

Chapter 12

Deficits of Japanese Nuclear Risk Governance Remaining After the Fukushima Accident: Case of Contaminated Water Management

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Abstract It was found that many deficits of nuclear risk governance in Japan before and after the Fukushima accident. Not only were they created and embedded before the Fukushima disaster, but it has been remained or even worsened even after many accident reports were published and pointed out many problems and suggested ideas to remedy them.

In this paper, the author would analyze such remained problems found in the postaccident “on-site management” policy and measures, taking the case of contaminated water management at the Fukushima Daiichi Nuclear Power Plant. Firstly, the development of contaminated water management policy measures and institutional framework would be described in a chronological manner, which is one of the most typical and difficult tasks of “on-site management.” Then, the cause of their failure trajectory would be analyzed by using a sociological concept “structural disaster” to understand the malfunctions which are continuously repeated not by identifiable particular factors but by inappropriate design of the socio-technical interface. This conceptual standpoint would suggest that the problems are not solvable by each of technical improvement, superficial institutional reform, nor prosecution and punishment of relevant individuals or organizations but by the redesign of that interface as a whole. Finally, based on this perspective, the author would discuss the ideas to remedy the deficits that might lead to further continuation of “structural disaster” in nuclear field.

Keywords Deficits of nuclear risk governance • Failure trajectory of postaccident on-site management • Contaminated water management at Fukushima Daiichi nuclear station • Structural disaster

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12.1 Introduction: Failure Trajectory of Postaccident On-site Management

There were many deficits of nuclear risk governance in Japan before and after the Fukushima accident, as Taketoshi Taniguchi, the leading Japanese scholar in the field, illustrates by using the framework of “risk governance deficits,” proposed by IRGC (International Risk Governance Council) [1, 2]. Not only were they created and embedded in the governance system before the Fukushima disaster, but it has been remained or even worsened after many accident reports were published and pointed out many problems which led the worst nuclear catastrophe in the history of Japanese nuclear utilization and suggested their recommendations to remedy them.

In this paper, the author would analyze such remained problems found in the postaccident “on-site management” policy and measures, taking the case of contaminated water management at the Fukushima Daiichi Nuclear Power Plant. “On-site management” includes many recovery works performed at the Fukushima Daiichi site—“stabilization” work in the language of the government and the Tokyo Electric Power Company (TEPCO)—such as setting up building covers to limit the further dispersion of radioactive substances; reinforcing buildings feared to have lost structural strength due to the effects of hydrogen explosions; containing contaminated water with various concentrations of radioactive substances, generated as a result of continuous water injection and cooling; and collecting and transporting leftover spent fuel.

It is one of the most difficult problems in the on-site management tasks mentioned above that the management of the highly radioactive contaminated water building up day by day. Due to various technical limitations, the temporary water injection and cooling system was built as not totally closed-cycle, and the damage caused by the accident allowed a huge amount of groundwater to flood the buildings. Inevitably, as the water gets contaminated with radioactive substances, highly radioactive contaminated water is continually produced. On top of this, since the path carrying the contaminated water to sea could not initially be identified or blocked, there were fears of marine pollution spreading.

Regarding this contaminated water treatment at the Fukushima site, a series of “follow-up” measures have been taken and caused the delay of underground water pump-out. Finally, the “ice wall” project to block underground water intrusion seems to be failed. Failures result in the increase of total amount of contaminated water and further social distrust about the feasibility and progress of Fukushima decommission project in Fukushima residents, entire Japanese society, and international community.

In the following sections, the author would describe the development of contaminated water management policy, measures, and institutional framework in chronological manner and then analyze the cause of their failure trajectory using a sociological concept “structural disaster” developed and suggested by Miwao Matsumoto, the pioneering sociologist of science who has shed light on the problems at the interfaces among science, technology and society, to understand

the malfunctions which are continuously repeated not by identifiable particular factors but by inappropriate design of the socio-technical interface. This conceptual standpoint would suggest that the problems are not solvable by each of the technical improvement, superficial institutional reform, nor prosecution and punishment of relevant individuals or organizations but by the redesign of that interface as a whole [3, 4]. Finally, based on this perspective, the author discusses the ideas to remedy the deficits that might lead to further continuation of “structural disaster” in nuclear field.

12.2 Contaminated Water Management at Fukushima Daiichi Nuclear Power Plant

12.2.1 Failure to Build Consensus Through Explanations After the Fact and Follow-up Measures [1]: Delay in Addressing the “Groundwater Bypass” Problem

Thinking back now, more than 4 years since the accident, despite the common perception that the contaminated water problem only rose to prominence after the “acute phase” immediately following the accident, in reality the challenge of coping with the increasing volume of contaminated water was an agonizing problem in the locality from immediately following the accident. In fact, between April 4 and 11, 2011, lightly contaminated groundwater was released into the sea as a desperate, last-resort measure to secure space for highly radioactive contaminated water. This move was criticized by a number of neighboring countries. On May 11, 2011, only 2 months after the accident, a newspaper article described the seriousness of the contaminated water problem in a comprehensive manner [5].

As mentioned in that newspaper article, the factor that attracted attention as the biggest factor of the buildup of highly contaminated water was the problem of groundwater flooding [6]. The necessity for drastic measures to address this problem had already been recognized by the government and TEPCO in 2011 according to an official document of the first “Steering Meeting Under Government and TEPCO’s Mid-to-Long-Term Countermeasure Meeting,” but it was not until April 23, 2012, at the fifth “steering meeting,” that the so-called “groundwater bypass” plan was officially presented. This was a detailed proposal to radically limit the buildup of contaminated water by pumping up groundwater before it could flood into nuclear reactor buildings to be contaminated by contact with radioactive substances. At the meeting, TEPCO presented a document titled *Use of Groundwater Bypass to Reduce Quantity of Groundwater Flooding into Buildings of Reactors Nos. 1 to 4*. TEPCO publicly announced anew its plan to pump up groundwater from before the flooding at a press conference on June 18, 2012 [7]. At the same time, TEPCO began providing explanations to fishing industry representatives, one of the major stakeholders. Since the problem of the release of the lightly

contaminated water into the sea, mentioned above, the fishing industry representatives in Fukushima Prefecture became very sensitive about the contaminated water problem, so securing their agreement was vital to the success of TEPCO's plan. Even beyond the summer of 2012, TEPCO continued providing explanations to meetings of the association heads of the Fukushima Prefectural Federation of Fisheries Co-operative Associations ("Fukushima Fisheries Co-op").

Apparently, as a result of this process, in January 2013, the Fukushima Fisheries Co-op agreed to cooperate with TEPCO, reasoning that releasing groundwater was not the same thing as releasing contaminated water. Between that time, however, a leak of highly contaminated water occurred at the plant, and there were several suspected releases of water from the plant into the sea. This made the fishing industry representatives distrustful of TEPCO and led them to adopt a harder line in their negotiations. TEPCO proceeded to prepare facilities for their groundwater bypass, and they were ready to pump up groundwater and release it into the sea at any time, but a meeting of the association heads of the Fukushima Fisheries Co-op on May 13, 2013 decided to withhold its official agreement for a groundwater release [8]. If agreement had been obtained, TEPCO was set to start pumping up and releasing groundwater on the very next day, May 14, but it ultimately took another year or so before it could actually start releasing.

The reported reasons for withholding agreement to the plan was that a consensus could not be built among the co-op members, with members expressing views such as "only TEPCO is saying this, so we co-op members cannot trust them," and "we want TEPCO to clarify (explain to co-op members) that this is the national policy," according to the comments of co-op members cited in news paper articles [8, 9].

After this, a system was set up under which the responsible government body, the Agency for Natural Resources and Energy of the Ministry of Economy, Trade, and Industry (METI), and TEPCO would jointly provide explanations to stakeholders such as the fishing industry representatives. A number of explanatory meetings were subsequently held for fishing industry representatives and residents to gain the positive support to their groundwater bypass plan. Even though these efforts were made by them, however, multiple incidents of contaminated water leakage and newly discovered cases of water contamination were exposed after that, making it difficult to build a consensus.

Consequently, at an explanatory meeting organized by the national government and TEPCO for the Soma-Futaba Fisheries Cooperative Association ("Soma-Futaba Fisheries Co-op"), held on September 3, 2013, a chorus of criticisms about the release of groundwater was voiced. It was reported that the head of this association stated that "a decision on whether or not to agree to the bypass plan would be made no earlier than October, after gaging the reaction of distributors and consumers"[10].

On the same day as this explanatory meeting, the government's Nuclear Emergency Response Headquarters issued its "Basic Policy for the Contaminated Water Issue at the TEPCO's Fukushima Daiichi Nuclear Power Station." This policy provided for the setup of the "Inter-ministerial Council for Contaminated Water and Decommissioning Issues," the "Intergovernmental Liaison Office for

Contaminated Water and Decommissioning Issues,” the “Intergovernmental Council for Fostering Mutual Understanding on the Contaminated Water Issue,” and the “Fukushima Advisory Board Under the Council for the Decommissioning of the TEPCO Fukushima Daiichi Nuclear Power Station.” In addition, the policy directed the national government to take, for the first time, direct financial measures toward contaminated water countermeasures (with provision for total funding of 47 billion yen). Then, the government and TEPCO continued working to provide explanations to stakeholders aimed at building a consensus, and on February 3, 2014, METI publicly disclosed “emission standards” for groundwater from the groundwater bypass, formulated jointly with TEPCO, stating that METI had explained the standards to the chairman of the Fukushima Fisheries Co-op.

Some time later, beginning in March 2014, efforts to reach a consensus intensified, but there were still further twists and turns in the process. On March 14, 2014, the government and TEPCO held an explanatory meeting for the Soma-Futaba Fisheries Co-op. Despite multiple expressions of opposition, the head of the co-op announced his approval, yet 4 days later, on March 18, the governing council of the Soma-Futaba Fisheries Co-op deferred a final decision on approval of the groundwater bypass plan. On the same day, the fishery co-op of Iwaki City decided to approve the plan at a meeting of its governing council. Finally, on March 24, 2014, the Soma-Futaba Fisheries Co-op officially issued its decision to approve the groundwater bypass plan, and on the following day, March 25, a meeting of the association heads of Fukushima Fisheries Co-op decided to approve the plan, with the submission of a request in writing to the government and TEPCO regarding the implementation of the plan.

Finally, on April 9, 2014, TEPCO began pumping up groundwater from wells, in accordance with the groundwater bypass plan, and on May 21, 2014, it released this groundwater (560 metric tons) into the sea for the first time.

So this groundwater bypass plan took two years to come to fruition, from the presentation of a detailed plan to the beginning of implementation. It is undeniable that the delay in executing the bypass plan to drastically control groundwater inundation greatly impacted the prospects for the overall success of the countermeasures to contain highly contaminated water. On August 2, 2013, the Nuclear Regulation Authority’s (NRA) working group on contaminated water countermeasures pointed out that the groundwater level might rise suddenly as a sea-side impermeable wall was constructed and that even on completion, the outflow of contaminated water might not stop.

It should be viewed especially regrettable that by the spring of 2013, after having gone so far toward securing a final consensus from the fishing industry representatives, the most influential stakeholder, in fact consensus, could not be obtained and the process of building consensus process was carried forward anew.

12.2.2 Failure to Build Consensus Through Explanations After the Fact and Follow-up Measures [2]: Postponing “for the Time Being” the Response to the Problem of Releasing Lightly Contaminated Water into the Sea

One major factor that influenced the overall ins and outs of this story was the problem of releasing lightly contaminated water into the sea, which the author touched on earlier. The sudden buildup of contaminated water immediately following the accident rapidly caused a shortage of space to store contaminated water. As a result, in order to avoid highly contaminated water being inadvertently released into the sea, for a period of 1 week starting on April 4, 2011—approximately 3 weeks after the accident—lightly contaminated water was released into the sea to free up space to store more highly contaminated water. Given that this release was an emergency measure, the procedure for securing the approval of stakeholders was rather inadequate. As a result, there was criticism of the action from within and outside Japan, giving rise to a distrust of the government and TEPCO in relation to the handling of contaminated water.

Later too, the contaminated water storage capacity remained chronically insufficient, so from the same time as the abovementioned groundwater bypass plan, the idea of “releasing treated and purified contaminated water into the sea” was studied. However, in this case too, the views of stakeholders were not adequately reflected in the proposal. This adversely affected the effort to build a consensus on this later, delaying a response to the problem in terms of time.

When TEPCO publicly disclosed on December 8, 2011, that it was considering the release of treated and purified contaminated water into the sea, on the same day, Ikuhiro Hattori, the chairman of the National Federation of Fisheries Co-operative Associations (“National Fisheries Co-op”), visited TEPCO to express strong opposition to the proposal, calling it unacceptable. In the end, the idea of releasing treated and purified contaminated water into the sea was not included in the plan that TEPCO submitted to the Nuclear and Industrial Safety Agency (NISA) of METI on that same evening [11].

In a press conference on the same day, Nobutaka Tsutsui, Senior Vice-Minister of Agriculture, Forestry and Fisheries, also stated that the “release is unacceptable,” indicating that TEPCO had publicly disclosed the plan without prior consultation with the major stakeholders.

As expected, in a plan submitted anew on December 15, 2011, TEPCO stated clearly that treated water “would not be released into the sea” by them for the time being [12]. Also on the same day, the Iwaki City Council in Fukushima Prefecture formally decided to request the repeal of the release plan.

Yet, according to some experts, the release of very lightly contaminated water within the limits of specified standards, with due consideration for risk management, is unavoidable. In a press conference on July 24, 2013, Shunichi Tanaka, the

Chairman of the Nuclear Regulation Authority, in reference to contaminated water within the limits of standards—not in reference to highly contaminated water that is treated and purified—stated that, “My frank opinion is that it’s probably unavoidable to release a certain amount” [13]. Also, the review mission of the International Atomic Energy Agency (IAEA), which investigated the efforts to decommission the Fukushima Daiichi Nuclear Power Plant over 10 days, submitted a “summary report” to the Japanese government on December 4, 2013, with a recommendation that the controlled release of lightly contaminated water into the sea should be considered as an option [14].

While TEPCO put off the release of treated and purified contaminated water into the sea “for the time being,” this effort cannot be easily excluded from a task list for appropriately managing the contaminated water problem. The fact that TEPCO initially tried to deal with the problem without securing a suitable consensus of stakeholders and that they took the easy option of deferring action “for the time being” in response to the opposition of stakeholders toward the issue may have considerably hindered the overall optimization of the contaminated water management. If TEPCO recognized that both the groundwater bypass plan and the plan to release treated and purified contaminated water into the sea were unavoidable and also that such countermeasures are more effective if taken promptly—and conversely, that they are unlikely to be effective and might even irreversibly aggravate the situation if not taken soon enough—it should have taken greater care in presenting its countermeasures in a form that ensures definite results, and even in the face of criticisms and doubts, it should have insisted on the necessity and effectiveness of the plans and the sufficiency of safety considerations, rather than simply “withdraw” or “defer” their plan. It is vital that TEPCO make decisions from a comprehensive perspective and with a clear commitment and that it presents its plans accordingly.

12.2.3 Incremental Development of a Governance System

TEPCO is not the only one grappling with these kinds of problems. The effort to construct a risk governance system for the Fukushima Daiichi Nuclear Power Plant, led by the government, could not be expected to be perfectly conceived from the start. By its very nature, it is an incremental development process.

The first platform set up by the government to comprehensively tackle measures aimed at decommissioning the plant, including contaminated water countermeasures, was the “Government and TEPCO’s Mid-to-Long-Term Countermeasure Meeting,” a coordinating body established on December 21, 2011. This body was set up based on an understanding that the situation would shift from a short-term recovery phase after the accident toward a medium to long-term decommissioning phase, in line with a declaration on December 16, 2011, by Prime Minister Yoshihiko Noda (then) about “recovery” after the accident. In response to a view of the Nuclear Emergency Response Headquarters that “in order to accelerate

decommissioning, in addition to reinforcing research and development (R&D) systems focused on removal of fuel debris, it is important to construct a system to seamlessly manage on-site work and the progress of R&D,” at the same meeting in February 2013 a decision was made to transform the coordinating body into the “‘Council for the Decommissioning of TEPCO’s Fukushima Daiichi Nuclear Power Station,’ to include the heads of the main institutes engaged in R&D, in addition to the government and TEPCO” [15].

Later, in April 2013, the “Committee on Countermeasures for Contaminated Water Treatment” was set up under the “Council for the Decommissioning of TEPCO’s Fukushima Daiichi Nuclear Power Station,” to manage the planning and progress of government countermeasures to deal with the contaminated water problem. This committee put together a document, “Direction of Measures to be Taken (first round),” which was approved by the “Council for the Decommissioning of TEPCO’s Fukushima Daiichi Nuclear Power Station” on June 27, 2013. This guideline was organized around three main pillars for action—introduction of a schedule for each nuclear reactor, enhancement of communication (through the “setup of the Fukushima Advisory Board Under the Council for the Decommissioning of TEPCO’s Fukushima Daiichi Nuclear Power Station (tentative name)” for example), and “full-scale development of a system for gathering together international expertise.” This third objective regarding “development of an international system” led to the establishment of the International Research Institute for Nuclear Decommissioning (IRID) on August 1, 2013. Furthermore, within the “Committee on Countermeasures,” three “task forces” were set up between June and December 2013 to deal separately with each of these main challenges.

It is puzzling, however, that in December 2013 an “R&D Promotion Headquarters” was set up under the “Council for the Decommissioning of TEPCO’s Fukushima Daiichi Nuclear Power Station,” and in that case too four subordinate bodies were set up to undertake technical investigations—a “Working Team for Spent Fuel Pool Countermeasures,” a “Working Team for Preparation of Fuel Debris Removal,” a “Working Team for Radioactive Waste Processing and Disposal,” and a “Joint Task Force for Remote Technologies.”

On top of this, as already mentioned, in September 2013, the government’s Nuclear Emergency Response Headquarters issued its “Basic Policy for the Contaminated Water Issue at the TEPCO’s Fukushima Daiichi Nuclear Power Station,” which called for the establishment of four subordinate bodies—the “Inter-ministerial Council for Contaminated Water and Decommissioning Issues,” the “Intergovernmental Liaison Office for Contaminated Water and Decommissioning Issues,” the “Intergovernmental Council for Fostering Mutual Understanding on the Contaminated Water Issue,” and the “Fukushima Advisory Board Under the Council for the Decommissioning of the TEPCO Fukushima Daiichi Nuclear Power Station.”

A “Decommissioning and contaminated water countermeasures team” was set up within the “Inter-ministerial Council for Contaminated Water and Decommissioning Issues” to investigate “studies of decommissioning and contaminated water countermeasures policy,” “process management and risk clarification

of decontamination and contaminated water countermeasures,” “R&D needed for decommissioning and contaminated water countermeasures,” and “collecting accurate information rapidly, providing it to residents, reporting it internationally, and addressing damage caused by rumors” [16].

The “Intergovernmental Council for Fostering Mutual Understanding on the Contaminated Water Issue,” was set up at the same time, for the purpose of “enhancing information sharing in the locality” by TEPCO and the government regarding the contaminated water problem and the status of investigations into how to address the problem, “enhancing collaboration in the locality” between relevant bodies regarding contaminated water measures, and conducting “studies on how to proceed specifically with countermeasures, process management, and coordination between stakeholders.”

The third new body, the “Fukushima Advisory Board Under the Council for the Decommissioning of the TEPCO Fukushima Daiichi Nuclear Power Station,” was set up in February 2014 under the chairmanship of (then) State Minister of Economy, Trade and Industry Kazuyoshi Akaba (in charge of the abovementioned “Decommissioning and contaminated water countermeasures team”), with a membership including the deputy governor of Fukushima Prefecture; the heads of relevant municipalities in Fukushima Prefecture; representatives of local commerce, industry, agriculture, forestry, and fisheries interests; NPO representatives; and local community representatives.

In addition to all this, the NRA also set up its own “Specific Nuclear Facility Monitoring and Evaluation Committee” (set up in December 2012), along with a subordinate body, the “Working Group on Contaminated Water Countermeasures” (set up in August 2013), and also a “Team on Marine Monitoring” (set up in September 2013).

12.3 Discussion: Contaminated Water Management as a Case of “Structural Disaster”

Of course, the challenge of responding to this nuclear power plant accident was an extraordinary one. It would have been difficult to put in place any organizational system ahead of time, so this situation can be understood to be the outcome of the government proceeding flexibly to set up a system in accordance to the issues emerging along the way. Regrettably, however, there are too many deliberative bodies, and it is unclear how they all relate to each other. And even with this complicated system, it was not until 2013, approximately two years after the nuclear power plant accident, that the system was finally accelerated to be set up and operational. Considering, for example, that it was late 2011 when TEPCO presented and later withdrew its plan to release treated and purified contaminated water into the sea, as mentioned before, I can’t help thinking that if at this point in time a system had been set up to enable TEPCO to work together with the

government to pursue decision-making based on comprehensive investigation and coordination, and careful and open consensus building, the outcome could have been different.

This author's regret should not be considered as just a hindsight criticism. Rather, it must be understood as a result of the deficits of Japanese nuclear governance as Taniguchi demonstrates [1]. As mentioned earlier in this paper, his analysis adopts the "risk governance deficits" framework formulated by IRGC [2]. For example, the failures of contaminated water management described in this paper are counted as results of "Lack of adequate knowledge about values, risk perception, interests" deficit. He points out that another deficit, "Provision of biased, selective or incomplete information," is also found and the cause of it is something to do with the previous deficit. The problem is, thus, continuation or even reproduction of deficits after the accident. Why did the impact of worst accident not become an opportunity to stop it and change the Japanese nuclear governance better?

Matsumoto suggests a sociological concept that could shed light on the mechanism behind such persisting wrong trajectory: "'structural disaster' of the science-technology-society interface" [3, 4, 17]. This type of disaster is caused not by some failure of science, of technology or of society as separated manner. He argues, it should be considered as "the failure of the science-technology-society interface" [17]. There is no single technical failure, no obvious scientific misunderstanding, or no single person to be blamed. Rather, the interface among those heterogeneous elements of society as a whole suffers from serious problems. This understanding strongly suggests the possibility that "Efforts to pursue the perfect science cannot prevent the next problem. The perfect technology cannot, too. Society also cannot prevent it by ethical regulations" as Matsumoto points out. This perspective suggests us that the problems centering on Japanese nuclear policy and practices are not solvable by each of the technical improvement, superficial institutional reform, nor prosecution and punishment of relevant individuals or organizations but by redesign of that interface as a whole.

Of course, such a systematic view on technological failure has been developed, even before the Matsumoto's concept, for many years. There are many famous concepts to analyze it, such as "normal accident" [18], "organizational accident" [19], and so on. "Structural disaster" concept integrates such previous works and makes it clearer the conditions that cause the chain of accidents with similar characteristics.

According to Matsumoto, "structural disaster" consists of the following five elements [17]:

1. Following wrong precedents carries over problems and reproduces them.
2. Complexity of a system under consideration and the interdependence of its units aggravate problems.
3. Invisible norms of informal groups virtually hollow out formal norms.
4. Patching over problems at hand invites another patching over for temporary countermeasures.

5. Secrecy develops across different sectors and blurs the locus of agents responsible for the problems in question.

The author does not step into precise and point-to-point review of Fukushima contaminated water management case to determine if it meets the conditions above here, due to the limit of pages, but let him just point out some pertinent facts with those characteristics in the cases described in the previous section.

For example, the several causes of the delay of consensus-building and technical practice of the contaminated water treatment at Fukushima Daiichi site (both of groundwater bypass and lightly contaminated water release programs) can be considered as the cases of these elements. So-called “Kokusaku-Min-ei” (planned by the national Government, operated by private industry) scheme was not effective to gain public and stakeholders’ trust for those measures, but TEPCO had acted as the front-end of those activities especially before the Governmental decision on September 2013. This fact can be interpreted as a result of elements 1 and 3. “Kokusaku-Min-ei” scheme was considered as the standard format of any nuclear activity.

This belief was strongly shared by many of the important stakeholders, such as the governments, TEPCO themselves, other member of industry, and even some of journalists and the general public. This seemed to be realized not by some formal consensus explicitly formed after the accident but by shared belief taken over from pre-Fukushima custom in nuclear industry in Japan. This point can also be interpreted as a sign of element 5, because the reason of “switch” of initiative from TEPCO to the government was not clearly discussed in public and explained well.

Also, too many relevant bodies and complicated network among them due to incremental development of the governance system for the contaminated water treatment can be seen as appearance of elements 2. Moreover, the “for the time being” strategy is a strong sign of element 4, of course.

In this way, the twists and turns story described in this paper shows many signs of those five conditions. It is obvious that the deficits identified by Taniguchi seem to be strongly related to the mechanism of “structural disaster.”

12.4 Concluding Remarks: To Remedy Structural Deficits of Japanese Nuclear Governance

In light of the discussion above, it can be said that sociological analysis of mechanism behind the series of problems of post-Fukushima accident on-site management should be important and prospective to think about the remedy for its failure trajectory, although the author could not demonstrate the result of detailed analysis in this paper.

Of course, it is essential to promote technical R&D to deal with contaminated water better. It should be useful to solve many difficult problems at the damaged

plant site. It is also critical to establish appropriate institutional and legal framework to support those activities.

However, even such effort might become a part of next “structural disaster” if we don’t have deliberate and proper understanding on the mechanism that creates the chain of accidents, incidents, and scandals. “Quick fixes” for superficial layer of problems often make the problems more complicated, unsolvable, and serious. Sociological perspectives should be able to make contributions to avoid it and to enrich our wisdom to tackle the deficits. As an idea for this, Matsumoto suggests his solution for “structural disaster” that includes the introduction and establishment of plural channels among science-technology-society by “position-indicated style” interpreters and research funding scheme to enable open, transparent, and responsibility traceable policy (it is the opposite to the faulty one that create “structural disasters”).

We can collaborate to stop the chain of “structural disasters” by considering such proactive suggestion from sociologist as well as other social scientist in various fields. The problem of structural deficits of Japanese nuclear governance can and should become the good and pioneering example of interdisciplinary collaboration between engineering and sociology (and other social sciences). It should be enhanced and promoted more immediately.

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