Chapter 22
Towards More Open-Minded Nuclear Engineering

Diversity, Independence and Public Good

Kohta Juraku

Abstract The implication of the PAGES project especially in Japan's post-Fukushima context is examined in this chapter, summing up the arguments of sister chapters in Part IV at the same time. Social scientific literacy is not just an "additional" component for nuclear engineers. Rather, it is one of the most "essential" parts of engineering competences and practices. This point has not been fully recognized, at least in the Japanese context so far. In this chapter, an epoch-making judgment by a Japanese court and the responses from nuclear engineers in Japan will be taken as a case to explore this issue. Japanese nuclear engineers misunderstood the judgment's argument and could not make appropriate counter-arguments against the court. This kind of misunderstanding of voices from society can result both in loss of political legitimacy and stagnation in technical evolution. Looking at the original nature of engineering itself, the need for fundamental change to re-establish diversity and independence in nuclear engineering, and the significance of social-scientific literacy to realize it, will be discussed.

Keywords Human rights · Post-Fukushima accident · Legitimacy · Innovation · Diversity · Independence · Open-minded · Public good

22.1 Introduction

This brief chapter tries to examine the implications of the PAGES project, especially in the post-Fukushima Japanese context, summing up the arguments of sister chapters in Part IV at the same time. The PAGES project and its participants consider social scientific literacy not just as an "additional" component for nuclear

K. Juraku (✉)
Department of Humanities and Social Sciences, School of Science and Technology for Future Life, Tokyo Denki University, 5 Senju Asahi-Cho, Adachi-ku, Tokyo 120-8551, Japan
e-mail: juraku@mail.dendai.ac.jp

© The Author(s) 2015

J. Ahn et al. (eds.), *Reflections on the Fukushima Daiichi Nuclear Accident*,
DOI 10.1007/978-3-319-12090-4_22

engineers. Rather, it is one of the "essential" parts of engineering competences and practices. In our understanding, the importance of this perspective even becomes greater and greater, especially in this post-Fukushima nuclear scene.

However, the author regrettably has to say that this perspective has not been fully and appropriately recognized by nuclear engineering experts as well as some of the other stakeholders at least in the Japanese context, though it has been over 3 years since the Fukushima Daiichi nuclear accident unfolded. In the sections below, an epoch-making judgment by a Japanese court and the responses from nuclear engineers in Japan will be taken as a case to explore this issue. Japanese nuclear engineers' misunderstanding of the judgment's argument will be examined critically. Then, looking at the original nature of engineering itself, the need for fundamental change in nuclear engineers' mindset and the significance of social-scientific literacy will be discussed.

22.2 Denial of Nuclear Power: A Message from Japanese Court

On May 21, 2014, Fukui District Court delivered a judgment about the operation of Oi Nuclear Power Plant (NPP) owned and operated by Kansai Electric Power Company. The court ordered the prohibition of operation of Units 3 and 4 of the power station, siding with a group of 189 citizens, the plaintiff. It was the first case of loss of nuclear power operator at a court since the Fukushima nuclear accident occurred.

There had been several court decisions that supported nuclear opponents' arguments even before the Fukushima nuclear accident, but this judgment ordered the halt of the nuclear power operation directly based on Constitutional human rights—personal rights—for the first time in Japanese legal history. The sentence points out the reality of the damage caused by the Fukushima accident and characterizes it as a critical threat to fundamental human rights. It says as follows:

> Nuclear utilization [in Japan] is limited to civilian use so that the operation of a nuclear power plant is a means of electricity production, which belongs to the freedom of economic activities [guaranteed by the Constitution], and is inferior to the core part of personal rights, legally speaking. Then, it cannot be imagined that the fundamental [human] rights could be exceptionally broadly denied as much as by a nuclear accident, except for a huge natural disaster or war…. It makes sense that any commercial activities which have such concrete risk should be prohibited… [1].[1]

The court clearly distinguishes the risk posed by a nuclear accident from other risks generated by general industrial activities, not by its probability but by the qualitative nature of its potential hazard (i.e., long-term radioactive contamination of the environment and evacuation and damage to the community as a result).

[1] Translated and supplemented by the author.

It also determinably denies the application of cost-benefit analysis for nuclear risk through very strong criticism.

> The court thinks that we are not allowed to participate in nor decide something about the discussion that compares the rights of many people to their life itself to the cost of electricity production… There is a discussion about outflow or loss of national wealth as regards this cost issue; we should not consider the huge trade deficit generated by the halt of the operation of these nuclear power stations as outflow nor as loss of national wealth. National wealth consists of productive land and people's life upon that land, thus the court thinks that irreparable damage of the national land is loss of national wealth [1].[2]

In other words, this judgment argues that our society can no longer allow the existence of nuclear power utilization (at least in Japan, thinking about its narrow national territory and density of population). It is not the health effect of radiation exposure to the public that is the central problem of the risk of a nuclear accident, but the disastrous effect on people's life, according to their formulation. It points out that what happened and is happening in Fukushima is clear evidence and this fact validates their understanding. This is an extraordinary fundamental criticism of nuclear power technology and its utilization.

22.3 Responses from Nuclear Engineers in Japan

This radical message by the court promptly attracted strong attention from nuclear engineers in Japan, as well as from other stakeholders and citizens. Almost all responses from nuclear experts were vivid criticism, or even outrage, against the decision. They found many faults among the technical descriptions in the judgment and concluded the decision had serious deficits because of "misunderstanding" about the upgraded safety measures of the Oi NPP.

The Atomic Energy Society of Japan (AESJ), the most comprehensive professional and academic body in the nuclear field in Japan and the counterpart to the American Nuclear Society (ANS), published their press release about the court's judgment on May 27 and strictly criticized it because "it might cause serious misunderstanding among people about improved safety measures at the nuclear power plant"[3] [2]. It accuses the court's formulation of the problem as "an opinion that calls for 'zero risk'" and as "not appropriate as the legal decision by court." It criticizes the court their denial of "engineering safety" because it is accepted in "almost all fields of science and technology" and "it is unfair that the court does not accept it for nuclear power stations though they should be impartial."

It also argues that another Fukushima-class nuclear accident is preventable by implementation of appropriate counter-tsunami, anti-severe-accident, and disaster prevention measures so that it would not violate personal rights.

---

[2] Translated and supplemented by the author.

[3] Translated by the author. The following quotations are also.

Many nuclear experts showed quite similar opinions in newspapers, on the web, and in other media. It was an "unscientific" or even "anti-scientific" challenge from a legal expert—the Chief Judge of the Fukui District Court—who doesn't have sufficient and appropriate technological expertise. Conservative newspapers (Yomiuri, Nikkei and Sankei newspapers) also published their editorials and extend their support to such opinions [3–5], while their liberal counterparts (Asahi, Mainichi and Tokyo newspapers) admired the court's decision [6–8].

However, such criticisms themselves contain many "misunderstandings." For example, AESJ's press release criticizes the denial of the nuclear risk by the court as "zero-risk" oriented thinking but it is not the case. The judgment distinguishes the nuclear risk by its nature and the scale of hazard potential, not by its probability or so-called "death-ratio" as the author introduced earlier. It never naively calls for "zero-risk." Rather, it questions the destructive nature of nuclear risk itself in terms of qualitative considerations.

Also, some arguments cited judicial precedent sentenced by the Supreme Court about the appropriateness of the safety review of nuclear facilities and point out the contradiction between it and this judgment, but it is also incorrect.[4] The former one was an administrative lawsuit so that the court reviewed the legality of the safety review, but this case was a civil case about human-rights violation. These two types of lawsuits have different nature and the points in dispute are also different. Therefore the judgments can be legitimated by different logics. The later judgment carefully clarifies the differences of the jurisdictions before it comes to the detailed considerations of the illegalness of the NPP operation in terms of the constitutional human-rights violation.

The critics of the decision by the Fukui District Court seems to misunderstand, or at least not to read the sentence carefully, before they expressed their outrage against the legally powerful and fundamental denial of nuclear power utilization. Why could not they catch the point raised by the Court? Why did they show such reaction against the decision?

22.4 Don't Refuse, but Inspired by the Voice from Society

As Sunderland points out in Chap. 18, the problems centering around the nuclear power utilization "are not amenable to engineering's traditional utilitarian reasoning and optimization studies" in Post-Fukushima era [9]. However, the outraged experts seemed not to recognize this important and irreversible change. As she

[4] Ikata NPP (owned and operated by Shikoku Electric Company) safety review case is cited in their arguments. This was the first case of a lawsuit that dealt with the legality of the national Governmental safety review for commercial nuclear power stations. In that case, the Supreme Court of Japan established their criteria on the legality of safety review. It admitted relatively broad administrative discretionary powers on each case for governmental ministries and agencies and limited their jurisdiction to the appropriateness of the process of safety review.

argues, “one of the core issues with the problems surrounding Fukushima is that the answers rely on more than numbers” [9]. Fukui District Court’s critical point is tightly connected to this notion. In fact, the discussions in our Summer School covered this issue and “much time was devoted to searching for ways that nuclear power could be justified without weighing its costs and benefits in numerical terms” [9].

It is regrettable that the mainstream Japanese nuclear engineers still refuse this change and look aside from the crisis of “legitimacy” as Oda concerns about it in his chapter [10]. They have seemed to be stubbornly attached to defend the “current” nuclear system and its logic of safety and to try to make the world friendlier to them. There have been no alternative ideas to safety improvement of the current nuclear fleet by so-called backfitting and to increase emergency preparedness explicitly suggested by the Japanese nuclear engineering community. They have been eager to ‘explain’ those improvements but reluctant to do something fundamentally different with their past practices.

However, if the expert community interpreted the voices from society more sensitively and humbly, they could suggest much more drastically different answer to make nuclear power technology more preferable for society, in the author’s opinion. For example, they could suggest clear commitment to dry-cask storage system of spent fuel with passive safety feature to substantially decrease the risk of spent fuel management. The court’s judgment points out the vulnerability of barriers of spent fuel pool and considers it as one of the most contributory sources of possible massive radioactive release. Their critical criterion of risk acceptance is the scale of potential hazard so that the inventory of nuclear fuels is the most critical factor to discuss nuclear safety. This safety improvement should have much bigger impact on Judge’s impression about the efforts by the nuclear community than a set of ‘explanations’ of sufficiency of current safety measures.

Also, some nuclear engineers could have suggested the introduction of so-called small- and medium-sized reactors (SMRs), instead of huge 1 GWe class power plant, which have been the mainstream in Japanese nuclear power utilization. If we think about the issue of inventory of radioactive materials on each site and the discussion on the promotion of renewable energy utilization and the shift to more distributed power system, we can understand the advantages of SMRs technology. Of course, it is unclear whether the society successfully would accept these ideas and would agree to continue the nuclear power program with improved risk management and compatibility with distributed power system. There seems to be a great deal of possibility that people say “no” even if nuclear engineers suggest such ideas.

However, the most important thing here is not the result of such suggestions, but the spontaneous efforts by nuclear engineers to be “introspective” themselves as both of Sunderland and Oda argue [9, 10]. People can think about the substantial difference between the efforts to defend their legacy by some ‘explanations’ and to overcome the failure by their wisdoms and innovations. It should have totally different impact on the people’s respect for their nuclear engineers regardless of the appropriateness of the policies and behaviors by the Government and other responsible organizations (such as TEPCO).

Nuclear engineers should not refuse the questions and criticisms from the other members of society, but should listen to them carefully, think about the implications for them deeply and response to them sincerely in proactive manner.

22.5 Democratization of Nuclear Engineering: Not Just for Political Correctness, but Also for Innovation of Technology

As Bollerri discusses, nuclear technology is not a market-oriented enterprise. It has been strongly committed and controlled by the governments so that "there is a lack of experience with direct interaction between the nuclear engineer and the public" [11]. He also mentions about the consequences of this "detachment from their 'client'" as follows:

> This has led many times to an 'us versus them' mentality which only fosters antagonism. This has historically shown to be the wrong approach. This can occur when so-called 'technocrats,' while well intentioned, try to make decisions based solely on science and engineering by relying on a responsibility for 'good of the public,' without experiencing or communicating directly the public, whom these decisions affect [11].

What the author discussed in the previous sections can be interpreted as a case of this phenomenon. Historically speaking, Science and Technology Studies (STS), Sociology of Science and Technology and History of Science and Technology have critically examined such mechanism motivated by the improvement of political legitimacy and the democratization of science and technology. In other word, they have problematized this issue for the sake of the other members of society, not for engineers. However, the author would like to argue that this situation is critically problematic not only for the rest of society, but also for engineers themselves at the same time, when we think about the future of (nuclear) engineering *in* society.

Achievement of engineering is not limited to *improvement* of technology. *Innovation* of technology should also be, or sometimes more, important and exciting for engineers. Of course, improvement also requires substantial innovation in many cases. But, what is really admired by their colleagues and 'clients' is the epoch-making breakthrough that provides brand-new options for society.

This kind of innovation is sometimes not a direct evolution of preceding technology and its appraisal. Christensen sheds new light on mechanism of innovation by examining many cases of "disruptive innovations" in his famous book *The Innovator's Dilemma* [12]. He emphasizes the importance to be free from stereotypical, conservative mindsets that prevent such breakthrough. It should be noted that experts tend to be possessed by conventional appraisal standard of technical merits. Sony's engineers could not change their goal for the best portable audio player from its sound quality, battery life and compact body to something another. Their product—the Walkman—had monopolized the market in the past, but their

position was suddenly replaced by a new comer with the huge storage capacity–Apple's iPod, although it was not superior to Walkman in terms of the conventional advantages listed above. Apple's engineers were free from the traditional belief in the business, found a potential need in the market—to bring personal jukebox—and realized it by existing technical components. As Sony's engineers, nuclear engineers who cannot free from the traditional belief—bigger output for centralized power distribution system and conventional cost-benefit analysis—could be left by their 'client' in the Post-Fukushima society. Rapid promotion of renewable energy and liberalization of power industry is inevitably and irreversibly being carried out now, though Japanese national policy has not chosen the clear commitment to rapid phase-out from nuclear power so far. If nuclear engineers could not provide any suitable nuclear power system that is nicely compatible with distributed power system provided by renewable power sources, they might not be able to keep their presence both in energy technology field and in society.

If Japanese nuclear engineers had understood this need and another need for intrinsic safety, which was discussed in the previous section, more rapidly and precisely, some of them might have suggested different nuclear power system with SMRs for society, not just to say something about the safety improvements of the existing large-scale NPPs across Japan. It is not necessary that every engineer defends the appropriateness and advantages of current nuclear power system and supports the Governmental and the utility companies' policy of nuclear power utilization. However, there have been only a few fundamentally different proposals of nuclear power utilization for Post-Fukushima era so far. Almost no engineer is trying to change such a big picture at least in Japan. This is quite unnatural and unsound situation when we think about the competitive nature of engineering practices.

22.6 Concluding Remarks: Independence and Diversity of Nuclear Engineering for Unprecedented Challenge

Engineering is inherently dynamic activity. Many engineers are doing their works under competitive circumstances and love it. Difference makes advantages. Diversity motivates technological evolution. As the author cited Christensen's analysis above, so-called the B to C (Business to Consumer) fields, such as consumer appliances business, have such a nature in fact. However, nuclear technology is unfortunately much more "national capitalistic" because of its technical nature and historical origin [13]. Furthermore, the power utility business also has bureaucratic constitution because it is a vital infrastructure system and never allowed to make any serious failure. These factors make the mindset of the members of "nuclear village" more and more conservative and closed-minded. These characteristics of nuclear industry and policy-making system have created a

path-dependent, failure trajectory and resulted in the occurrence of "structural disaster," as Matsumoto discussed in Chap. 10 [14].

However, as briefly illustrated in this chapter, what society requests to engineers is being changed fundamentally now. This change had been unfolded even before the Fukushima Accident happened, but both of magnitude and velocity of it has been even increased so much in this Post-Fukushima society. If nuclear engineers don't listen to people's voice, don't change their thinking, don't suggest alternative picture of nuclear utilization for society, the future of nuclear technology could never be positive one. What people would like to have is never intentionally unified, stereotypical answer that suggests the existence of bureaucratic control on the nuclear engineering community. But, citizens and all other stakeholders desire to have more diversified and organized options that have been elaborated through unfettered discussion and sincere efforts by independent engineers. They are waiting for the nuclear engineers to break their fetters of "nuclear village". As Borrelli argues, we need 'third generation' nuclear engineers "that will lead and shape perspectives on nuclear technology and develop new relationships with society" [11].

It is the era of unprecedented challenges in nuclear field. Innovation in nuclear power system, treatment of contaminated environment by the Fukushima Accident, decommission of damaged Fukushima plants, management of various kinds of radioactive wastes, almost all contemporary challenges in the nuclear field have no established paradigm or concrete model-cases. It's not the era of "long-term plan" set by the Government as the rock-ribbed law. Most of them are not just technically solvable in the sense of conventional engineering practices. They "rely on more than numbers" [9].

Social-scientific literacy is not a tool to manipulate public sentiment, rejecting their voices. It is a method to listen to it carefully, to find and grasp needs in society, to suggest engineers' proposal to society in humble and sincere manner and to collaborate with other stakeholders than nuclear engineers' 'old friends.' Engineers can take its advantages to make their thoughts and practices more open-minded ones as discussed in this chapter. It can become a strong tool to break their fetters, of course.

Return of diversified and independent nuclear engineers is now being waited by society.

Open Access This chapter is distributed under the terms of the Creative Commons Attribution Noncommercial License, which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

References

1. Fukui District Court (21 May 2014) Judgment, Case (wa) No.394 (2012) and Case (wa) No.63 (2013)
2. Atomic Energy Society of Japan (27 May 2014) Statement for the juridical decision of prohibition of Oi nuclear power station units 3 and 4 operation. Available via AESJ website http://www.aesj.or.jp/info/pressrelease/PR20140527.pdf. Accessed 20 July 2014
3. Yomiuri Newspaper (22 May 2014) Editorial: Oi restart case: Denial judgment led by unreasonable reasoning
4. The Nikkei (23 May 2014) Editorial: Questions for the Oi prohibition judgment
5. Sankei Shimbun (23 May 2014) Editorial: Restart of Oi was refused: Unscientific and unrealistic judment
6. Asahi Shimbun (22 May 2014) Editorial: Oi prohibition judgment: It cannot be 'Neglected'
7. Mainichi Shimbun (22 May 2014) Editorial: Prohibition of Oi NPP: Warning for restart without debate
8. Tokyo Shimbun (22 May 2014) Editorial: Oi prohibition case: A judgment to protect people's life
9. Sunderland M (2014) Educating the Post-Fukushima Nuclear Engineer. In: this volume, Chapter 18
10. Oda T (2014) Nuclear engineers for society: What education can do. In: this volume, Chapter 20
11. Borrelli RA (2014) Reflections on developing an identity for the third generation nuclear engineer in the post-Fukushima society. In: this volume, Chapter 19
12. Christensen CM (1997) The innovator's dilemma: When new technologies cause great firms to fail. Harvard Business School Press, Boston
13. Yoshioka H (1999/2011) Shin-ban genshi-ryoku no shakai-shi: Sono nihon-teki-tenkai. Social History of Nuclear Power: The Trajectory in Japan (2nd ed.). Asahi-shimbun Shuppan, Tokyo
14. Matsumoto M (2014) The "structural disaster" of the science-technology-society interface: From a comparative perspective with a prewar accident. In: this volume, Chapter 10