The Failed Nuclear Risk Governance: Reflections on the Boundary between Misfortune and Injustice in the case of the Fukushima Daiichi Nuclear Disaster

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Abstract

Although technological progress has greatly created the possibilities for the expanded reach of risk management, its newly manufactured uncertainty may bring about a big scale of catastrophe. In order to control risk of the nature, the human ironically may create a hybrid monster that the human cannot control. The Fukushima Daiichi nuclear disaster also can be described as a hybrid monster, in which natural and technological elements combine to produce uncontrollable risks that may have disastrous consequences. This article scrutinizes the politics of the boundary between calculable risks and unpredictable uncertainty as well as the politics of the boundary between misfortune and injustice by focusing upon the lineage of a hybrid monster such as the Fukushima Daiichi nuclear disaster. Following the check of implications of a hybrid monster, we will interrogate historical lineage. Third we will examine the way in which technocratic politics of <risk/uncertainty> would influence the boundary between misfortune and injustice. Fourth we will scrutinize problems with the probabilist way of thinking, which tends to suppress the risk of nuclear technology. Finally we shed a light on technocratic governance forcing the people to become resilient.

As recent Science and Technology Studies (STS) literature suggests that scientific and technical knowledge needs to be seen as situated in social and material spaces(Simondo 2010, 204, O'Malley 2004), political interests would shape the presentation of scientific facts and predictions in areas of high uncertainty(Heazle 2010, Jasanoff 1990, 6) and the configuration of political actors in each country may bring about the different perceptions of risk and its related different regulatory policy(Jasanoff 2005, Brickman, Jasanoff, and Ilgen 1985, Vogel 2012, Jasanoff 2012, 23–58). As scientific knowledge becomes more closely aligned with economic and political power, new expert elites try to manipulate the unknown uncertainty in accordance with its vested interests in the name of risk management. Particularly in the field of the post-normal science where system uncertainties and value-loadings (decision stakes) are high, the *political* would become conspicuous(Funtowicz and Ravetz 2003). In addition, since risk is driven by mental perception, there are various kinds

of conceptualizing risk in accordance with value and culture. According to Slovic, "people holding an egalitarian preference for wealth and power to be distributed equally in society had higher perceived risk for a wide range of hazards and were particularly concerned about nuclear power. People who prefer a hierarchical social order, in which experts and authorities are in control, had much lower perceptions of risk and more favorable attitudes toward nuclear power." (Slovic 2000, 33–37) While both technocratic political power structure and risk culture of each society over-determine the risk communication, the risk-taking policy by a hierarchical risk communication sometimes leads to the unequal distribution of risk, which may impose real hazards and human insecurities upon the people in the peripheral regions. The Fukushima Daiichi Nuclear Disaster is one of such cases.

While scrutinizing the boundary between the misfortune and the injustice from the perspective of the semi-periphery like Fukushima in Japan and bringing back *the political* in the *depoliticized* science and technology issue, this article tries to shed a new light upon the risk governance issue in the field of political sociology (Aradau and Munster 2011, O'Malley 2004, Power 2007, Ericson, Doyle, and Barry 2003, Baker and Simon 2002, Amoore and Goede 2008, Rasmussen 2006, Coker 2009, Lobo-Guerrero 2011, 2012, Aven and Renn 2010, Renn 2008, Lim 2011). In other words, this article tries to examine the socially constructed boundary between calculable risk and the unknown uncertainty as well as the politically demarcated line between misfortune and injustice by deploying Foucauldian analysis of the relation between power and knowledge in the nuclear risk governance, which the conventional probabilistic risk analysis tends to underestimate. Danger is real but risk is socially constructed[1]. In the same way, disaster is real but misfortune is socially constructed. In the case of the failed risk governance, both are closely connected to each other. This is the starting point of our argument.

The argument proceeds in five steps. In the first section, we scrutinize the politics of the socially constructed boundary between calculable risks and unpredictable uncertainty as well as the politics of the boundary between misfortune and injustice by focusing upon the lineage of a hybrid monster such as the Fukushima Daiichi nuclear disaster. The second section explores historical lineage of the hybrid monster in Japanese context. The third section examines the way in which technocratic politics of <risk/uncertainty> would influence the boundary between misfortune and injustice. The fourth section focuses on problems with the probabilist way of thinking, which tends to underestimate

1 As the actor network theory suggests, we need search for the closer linkage between the constructionist and sociological approach and the realist and individualist approach to risk.

the uncertain catastrophe co-produced by both nature and science & technology (including nuclear technology). In the final section, we pay our attention to the way in which the failed nuclear risk governance requires the people to become resilient subjects in the low level radiation, which is also related to the unknown danger or the limit of the probabilist way of thinking.

Faced with Uncontrollable Hybrid Monsters

The tragedies that hit the Tohoku Region of Japan on March 11, 2011 are indeed rare. Faced with the vulnerabilities of our lives that the tsunami manifested, we are still mulling over how to comprehend these multiple tragedies. One response to the tragedies is to draw a future lesson from the experience while mourning the victims' deaths. While some people accept the tragedy as a misfortune, others reject it, asking, "Why us?"

Concerning this point, Judith Shklar wrote about the relationship between misfortune and injustice as follows.

> The difference between misfortune and injustice frequently involves our willingness and our capacity to act or not to act on behalf of the victims, to blame or to absolve, to help, mitigate, and compensate, or to just turn away. —Though it is undoubtedly changeable and indefinite, the difference between misfortune and injustice will not go away, and there are good reasons why we should retain it. We need it not only to make sense of our experiences but also to control and restrain the public sources of danger to our safety and security. But we must recognize that the line of separation between injustice and misfortune is a political choice, not a simple rule that can be taken as a given. The question is, thus, not whether to draw a line between them at all, but where to do so in order both to enhance responsibility and to avoid random retaliation. (Shklar 1990, 2–5)

As the very distinction between injustice and misfortune can sometimes be mischievous (Shklar 1990, 55), our sense of injustice may become protection against oppression by making clear the unjust distribution of risk and danger. In other words, our sense of injustice, while transforming the misfortune into an issue of injustice, may reawaken *the political* against depoliticizing governance that tries to impose a sense of unavoidable misfortune upon the people. Therefore, establishing a boundary between misfortune and injustice is often an objective of political bargaining and is determined contingently through hegemonic struggles.

In that sense, the Fukushima Daiichi nuclear disaster, which is ultimately

declared a Level 7 (Severe Accident) by the International Nuclear Event Scale (INES), is a typical issue for political bargaining over the boundary between injustice and misfortune. More than one hundred thousand people were forced to leave their homes owing to the high degree of radiation caused by the collapse of a nuclear reactor system. These internally displaced persons (IDPs) blame the Japanese government and Tokyo Electric Power Company (TEPCO) for permitting the large-scale radioactive contamination of their homeland. Before the Fukushima Daiichi nuclear disaster, the term "IDPs" was often regarded as a description of persons suffering from humanitarian crises far away from Japan. However, because of the nuclear radiation leaks, the realities of IDPs suddenly hit the people who lived in the 20 km evacuation zone near the Fukushima Daiichi nuclear power plant. According to the official report of the Fukushima Nuclear Accident Independent Investigation Commission (the National Diet of Japan), the accident was clearly "manmade" and there were many opportunities for taking preventive measures prior to March 11, 2011.

TEPCO was quick, however, to assign the accident cause to the tsunami, and state that earthquake was not responsible for damage to equipment necessary for safety. By emphasizing the unexpected huge scale of tsunami, TEPCO tried to defend itself by proclaiming that the company has little responsibility for the nuclear disaster because the situation was beyond the realm of regular expectations(TEPCO 2012, 27–28). According to TEPCO, the disaster was an extremely unlikely *black swan event* and simply a terrible misfortune.

However, it is quite difficult to describe this disaster simply as a misfortune. As the Independent Investigation Commission report criticizes, "it is impossible to limit the direct cause of the accident to the tsunami without substantive evidence. The Commission believes that this is an attempt to avoid responsibility by putting all the blame on the unexpected (the tsunami), as they wrote in their mid term report, and not on the more foreseeable earthquake. —The commission concludes that there were organizational problems within TEPCO. —Had there been a higher level of knowledge, training, and equipment inspection related to severe accidents, and had there been specific instructions given to the on-site workers concerning the state of emergency within the necessary time frame, a more effective accident response would have been possible.(Kurosawa et al. 2012, 17)" Another investigation committee, which was set up the Cabinet, also harshly criticized TEPCO as follows. "TEPCO bears critical responsibilities to society as a nuclear operator primarily responsible for nuclear power plant safety. Nevertheless, TEPCO was not sufficiently prepared for such an accident, that natural disasters including tsunami may lead to large-scale core damage. Furthermore, TEPCO had not taken adequate

preparedness for tsunami risks beyond design basis at the Fukushima Dai-ichi NPS. The accident showed quite a number of problems with TEPCO such as insufficient capability in organizational crisis management; hierarchical organization structure being problematic in emergency responses; insufficient education and training assuming severe accident situations; and apparently no great enthusiasm for identifying accident causes.(Hatamura et al. 2012, 24–25)" In sum, an organization-driven mindset that prioritized avoiding risk to the organization rather than the public may bring about the severe accident.

Furtheremore, prior to the accident, some scientists and anti-nuclear activists had continued to caution that nuclear power could bring about an uncontrollable disaster due to unpredictable causes, including a series of human errors and unexpected natural disasters such as earthquake and tsunami, and that such a disaster would reach the catastrophic level and cause such harm that the original natural environment cannot be restored. It is a high risk to build nuclear power stations on the Japanese archipelago, which is known for experiencing earthquakes and tsunamis owing to its location on the edge of the Pacific Ring of Fire. In short, we will not be able to prevent the severe accident by technical improvements and organizational efforts. When risks have catastrophic worst-case scenarios, it makes sense to take special measures to eliminate those risks, even when existing information does not enable regulators to make a reliable judgment about the probability that the worst-case scenarios will occur (Sunstein 2007, 119). Based on such a catastrophic precautionary principle, some scientists and anti-nuclear activists have claimed that nuclear power stations should be closed in order to avoid a catastrophe. However, despite these warnings and previous catastrophes such as the Chernobyl disaster, the Japanese government continued to build nuclear power stations each year, totaling 54 plants when the Fukushima Daiichi nuclear accident occurred.

If the disaster was not a misfortune, who is to be blamed for it? According to a social anthropologist, one way of explaining misfortune is moralistic: Misfortune occurred because someone offended the ancestors by breaking a taboo (Douglas 1992, 5–6). Another explanation is to attribute misfortune to the work of individual adversaries or an outside adversary. Thus, some people attribute the Fukushima Daiichi nuclear disaster to the technocratic regime (*Genshiryoku-mura* [nuclear power village])[2] that promoted pro-nuclear power

2 As Onishi and Belson described, "Just as in an average Japanese village, the like-minded people in the nuclear power village —nuclear industry officials, bureaucrats, politicians and scientists —have prospered by rewarding one another with construction projects, lucrative positions, and political, regulatory support. The few openly skeptical of nuclear power's safety become village outcasts, losing out on promotions and backing." (Onishi and Belson 2011)

policies with cover-ups of safety problems despite warnings from the anti-nuclear social movements(Onishi and Belson 2011). Others say that the use of nuclear energy itself was the act of violating a taboo of the environmental Gaia (earth-life) system.

Although technology has greatly decreased the empire of fatality, its newly man-made risk and uncertainty may lead to a large-scale catastrophe. By seeking to decrease risks of the nature, the science & technology may co-produce an un-controllable *hybrid monster with the nature*. As the Fukushima Daiichi nuclear disaster was one convergent consequence of a triple severe accident—a magnitude 9.0 earthquake, followed by a 14–meter tsunami, and the subsequent full meltdown—it can be described as a *hybrid monster*. According to Bruno Latour, modernity involves a dual process of "purification" and "hybridization." Hybridization involves a mixture of nature and culture, while purification involves the clean construction of nature separated from society and the self. "The more we forbid ourselves to conceive of hybrids, the more possible their interbreeding becomes—such is the paradox of the moderns, which the exceptional situation in which we find ourselves today allows us finally to grasp" (Latour 1993, 12). The Fukushima Daiichi nuclear disaster shows such an exceptional situation as well as the interconnectivity of nature and society. In short, both the nature (earthquake and tsunami) and the human's nuclear technology co-produced a *hybrid monster,* which is continuing to leak high level of radiation.

In Ulrich Beck's sociological terminology, this exceptional situation can be described as a world risk society. The project of modernity, which tries to decrease risks by controlling nature through the application of science technology, newly manufactures uncertainty. Science and technology, which were once the sources of safety, have become the source of risk (Douglas and Wildavsky 1982, 10). As Beck pointed out, manufactured uncertainty, which involves the conversion of the unseen side-effects of industrial production into global ecological flashpoints, is not strictly a problem of the world surrounding us—not a so-called "environmental problem"—but rather a deep institutional crisis of the first (national) phase of industrial modernity ("reflexive modernization") (Beck 1999, 33). The resulting threats, which are neither calculable nor insurable, make us all members of a world risk society. As Beck agreed with Latour's argument about the hybrid world, the notion of a world risk society is pertinent to a world that can be characterized by the loss of a clear distinction between nature and society (Beck 2000, 221).

As long as the distinction between nature and society is not clear, there is no purely objective science and technology that is not contaminated by the

political. In the case of large-scale science and technology, such as nuclear power, that needs a large amount of budgetary money, the degree of *political* contamination must be high. Here, we should focus on variations in the degree of *political* contamination among OECD countries as well as contrasting ideological groups. While some states such as France accept relatively high nuclear risks, others such as Germany avoid them. Even within American society, there is competition between both pro-nuclear and anti-nuclear identities for the individual and groups involved (Downey 1986). As Douglas and Wildavsky pointed out, the political argument over technology is conducted between the heavily risk averse and the risk takers (Douglas and Wildavsky 1982, 67). As far as the perception of the risk and uncertainty is socially constructed, the hegemonic competition will over-determine the content of the risk culture in each society. This will lead to differences in terms of risk acceptance among countries.

If the heavily risk averse groups strengthen upon the regulatory policy in order to avoid the *false positives*, the adopted stringent regulation may sometimes lead to unnecessary over-regulation. But if the risk takers take initiatives in regulatory policy-making to reduce *false negatives*, it may lead to harmful under-regulation(Vogel 2012, 17). We can notice the latter even in the case of the nuclear power policy. In order to understand the different regulatory choices with respect to nuclear power among the developed countries, we need pay an attention to the contextual condition of each case. In other words, without understanding socially constructed risk culture in line with the Japan's historical and political path, we cannot understand why the risk takers took initiatives in the nuclear power policy there, which finally led to the Fukushima Daiichi nuclear disaster.

Embracing Nuclear Power: From Hiroshima to Fukushima

Following the Fukushima Daiichi incident, the Canadian newspaper, *Globe and Mail,* carried an article titled "Why Japan embraced nuclear power after suffering the atomic bomb" (Allemang 2011). As the citation of John Dower's comment suggested, this title is a paraphrased reference to Dower's famous book *Embracing Defeat: In the Wake of World War II.* Despite the horrible experiences of Hiroshima and Nagasaki, why has Japanese society embraced nuclear power as well as defeat?

It is certain that Japan's historical path of nuclearization was derived from Eisenhower's Atoms for Peace. President Eisenhower delivered a speech titled

"Atoms for Peace" to the General Assembly of the United Nations on December 8, 1953. Despite the speech's beautiful rhetoric, it is clear that Atoms for Peace was a part of apocalypse management. It was a response to rapid changes in the world situation: the Soviet gaining H-bomb capability, moving the superpower contests toward mutually assured destruction; the Soviet "peace offensive" threatening to undermine the "free world" alliance; and colonial empires beginning to crumble, creating new nationalisms and an emerging bloc of neutral nations (Chernus 2002, 128). As Medhurst pointed out, the Atoms for Peace campaign had military/security, economic, diplomatic, and psychological dimensions, all of which were coordinated to achieve one or more specific goals (Medhurst 1997, 575). From the military perspective, talk of the "peaceful atom" served to divert attention away from real military build-up such as "massive retaliation" and the nuclearization of NATO. In other words, one of its goals was to play up the beneficial uses of nuclear energy, and thereby downplay its destructive evil image and public fears about the nuclear holocaust represented by Hiroshima and Nagasaki (Hewlett and Holl 1989, 306–07).

Another goal was to invite foreign governments to enter into bilateral agreements that would lead to the construction of power reactors in exchange for radioactive ores or access to lucrative markets, including Japan. Another diplomatic goal was to strengthen US-led international control of nuclear technology for preventing nuclear proliferation while permitting other countries' "peaceful" use of nuclear energy. In this political context, Article 4 of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) stipulated the following: "All the Parties to the Treaty undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy." However, this loophole subsequently led to unintended nuclear proliferation to India, Pakistan, Israel, and North Korea (Fuhrmann 2012). Although Atoms for Peace aimed at non-proliferation, it easily became 'Atoms for War'. In short, it is impossible to distinguish between Atoms for Peace and Atoms for War. There is an intrinsic link between the military and civilian aspects of nuclear power.

Japanese society gradually began to embrace nuclear power by accepting the propagandistic rhetoric of Atoms for Peace. Some ambitious Japanese politicians such as Yasuhiro Nakasone also tried to utilize Atoms for Peace as an opportunity to introduce nuclear power in Japan in preparation for having a latent capability for future nuclear rearmament. However, the Japanese nuclearization process was not smooth. First, the people's experience and memory

of Hiroshima and Nagasaki has strongly negative impact on their impression of nuclear power in Japan. In addition, the code-named *Bravo*, an explosion of a thermonuclear hydrogen bomb, vaporized the atoll, spread radioactive fallout well outside the designated security area, and contaminated thousands of Marshall Islanders and the crew of a Japanese fishing boat named *Daigo Fukuryu Maru (The Fifth Lucky Dragon)* on March 1, 1954. Twenty-three of all crewmembers were exposed to a high level of radiation and fell sick. One of them, Aichiki Kuboyama, died six months later owing to cancer. This resulted in an international uproar and reignited the Japanese anti-nuclear movement. However, the US government denied any responsibility for the events by claiming that they could not admit any causal relation between the nuclear explosion and crewmembers' sickness (Homei 2012). This case also showed that scientific findings related to the effect of radiation are contaminated by the *political*. The US government tried to hide the bad consequences of radioactive contamination by paying *ex gratia* money, not compensation, of USD two million to Japan, and the Japanese government accepted it in exchange for not pursuing the acknowledgment of American responsibility. Following this setback, both US and Japanese governments tried to forward the bright image of Atoms for Peace by mobilizing TV programs and exhibitions and eventually succeeded in implanting this notion in the dominant public discourse. By accepting the false dichotomy between peaceful use and military use of nuclear energy, Japanese society embraced nuclear power while linking the memory of Hiroshima and Nagasaki to a peaceful national identity. Ironically, the peace (anti-nuclear weapon or disarmament) movements took the lead in the social movement sectors by surpassing the anti-nuclear power movements during the 1950s and 1960s in Japan.

Following the oil crisis in the early 1970s, Japan as an energy-starved nation accelerated its full-scale building of nuclear power plants. The 1973–1974 oil crisis, which was triggered by the political instability in the Middle East, forced Japan to face its energy security issue and to diversify its energy sources. Since then, the Japanese government continued to construct nuclear power plants at an average pace of about two reactors per year in the name of energy security. Taking seriously the risks of accidents and the costs of disposing spent fuel, the anti-nuclear movement tried to stop the construction of nuclear plants However, the government and the electric companies succeeded in overcoming the anti-nuclear movement by delivering numerous subsidies to local communities that accepted the nuclear power plants, in accordance with three electric power laws (*Dengen Sanpo*) promulgated in 1974. For small local communities far away from the global city of Tokyo, a nuclear plant meant millions of dollars in

grants and loans, new infrastructure including roads and public buildings, and potential jobs in exchange for accepting nuclear risks. In short, the government imposed unequal distribution of risks upon local communities by buying them out. The Fukushima Daiichi incident has clearly exposed such an unequal and unjust distribution of risks.

After the Three Mile Island (TMI) accident in 1979 and the Chernobyl accident in 1986, most countries refrained from constructing new nuclear power sites. Japan also could not gain new sites for nuclear power, except a few (*Totsu* in *Aomori* and *Kaminoseki* in *Yamaguchi*), owing to strong protests from local communities and environmental movements. However, Japan continued to construct nuclear power reactors at existing sites even after the Chernobyl accident. In addition, it promoted the development of the nuclear fuel cycle and fast breeder reactors (FBR). Despite strong protests following the Chernobyl accident, in 1988, the Japan Nuclear Fuel Industries Company (*Donen*) began building a large commercial reprocessing plant, a uranium concentration plant, and a low-level waste disposal facility at one of the poorest villages, *Rokkasho Mura,* in Aomori. Although the strong opposition delayed construction, the nuclear industry commitment to the project was quite firm. Moreover, the government did not have second thoughts about this and consolidated support by buying out the local population with government subsidies. Although the US and Europe canceled several FBR programs owing to technical difficulties and economic infeasibilities, the Japanese government still adhered to the nuclear fuel cycle program and FBR construction. There may be political ambitions to maintain latent capabilities to have nuclear weapons behind the government's ambitious plan to use plutonium "peacefully," as some politicians claim (Samuels 2007, 176). Behind the technopolitics that promoted nuclear programs in Japan, politicians and technocrats have nurtured a prestigious national identity through the development of nuclear-related science technology under the umbrella of the US-led non-proliferation regime.[3] Similar to France, the national radiance would emanate from nuclear technological prowess in Japan too (Hecht 2009, 330).

Japanese nuclear technopolitics is managed mainly by a tripartite coalition of the techno-bureaucrats, Liberal Democratic Party (LDP) politicians, and the electric power companies. As in France, the centralized control of nuclear power policy has closed the political opportunity for anti-nuclear power move-

3 Although US Presidents Ford and Carter tried to curtail the civilian use of plutonium after India's nuclear testing in 1974, which indicated the danger of converting it for nuclear weapons, Japan pressured the US to revise the Japan–US Nuclear Agreement, allowing Japan to continue its nuclear fuel cycle project.

ments in Japan. Compared to the case in other industrial countries such as Germany and Switzerland (Koopmans and Duyvendak 1995), Japan's anti-nuclear energy movement and its critical voices have had surprisingly little influence on the decision-making process (Dauvergne 1993, 591). Japanese nuclear technopolitics can be described as a sub-government that refers to the decoupling of the government from democratic control (Yoshioka 1999, 20–21). As the concept of sub-government is also applied to American nuclear power (Hayden 2002, Temples 1980), the decoupling of the government from democratic control is common in the field of advanced science technology. However, the US and Japan have taken very different paths of nuclear sub-politics. While the American nuclear sub-government was decentralized through independent Nuclear Regulator Commission (NRC) following the TMI accident, the US Congress and the market also began to treat the nuclear power industry indifferently owing to its rising cost (Joppke 1993, Jones 1991). In Jones's words, the demise of nuclear power reflects the very functioning of the democratic process. On the other hand, the newly regulating agency was also put under the guidance of the pro-nuclear Ministry of Economy, Trade and Industry (METI, formerly MITI), and the tripartite coalition has remained firm in the case of Japan. Japanese civil society did not strengthen its democratic control of nuclear power policy because dissident movements were annulled by the politics of influence peddling large subsidies, which eventually imposed an unequal distribution of risks upon the poor peripheral areas. Without an effective checking agency, the resilient triple alliance of the techno-bureaucrats, LDP politicians, and electric power companies remained intact even after some serious accidents, including the JCO accident at Tokai village in 1999, which was level 4 on the international nuclear event scale.[4] In short, the inefficient and costly nuclear power enterprise survived due to protection by the technopolitics that is characterized by centralized control and lacks critical and reflective inputs from civil society.

4 On September 30, 1999, as three workers were preparing a small batch of fuel for the experimental fast breeder reactor, the nuclear fission chain reaction became self-sustaining and emitted intense gamma and neutron radiation owing to human errors. Two workers died because of severe damage to their organs and a near-zero white blood cell count.

Technopolitics of "Risk/Uncertainty"

As Gabrielle Hecht pointed out in his book on nuclear power and national identity in France, a key component of technopolitics is the manipulation of uncertainty (Hecht 2009, 334). We notice a similar pattern in the case of Japan. Technocrats, who have vested interests in nuclear industries, tend to underestimate risks by manipulating uncertainties. It is noteworthy that the Japanese nuclear industry has a history of falsifying data and hiding accidents. Although we must distinguish between falsifying data and manipulating uncertainties, excessive manipulation of uncertainties may have brought about technocrats' ignorance of the possibility of an unfamiliar event happening or the interpretation of data in accordance with vested interests. Such uncertainties include a 14–meter-high tsunami hitting nuclear power sites, a series of human errors leading to the meltdown of nuclear reactors, uncontainable nuclear wastes, and so on. Risk-assessment experts did not predict these events before the Fukushima Daiichi nuclear disaster. Experts who calculate risk on the basis of the known past fail to predict the occurrence of uncertain phenomena and tend to ignore the uncertainty because expecting the unexpected would bring about unaffordable high costs for preventive measures. Both promoters and regulators of nuclear powers often ignore warnings about *unknown catastrophes* because they see them as a mere obstruction to their operations.

In order to understand the problem of *unknown catastrophes*, we should try to distinguish calculable risk from incalculable uncertainty despite of blurring or overlapping of both categories and the predominant probabilistic risk management (O'Malley 2004, 13–15). As Frank Knight pointed out almost ninety years ago, we know the probability of risks but we do not know the same about uncertainties (Knight 1971 (orig. 1921)). John Maynard Keynes also wrote about uncertainty as follows.

> By "uncertain" knowledge, let me explain, I do not mean merely to distinguish what is for certain from what is only probable. The game of roulette is not subject, in this sense, to uncertainty; nor is the prospect of a Victory bond being drawn. Or, again, the expectation of life is only slightly uncertain. Even the weather is only moderately uncertain. The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of copper and the rate of interest twenty years hence, or the obsolescence of a new invention, or the position of private wealth-owners in the social system in 1970. About these matters there is no scientific basis on which to form any calculable probability whatever. We simply do not know. (Keynes 1937, 213–4)

In short, uncertainties are both known unknowns and unknown unknowns.

By "very uncertain," we do not mean the same thing as "improbable." It is quite difficult to apply probabilistic risk calculations to uncertain phenomena, in particular the case of unknown unknowns. Our conventional approach to risk is "probabilistic," but the Fukushima Daiichi nuclear disaster has reminded us of the importance of the "possibilistic" approach (or the worst-case approach) to uncertainties (Pritchard 2012). Probabilistic thinking, which dominates the nuclear industry, inherently downplays some possibilities such as a magnitude 9.0 earthquake or 14–meter tsunami until such an event really happens. We should pay attention to the way in which the unpredictable dynamics of hybrid monsters lead to serious accidents through possible seismic changes, which cannot be predicted by the probabilistic inferences and can be imagined only by possibilistic thinking (Clarke 2006, passim). As Charles Perrow also suggested, because of the complexity of nuclear plants and their tight coupling, serious accidents are inevitable, even with the best management practices and attention to safety (Perrow 2007, 172).

In addition, as Lee Clarke pointed out, probabilism tends to protect the powerful and often results in the non-powerful being placed in danger (Clarke 2006, 50). Patterns of suffering that follow divisions of race, class, gender, or geography are examples of structured destruction, not just accidental disasters. Mary Douglas also indicated the same point as follows. "Since the present distribution of risks reflects only the present distribution of power and status, fundamental questions are raised by the justice issue (Douglas 1985, 10)." Following the Fukushima Daiichi nuclear disaster, most people who were forced to leave their homes had been living in the rural areas far away from global cities such as Tokyo. Some of them accepted the presence of nuclear plants in exchange for subsidies while believing in the safety guarantee based on probabilistic thinking. We can notice one sort of North–South relation in the pattern of suffering in this case. Reflecting the geographical pattern of suffering, such as center–periphery, probabilistic thinking is not enough to prevent this kind of black swan tragedy, in particular for the people living in the periphery. In other words, statistical risk-taking behaviors by privileged persons will eventually bring about calamity for the under-privileged, as the world risk society is unevenly structured.

To what extent one seriously considers the possibility of a black swan depends on the risk culture or institutional constraint of each society as well as each observer's social position. For example, we can see differences in the way in which the Chernobyl disaster had an impact on people's perception of risks with regard to nuclear power plants. While some countries tried to abolish nuclear power by converting it into renewable energy, others continued to cling

to it even after the Chernobyl disaster (Flam 1994). In the same way, countries responded differently to the Fukushima Daiichi nuclear accident. Several countries, including Germany, Switzerland, Sweden, Italy, Spain, and Belgium are moving away from earlier decisions to extend the operating lives of existing nuclear plants or to build new plants. In particular, Germany took action soon after the Fukushima Daiichi nuclear accident. On March 15, 2011, the German government permanently shut down the 8 oldest of its 17 nuclear units. In June 2011, the German parliament passed a law to phase out the remaining plants by 2022. On the other hand, permanent members of UNSC (known as the P5; the US, the UK, France, Russia, and China) continue to maintain nuclear power energy as an option as well as nuclear weapons. In addition, not only China but also other Asian countries such as South Korea, Taiwan, and India are eager to construct new nuclear energy plants. In addition, non-nuclear rising economies including Turkey, Vietnam, Saudi Arabia, and the UAE (Abu Dhabi) have committed to start building nuclear power plants. Although the accident at Fukushima overshadows the recent nuclear renaissance activated by the propaganda that nuclear power represents a potential source of carbon-free electricity production, its effect seems to be quite modest at the global level (Joskow and Parsons 2012). In short, the political forces, which tend to underestimate the uncertain danger of nuclear powers, are still hegemonic in the P5 countries of UNSC as well as rising Asian developmental states.

In this context, how Japan will respond to the Fukushima Daiichi nuclear accident is crucial for the future trend of nuclear energy. After the disaster, public opinion shifted toward a new frame for understanding nuclear power, characterizing it as a *Faustian devil's bargain* between expanding nuclear fission (i.e., accumulating radioactive wastes and possible catastrophic nuclear disasters) and enduring climate change. Most members of the public are unwilling to take any more risks by engaging with nuclear energies. However, some of them will gradually begin to forget the disaster and try to restart the operation of existing nuclear plants for economic recovery while still believing in *progress* in the development of nuclear technologies and criticizing the anti-nuclear power movements as hysteric NIMBYism ("not-in-my-backyard" attitude). As Gamson and Midigiliani pointed out, majority of the public's attitude toward nuclear energy is better described as ambivalent than as pro or con. While interacting with changing media discourse and events, public attitudes for and against nuclear power have also changed over time (Gamson and Modigliani 1989). We can notice a similar pattern in the case of Japan. Following the Fukushima Daiichi nuclear disaster, most people have begun to support discourse emphasizing the importance of the "possibilistic" approach (or the worst-case

approach) to uncertainties and advocating the phase-out of vulnerable nuclear plants in the next few decades or so.[5] Citizens are stepping forward to engage in community-based science, challenge the manipulated information and misleading explanations given to them by the government and electric companies, and protest nuclear policies (Aldrich 2012).

It still remains unclear whether Japan will follow the same path as Germany, partly because the US government is trying to stop Japan's nuclear phase-out, and the built-in pro-nuclear lobby (*Genshiryoku-mura*) in Japan is also utilizing American pressure for its own sake.[6] The third Armitage report instructed Japan in its future nuclear policy as follows. This long quotation clearly tells us about how American policy makers, particularly the "Japan handlers," think about Japan's role related to American nuclear strategy.

> Japan has made tremendous progress in boosting energy efficiency and is a world leader in energy research and development. While the people of Japan have demonstrated remarkable national unity in reducing energy consumption and setting the world's highest standards for energy efficiency, a lack of nuclear energy in the near term will have serious repercussions for Japan. Without a restart of nuclear power plants, Japan will not be able to make meaningful progress toward her goal of cutting carbon dioxide (CO_2) emissions by 25 percent by 2020. Nuclear power is and will remain the only substantial source of emissions-free, base load electricity generation. Environment Ministry data reportedly shows that without a nuclear restart, Japan's emissions can fall at most by 11 percent by 2020; but with a restart, emissions reductions could approach 20 percent. A permanent shutdown would boost Japan's consumption of imported oil, natural gas, and coal. Moreover, postponing a decision on national energy policy has the potential to drive vital, energy-dependent industries out of Japan and may threaten national productivity.
>
> A permanent shutdown will also stymie responsible international nuclear development, as developing countries will continue to build nuclear reactors. China, which suspended reactor approvals for over a year following Fukushima (but did not suspend progress on ongoing projects), is restarting domestic construction of new projects and could eventually emerge as a significant international vendor. As China plans to join Russia, South Korea, and France in the major leagues of global development in civilian nuclear power,

5 For example, as Kansai Electric Power Co. prepares to fire up a reactor at the Oi nuclear plant, more than ten thousand people gathered in front of the prime minister's office to protest every Friday night. Kazuko Nagata, "Protest rally against Noda, Oi Reactor restarts intensifies," *The Japan Times,* June 30, 2012.

6 On September 19, 2012, the Japanese government was forced to stop short of formally adopting the goal it announced just one week ago—to phase out nuclear power by 2040—after the plan drew intense opposition from business groups and the US government. *The Tokyo Shimbun,* September 20, 2012.

> Japan cannot afford to fall behind if the world is to benefit from efficient, reliable, and safe reactors and nuclear services.
> For its part, the United States needs to remove uncertainty surrounding disposal of spent nuclear waste and implement clear permitting processes. While we are fully cognizant of the need to learn from Fukushima and implement corrective safeguards, nuclear power still holds tremendous potential in the areas of energy security, economic growth, and environmental benefits. Japan and the United States have common political and commercial interests in promoting safe and reliable civilian nuclear power domestically and internationally. Tokyo and Washington must revitalize their alliance in this area, taking on board lessons from Fukushima, and resume a leadership role in promoting safe reactor designs and sound regulatory practices globally. The 3–11 tragedy should not become the basis for a greater economic and environmental decline. Safe, clean, responsibly developed and utilized nuclear power constitutes an essential element in Japan's comprehensive security. In this regard, US-Japan cooperation on nuclear research and development is essential. (Armitage and Nye 2012, 2–3)

In short, the US will not allow Japan to take the phase-out option for the necessity of maintaining nuclear energy as an essential part of the American comprehensive national security policy. The Japanese government will not dare resist this pressure from the US and the pro-nuclear business community unless its civil society continues to challenge the nuclear status quo. In other words, human security will be sacrificed in the name of (inter-)national security. However, nuclear power project would be a market failure without large subsidies. In addition, it is necessary for justifying nuclear power to continue trimming the data on costs and accidents (Shrader-Frechette 2011b, 69–109).

Political Bargaining between Probabilism and Possibilism

Pro-nuclear power governments tend to ignore worst-case possibilities by political uses of probabilism. We need to recognize that statistical evaluation and management are irreducibly political and that the human dimension of biased risk evaluation cannot be removed (Shrader-Frechette 1991, 218). On the other hand, "rational" risk analysts may label people who think about catastrophes as irrational. Like the Greek mythological prophet Cassandra, who could not do anything but foresee the catastrophic future because no one believed her predictions, the anti-nuclear discourse based on the worst-case scenario tends to lose its legitimacy in the risk culture that is dominated by the probabilist way of thinking (Clarke 2006, 35–41). However, a nuclear accident such as the

Fukushima Daiichi nuclear disaster is not just a rare or black swan event. As Perrow repeated, it is a normal accident or a system accident that can happen on the condition of the complex (non-linear) interaction and tight coupling of failures (Perrow 1999, 62–100). Nuclear proponents try to ignore this aspect of reality by labeling a critical voice as nuclear phobia. Here, we can notice *the politics* behind the conflict between different risk perceptions about nuclear power.

In the same manner, nuclear proponents also tend to underestimate the negative consequences of being exposed to radiation and sometimes try to cover up inconvenient truths. According to them, radiation risks are very low, and any confirmed medical problems associated with nuclear accidents are the result of stress, anxiety, or nuclear phobia, and not radiation (Shrader-Frechette 2011b, 122–126). We notice this kind of blame-the-victim argument assisted by a flawed statistical method in the cases of Hiroshima, Nagasaki, Bikini, Hanford (D'Antonio 1993),[7] among others. At present, some scientists are following the same line of argument by trimming the data to underestimate the negative influence of radiation on the people around Fukushima.

The Japanese government has ordered the evacuation of areas that received more than 20 mSv per year from the damaged Fukushima Daiichi nuclear reactors and storage pool. However, it is not certain that this evacuation is enough to protect the health of the population there. No one knows exactly how and to what extent low-level radiation exposures will affect people's health. In the case of low-level radiation exposures, particularly internal radiation, it is difficult to prove a causal relation between radiation and a disease like cancer. Even in the case of Hiroshima, it was not until 2007 that internal radiation came to be considered legally in the "A-bomb disease class action lawsuits" (Kazashi 2012). In the case of accidents at nuclear power stations, it seems more difficult to prove an invisible causal relation owing to a lack of data and complex interactions. To minimize compensations for the victims and to suppress the risk of nuclear technology, the technocratic governance has underestimated the dam-

7 In the case of Hanford, the official report denied the causal relation between dose to the thyroid from Hanford radiation and the disease outcome of the population living there in accordance with statistical logic. "In conclusion, the results of the HTDS provide no evidence of a statistically significant association between increasing thyroid radiation dose from Hanford and the cumulative incidence of any primary outcome studied. These findings do not definitively rule out the possibility that Hanford radiation exposures are associated with an increase in one or more of the outcomes under investigation. However, it does mean that if such associations exist, they were likely too small to detect using the best epidemiologic methods available." *Hanford Thyroid Disease Study Final Repor*t. By Study Management Team (Scott Davis, Kenneth Kopecky and Thomas E. Hamilton). Fred Hutchinson Cancer Research Center, 2002, p. liii.

age caused by low-level radiation. However, as the uncertainty does not imply low risk, the unknown effect of low-level radiation does not mean safety. An acceptable level of radiation is nothing but a toleration level established out of economic and political interests (Beck 1992, 65–67). In short, the borderline between safety and danger, like the radiation protection level, might be determined by political bargaining.

The problem is that voiceless people may be the most affected by the disaster, which can be described as an environmental injustice inherent in the nuclear governance. In particular, children are more vulnerable to health risk by radiation and may suffer from radiation-induced thyroid cancer. We are not certain what will happen to the children who were exposed to low-level radiation. However, by looking at precedent cases such as the TMI accident, we can predict what kind of attitude the nuclear industry and government will take toward probable increased health problems. According to Shrader-Frechette, "the dominant position, which is also that of the US government and the nuclear industry, is that there was no consistent evidence that radioactivity released during the nuclear accident had a significant impact on the overall mortality experience of these [TMI] residents. Instead, the official US position (and dominant or majority scientific) position is that TMI-related *stress* likely caused the post-accident increases in cancer and mortality in nearby areas (Shrader-Frechette 2011b, 127–8)." The minority position is that TMI radiation is the more likely cause. The same pattern of experts' discourse is now emerging in the case of Fukushima. While the majority denies the possibility that low-level radiation will cause serious health problems in the population, critics point out that radiation safety standards themselves appear severely flawed and that the dominant causal hypothesis is less plausible because of its flawed statistical inference or questionable practice relying on classical statistical tests in non-experimental studies. While examining the actual consequences of low-level radiation, each stakeholder who adopts a different standpoint between probabilism and possibilism will continue to engage in political bargaining to determine Japan's radiation safety standards. As the case of TMI suggested, even if people suffer from leukemia or thyroid cancer after Fukushima, the government may deny any responsibility for it by mobilizing blame-the-victim logic.[8] In other words, political bargaining between probabilism and possibilism overshadows the political delimitation of a borderland between misfortune and injustice. Although

8 In 2012, the first thyroid cancer sufferer was found among those who received medical checks in Fukushima, but medical experts denied the link between the Fukushima accident and the cancer. "Fukushima finds first child thyroid cancer after 3/11," *The Japan Times,* September 13, 2012.

the probabilist way of thinking tries to depoliticize this unknown disaster and treats it as just a misfortune, the possibilistic way of thinking shows that the black swan claim is false and that the disaster was a consequence of the failure of flawed statistical risk analysis (Shrader-Frechette 2011a).

Required Resilient Subject after the Failure of Nuclear Risk Governance

Following TMI and the Chernobyl accident, the possibilistic way of thinking became temporarily influential even in Japan. According to public opinion surveys, as concerns about nuclear safety increased, public support for nuclear power declined and lost its majority position in the beginning of the 1990s (Honda 2005, 206). However, social amnesia brought back nuclear power as an effective energy for reducing carbon dioxide emissions in the beginning of the 21st century. Although there was strong opposition against the construction of nuclear power sites, nuclear proponents tried to expand nuclear power in the name of *nuclear renaissance*.

However, those who envisioned a *nuclear renaissance* suffered a serious setback as a result of the Fukushima Daiichi nuclear disaster. Thousands of acres have been poisoned by the meltdown of the Fukushima Daiichi nuclear reactors. In addition to air and soil being contaminated by continuing radiation, tons of irradiated water is still leaking from the Fukushima Daiichi nuclear power plant into the Pacific Ocean[9]. More than one hundred thousand people have been forced to leave their homes as IDPs. Because of this continued effect of the disaster, the current technocratic governance has sought to force people to become resilient subjects who are capable of dealing with situations of high uncertainty, including low-level radiation.

Owing to the high uncertainty of the current complex system, the technocratic governance has attempted to increase the adaptability or resilience of Japanese citizens rather than to reduce their vulnerability or increase the capability of the people (Frerks, Warner, and Weijs 2011, Walker and Cooper 2011). Pat O'Malley explained the notion of a "resilient subject" as follows.

> The newly resilient subject may take advantage of risk calculations and predictions where available, for it is not at all that statistical risk has been superseded.

9 TEPCO finally admitted that an estimated 20 trillion to 40 trillion becuerels of tritium from the Fukushima Daiichi nuclear plant may have flowed into the Pacific Ocean since May 2011. "Huge leal of tritium feared in Fukushima," *The Japan Times*, August 3, 2013.

> But resilience differs from both archival-statistical risk and enactment, to a greater or lesser degree, in three respects. First, and perhaps most important, it is not specific to the governance of particular threats, or indeed even to threats per se. It is a technology that is imagined to equip the subject to deal with uncertainty in general. Second, resilience emerges as a new technique better adapted to govern situations of radical uncertainty: to deal with possible events that have either not been predicted statistically or not thought to be sufficiently likely to warrant enacting or in other ways rehearsing. Resilience occupies an increasingly prominent place in large measure because it is in these ways a technique of "incalculable" uncertainty rather than "calculable" risk. (O'Malley 2010, 505–6))

Although the concept of resilience resonates with advanced neo-liberal governmentality, we should pay attention to the fact that nuclear industries cannot survive without large subsidies. In other words, the resilient subject is not always required in the context of neo-liberal governance. As Duffield reminded us that nuclear civil defense requires societal resilience(Duffield 2011), the resilient subject is sometimes required in the context of high uncertainty derived from wasteful and costly *security dispositif*. The high cost of nuclear powers is justified in the name of national security (or energy security). Nuclear technocratic politics manufactures new uncertainties by taking high risks and denying the possibility of the worst-case scenario and eventually brings about uncontrollable hybrid monsters, which leads to widespread human insecurities. On the other hand, it also mobilizes the bio-political security technique of resilience in order to overcome endless emergencies. This kind of paradoxical situation seems to be a sign of the dusk of the modern civilization or the looming unknown catastrophe.

Risk-taking ventures of science technology based on a false dichotomy between nature and culture are now in systemic crisis. Following Chernobyl, the case of Fukushima brought us to a crucial juncture of modern civilization. Now, we must recognize that our rationality is quite bounded under imperfect information and that probabilistic risk management is not enough to deal with a systemic disaster that might be brought by the combination of complexity and coupling (Perrow 1999). Fortified bunkers will not work in total war, which includes environmental terror (Duffield 2011). To avoid the emergence of a runaway hybrid monster, we should abandon one sort of technological system that might give us incurable catastrophic damages. Instead of the nuclear-based military-techno-bureaucracy complex, we must seek an alternative soft energy path based on renewable energies. Related to the essence of technology, Heidegger pointed out as follows.

> What is modern technology? It too is a revealing. Only when we allow our attention to rest on this fundamental characteristic does that which is new in modern technology show itself to us. And yet the revealing that holds sway throughout modern technology does not unfold into a bringing-forth in the sense of poiesis. The revealing that rules in modern technology is a challenging [Herausfordern], which puts to nature the unreasonable demand that it supply energy that can be extracted and stored as such. But does this not hold true for the old windmill as well? No.—In contrast, a tract of land is challenged into the putting out of coal and ore. The earth now reveals itself as a coal mining district, the soil as a mineral deposit.—Air is now set upon to yield nitrogen, the earth to yield ore, ore to yield uranium, for example; uranium is set upon to yield atomic energy, which can be released either for destruction or for peaceful use. (Heidegger 1997(orig.1953), 14)

The recent nuclear disasters give us an opportunity to rethink the uncertain danger of "a challenging revealing that puts to nature the unreasonable demand." To control the uncertainty of nature and promote emancipation from its restraints, humans have developed technological civilization. However, the excess of technology has manufactured a hybrid nature that may bring about very dangerous uncertainties and is pushing humans forward to the brink of extinction by intentionally or unintentionally releasing destructive forces. To prevent such a catastrophe, we must recover a creative imagination by which we can give rebirth to *poiesis* and imagine an alternative *techne*. The faculty of imagination is indispensable to creative knowledge production, but nowadays, the imagination is also subordinated to a rational framework and routinized in its reproductive function (Aradau and Munster 2011, 80). As routinized poor imagination gives us room only for a probabilistic way of thinking and not for possibilistic thought, it may eventually invite unknown catastrophe. Related to this point, Jean-Pierre Dupuy said the following in a very pessimistic tone. "The obstacle (for avoiding catastrophe) is not uncertainty but the fact that nobody cannot believe in the possibility of the worst case" (Dupuy 2006, 165). However, if the worst case happens, it will be too late. Furthermore, that catastrophe would be characterized as a structured pattern of suffering and human insecurities (serious environmental injustice) rather than an evenly distributed misfortune. After Fukushima, we need bring back the spirit of radical democracy based on the equality of incommensurables against calculating technocratic governance requiring resilient subject in order to stop the reoccurrence of equivalent catastrophes under the guidance of totalizing technological civilization (Nancy 2012, 69).

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