

The second update of the Fukushima Daiichi Nuclear Station accident (June 1 through August 31, 2011)

SHIBUTANI Yu

Institute of Asia-Pacific Studies, Waseda University, Waseda Bldg. 1-21-1, Nishiwaseda, Shinjuku-ku, Tokyo 169-0051 Tokyo, Japan (shibutaniju@aol.com)

Abstract: The Fukushima Daiichi accident occurred on March 11, 2011. The Japanese government and Tokyo Electric Power Company (TEPCO) encountered great deal of difficulties to stabilize the nuclear power reactor. Although the maximum radiation level has decreased, it still accounts for one-fifth of the level detected as of end of August 2011. There are currently growing concerns regarding the complexities of nuclear energy that are faced by the society of Japan. Owing to the occurrence of the Fukushima Daiichi accident, the firm belief on absolute safety of Japan's nuclear power plants has suddenly collapsed. Over the past decades, people tended to trust the government and electric power companies, which assured the safety and ensured about the necessity of nuclear power. However the recent disaster that took place in Fukushima has triggered public anger and distrusts that lead to negative campaigns against nuclear energy, in addition to oppositions against the government and nuclear power companies. The harsh public criticism has forced the government to separate the Nuclear and Industrial Safety Agency (NISA) from affiliation with the Ministry of Economy, Trade and Industry (METI). This action was taken since NISA had expressed contradictions with METI, which is the promoting agency for nuclear energy. The nation-wide opinion poll and surveys undertaken by Asahi Shimbun, a leading Japanese daily newspaper, has announced that 74% of respondents supported the policy to phase-out all nuclear power plants with the final goal to completely end the operation of nuclear plants. A mere 14% of the respondents disagree. There are approximately 100,000 or more residents that evacuated from the dangerous Fukushima Daiichi zone and were suffering from immediate threats such as radiation exposure, health problems, sanitary contamination, products shipment ban, business slump, groundless rumors, etc. These conditions have severely weakened their capability to completely recover and return to their normal lives. According to the Japan Center for Economic Research that was quoted by the New York Times, huge sums of compensation claims for TEPCO would account for 11-15 trillion JPY, or US\$ 136-186 billion. However it is not yet known how much higher would the cost be incurred in the long term. On August 30, 2011, the cabinet of former Prime Minister (PM) Naoto Kan has resigned *en masse*. Kan left his post after less than 15 months in power, and he apologized in his statement that his cabinet could not respond satisfactorily to the March 11th disaster and Fukushima nuclear accident. Former Financial Minister of Kan's cabinet, Yoshihiko Noda, was elected as PM in anticipation of continuing nuclear crisis.

Keyword: Fukushima Daiichi accident; nuclear policy; stress test; nuclear energy; power saving

1 Introduction

This article presents the second updated development report on the Fukushima Daiichi accident observed from June 1 through August 31, 2011, following the first report based on the observation from March 11 to May 31, 2011'.

All of news sources quoted in this article are taken from press releases by the Nuclear and Industrial Safety Agency (NISA) of the Ministry of Economy Trade and Industry (METI), Tokyo Electric Power Company (TEPCO), the NHK (Japan Broadcasting

Corporation), which aimed to monitor the statements of the Chief Cabinet Minister and other relevant organization. The Asahi Shimbun, a leading Japanese paper, has reported intensively on the results of the public opinion poll on nuclear on June 14, 2011.

2 Nuclear policy changes revisited

2.1 "Less nuclear-dependent society"

The former Japan Prime Minister Naoto Kan has declared that Japan will revise its energy policy from the beginning and reduce its dependence on nuclear power, aiming to create a society with less dependence on nuclear power. The former Prime Minister made the remark at a news conference in Hiroshima City, on August 6, 2011, shortly after the 66th anniversary

Received date: August 24, 2011
(Revised date: October 2, 2011)

commemoration ceremony of the US atomic bombing of the city.

The Cabinet panel on Energy and Environment agreed that the current energy policy shall be completely changed under the new scenario with the long-term timetable and goal. The core philosophy that includes the post-Kyoto Protocol commitment has yet to be initiated. (NHK, August 6)

On August 30, 2011, the former Prime Minister Kan and his cabinet ministers resigned *en masse*, and he apologized in his statement that his cabinet could not respond satisfactorily to the March 11th disaster and nuclear accident. He insisted on the importance of the legislative action for adoption of renewable energy promotion law which has passed the Diet. (NHK, August 30)

2.2 The new nuclear safety agency approved

The Cabinet has approved to set up a new nuclear safety agency under the Environment Protection Ministry by April 2011, which would take over the functions of the NISA, Nuclear Safety Commission, and the radiation monitoring undertaken by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). The new nuclear safety agency is separated from the current regulatory functions of METI/ANRE (Agency of Natural resources and Energy), which promotes nuclear energy. (NHK, August 15)

Another reason behind the establishment of the new agency should be separated from METI umbrella is because NISA's suspected involvement in nuclear scandals to manipulate public opinion in order to support the restart of Genkai nuclear power plant in Saga prefecture. (NHK, July 8)

2.3 Confusion over the stress tests and terms for restarting operations

The distrusts between central and local government are growing as the former has repeatedly changed its course in handling the nuclear crisis and the hasty decision to implement the stress tests without adequate preparation. Speaking at a Diet committee meeting on July 7, 2011, METI Minister Banri Kaieda conveyed his apologies on behalf of the government

for their abrupt decision to introduce stress tests at the Genkai plant in Saga prefecture and other areas in neighboring municipalities while the safety of the reactors was not yet assured. The government was also expected to do more to win support from the public.

Former Prime Minister Kan explained to the Diet regarding his instructions to the METI Minister Banri Kaieda as well as the minister in charge of nuclear accident Goshi Hosono, to devise a new set of standards that idle reactors must meet prior to reoperation.

According to the former Prime Minister Kan, the problem with the current law is that the operation of idle reactors can be restarted with approval by NISA, although that the agency was primarily responsible for the failure of Fukushima Daiichi accident prevention. He instructed the two ministers to propose new safety rules that will be acceptable by the general public. (NHK, July 7)

METI Minister Kaieda announced on August 4, 2011, that three top officials of METI, ANRE and NISA in charge of nuclear policy were replaced due to their failures in proper handling of the Fukushima Daiichi accident. (NHK, August 4)

2.4 The first Fukushima investigation panel

The government panel that was assigned to investigate the accident at Fukushima Daiichi has commenced the work in early June 2011. The panel consists of ten experts from various fields, and two technical advisors. At the first meeting, the former Prime Minister ordered the panel to extensively examine the technological and other issues, including the closed inner circle what is called "Genshiryoku mura" ("Nuclear Village"), a strong guild formed by the interested peoples in industry, bureaucrats, and academia to promote nuclear power in Japan. He also singled out the fact that METI was responsible for both the promotion and regulation of nuclear power policy.

The Chairman of the panel for investigation on the Fukushima Daiichi accident, Yotaro Hatamura, who is Professor Emeritus of Tokyo University addressed

that this panel needs to convincingly respond to the queries that may arise from the public. He stressed that the panel would not aim to identify the organization or agency responsible for the Fukushima Daiichi accident. Four teams within the panel would discuss about the technical problems of the accident, the background of social issues, the national regulation system of nuclear safety, and other pertinent issues. The panel members visited the Fukushima Daiichi plant in June 2011, and it planned to complete the interim report by the end of 2011 and finalize the draft after the nuclear reactors are under control. (NHK, June 7)

2.5 Continuing reassurance of nuclear export policy

On August 5, the Cabinet approved the plan for Japan to continue ongoing negotiations and uphold past agreements on nuclear export. Chief Cabinet Secretary Yukio Edano stated that the government's decision is consistent with the prime minister's recent statement of "less dependence on nuclear energy option".

Chief Cabinet Secretary Edano claimed that the importance of compiling policies on nuclear technology cooperation at an early stage is based on conclusions drawn from the Fukushima nuclear accident. Until the Fukushima Daiichi accident, the government had been promoting nuclear plant exports as part of the nation's economic growth strategy, as negotiations were underway with Vietnam, Turkey, Jordan, Lithuania, and Kazakhstan. (NHK, August 5) On July 29, TEPCO withdrew from the bid for Turkey nuclear power plant project

2.6 Report of IAEA team visitation to Fukushima

The IAEA team, consisted of eighteen members, inspected the Fukushima Daiichi plant and other nuclear facilities from May 24 through June 1, 2011. The leader of the IAEA survey team to Japan, Michael Weightman, handed the report to the Prime Minister's Advisor Goshi Hosono, whom later was assigned as the minister in charge of nuclear accident, in Tokyo on June 1, 2011. The report pointed out that Japan underestimated the impacts of the tsunami. It urges the government to correctly assess the risks of all natural disasters, and devise protective measures in

the design and operation of nuclear power plants (see Table 1). The report adds that NISA should be independent and be given clear roles based on IAEA standards, so that it may properly respond to disasters. Minister in charge of Nuclear Accident Hosono thanked the team for its extensive and detailed investigation, and stated that the Japanese government will make the best use of the report. The team leader claimed that his team had been given access to all the required information and was able to complete the report promptly. The accident in Fukushima has valuable lessons that can be shared by other countries. (NHK, June 1)

Table 1 "Lessons learned from the Fukushima Daiichi nuclear power plant accident"

<p>Strengthen preventive measures against possible severe accident, including:</p> <ol style="list-style-type: none"> (1) Strengthen measures against earthquakes and tsunamis (2) Ensure power supplies (3) Ensure robust cooling functions of reactors and pressure containment vessels (PCVs) (4) Ensure robust cooling functions of spent fuel pools (5) Thorough accident management (AM) measures (6) Response to issues concerning the siting with more than one reactor (7) Consideration of nuclear power station arrangement in basic designs (8) Ensure water tightness of essential equipment facilities <p style="text-align: right;">(source: NISA, 2011)</p>

2.7 International repercussion

Subsequent to the Fukushima Daiichi accident, Germany has decided upon phasing out all of seventeen nuclear power plants by 2022 – a decision ratified in August 2011 by the German parliament. The Swiss government has shelved plans for building up to three new nuclear power plants and decided to phase out nuclear power plants altogether between the year 2020 and 2035. Italy decided to eliminate any nuclear energy scenarios on July 26, 2011, although it was already in the scheduled referendum. Turkey shares similar reluctance about nuclear energy.

The decommissioning decision of the Fukushima Daiichi prompted British MOX plant to close its operations.

2.8 Renewable energy bill enacted

On August 23, 2011, feed-in-tariff law, by which utilities are required to pay a premium price for electricity from renewable sources, was enacted at the Diet, which was expected to aid Japan to leap to the forefront of the solar, wind, geothermal, and bio-fuel market in place of nuclear power.

3 Roadmap to stabilize damaged reactors

3.1 Sharp decrease in radioactivity level

The government and TEPCO stated on August 17, 2011, that the maximum radiation levels around the Fukushima Daiichi plant during the past 2 weeks were 200 million Becquerel per hour. This is one-fifth the levels detected in July, and one 10-millionth the levels in mid-March, shortly after the accident that occurred at the plant.

The government and TEPCO claimed there was no major change in their timetable for bringing the plant under control, and that their goal remained to be to achieve cold shutdown of the reactors while processing contaminated wastewater and to reduce radioactive emissions. (NHK, August 17)

3.2 The first stage targets achieved

The first stage of the roadmap outlined in mid-April for stable cooling of the reactors has been completed on schedule by mid-July, as per the announcement from the government and TEPCO on July 17. The added radiation levels in the plant's surrounding air and sea water areas have been steadily reduced, the No.1, 2 and 3 reactors have been steadily cooled down, and that nitrogen has been injected into their containment vessels to prevent hydrogen explosions. Pools of spent nuclear fuel were also stable. Under the revised plan, the second stage is to be completed by January 2012, and mid-term targets are to be achieved within three years after that the commencement of the second stage.

3.3 Contaminated water dilemma

Despite the achievements of the first stage targets, the crisis has yet to end. Although cooling of No.1, 2 and 3, and 4 reactors have been continuing since late June by decontaminating highly radioactive stagnant water and later circulating it, approximately one billion

Becquerel of radioactive substances were believed to be released every hour from the three reactors. The accuracy of this figure is not determined as the estimate is based on readings of the air on the plants' premises. (NHK, July 29 and August 12)

The NISA stated that the temperatures of reactors have been relatively stable at approximately 100 degrees centigrade. However, the filtering equipment – which is the key part of the system – encountered several issues. Repeated suspension of the equipment's operation has slowed down the water decontamination process as of mid-August (NHK, August 12)

The assessment team admitted that contaminated water has leaked out of storage tanks, and that water level settings at the water purification facilities were incorrect. Moreover TEPCO has detected 10,000 milli-sieverts of radioactivity per hour at the stricken plant. The level is the highest detected on the site since the nuclear accident in March. (NHK, August 2)

Seawater collected near the water intake of the No. 3 reactor was recorded at 1.3 becquerels of cesium 134 per cubic centimeter, which is 22 times higher than the national legal limit. (NHK, August 1)

TEPCO has now restored all circulating cooling systems for spent-fuel storage pools at No. 4 reactor as of August 10. TEPCO reinforced the wall with steel pillars and concrete, and installed a cooling device with a heat exchanger to establish the circulatory cooling system. (NHK, July 31)

3.4 Health checks on workers

TEPCO released a revised version of its road map on June 17, which referred to on-site workers radiation management and health care.

3.5 Difficulties on decontamination process

The water that has been contaminated was re-used for cooling the damaged reactors instead of fresh water injection which would lead to additional amount of contaminated water. The processed of decontamination and re-circulation of wastewater were commenced on June 27th. The system decontaminated radioactive water that has been accumulated in the plant, which later be circulated.

Additionally, TEPCO halted the process of salt removal from the contaminated water after recurring alarm that went off due to technical problems on the installation of the desalination equipment. (NHK, July 25)

TEPCO has found that the cooling system's decontamination rate was approximately 53 percent during the past week, whereas the target rate was 70 percent. They were unable to reach the target rate within three consecutive weeks. (NHK, July 20)

3.6 Showdown of French, US and Japanese decontamination devices

More than 105,000 tons of contaminated wastewater has accumulated at the plant, while TEPCO initially expected that it could soon run out of storage capacity as of mid-June, when they were testing the French-AREVA device for about 8 hours by using relatively low-level radioactive water. According to AREVA, the device used a particular chemical agent to remove radioactive substances from the water. This followed the test of a US-made device that absorbs radioactive cesium. TEPCO claimed that further to the 10-hour trial run, the cesium in the water dropped to about one-3,000th of the level marked prior to the test. Moreover, the US and French equipments have been suspended against the will of TEPCO due to unexpected technical impediments. (NHK, July 7)

Japanese Toshiba has developed a system to decontaminate radioactive wastewater named "Sarry (Simplified Active Water Retrieve and Recovery System)". (NHK, August 1)

The new Japan-made device consists of 14 cylindrical tanks containing a mineral called zeolite, which absorbs cesium and other radioactive substances.

3.7 Contaminated sludge barriers

Nearly 50,000 tons of sludge at the water treatment facilities has been identified with radioactive cesium contamination in Fukushima Daiichi. Over 1,500 tons is highly contaminated that it can no longer be buried for disposal. (NHK, July 29)

3.8 External power transmission problem

TEPCO stated on July 22 that a current breaker was

tripped by a sudden surge in the external power lines, which caused electricity shut down to the No. 3 and 4 reactors.

The operator was forced to suspend the radioactive water treatment system. Another cooling system at the No.3 reactor's spent fuel storage pool was also shut down. (NHK, July 22)

3.9 IAEA head visit to Fukushima Daiichi

IAEA Director General Yukiya Amano visited the Fukushima Daiichi nuclear plant in later July. He claimed that the IAEA may help Japan with its expertise and experience in radiation decontamination, handling of melted reactor cores and extraction of spent nuclear fuel rods. Former Prime Minister Kan had a meeting with him in Tokyo and thanked IAEA's further technical supports for the decontamination and disposal of damaged reactors by reporting that Japan had completed the first stage of bringing the Fukushima nuclear disaster under control, and was moving on to the second stage to bring the reactors to stable cold shutdown stage. (NHK, July 26)

4 Issues on the restart of inspected nuclear plants

4.1 Governors' stances on the restart of plants

Japan Atomic Industry Forum (JAIF) has compiled the research report based on the compilation of opinions by the prefectural governors on METI Minister's request for the nuclear power plants' restart, which were in suspension or under inspection, according to JAIF's website as of June 2, 2011.

Table 2 Official announcement of prefectural governors of nuclear sites regarding the restart of inspected nuclear plants

Prefecture	Local Governors' Stances
Hokkaido	would not consent to restart the Tomari No. 1 plant
Aomori	would have deliberate and strict consideration on the Higashidori plant restart, in consultation with the local nuclear safety committee and assembly
Miyagi	was not in the position to make any comments for the Onagawa plant restart at that moment.

Fukushima	was convinced that it was impossible to think about the Fukushima Daini plant restart of operation.
Ibaraki	regarded METI Minister's declaration as insufficient, owing to the fact that the Tokai Daini is exempt from METI Minister's request
Niigata	regarded METI Minister's request as not worthy, as METI's inappropriately oversaw both nuclear power regulation and promotion
Shizuoka	perceived it as impossible to think about the Hamaoka restart.
Fukui	would not give consent prior to obtaining compelling responses from METI
Ishikawa	would not give consent prior to obtaining compelling responses from METI

4.2 Hokkaido reactor resumed operation

A nuclear reactor in Hokkaido was the first plant in Japan to resume commercial operations since the March 11th disaster. The No. 3 reactor at the Tomari nuclear power plant operated by Hokkaido Electric Power Company had been in test-run mode for 5 months following a routine checkup. NISA has carried out final inspections on the reactor by mid-August, which then lead to the governor of Hokkaido to agree on resuming the No. 3 reactor on August 17.

4.3 Two stages of required stress tests

NISA has outlined the plan that the two-stage stress tests would involve computer simulations to gauge reactors' endurance during earthquakes, tsunamis and loss of power and cooling ability. The first-stage tests were to cover reactors that were suspended due to regular safety inspections. The secondary tests were supposedly more comprehensive and cover all active reactors to help decide whether they should remain in operation. The agency would inquire the utility companies to report on the results of the secondary tests in 2011. Test details would be discussed at the meeting of the Nuclear Safety Commission. (NHK, July 15)

The committee consisting of the governors of twenty five prefectures that host nuclear power plants at the respective prefectures has criticized the central government for the hasty decision to implement the stress tests that was done without adequate preparation. The individual prefectures have no confidence to

evaluate the appropriateness of the stress test by themselves. (NHK, July 7)

4.4 Public opinion poll on nuclear

A leading Japanese newspaper Asahi Shimbun announced the result of a nation-wide opinion poll on June 14 with the outcomes as presented on Table 3.

Table 3 Result of nation-wide opinion poll for nuclear power conducted by Asahi Shimbun on June 14, 2011

Questions	Responses
1. Do you agree with the utilization of nuclear power generation?	Yes 37%, No 42%, Others 21%
2. Should additional safety measures be achieved, do you support the restart of nuclear power plants, all of which have completed regular inspections?	Yes 51%, No 35%, Others 14%
3. Do you support the policy to phase-out all nuclear power plants with the final goal to eliminate nuclear power plants altogether?	Yes 74%, No 14%, Others 12%
4. Do you think renewable energy will replace nuclear energy?	Yes 64%, No 24%, Others 12%

Asahi Shimbun's nation-wide opinion poll on June 14 was conducted by a computerized random sampling survey which is called as Random Digit Dialing (RDD). By RDD, the surveyors use residential land phone, not mobile or IP telephones, for voters in Japan except for damaged residents in the prefectures of Iwate, Miyagi and Fukushima. The sampling survey accounted for total 3,394 voters, with 1,980 valid responses or 58 percentage of reply. Some poll analysts criticized that the random sampling by RDD is not the deliberative poll.

But any way based on the observation from the poll, it is perceived that the respondents encountered difficulties and dilemma as they encountered electricity blackout even – despite in small scale – in late March to early April 2011. As all of the respondents use electricity for carrying out daily activities and therefore faced with their difficulties due to the blackouts, the condition lead to the poll results to have divergent figures with narrow

difference of respondents responding “yes” to agreement on nuclear power utilization and “no” to disagreement, as presented in the response on question 1.

Secondly, under the conditions to additional safety measures be achieved, majority of respondents (51%), supported the restart of nuclear power plants, as they feel that they were in critical situation to avert blackouts and panic. 35% of the respondents opposed the restart of nuclear power plants, driven by sentiment and distrust.

Thirdly, regarding the medium and long term plans, 74% of the respondents supported the policy to phase-out all nuclear power plants with the final goal to eliminate nuclear power plants altogether, which may lead to “Less Nuclear-Dependent Society”. Feed-in-tariff law for renewable energy would also be preferred as result, which was advocated by former Prime Minister Kan.

It should be noted however, that the media has played a major role in providing dramatic exposures in the news that may to some extent affected the responses from respondents. This poll research was conducted during the difficult situation due to alleged reactors meltdown and failures of cooling process.

4.5 Town meeting at Genkai-cho

On June 26, a live televised public hearing was held at Genkai-cho in Saga prefecture on whether to restart the reactors at the Genkai nuclear power station operated by Kyushu Electric Power Company. The company was under suspicion for trying to sway public opinion in the hopes of persuading the governor of southern Saga Prefecture to support the restart of operation. A scandal that the company’s request to attend a public opinion hearing meeting organized by NISA was distributed by e-mails to many managers of its cooperating subordinate companies has revealed a bizarre twist to a decision whether to allow Japan’s idled reactors to restart.

4.6 Tokyo High Court Hearing

On July 6, 2011, the hearing at the Tokyo High Court concerning the Chubu Electric Power Company’s Hamaoka nuclear power station in Shizuoka

Prefecture was held. The plaintiffs filed the suit in 2003 to the Local Court in Shizuoka Prefecture demanding a halt to the plant’s operations, citing the high possibility of nuclear accident caused by the predicted major Tokai earthquake. The judge of the local court had rejected the plaintiff’s appeal by supporting the government decision to approve the Chubu Electric Company’s application to construct Hamaoka nuclear power station because of the rationality that the government has the administrative right to judge the appropriateness of the application. But the plaintiff had appealed to Tokyo High Court because of disapproving the decision made by the local court. It was the first session since all the three reactors of Hamaoka nuclear power station were stopped by Chubu Electric Power Company in May, to respond with Prime Minister Kan’s strong request to shutdown their operation immediately until firm countermeasures be established against strong earthquake and tsunami. (NHK, July 6)

According to Prime Minister, the plant is located in an area where a major quake was predicted to occur with the largest probability in Japan within 30 years by a recent report of a research institute for national land and geography issued in January 2011. (However, according this report, it predicted the occurrence of the earthquake of March 11, 2011 with 0 percent within 30 years.)

In light of current turbulent circumstances surrounding the Hamaoka nuclear power stations, judges at the Tokyo High Court, who have less special knowledge about nuclear safety, will inevitably meet difficult citation, in tough controversy between knowledgeable plaintiff and defendant, who are also nuclear specialists. In another word, how and what technical eligibility judges should provide reasonable interpretation and scientific proof reading in the Tokyo High Court debates.

4.7 Anxieties from neighboring municipalities

Fukui prefecture has 14 reactors among which 11 are operated separately by Kansai Electric Power Company (KEPCO). Some of the reactors were suspended due to regular checkup as of mid-August. Twenty six municipalities including Kyoto of Kansai district, despite not having any nuclear power plants,

requested KEPCO not to resume operations without signing the disaster prevention agreement or “Anzen Kyotei”, which will be further elaborated in sub chapter 4.9. (NHK, June 22)

4.8 Eleven prefectures; “No more nuclear plants”

Of the total forty seven prefectures in Japan, eleven prefectures agreed that nuclear power plants should be abolished or reduced in the future, according to an Asahi Shimbun research on June 17, 2011. Thirty-one prefectures opted not to answer the question. None of the prefectures agreed that nuclear power plants should be increased. Four prefectures agreed that nuclear power plants should be maintained at current levels, and one prefecture preferred them to be reduced or kept at the current levels. Nine prefectures including Shizuoka, Tochigi, Saitama, Kanagawa, Nagano, Osaka, Tottori, Okayama and Kochi agreed that the number of nuclear power plants should be reduced. Twenty-five prefectures, including six prefectures that host nuclear power plants supported the Fukui's stance, which called for prior-consensus with KEPCO in terms of safety, radiation monitoring, on-site inspection and evacuation path. Fukui prefecture is home to 14 nuclear reactors, the largest number in Japan.

4.9 “Anzen Kyotei” (voluntary safeguard agreement)

The community agreements on nuclear safety with electric power companies are called “Anzen Kyotei”, which have been voluntarily concluded in Japan to protect local residents from nuclear disasters. It ensures proper radiation monitoring, emergency communication, on-site inspection and prior-consensus when nuclear plants are newly built or expanded.

Prior to the Fukushima Daiichi accident, “Anzen Kyotei” have only been limited to local governments (prefecture, city, town and village level), that host nuclear power plants. For example, Niigata Prefecture and Kariwa Village have each concluded the agreement with TEPCO. However after the Fukushima Daiichi accident, the situation has dramatically changed. More than thirty local governments including prefecture, city, town and village that do not have any nuclear power plants

were strongly demanding for “Anzen Kyotei” with electric power companies. For example, Kyoto, Shiga and Osaka prefectures, which are neighboring cities to Fukui, are anxious about the possible nuclear disaster. Therefore they demanded KEPCO to conclude “Anzen Kyotei” The Kansai Economic Federation organized by business industries also demanded KEPCO, in addition to Chugoku, Shikoku and Kyushu District.

The definition of “Anzen Kyotei” is based on “Emergency Planning Zone (EPZ)” or evacuation zone within a radius of 8 to 10 km surrounding the reactor, which was mandatory by law. “Non-nukes” groups such as Osaka and Shiga demand that “Anzen Kyotei” should be also applied for their areas, because there are possibilities for radiation fall-out far beyond the radius of 8 to 10 km. As “Anzen Kyotei” agreement is applied more extensively, the existing nuclear plants that are either in testing or in suspension stage may have to be suspended or delayed to restart.

“Anzen Kyotei”, is a very unique mechanism maybe peculiar in Japan. This is a voluntary agreement between local governments and the electric power companies on the safety operation of nuclear power plants, and is not legally binding with the national law. The existence of “Anzen Kyotei” has been long effectuated as “double standard” for the permission of nuclear power plant operation in Japan. Once the “Anzen Kyotei” be concluded, nuclear subsidies would be provided by the electric power companies onto local communities for purposes such as funding the construction of cultural center and town hall. This kind of incentive provision is one of the reasons for the surrounding municipalities to request “Anzen Kyotei”.

According to Nuclear Safety Commission (NSC) in Japan, Emergency Planning Zone (EPZ) is a designated area to be used for the anticipatory protective actions for the public in case of a nuclear accident and radioactive release, In Japan being subjected to the rule of NSC, the EPZ covers area within a radius of 8 to 10 km surrounding the reactor,. Within the EPZ, the disaster preparedness activities should be planned in advance and once the nuclear

emergency is issued by Japanese government all the relevant institutions should perform the designated activities on a continuous basis.

5 Energy saving efforts to mitigate power shortage

5.1 Power shortage in summer

Japan has limited solutions to avoid possible blackouts in the critical peak demand in summer. This unusual condition occurs because of the prospect that the capacity of electric power generation might be significantly reduced due to the difficulty of continuing the operation of many nuclear power plants after Fukushima Daiichi accident, for which many local communities' hesitate to approve the restart of nuclear power stations nation-wide.

While TEPCO has installed power generation capacity of 78.1 million KW by end of March, this figure is actually reduced to 56.1 million KW by end of August. Thus, TEPCO faced a huge deficit due to a variety of sector reasons such as with nuclear (2.5 million from 18.2 million KW capacity), thermal power (40.4 million from 45.3 million KW), and hydroelectricity (10.1 million from 14.6 million KW).

By the end of August, TEPCO would get new electricity procurement from Independent Power Producers (IPPs) of 3.1 million KW. It includes emergency generators, as alternative power sources, although this extra electricity remains far lacking to meet the huge deficit. (Asahi Shimbun, August 1).

The government invoked a 15% consumption reduction order for large consumers of 500kW capacity or more in TEPCO and Tohoku service area of eastern Japan, effectively from July 1 through September 30.

On August 18 TEPCO has recorded the highest power consumption on daily basis with 49.4 million KW in the TEPCO's service areas of Kanto district, which level for the first time reached 90% utilization rate of generation capacity, at the highest temperature of 36.1°C since late July in Tokyo, (Asahi Shimbun, August 19).

In later July 2011, Tohoku suffered from heavy

rainfall damages to hydroelectricity, with further deficit caused by earthquake and tsunami in March. On August 8, TEPCO has twice shared 600 thousands KW for Tohoku of which utilization rate was 96.6%, or near to critical blackout.

5.2 Difficulties in Kansai district

Meanwhile, additional accidents which occurred at one of the Fukui's nuclear power plants, Shimane prefecture's thermal power plant and hydroelectricity damage caused by heavy rainfall in Tohoku district in mid-July consumed the expected supply margin. In Kansai district, KEPCO with seven reactors in suspension out of the total eleven reactors accounted for the highest level of 94% utilization rate. Tohoku Electric Power Company (TOHOKU), Chubu Electric Power Company (CHUBU) and Kyushu Electric Power Company (KYUSHU) accounted for 97%, 92%, 92% rates respectively, with the entire Japan struggling to pull through the critical summer.

KEPCO has asked clients in Kansai district to minimize energy consumption by 15% at peak hours between July and September, due to the suspended accident of the No. 1 reactor at Ohi nuclear plant on July 16, as well as the No. 4 reactor at Takahama nuclear plant due to regular inspections. KEPCO's power deficit of about 3.2 million KW implies that KEPCO would not be able to utilize the above-mentioned three reactors for several months. By end of August, seven of KEPCO's 11 nuclear reactors have halted operations. Other three electric utility companies including Kyushu, Chugoku and Shikoku, have also encountered difficulties to supply extra electricity for KEPCO.

5.3 Power saving and peak shift

In summer 2011, the TV morning news aired the electricity forecast projecting the peak demand for the day and the maximum utilization factor. The entire Japan was then in power saving mode; with a wide variety of energy saving measures taken at factories, offices, and households, including air conditioning temperature control at 28°C with the introduction of Cool Biz attire style, using LED lights, work-sharing, and midnight or weekend operation shift. Power demand path in eastern Japan was running far below the previous year, as peak shaving and shift model had

already been well built-in.

After summer 2011, keeping the nuclear units dormant would put Japan in a serious power deficit. Thermal power stations would have to be kept operating at extremely high rates year-round unless economic contractions or significant power saving take place.

TEPCO planned to shut down No. 7 reactor of the Kashiwazaki-kariwa nuclear power in Niigata Prefecture for a regular inspection in August, which means 74% of Japan's nuclear reactors will be out of service and 40 out of 54 nuclear reactors in Japan will be inactive. (NHK, August 22)

6 Radioactive contamination and the compensation

6.1 Nuclear damage compensation standard

Japan's Diet has passed the legislation to assist TEPCO to compensate victims of the crisis at the Fukushima Daiichi on August 3. The government will also issue special bonds to inject public funds into the newly established body to co-finance with TEPCO at the earliest. (NHK, August 3)

On August 29, TEPCO announced standards for compensation guidelines which cover damage inflicted from March 11 to August 31. The compensation included the cost reimbursements for that for travel with up to approximately USD 65 per trip per person for government-ordered evacuations within Fukushima Prefecture. Lodging fees for evacuations were provided with up to approximately USD 104 dollars per night. The utility company stated that it could compensate beyond the standards in some particular cases. The company was also to provide evacuees with compensation of approximately USD 1,300 per month for mental suffering, as well as medical fees for injuries and illnesses caused by evacuations. Income lost due to evacuations would also be covered. (NHK, August 30)

TEPCO could face as much as 11 trillion JPY, or USD 136 billion in compensation claims, according to the Japan Center for Economic Research. (New York Times on-line, June 28)

As of August 2011, TEPCO has paid 69 billion JPY in provisional compensation since April, which has been paid to evacuees namely households, farmers (*i.e.* vegetable, cattle and rice farmers), and fishermen, whose product shipments have been banned or have suffered damage from rumors on possible radiation contamination in their products. (NHK, August 3)

6.2 Evacuation process reviewed

The day after the tsunami that triggered the continuing disaster at the Fukushima Daiichi nuclear plant, thousands of residents at the nearby towns gathered to evacuate. The government's current evacuation order arrangements are two-layered: a no-entry zone within 20-kilometer radius of the troubled nuclear plant, and designated areas outside the zone where radiation levels are feared to exceed the internationally recommended limit of 20 milli-sieverts per year. In light of this, the government requests to evacuate the recommendation spots will be focused on households with small children and pregnant women. Moreover, four locations in Date and Minami-Soma, both in Fukushima Prefecture, are likely to be designated as a new kind of evacuation point, so called "hot spots", because of high levels of radiation exposure. High levels of radiation have been detected at some locations, even though they are outside the no-entry and planned evacuation zones. (Yomiuri, June 18)

Although the SPEEDI manual edited by the MEXT had been worked out to make forecasts of radiation dispersal to guide evacuees away from radioactive plumes, it was perceived to be inaccurate and was later disregarded by the MEXT.

The IAEA expert mission to Japan, as previously illustrated in sub chapter 2.6, has praised in its preliminary summary report on June 1 that "the Japanese Government's longer term response to protect the public, including evacuation, has been impressive and extremely well-organized". However, on July 4, the Atomic Energy Society of Japan, a group of nuclear scholars and industry executives stated, "It is extremely regrettable that evacuation information was not released to the public until three months after the fact, and also criticized the authorities which had yet to disclose information, for

fear of making panic.” (New York Times on-line August 8)

On August 21, the government decided that exclusion orders in some areas will remain in effect due to high levels of radiation, although it had planned to lift exclusion orders within 20 km.

6.3 Food contamination rumors

As of July 24, at least 2,600 cows were suspected of having been fed with rice straw contaminated with radioactive cesium were found to have been shipped from Fukushima, Miyagi, Iwate and over 10 prefectures to all areas of Japan, except Okinawa. The spread of cows suspected of contamination with radioactive cesium wee from the Fukushima Daiichi. As radioactive cesium level exceeded the government limit of 500 Becquerel per kg was detected in beef meat that derived from farms in Fukushima Prefecture, the government has ordered a halt to shipment of cows from the prefecture. (Japan times, July 26)

The Japanese government stated that they would buy-back the beef that contain unsafe levels of radioactive cesium that has already reached the distribution chain. (NHK, July 26)

Most fishing in Fukushima prefecture has been suspended, and no fishing vessels were allowed within 20 km of the Fukushima Daiichi reactors because of Japanese Coast Guard restrictions. Japanese authorities monitored seafood products as the fishing vessels landed. In addition, they were collecting comprehensive samples of organic material in three layers of the ocean (surface, middle, and deep) in order to assess any specific impact on species that live in each habitat.

6.4 Radiation monitoring strengthened

Chairman of the Japan Atomic Industrial Forum Inc. (JAIF) Takuya Hattori, addressed at the Forum on the Fukushima Accident held at OECD/NEA in Paris, France on June 8, stressing that the release of radioactive material into the environment scored $0.3\sim 0.6 \times 10^{18}$ Bq I-131 eq, which accounts for 1/10 or below the case of Chernobyl accident. of which figure is said to be 5.2×10^{18} Bq I-131 eq. according to JAIF

website sources.

The newly appointed Minister for the Restoration from and Prevention of Nuclear Accident (the former Adviser to former Prime Minister Kan) Goshi Hosono, stated to the Diet that the government hoped to lift the evacuation orders for the 20-kilometer no-entry zone and the planned evacuation areas after completion of the second stage of the plan in forthcoming January. In the second phase, the government aimed to significantly reduce the volumes of radiation emitted from the plant. (NHK, July 20)

The government has decided to start comprehensive radiation monitoring in 2011 by coordinating organizations that have been checking radiation levels since the Fukushima nuclear accident. This action plan is in response to criticism about difficulties in referring to results of such inspection by various ministries, agencies, prefectural governments and utilities companies. (NHK, August, 2)

Furthermore, TEPCO is under pressure to ensure the flawless operation of a system to decontaminate radioactive water, which threatened to overflow. More than 110,000 tons of the highly radioactive water has accumulated within the nuclear power plant complex. The amount was growing by 500 tons per day as fresh water was injected to cool down the reactors. (NHK, June 16)

6.5 Land and marine contamination

On June 2, IAEA survey mission to Japan has assessed and reported that low levels of Cs-137 deposition were detected in a few prefectures within a few days since 18 May with the detected values range of from 2.2 to 91 Bq/ m² for Cs-137 outside the Fukushima Daiichi. On May 31, the gamma dose rate in Fukushima prefecture was 1.5 μSv/h. In all other prefectures, gamma dose rates were below 0.1 μSv/h; with a general decreasing trend, according to the IAEA survey report.

At sea, the radiation activity found in surface sediments at the near shore stations close to the reactors was between 24 and 320 Bq/kg for Cs-137 in the middle of May. The activity in sediments decreases with distance, but was also highly

dependent upon the sediment type, according to IAEA report. The contamination of marine sediments indicated the enrichment of radio-caesium on particulate matter and its removal from the water column into the sea floor.

6.6 Lower radiation limit for school children

The government stated that the annual radiation limit for school children will be lowered as early as this August. The government has set the limit for accumulated external radiation for children involved in outdoor activities at 20 milli-sieverts per year, in the wake of the Fukushima nuclear accident.(NHK, August 4)

6.7 Chinese marine monitoring result

The State Oceanic Administration (SOA) of the People's Republic of China has contributed its article on the preliminary results of the environmental radioactivity monitoring in the Western Pacific Ocean, which was published in the Chinese Science and Technology Daily (STD) web site. The SOA has analyzed and co-worked with STD in the written paper that presented findings from the marine radioactivity monitoring at 252,000 square km off Fukushima. Seawater samples detected cesium-137, strontium-90, and cesium-134, which normally cannot be found in the sea. The contaminated cesium-137 and strontium-90 account for 300 times and 10 times more than Chinese water quality standard.

The SOA has been responding to radiological emergency tracking surveillance. According to the surveillance, the Fukushima's leakage contamination has not yet affect China for the time being, but there may be a variety of possible impacts including the convergence of "Kuroshio" extension to the south and north, exceeding far beyond the coastline of Japan islands. The SOA has not ruled out the possibility of nuclear pollutants penetration onto the sea areas under the jurisdiction of China.

7 Closing remarks

Real politics lead the issue of nuclear energy to the forefront of national interest and overall energy strategy. Former Prime Minister Naoto Kan initiated the "Less Nuclear Dependent Society", which was a risky political movement and triggered momentous

nation-wide controversies for the first time since the 1950s.

Public health care and radiation risk monitoring were also pushed as the at top agenda for nuclear evacuees from around the Fukushima Daiichi. To reduce risks, the nuclear damage compensation law was passed in the national Diet. TEPCO has announced the guidelines for the payment standards for compensation.

In the light of human risk factors, local residents against nuclear power would halt, delay, and suspend nuclear power plants to restart, which would lead to severity of power shortage.

In terms of regulatory risks, a new core organ to govern nuclear safety will be transferred from NISA/METI to Ministry of Environmental Protection (MEP) affiliation in next April, during which transition period smooth shift-mechanism must be worked-out.

The feed-in-tariff law, by which utilities are required to pay a premium price for electricity from renewable sources, was passed at the Diet on August 23.

Finally, former Prime Minister Kan's cabinet resigned *en mass* on August 30, and former Financial Minister, Yoshihiko Noda was elected as Prime Minister in anticipation of the continuing nuclear crisis.

Nomenclature

AM	Accident Management
ANRE	Agency of Natural Resources and Energy
CEO	Chief Executive Officer
CHUBU	Chubu Electric Power Company
EPZ	Emergency Planning Zone
G8	The Group of Eight industrial countries
IAEA	International Atomic Energy Agency
IEEJ	Institute of Energy Economics of Japan
INES	International Nuclear and Radiological Event Scale
JAIF	Japan Atomic Industry Forum
KEPCO	Kansai Electric Power Company
KYUSHU	Kyushu Electric Power Company
METI	Ministry of Economy, Trade and Industry
MEXT	Ministry of Education, Culture, Sports,

	Science and Technology	July 11	Situation clearer, but problems remain after 4 months of nuclear crisis
NISA	The Nuclear and Industrial Safety Agency	July 13	Water leaks hinder Fukushima purifying unit
NHK	Nippon Hoso Kyokai (Japan Broadcasting Corporation)	July 17	The first stage of the Fukushima Daiichi for the cooling completed, reported by NISA and TEPCO
NPS	Nuclear Power Station	July 18	TEPCO: 1st-stage goals largely achieved at Fukushima plant
NSC	Nuclear Safety Commission	July 19	Japan, Russia step up cooperative energy supply efforts with Japan including LNG shipment
SPEEDI	Systems for Prediction of Environmental Emergency Dose Information	July 23	Caribbean blasts shipments of nuclear waste to Japan
TEPCO	Tokyo Electric Power Company	July 28	17 cities jump on Softbank energy bandwagon
TOHOKU	Tohoku Electric Power Company	July 28	Keidanren chief warns of economic collapse if Fukushima crisis mishandled

APPENDIX

Updated calendar; June 1 through August 31, sourced by NHK and Asahi Shimbun

		July 28	IAEA Director General Yukiya Amano visited the Fukushima Daiichi
		July 29	TEPCO withdraws from bid for Turkey nuke plant project
		August 1	A Japanese made decontamination device called "Sarry" has started
June 1	The interim IAEA survey report on the Fukushima Daiichi accident was disclosed	August 2	10,000 milli-sieverts of radioactivity detected, the highest level ever since
June 6	Prime Minister Kan's adviser Goshi Hosono (current Nuclear Minister) flew to the US, Britain and France	August 3	Nuclear damage compensation bill enacted
June 7	The first panel on the Fukushima Daiichi accident investigation was held	August 4	The government set the limit for external radiation for children at 20 milli-sieverts per year
June 10	Radiation above standards found in Shizuoka tea leaf	August 4	METI minister announced that three top officials of METI, ANRE and NISA in charge of nuclear policy be replaced
June 11	Leaks could delay treatment of radioactive water at the Fukushima Daiichi	August 4	Fukushima crisis prompts British MOX plant to close
June 13	Strontium detected in groundwater and sea around the Fukushima Daiichi	August 5	Cabinet advised that Japan should continue nuclear export policy
June 13	Demonstrations against nuclear power blanket Japan	August 6	Prime Minister Naoto Kan declared "less dependent on nuclear generation society"
June 14	74% of voters back dumping nuclear power in opinion poll (Asahi Shimbun)	August 8	Tohoku power generation accounts for 96.6% utilization rate at the highest level nearer to blackout
June 16	China delays nuke reactor start at Ling Ao	August 15	The Cabinet has approved to set up a new nuclear safety agency under the Environment Protection Ministry in next April
June 20	Prime Minister Kan gives green light for resumption of nuclear reactors	August 17	TEPCO announced that maximum radiation levels around the Fukushima Daiichi were 200 million becquerels per hour, comparing one-10 millionth levels in mid-March
June 20	IAEA Ministerial Conference was held in Vienna	August 17	The Tomari No.3 in Hokkaido resumed the first plant since the March 11 accident.
June 22	Local municipalities in Kansai District where no nuclear plant at home requested "Anzen Kyotei"	August 18	TEPCO accounts for the highest power consumption of 49.4 million KW in a single day
July 1	The government invoked a 15% consumption reduction order for large consumers of 500kW or more in eastern Japan	August 23	Lower House passed a bill on renewable energy
July 4	The Atomic Energy Society of Japan criticized lack of government information disclosure on radiation release	August 29	Compensation guidelines announced by TEPCO
July 5	METI/NISA endorsed to introduce two staged stress tests	August 30	Prime Minister Naoto Kan resigned, and former Financial Minister Yoshihiko Noda was newly elected as Prime Minister
July 8	NISA alleged involvement with nuclear scandals to manipulate public opinion		
July 9	Beef from Fukushima found with high levels of radioactive cesium		
July 10-15	Germany has decided all of seventeen nuclear power plants be phased out by 2022. Italy also decided to say completely no nuclear plant.		