retrieved from <https://www.tepco.co.jp/about/ir/library/disclosure/pdf/200401-1.pdf> (In Japanese.)

¹⁰¹ Okuyama, T., & Murayama, O. (2019). *Baburu keizai jiken no shinsō* [Behind the incident of Japan's burst bubble]. Tokyo: Iwanami Shoten. (In Japanese.)

division head at Kansai Electric Power Company, the second largest power utility in Japan after TEPCO and headquartered in Osaka, had all individually accepted money and goods worth over 300 million yen from Eiji Moriyama, a former deputy mayor of Takahama, Fukui Prefecture, where the Takahama nuclear power plant is located. This abnormal “accomplice-like” and ambiguous give-and-take relationship between Moriyama, the leading local nuclear face, and the KEPCO executives had been ongoing since the 1980s, worsening in the wake of the Fukushima Daiichi nuclear accident. Here once again you can see the pestilence that afflicts the Japanese power industry.

Triggered by a tax investigation by the national tax authorities and a scoop by Kyodo News, KEPCO established a third-party committee to investigate the circumstances. The report by the third-party committee, written by a former prosecutor general, pointed out as follows that the cause was an “introverted corporate culture that did not face inconvenient truths.”¹⁰²

“There is a strong focus from both the management perspective and the perspective of providing a stable power supply on the stable operation and running of nuclear Power Stations, a supreme task that supersedes compliance, upholding traditions and self-protection being given precedence over the expectations of Kansai Electric Power’s ‘outside’ stakeholders including users and shareholders.”

In this way, in a corporate culture that placed utmost importance on operating nuclear power plants, KEPCO maintained an inappropriate and abnormal relationship. This did not stop at being a mere money scandal, but led to doubts about KEPCO’s safety culture and the safety of its nuclear power plants given that it was incapable as an organization of properly assessing risks.

These issues as well as the suggestions of the KEPCO third-party committee also apply verbatim to TEPCO.

7. TEPCO’s reform still only midway

We do not say that safety culture, safety regulations, and nuclear operators including TEPCO have not changed since the Fukushima nuclear accident.

Yamana said not only was remorse about the state of nuclear safety shown and protection at the site of nuclear power plants and measures against severe accidents reviewed as well as regulations strengthened, but the occurrence of the Fukushima Daiichi nuclear accident led to a “rethinking of the safety culture and engineering ethics.”¹⁰³

Of these, Yamana was very impressed with the Anegawa Plan, which was the starting point for TEPCO’s turnaround, saying, “It was very well done. If you look at it, most of the gangrene was mentioned there, and I would like to see it get across properly to the whole company.” At the same time, he voiced concern that “However, we need more work and a sense of urgency so that it reaches the very bottom of TEPCO.”

When asked if TEPCO was qualified to run the Kashiwazaki-Kariwa Nuclear Power Station, Yamana answered, “As an ordinary citizen, I would have to say it is necessary for the Anegawa Plan to reach one hundred.”

¹⁰² Kansai Electric Power Company. (2020, March 14). *Chōsa hōkoku-sho* [Survey report]. Retrieved from https://www.kepcoco.jp/corporate/pr/2020/pdf/0314_2j_01.pdf#page=163 (in Japanese) p.155, p.163, pp.188–189

¹⁰³ Interview with Hajimu Yamana, December 11, 2019.

The former chairman of the Nuclear Regulation Authority, Shunichi Tanaka warns that the memory of the Fukushima nuclear accident and the lessons learned are fading.

“The lessons learned from the earthquake disaster and from the Fukushima Daiichi accident are understood by some people in the electric power companies, but I feel that many people don’t understand them or have forgotten them.”

Tanaka cited as one example of this that TEPCO announced in the summer of 2019 that it would take steps with regard to the Kashiwazaki-Kariwa Nuclear Power Station that assumed the decommissioning of one or more of the remaining Units 1-5 within 5 years after restarting Units 6 and 7.

In an interview with the *Niigata Nippo*, a local newspaper, Tanaka said:

“Decommissioning Units 1 to 5 and restarting Units 6 and 7 are two different issues. If you want to operate Units 6 and 7, you need to explain about the restart to residents separately from the decommissioning. TEPCO lacks the openness to turn an earnest ear to local concerns.”¹⁰⁴

Tanaka also commented in our interview that “operating Units 6 and 7 and decommissioning are on completely different dimensions, and they really aren’t qualified to operate nuclear power if they’re still confabulating them just in case the mayor says something.”¹⁰⁵

Tanaka did not explicitly point this out, but it is apparent that winning over the mayor by making restarting and decommissioning part of the same “deal” was hardly the result of truly considering safety and public understanding. If there was an engineering assessment at the TEPCO site that there was no issue of safety in restarting Units 1 to 5, or even if the opposite engineering view prevailed on site, the “deal” had to be viewed as an example of a business judgement where TEPCO’s management stressed the wishes of government at the expense of onsite engineering assessments.

Summary

From the verification results described in this chapter, we identified the following issues and lessons.

(1) Do not dismiss without justifiable reason engineering judgement for business reasons. Despite the fact that the recognition of the objective facts that form the premise or basis of a business decision should never be distorted at the convenience of upper management nor onsite engineering assessments be overturned by a management call without justifiable grounds when taking important decisions in a large-scale organization with many diverse stakeholders like TEPCO, this kind of “should-never” decision-making went unchallenged in TEPCO, resulting in the occurrence of the Fukushima nuclear accident and the confused accident response. In this respect, the present status is that lessons have not yet been fully taken into account and, as a result, measures are insufficient.

(2) In large-scale infrastructure facilities where an accident may harm the lives and well-being of many people, as much diversity as possible in safety equipment and measures to deal with the accident must be readied. Although cost-effective measures to reduce risk should greedily be pursued, TEPCO failed to do so, which led to the occurrence and spread of the Fukushima nuclear accident. This point

¹⁰⁴ *Genshiryoku kisei zen incho Tanaka Shunichishi ni kiku: Hairo to saikado betsumondai* [Interview with former Chairman of the Nuclear Regulation Authority Shunichi Tanaka on the problems of decommissioning and reoperating the plant] (2019, September 15). *Niigata Nippo*. (In Japanese)

¹⁰⁵ Interview with Shunichi Tanaka, November 20, 2019.

is shared as one of the major lessons of the Fukushima nuclear accident, and measures have been built up over the past 9 years. The reality, however, is that rather than reduce probabilistic risk, deterministic and rigid responses abound along the lines of it being adequate for “things to just meet the criteria”.

(3) There are many instances pointing to TEPCO and the nuclear power industry relying on a top-down style of communication with an aversion to brutally honest discussions and a preference for sounding each other out on where an acceptable consensus lies as well as a corporate culture of passive resistance as background factors for the Fukushima Daiichi Nuclear Power Station accident and its spread, as well as the confusion in information relay. However, TEPCO itself has not yet fully come to terms with this lesson. As such, the situation is one where concrete correctional measures have not been adequately implemented.

In compiling this report, we requested through TEPCO Holding’s public relations office face-to-face interviews with President Tomoaki Kobayakawa and Chief Nuclear Officer Shigenori Makino, but the company refused.

References

- Asahi Shimbun. (2012). *Kenshō Tōden Terebi Kaigi* [Investigation: TEPCO's Televised Meeting]. Asahi Shimbun. (In Japanese.)
- Atomic Energy Society of Japan. (2014). *Fukushima Dai ichi genshiryoku hatsudensho jiko ni kansuru chōsa inkai* [Final Report on the Accident at Fukushima Daiichi Nuclear Power Plant]. Report, March 26. Tokyo: AESJ. (In Japanese.)
- Cabinet Office, Government of Japan. (2012). *Seifu jiko chō saishū hōkokusho* [Final Report of Investigation Committee on the Accident at Fukushima Nuclear Power Stations of Tokyo Electric Power Company]. Report, June 23. Tokyo: Cabinet. (In Japanese.)
- Fukushima Evacuee Lawsuit. (2019, September 5). Group 1 preliminary appeal, preparatory document no.5 submitted by TEPCO Holdings' legal attorney. Retrieved from https://8b1b4cba-02ec-489e-99fb-71f4eee99d09.filesusr.com/ugd/8b6c85_d42489c05d60407c9ba883b92714106f.pdf#page=17 (In Japanese.)
- Hashimoto, M., Shimazaki, K., & Sagitani, T. (2015). *2011-nen 3 tsuki 3-nichi no jishinchōsakenkyūsuishinhonbu jimukyoku to denryoku jigyo-sha ni yoru Nihon kaikō no chōki hyōka ni kansuru jōhō kōkan-kai no ikisatsu to mondaiten* [Background and problems of information exchange on the long-term evaluation of the Japan Trench between the Secretariat of the Earthquake Research Promotion Headquarters and electric power companies on March 3, 2011]. *Monograph of the Seismological Society of Japan*, 3, 34–45. Retrieved from <https://www.zisin.jp/publications/pdf/monograph2015.pdf#page=37> (In Japanese.)
- Independent Investigation Commission on the Fukushima Daiichi Nuclear Accident. (2012). *Fukushima gennpatsu jiko dokuritsu kenshō inkai: chōsa, kenshō hōkoku sho* [Independent Investigation Commission on the Fukushima Daiichi Nuclear Accident: Report on the Inquiry and Investigation]. Tokyo: Rebuild Japan Initiative Foundation. (In Japanese.)
- Institute of Nuclear Power Operations. (2012). Special Report INPO 11-005, *Lessons Learned from the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station*. August 1. Atlanta: INPO. Retrieved May 8, 2020 from <https://www.nrc.gov/docs/ML1221/ML12219A131.pdf#page=40>
- Interview with former Chairman of the Nuclear Regulation Authority Shunichi Tanaka on the problems of decommissioning and reoperating the plant, Niigata Nippo, September 15, 2019.
- Interview with Hajimu Yamana, December 11, 2019.
- Interview with Kazuhiko Toyama, March 18, 2020.
- Interview with Takashi Shimada, February 27, 2020.
- Interview with TEPCO executive, November 27, 2019.
- Interview with Shunichi Tanaka, November 20, 2019.
- Investigation Commission on the Accident at Fukushima Daiichi Nuclear Accident Power Plant (2012). *Fukushima Nuclear Accident Analysis Report (Final Report)*. Tokyo Electric Power Company.
- Investigation Committee on the Accident at the Fukushima Nuclear Power Stations of Tokyo Electric Power Company, Government of Japan. (2011). *Chōshu kekka-sho* [report of hearing results]. November 30. Tokyo: GOJ. Retrieved May 26, 2020 from http://warp.da.ndl.go.jp/info:ndljp/pid/10317644/www.cas.go.jp/jp/genpatsujiko/hearing_koukai/348_349_koukai.pdf#page=13 (In Japanese.)
- Iwano, M. (2017). *Miki Takeo Hisho Kaikoroku* [Takeo Miki's Secretary Memoirs]. Tokyo: Yoshida Shoten. (In Japanese.)
- Japan Atomic Energy Commission. (n.d.). *Genshiryoku riyō ni kansuru kihon-teki kangaekata* [Basic Policy for Nuclear Energy]. Retrieved from <http://www.aec.go.jp/jicst/NC/sitemap/bunya22.htm#kakugi> (In Japanese.)

- Japan Atomic Energy Commission. (June 30, 2017a). *Iin kara hitokoto* [A word from the committee]. *Atomic Energy Commission Mail Magazine*, no.224. Retrieved from <http://www.aec.go.jp/jicst/NC/melmaga/2017-0224.html> (In Japanese.)
- Japan Atomic Energy Commission. (July 20, 2017b). *Basic Policy for Nuclear Energy*. Retrieved from http://www.aec.go.jp/jicst/NC/about/kettei/kettei170720_e.pdf#page=6 (In Japanese.)
- Kamikawa, R. (2018). *Denryoku to seiji jō: Nihon no genshiryoku seisaku zenshi* [Electric power and Politics: Japan's History of Nuclear Policy]. Tokyo: Keiso Shobo Publishing. (In Japanese.)
- Kansai Electric Power Company. (2013, December 20). *Shiryō 3–5 "Takahama 3-gō-ro oyobi 4-gō-ro kahangata jūdai jiko-tō taisho setsubi hokan basho oyobi akusesurūto ni tsuite"* [Documents 3–5, Takahama Units 3/4: portable equipment for severe accidents– storage locations and access routes]. Retrieved from <https://warp.ndl.go.jp/info:ndljp/pid/10249547/www.nsr.go.jp/data/000034987.pdf#page=3> (In Japanese.)
- Kansai Electric Power Company. (2020, March 14). *Chōsa hōkoku-sho* [Survey report]. Retrieved from https://www.kepco.co.jp/corporate/pr/2020/pdf/0314_2j_01.pdf#page=163 (in Japanese.)
- Ministry of Economy, Trade and Industry Nuclear Safety and Security Agency. (2004, October 18). *Keisui-gata genshiryokuhatsudenjo ni okeru 'akushidentomanejimento seibi-go Katashiritsu-ron-teki anzen hyōka' ni kansuru hyōka ni tsuite* [Concerning the evaluation of "probabilistic safety assessment following improvement of accident management" in light water nuclear power plants]. Retrieved from <https://warp.da.ndl.go.jp/info:ndljp/pid/1368617/www.meti.go.jp/press/0005696/0/041018accident.pdf#page=10> (In Japanese.)
- Murayama, O. (2020, February 21). Kansaidenryoku moto fuku shachō Naitō Chimori no shōgen Kansaidenryoku shunō kara rekidai shushō e no seiji kenkin to genpatsu kensetsu rasshu no kankei wa? [Testimony of Former Vice President of KEPCO, Chimori Naito: What is the relationship between the rush to build nuclear power plants and political contributions from KEPCO executives to successive Prime Ministers? *Journal of Law and Economy Asahi Judiciary*. Retrieved from <https://judiciary.asahi.com/jiken/2020021900001.html> (In Japanese.)
- National Research Council. (2014). *Lessons Learned from the Fukushima Nuclear Accident for Improving Safety of U.S. Nuclear Plants*. Washington, DC: The National Academies Press.
- Nico Nico News. (May 15, 2012) *Tōkyō denryoku kisha kaiken* [TEPCO press conference]. [Video]. Retrieved June 15, 2020 from <https://live.nicovideo.jp/watch/lv92597723> (In Japanese.)
- Okuyama, T. (2004). *Naibu kokuhatsu no chikara - Kōeki tsūhōsha hogohō wa nani o mamoru no ka* [The power of whistleblowing: what does the Whistleblower Protection Act protect?]. Tokyo: Gendaijin Bunsha. (In Japanese.)
- Okuyama, T. (2014). Intabyū genpatsu o tsudukeru shikaku tōkyō denryoku jōmu: genshiryoku gijutsusha toppu Anegawa Naohiro san [Interview: The credentials to continue producing nuclear power, Anegawa Takafumi, top nuclear engineer and TEPCO official]. *Asahi Shimbun*. March 29. Retrieved May 26, 2020 from <https://judiciary.asahi.com/fukabori/2014041000001.html> (In Japanese.)
- Okuyama, T. (2016, March 30). *Nichibei de kon'nani chigau genpatsu jikonotaiō, Fukushima no kyōkun* [Lessons of Fukushima: The radically different responses to a nuclear emergency in Japan and the U.S.]. *Journal of Law and Economy Asahi Judiciary*. Retrieved from <https://judiciary.asahi.com/fukabori/2016032400001.html> (In Japanese.)
- Okuyama, T., & Murayama, O. (2019). *Baburu keizai jiken no shinsō* [Behind the incident of Japan's burst bubble]. Tokyo: Iwanami Shoten. (In Japanese.)
- Presidential Commission on the Space Shuttle Challenger Accident. (1986). *Report of the Presidential Commission on the space shuttle Challenger accident*. Last accessed May 12,

2020

at

https://spaceflight.nasa.gov/outreach/SignificantIncidents/assets/rogers_commission_report.pdf#page=99

Sanriku oki kara Bōsō oki ni kakete no jishin katsudō no chōki hyōka no heisei 23 nen sangatsu yoka jiten deno shusei soan ni tsuite [Draft amendments to “long-term evaluation of seismic activity from the coasts of Sanriku to Bōsō” as of March 8, 2011]. (In Japanese.)

Tokyo Electric Power Company. (n.d.). *Fukushima daiichi genshiryoku hatsudensho no jiko-ji no kyōkun to kadai wa?* [What are the lessons and challenges from the Fukushima Daiichi NPS accident?]. Retrieved from https://www.tepco.co.jp/kk-np/safety/images/how_image1.pdf (In Japanese.)

Tokyo Electric Power Company. (2002). *Akushidento manejimento seibi yūkōsei hyōka hōkoku-sho* [Accident Management Maintenance Effectiveness Evaluation Report]. (In Japanese.)

Tokyo Electric Power Company. (2004). *Akushidento manejimento seibi-go kakuritsuronteki anzen hyōka hōkoku-sho* [Probabilistic Safety Assessment Report following Accident Management Improvement]. (In Japanese.)

Tokyo Electric Power Company. (2012). Attachment 7-4 "Damage Status at Fukushima Daiichi Nuclear Power Station (After Tsunami)." In *Fukushima Nuclear Accidents Investigation Report*. Retrieved from https://www.tepco.co.jp/en/press/corp-com/release/betu12_e/images/120620e0106.pdf#page=323

Tokyo Electric Power Company. (2012, June 20). *Fukushima Nuclear Accident Investigation Report*. Retrieved from https://www.tepco.co.jp/cc/press/betu12_j/images/120620j0303.pdf#page=59 (In Japanese.)

Tokyo Electric Power Company Shareholder Lawsuit. (January 28, 2013). Plaintiff's Exhibit 349, Statement by Kazuhiko Yamashita, Tokyo District Public Prosecutor Legal Document.

Tokyo Electric Power Company. (2013). *Fukushima genshiryoku jiko no sōkatsuoyobi anzen kaikaku puran* [Fukushima Nuclear Accident Summary and Safety Reform Plan]. Report, March 29. Retrieved May 13 from https://www.tepco.co.jp/cc/press/betu13_j/images/130329j0401.pdf (In Japanese.)

Tokyo Electric Power Company. (2013). *Fukushima genshiryoku jiko no sōkatsuoyobi anzen kaikaku puran* [Fukushima Nuclear Accident Summary and Safety Reform Plan]. Report, March 29. Retrieved May 13 from https://www.tepco.co.jp/cc/press/betu13_j/images/130329j0401.pdf (In Japanese.)

Tokyo Electric Power Company Holdings Co. Ltd. (2020). *Baishō-kin no oshiharai jōkyō* [Payment status of compensation]. Retrieved from https://www.tepco.co.jp/fukushima_hq/compensation/results/ (In Japanese.)

Tokyo Electric Power Company Holdings Co. Ltd. (2020). *Genshiryoku songai baishō hai-ro-tō shien kikō kara no shikin no kōfu ni tsuite* [concerning grants from organizations supporting decommissioning and compensating nuclear damage]. Retrieved from <https://www.tepco.co.jp/about/ir/library/disclosure/pdf/200401-1.pdf> (In Japanese.)

Tokyo Electric Power Company Shareholder Lawsuit. (n.d.). Defendant's Exhibit B116.

Tokyo Electric Power Company Shareholder Lawsuit. (n.d.). Plaintiff's Exhibit 297, Witness Makoto Takao, No.4.

Tokyo Electric Power Company Shareholder Lawsuit. (n.d.). Plaintiff's Exhibit 298, no.3.

Tokyo Electric Power Company Shareholder Lawsuit. (n.d.). Plaintiff's Exhibit 349.

Tokyo Electric Power Company Shareholder Lawsuit. (n.d.). Plaintiff's Exhibit 298, Toshio Sakai Witness Interrogation Report, No.1.

Tokyo Electric Power Company Shareholder Lawsuit. (n.d.). Plaintiff's Exhibit 299, Witness Interrogation Report, No.1.

Tokyo Electric Power Company Shareholder Lawsuit. (n.d.). Plaintiff's Exhibit 466.

Tokyo Electric Power Company Shareholder Lawsuit. (2014, December 9). Plaintiff's Exhibit 488.

10-year Investigation Commission on the Fukushima Nuclear Accident:
Final Report by Investigation Commission on the Fukushima Nuclear Accident

- Tokyo Electric Power Company Shareholder Lawsuit. (2017, February 24). TEPCO auxiliary intervenor, preparatory document no.21.
- Tokyo Electric Power Company Shareholder Lawsuit. (2018, April 10). 5th Trial, Plaintiff's Exhibit 297, Witness Interrogation Report, No.1.
- Tokyo Electric Power Company Shareholder Lawsuit. (2018, April 11). 6th Trial, Plaintiff's Exhibit 297, Witness Interrogation Report, No. 2.
- Tokyo Electric Power Company Shareholder Lawsuit. (2018, April 24). 8th Trial, Plaintiff's Exhibit 289, Witness Interrogation Record, No.1.
- The Asahi Shimbun Special Press Department. (2014). *Genpatsu riken o ou* [Pursuing nuclear interests]. Asahi Shimbun Publishing. (In Japanese.) pp.162-175
- The National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission. (2012). *Tōkyō denryoku fukushima genshiryoku hatsudensho jiko chōsa iin kaihōkokusho* [The official report of the Fukushima Nuclear Accident Independent Investigation Commission]. Report, July 5. Tokyo: Diet. (In Japanese.)