

# The third update of the Fukushima Daiichi Nuclear Station accident (September 1 through November 30, 2011)

SHIBUTANI Yu

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

**Abstract:** This article provides the third update of the Fukushima Daiichi accident that occurred on March 11, 2011. In the report of the first update of the Fukushima Daiichi accident on March 11 through May 31, the situation was reported on both on-site and off-site of the Fukushima Daiichi, including; failed cooldown of decay heat and meltdown of stricken reactors; emergency evacuation of local residents, radioactive contamination, spread of biased rumors by the information closure by government, regional cooperation with China, Taiwan and Korea, and visit of IAEA investigation team to Japan. The report of the second update on June 1 through August 31 reported the issues of, harsh public criticism against government and electric power companies, results of the public opinion poll, a sort of gentlemen's agreements between nuclear power companies and local governments which would be peculiar tradition in Japan, the first revision of the road map to cold shutdown of stricken reactors, and submission of report on Fukushima Daiichi accident to International Atomic Energy Agency (IAEA). This article provides the third update from September 1 through November 30, particularly on the issues of the second revision of the road map where the "cold shutdown" state should be reached before the end of 2011, the overview of governmental organization on the overall energy and nuclear policy, and the establishment of the nuclear disaster response headquarters (HQ) in the Prime Minister's Office. The HQ in collaboration with Tokyo Electric Power Company (TEPCO) decided the framework of road map plans, provision of various assistance and compensation for the residents affected by the nuclear incident, redefinition by the Nuclear Safety Commission for evacuation areas, recovery process of radioactive decontaminated areas, investigation and verification of the Fukushima Daiichi accident, reorganization of TEPCO management and financial system, establishment of damage compensation scheme, and so on. As a consequence of the Fukushima Daiichi accident, Japan's nuclear policy has been challenged by the reversal of public opinion. The government of Democratic Party of Japan (DPJ) puts the highest priority on "innovative" energy and environmental strategies to seek the "best energy mix policy" by the use of more renewable energy and the reduction of nuclear energy reliance.

**Keyword:** Fukushima Daiichi accident; reshaping nuclear policy; revision of road map to restore accident

## 1 Introduction

This article presents the third installment of updated development report on the Fukushima Daiichi accident observed from September 1 through November 30, 2011. It is to complement the first and second articles that reported the updates from March 11 through May 31 and from June 1 through August 31, respectively.

All of the news sources quoted in this article were cited from the press releases of the Nuclear Emergency Response Headquarters, the Cabinet Office, the NISA (Nuclear and Industrial Safety Agency) of the METI (Ministry of Economy Trade and Industry), the IAEA (International Atomic Energy Agency), the TEPCO (Tokyo Electric Power Company), and the NHK (Japan Broadcasting Corporation). The news monitored the statements and press conferences of the Chief Cabinet Minister, as well as other relevant organizations. The Asahi Shimbun, a leading Japanese newspaper, was also quoted due to its continuous media coverage from March 11 to the present, which intensively reported

---

**Received date: December 9, 2011**

(Revised date: December 23, 2011)

the daily development nationwide. The Mainichi Shimbun and Fukushima Minpo Shimbun were also quoted.

## 2 New Prime Minister Yoshihiko Noda's stance

### 2.1 Shifting to mild stance

On September 2, the new Prime Minister (PM) Yoshihiko Noda delivered his first speech at the National Diet and asserted to put an end to the nuclear crisis. PM Noda stated that building new reactors was unrealistic and that Japan would decommission reactors at the end of their life spans with a gradual phase-out of the nuclear reactors across the country. On September 15, during the National Lower House session, PM Noda stated that under the current conditions, it was impossible to construct new nuclear reactors.

On September 22, PM Noda delivered the keynote speech at a high-level meeting on nuclear safety held at the United Nations (UN) headquarters in New York. He stated, "Japan should overcome the challenges caused by the accident at the Fukushima Daiichi, at all cost." PM Noda suggested that safety standards must be raised to the highest level possible, and urged member nations to review their nuclear power plants to ensure their abilities to withstand serious natural disasters. He stressed the need for international cooperation to strengthen nuclear safety. (NHK, September 23)

PM Noda additionally declared, "We will heighten the safety of our nuclear reactors so that they attain the highest standards in the world" and also stressed that Japan would continue to export its expertise in nuclear power generation technologies.

As for the subject on renewable energy, PM Noda did not pledge any specific target to be achieved. This was in contrast to the stance taken by former PM Naoto Kan, who presented the renewable energy policy at the Group of Eight summit held in Deauville, France, in May 2011. (Asahi Shimbun, September 27)

### 2.2 The difference of stances between PM Kan and PM Noda

According to the New York Times published on

November 2, PM Noda has different opinion from former PM Kan on the crucial issue of the future of nuclear energy. While former PM Kan called for an ending on what he called Japan's dependence on nuclear power, PM Noda has followed the business community by saying that Japan needs nuclear power to prevent electrical shortages that could further cripple its economy.

## 3 Structural changes in nuclear policy

### 3.1 "Strategic energy plan"

According to METI's press release on June 18, 2010, the Strategic Energy Plan of Japan has been established by the government in pursuant to the Basic Act on Energy Policy\*<sup>1</sup>. Considering the significant changes in the situation associated with natural and energy resources over the past few years, the government fully revised the Basic Energy Plan, and the Strategic Energy Plan of Japan was approved by the Cabinet on June 18, 2010.

(\*1) On June 14, 2002 the Basic Act on Energy Policy of Japan was established by the government, calling for the basic direction of the national energy policy on the basis of three fundamental principles of energy policy: "securing of a stable supply," "environmental suitability," and "utilization of market mechanisms." After the establishment of the Basic Energy Plan in October 2003, the first revision was made in March 2007. The second version was revised in June 2010 and was made in consideration of the changes in the situation associated with energy issues. Finally the government established it as the Strategic Energy Plan of Japan.

The Strategic Energy Plan that was revised in June 2010 focused on new perspectives: economic growth based on energy and structural reform of the energy industry with long-term targets for 2030, including;

- (a) Increasing the energy self-sufficiency ratio from 38% at present to around 70% (including nuclear fuel cycle)
- (b) Raising the zero-emission power source ratio from 34% at present to around 70%
- (c) Halving the CO<sub>2</sub> emissions from the residential sector
- (d) Maintaining and enhancing energy efficiency in the industrial sector at the highest level in the world.

- (e) Maintaining and/or obtaining top-class shares of global markets for energy-related products and systems

### **3.2 Advisory committee and policy planners**

In the structure of the Strategic Energy Plan of the Advisory Committee on Energy and Natural Resources chaired by Akio Mimura, Chairman of Nippon Steel Corporation in cooperation with the Agency for Natural Resources and Energy (ANRE) established by the law, has devised the long-term energy scenario including overall energy supply/demand plan. The energy scenario is referred to as the “Outlook for Long-Term Energy Supply and Demand” that is formulated every three to five years as a report of the energy supply and demand.

“The White Paper on Energy Policy” is a legal document reported annually to the Diet, following a cabinet decision based on Article 11 of the Basic Act on Energy Policy. The annual white paper is usually made of 3 parts. Part 1 sets the themes and topics in accordance with the recent situation, analyzes the policies and introduces trends. Part 2 shows the domestic and foreign energy trends. Part 3 looks back on the resources and energy policies in the previous fiscal year. However in the wake of Fukushima Daiichi accident on March 11, the 2011 annual white paper approved by the Cabinet on October 28 changed its regular contents. It illustrated that the Fukushima Daiichi accident had led the Japanese government to unusually "reflect on" its past energy policy. (The Mainichi Shimbun, October 28)

### **3.3 From LDP to DPJ government shift**

Japan's energy policy has long been under the jurisdiction of the ANRE / METI since 1950s, the period during which the Japan Liberal Democratic Party (LDP) took most of the government control. LDP favored the business community by declaring that Japan needed nuclear power to sustain its international competitiveness and to seek for inexpensive and abundance of energy sources in the national interests of security, economic growth and environment. LDP advocated nuclear energy as the top priority, until the time when LDP was defeated by the Democratic Party of Japan (DPJ) at the general election held in 2009. The DPJ's energy policy was

not perceived as major difference from the LDP's. DPJ also envisaged the safe use of nuclear energy at the first term in late 2009.

The first ever PM from DPJ Yukio Hatoyama (from September 16, 2009 to June 2, 2010) declared at the United Nations' Climate Change Convention on September 28, 2009, that Japan would realize the GHG reduction target by 25% against 1990 level by 2020. The successor of Hatoyama, Kan, virtually admitted the needs to use more nuclear energy in line with former PM Hatoyama's advice. Former PM Kan (who took office from June 2, 2010 to September 2, 2011) decided to prompt the debate at the Diet on July 14, to adopt the feed-in-tariff law for renewables, in the wake of Fukushima Daiichi accident. The bill was finally enacted at the Diet on August 28.

### **3.4 Complicated nuclear legislative organization**

#### **3.4.1 Japan Atomic Energy Commission (JAEC)**

Keeping close collaboration with the JAEC<sup>\*2</sup>, the ANRE/METI had been jointly working on the Japan's basic nuclear policy since 1950s.

(\*2) JAEC is authorized by the law to plan, deliberate and decide on the nuclear energy policy of the State, to provide its basic policy in the framework of nuclear energy policy. JAEC prepares the annual report referred to as the "White Paper on Nuclear Energy".

The JAEC is set up in the Cabinet Office together with the Nuclear Safety Commission, which is responsible for assuring safety of nuclear research, development and utilization activities. The MOFA (Ministry of Foreign Affairs), the MEXT (Ministry of Education, Culture, Sports, Science & Technology), the MHLW (Ministry of Health, Labor and Welfare), the MAFF (Ministry of Agriculture, Forestry and Fisheries), the METI (Ministry of Economy, Trade and Industry), the MLIT (Ministry of Land, Infrastructure, Transport, and Tourism), and the MOE (Ministry of Environment) promote administration for nuclear energy research, development, and utilization in consistence with the basic policies specified by the JAEC.

The JAEC is comprised of five Commissioners appointed by the Prime Minister with the Diet's consent for three-year terms. One of them is appointed as Chairperson. Their missions are to plan, deliberate, and decide on the basic policies or

strategies for the promotion of research, development, and utilization of nuclear energy. They also aim to adjust the activities of administrative organizations concerned, to mobilize the budget for these organizations to pursue the policies, and to provide opinions to the Ministers on the adequacy of applying the criteria of the Law on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors.

The JAEC, chaired by Shunsuke Kondo, a professor emeritus of the University of Tokyo, comprised of experts on nuclear energy. They have formulated the outlines of nuclear energy policy.

#### 3.4.2 Nuclear Safety Commission (NSC)

The NSC, chaired by Haruki Madarame, a former professor of University of Tokyo, is responsible for formulating on regulations and policies related to nuclear safety as well as prevention of radiation hazards based on expert knowledge on nuclear technologies and radiological protection. The NSC, in the event of a nuclear emergency, is supposed to convene the “Technical Advisory Organization in an Emergency”. It consists of the Commissioners and Advisors for Emergency Response and they are responsible to provide technical advice to the Prime Minister.

#### 3.4.3 Nuclear and Industrial Safety Agency (NISA)

The NISA is responsible for the administration of nuclear safety issues. It is separated from the function of promoting locations for nuclear power installations of the Electricity and Gas Industry Department of the Agency of National Resources and Energy (ANRE) under the organization of METI as described in the Fig. 1.

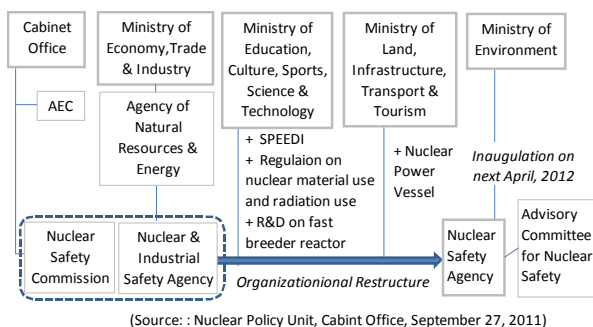


Fig. 1 Government nuclear safety organization: present and future.

#### 3.4.4 Legislative complexities and nuclear bureaucracy

In response to the Fukushima Daiichi accident, NSC became responsible for evaluation of environment radiation monitoring results in collaboration with the MEXT, which is responsible for controlling the implementation of environmental monitoring and publicizing the results.

MHLW is responsible for the restriction of distribution of foods, including raw milk and meat, and also to conduct the detection/measures taken against radioactive materials in tap water that is exposed to the nuclear power plant accidents.

The MOE released the plan for disposal of ash of incinerated waste that is contaminated with more than 8,000 becquerels and less than 100,000 becquerels of radioactive cesium per kilogram caused by the Fukushima Daiichi accident. This plan is subject to the bill on disposal of contaminated radioactive materials, which was enacted on August 30.

As described earlier, the separation of NISA from METI to MOE affiliation has been decided at the Cabinet which will be in effect as of spring 2012.

#### 3.4.5 Author's comments

The Fukushima Daiichi accident coincidentally revealed that Japan encounters legislative complexities and nuclear bureaucracy that deteriorates the functional networking to deal with responsibilities that need to be tackled.

## 4 Reshaping the framework for nuclear energy policy

### 4.1 “Nuclear Energy Strategy for Growth” in abortion

On May 25, 2010, JAEC presented the proposal on “Nuclear Energy Strategy for Growth”. JAEC envisaged that activities for the nuclear fuel cycle, including the interim storage of spent fuel, reprocessing, and disposal of radioactive waste, should be steadily promoted.

This proposal was supposed to be reflected in the “Framework for Nuclear Energy Policy” \*<sup>3</sup> which was due to be released in 2011. However the Fukushima Daiichi accident had resulted in the cancellation of

release of this proposal.

(\*3) On October 14, 2005, the Cabinet Council stated that the government would respect the Framework for Nuclear Energy Policy as a fundamental principle for research, development and utilization of nuclear science and engineering. On October 11, 2005, the Framework for Nuclear Energy Policy was devised by JAEC under the initiative of the former ruling party, LDP.

#### **4.2 Looming scenario of “Energy best mix policy”**

The government administration that is under the DPJ, firmly opposes the LDP. They put the highest priority on “innovative” energy and environmental strategy in order to seek for the “best energy mix policy” by more use of renewable energy. The scenario will be the core part of the next version of the “Framework for Nuclear Energy Policy” devised by JAEC that will be decided by the mid of 2012. The laborious work will be undertaken by the “Energy-Environment Council” in the Cabinet office.

#### **4.3 “Energy-Environment Council” (EEC) grips**

##### **4.3.1 Background of the EEC**

On June 22, the former PM Kan set up the EEC in the Cabinet Office chaired by the Minister for National Policy Unit (NPU) Koichiro Genba (of which currently Motohisa Furukawa was appointed by the Noda’s administration). The EEC is comprised of ministers including METI, MOE, MOFA, MEXT, MAFF and MHLW.

##### **4.3.2 Former PM Kan’s initiative**

Under the administration of former PM Kan, the EEC showed its determination to advance the “innovative” integration of energy policy with low-carbon policy, by reflecting the lessons learned from the Fukushima Daiichi accident. It particularly touches upon critical subjects as “less reliance on nuclear energy” strategy and economic verification of nuclear policy, including cost comparisons of renewable energies, and advanced enactment of feed-in-tariff bill on renewables.

On July 29, EEC released the interim report on the future vision with regard to the lowering dependence on nuclear energy and the establishment of a decentralized electric power system. The EEC also endorsed the feed-in-tariff for renewables.

The former PM Kan also approved to set up a new nuclear safety agency under the Environment Ministry on August 19, which would take over the functions of the NISA, Nuclear Safety Commission, and the radiation monitoring undertaken by the MEXT. It was scheduled to commence in April 2012.

##### **4.3.3 PM Noda’s leadership and EEC**

On August 30, PM Kan resigned and apologized that his cabinet could not respond satisfactorily to the March 11th disaster and nuclear accident. On September 2, former Finance Minister Noda was appointed as the new Prime Minister.

In the wake of the Fukushima Daiichi accident on March 11, the EEC intended to take over the major responsibilities of METI/ANRE and JAEC by assuming the leading roles (Asahi Shimbun Editorial Column, September 9).

On September 28, the Lower House special committee on investigation of the Fukushima Daiichi accident was established by joint agreement of DPJ, LDP, and other parties at the national legislation stage mandated by the law. The establishment of this investigation committee that also comprised of designated private sector members was the first time in the history of national Diet since the beginning of Japanese constitutional government.

#### **4.4 Deletion of the chapter on nuclear energy promotion in the White Paper**

On October 28, the government of Japan published “The White Paper on Energy Policy for FY2011” that was prepared by ANRE/METI.

In the main chapter of this White Paper, the government regretted its past energy policy. It called for reduction of the reliance on nuclear energy in light of the loss of national confidence on nuclear safety and vulnerability of the energy supply system. The White Paper deleted a section on nuclear power expansion declaration that had been presented in last year’s policy review. The White Paper clearly stated that the current energy plan should be reviewed thoroughly, with the statement that “Japan’s dependency on nuclear energy should be reduced as much as possible in the medium/long-term.”

The White Paper highlighted the vulnerability of the nation's energy infrastructure caused by the East Japan Earthquake, which damaged the supply chain or lifeline of electricity, gas and petroleum refinery. The White Paper pledged to strengthen the safety regulations on nuclear power generation, adding the necessity of stress test of the existing nuclear power generation, in accordance with IAEA methodology. It aimed to restart the halted nuclear reactors for the purpose of regaining the trust from local municipalities which host nuclear power plants.

The White Paper indicated that as the Fukushima Daiichi accident became a global issue, Japan should provide accurate information of the accident, as well as the lessons learned from the accident. It also mentioned that they should be shared to the international society through bilateral and multilateral cooperation schemes including the IAEA.

#### 4.5 Ad-hoc government investigation committee

##### 4.5.1 The Fukushima investigation and verification committee

In the Cabinet Office, the investigation and verification committee for the accident at the Fukushima Daiichi power station was established and was decided to be chaired by Yotaro Hatamura, a professor emeritus of Tokyo University. The committee started its intensive investigation including interviews and public hearings in June 2011. This committee is supposed to analyze the situation before the accident, the causes of the crisis, and the steps taken after the crisis to prevent the damage from spreading. The committee plans to compile a midterm report of its findings by the end of 2011<sup>[1]</sup>.

##### 4.5.2 TEPCO Management and Finance Investigating Committee

The government committee\*<sup>4</sup> estimated that TEPCO could avoid falling into negative net earnings without raising electricity tariffs if the company would be allowed to restart reactors at the Kashiwazaki-Kariwa power plant in Niigata Prefecture from the beginning of summer 2012 (Japan Times, September 27)

(\*4) The government-commissioned committee chaired by Kazuhiko Shimokobe, a bankruptcy lawyer, which is made up of five experts, has investigated TEPCO's finances and provides advice on restructuring.

##### 4.5.3 The Committee on Nuclear Incident Damage Compensation Investigation

The Committee on Nuclear Incident Damage Compensation Investigation led by Yoshihisa Noumi, a professor of Gakushuin University, formulated the draft guidelines with regard to damage compensation caused to nuclear incident.

## 5 Nuclear emergency response activities

### 5.1 "Nuclear Emergency Response Headquarters"

In the wake of the Fukushima Daiichi nuclear power plants accident, the former PM Kan declared the state of nuclear emergency and established the Nuclear Emergency Response Headquarters for the nuclear accident at the Cabinet Office on the same day.

As a consequence of eight months elapse, the government headquarters in response to the Fukushima Daiichi nuclear accident made the following decisions as of the end of November. Three key operation taskforces were established, each headed by senior vice-minister level. They devised a grand strategy to overcome nuclear crisis, which includes:

- government/TEPCO integrated response office
- team in charge of assisting lives of victims
- team in charge of responding to economic impacts, including cost assessment of nuclear power generation

As key advisory organs to assist the Prime Minister's Cabinet and taskforces, they are mainly initiated by the Cabinet Office, NSC and JAEC, which will develop the roadmap to stabilize the stricken Fukushima Daiichi reactors.

Figure 2 presents the image of nuclear emergency response system prepared by Tatsujiro Suzuki of JAEC.

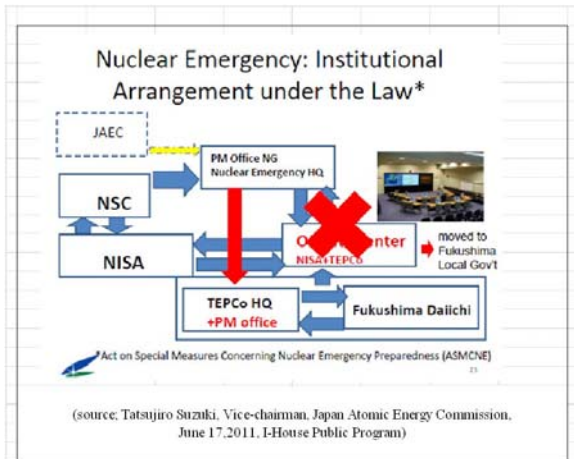


Fig. 2 Nuclear emergency: Institutional arrangement under the law.

### 5.2 Contamination Response Committee

This section explains about the contamination map (Fig.3) compiled by MEXT and the US Department of Energy (DOE).

The Radioactive Materials Contamination Response Committee under the Cabinet Office is being advised by the Science Council, universities, research institutions, enterprises and local municipalities.

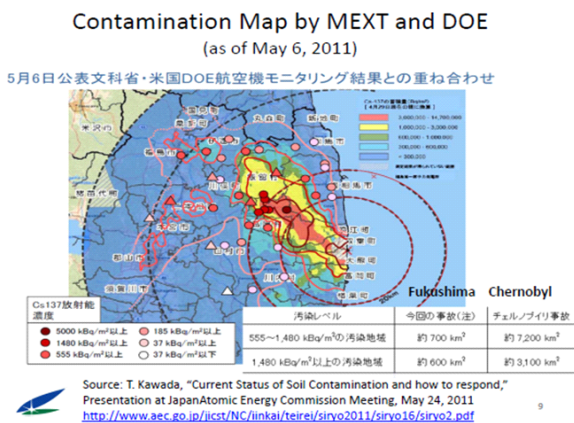


Fig. 3 Contamination map by MEXT and DOE.

According to the report of the Nuclear Policy Unit of Cabinet Office announced on September 27, the above-mentioned government institutions will take initiatives of prompt actions such as;

- on-site response and operation at the Fukushima Daiichi,
- decontamination process,
- radiation monitoring,
- debris disposal,
- evaluation of residential health, radiation exposure

- and decontamination,
- assurance of food stuff and drinking water sanitary,
- compensation of farm products contaminated by radioactive materials
- soil decontamination, and so on

## 6 Lifting the “Evacuation-Prepared Area” designations

### 6.1 Evacuation areas designated in Fukushima

On March 15, in the wake of the accident at Fukushima Daiichi plant, the Nuclear Emergency Response Headquarters established the Evacuation-Prepared Area, of which a response of “stay in-house” or “evacuate” is required within 20-30 km from the Fukushima Daiichi nuclear plant. Within these areas, entrance is strictly prohibited or restricted.

Subsequently, for fear of radioactive materials fallout outside evacuation prepared area and concerns on the accumulative dose that might reach 20mSv within 1 year period after the accident, residents were requested to evacuate to the ‘Deliberate Evacuation Area’ in a planned manner.

### 6.2 Loosening of the maximum radiation level

On early August, the maximum radiation levels around the Fukushima Daiichi plant during the first 2 weeks were 200 million Becquerel per hour, of which level is one-fifth of the level detected in July, and one 10-millionth of the levels in mid-March, according to NHK and Asahi Shimbun.

On November 11, the Fukushima Minpo Shimbun, a local newspaper published in Fukushima City, reported that owing to the Great East Japan Earthquake Disaster and the accident at the Fukushima Daiichi nuclear plant, the total number of evacuees in Fukushima Prefecture was approximately 150 thousand people, including 59 thousand people who left Fukushima Prefecture (Fig.4).

Conversely, several municipalities in Fukushima Prefecture have expressed their aspiration concerning the timing for the return of residents in the near future. Minami-Souma and Kawauchi Village, for example, decided that residents will be able to return home, to open schools and shops by spring 2012. In



Evacuation-Prepared Area, 2.98 microsieverts per hour radiation at Minami-Soma City was found in August, which decreased from 3.8 microsieverts per hour in July.

The International Commission on Radiological Protection recommends one millisievert per year as the long-term annual limit for ordinary people.



Fig. 4 Area division due to radiation levels.  
(Source: Fukushima Minpo Shinbun)

### 6.3 Lifting the evacuation-prepared area designation

On September 30, in light of securing safety and welfare of local public, the Nuclear Emergency Response Headquarters decided to lift the Evacuation-Prepared Area in case of Emergency designation.

Against the government perception, on October 29, the Associated Press (AP) reported that the Fukushima nuclear disaster released twice as much of radioactive substances into the atmosphere as Japanese authorities estimated, reaching 40 percent of the total from Chernobyl accident. The AP also reported that the estimate of much higher levels of radioactive cesium-137 derived from a worldwide network of sensors. Study author Andreas Stohl of the Norwegian Institute for Air Research stated that the Japanese government's estimates were only based on the data in Japan and that they would have missed the emissions that might be blown out to sea.

### 6.4 Decontamination improvement

Decontamination operations are the key to the lifting of the Evacuation-Prepared Areas in Case of Emergency designation.

On April 12, NISA estimated the total discharged amount of radioactive materials from reactors at the Fukushima Daiichi would be approximately  $1.3 \times 10^{17}$  Bq of iodine-131 and approximately  $6.1 \times 10^{15}$  Bq of cesium-137, according to the Report of Japanese Government submitted to the IAEA Ministerial Conference on Nuclear Safety on June 18.

On May 17, the Nuclear Emergency Response Headquarters formulated the Immediate Actions for the Assistance of Nuclear Sufferers, which clearly stated that prompt measures should be taken concerning the treatment of soil, *etc* in educational facilities in Fukushima Prefecture as part of assistance in the field of education. MEXT was expected to provide financial assistance under the framework of the school facility disaster reconstruction project.

### 6.5 Initiatives by NISA

In the attempt to decrease public anxiety due to possible radioactive contamination caused by the Fukushima Daiichi accident, the government declared to take primary responsibility on August 26 in collaboration with prefectures, municipalities and residents. The government also announced that the areas with radiation exposure of 20mSv or more per year, which were affected by the fallout of radiation materials from the Fukushima Daiichi plant accident, should be promptly and progressively reduced, following the 2007 Recommendations of the International Commission on Radiological Protection provided (ICRP) and memorandum proposed by NISA. To this end, for the residents living in such areas, the target level of radiation exposure per year should be reduced by approximately 50% as the decision of the government.

The Government has already initiated a model program for decontamination in the 12 municipalities in which evacuation orders have been issued. There are also local governments that have begun the decontamination operations and local governments have also been requested to select the areas for implementation of the model decontamination programs.

### 6.6 Start of temporary storages at minimum level

The essential key to progressing with these



decontamination operations will be temporary and intermediate storage facilities. MOE takes responsibility for issuing a roadmap concerning the modalities and the facilities.

At the end of September, the Environment Minister Goshi Hosono said that there were problems yet to be solved concerning the way irradiated waste materials would be stored in the regions where decontamination had taken place. Japanese officials turned to increasingly desperate measures, as traces of radiation were found in Tokyo's water and in water pouring from the reactors into the ocean. A preliminary government report predicted it would take 30 years or more to safely decommission Fukushima Daiichi (AP, November 13).

### 6.7 "Let's return home" appeal

Of the estimated total 2 million population of Fukushima Prefecture, there were 48,903 inhabitants or 2.5% of the population, who had once lived in and had to move out from the prefecture due to the earthquake, tsunami and Fukushima Daiichi accident, according to the local newspaper Fukushima Minpo Shimbun dated on August 9.

Fake rumors of radioactive contaminated materials that circulated nationwide and abroad resulted in damaging repercussions on the food industries, tourism, as well as trade industries. Fukushima prefecture and METI have provided loans for small and medium enterprises (SMEs) that were forced to move out from the areas affected by the nuclear power plant accident since June 2011.

On October 20, the Fukushima Prefectural assembly adopted a petition and appealed to the central government to scrap all ten nuclear reactors including Fukushima Daini plant.

MEXT has developed forecasts of radiation dispersal to guide evacuees away from radioactive plumes and to put priority to minimize the exposure of pupils and children, as well as to reduce the annual dose that pupils and others receive in school to one microsieverts or less in fiscal 2011.

### 6.8 Overlapping services on radioactivity monitoring

Various radiation monitoring services have been undertaken by MEXT, MOE, MHLW and Fukushima Prefecture separately, so that the radiation cross-monitoring of tap water were made by both MEXT and MHLW.

### 6.9 Increase of decontamination budget

The national budget allocation for decontamination accounts for the large sums of 1.1482 trillion yen (US\$15.3 billion) in fiscal 2011, including the secondary budget of 220 billion yen (US\$2.9 billion) and third supplementary budget of 245.9 billion yen (US\$3.2 billion). The supplementary budget system would reflect the necessity of urgency to overcome such nuclear accident or natural disasters, because as decontamination area expands, financial requirement to clean up was expected to tremendously increasing.

#### IAEA survey team to Fukushima on decontamination process

On October 14, Juan Carlos Lentijo, the leader of a team of experts from the International Atomic Energy Agency (IAEA), addressed at a news conference in Tokyo following the survey of decontamination efforts undertaken by several Japanese organizations. The survey that attempted to remove radiation from all of the affected area would be counterproductive with the decontamination cost estimations of more than 1 trillion yen (US\$12.99 billion). The IAEA report stated, "This investment of time and effort in removing contamination beyond certain levels (the so-called optimized levels) from everywhere, such as all forest areas and areas where the additional exposure is relatively low, does not automatically lead to reduction of doses for the public. It also involves a risk of generating unnecessarily huge amounts of residual material." (NHK, October 14)

### 6.10 Author's comments

Regarding the IAEA survey team report on the decontamination process in Fukushima as illustrated above, there is yet any official response issued by the Japanese government.

We were informed that radioactivity monitoring service had been notably undertaken by MEXT, MOE, MHLW and Fukushima Prefecture separately and at the same time. However, both MEXT and MHLW

monitor the radioactive materials of the same tap water. Overlapping bureaucratic organization and media bias have hampered smooth relief operations and distorted public perceptions toward the solution, which have resulted in public distrusts upon authorities and media.

As it will take probably 10, 20 or even 30 years ahead with the long-term radioactive contamination clean-up plan, it will cost higher than initially estimated. It might also yield moral hazard as people would demand more funds for relief or compensation, which would potentially lead to social, financial and political predicament.

## **7 Road map to restore the stricken Fukushima Daiichi**

### **7.1 “Cold shut down by the end of 2011”**

On September 19, Minister for the Restoration from and Prevention of Nuclear Accident, Hosono, stated, at the meeting of the International Atomic Energy Agency (IAEA) in Vienna, Austria, that Japan would conduct cold shutdown by the end of 2011, a few weeks earlier than initially planned. He stated so in spite of the fact that the revised road map, released on September 20, did not change the timing for the next stage of settling the Fukushima Daiichi accident, which would occur from mid-October to mid-January 2012.

From author’s perspective, Minister Hosono took political risks in light of people’s sentiment to wish to refuge from the dangerous zone and return to their homes.

On September 20, the Government-TEPCO Integrated Response Office in the Nuclear Emergency Response Headquarters announced the report on progress status of “Roadmap towards Restoration from the accident at Fukushima Daiichi”

On October 3, the Nuclear and Industrial Safety Agency (NISA) presented, for the first time, a plan to secure the safety of reactors at the Fukushima Daiichi after cold shutdown is achieved. The plan also included limiting and managing the emission of radioactive materials; removing decay heat from the nuclear fuel; preventing criticality in which a nuclear

chain reaction continues; and preventing hydrogen explosions.

### **7.2 Evaluation of Step 1 and Target of Step 2**

On October 13, former President of the Japan Nuclear Energy Safety Organization, Hideki Nariai, delivered a speech titled “Lessons Learned from the Fukushima Daiichi Nuclear Power Plant Accident” at the “Nuclear Energy Safety” Symposium organized by the Academy of Science in South Africa. He justified the “Evaluation of Step 1 and Target of Step 2”. Regarding the Evaluation of Step 1:

- (1) Stable cooling was established for reactors and fuel pools. The temperature at the bottom of reactor pressure vessel was kept at around 100 to 120 degrees centigrade.
- (2) The radiation dose has been declining during the period of Step 1 and it is confirmed that the exposure dose at the site boundary is approximately 1.7 mSv/year at the most (Cs134, 137),
- (3) Regarding Target of Step 2;
  - Continuation of the circulating cooling and attainment of cold shutdown status.
  - Release of radioactive materials under control and radiation dose.

### **7.3 “One year advancement” plan**

On November 9, Minister Hosono and Minister Yukio Edano instructed to initiate the timetable with TEPCO to start removing used fuel rods from spent fuel pools in 4 reactors within about 2 years. This was one year ahead of what the JAEC called for in its report. The Ministers also requested for the inclusion of the plan to begin removing melted fuel rods from the reactors within 10 years.

On November 12, Minister Hosono stated that the government would add another requirement: the temperatures of melted fuel that leaked from the pressure vessels must stay below 100 degrees centigrade.

### **7.4 The current situation at Fukushima Daiichi**

This section describes about the current situation at Fukushima Daiichi nuclear power station as cited from the Japanese daily paper Asahi Shimbun dated November 14 (Table 1).

**Table 1 Current situation at Fukushima Daiichi**

	No. 1	No.2	No.3	No.4
Reactors (as of Nov.12)				
Temperatures at bottom of pressure vessels	38.7 °C	69.5 °C	69.0 °C	No fuel at time of accidents due to regular inspection
Measures to prevent	Nitrogen injections at containment vessels			
Cooling of nuclear reactors	Cooling through injection of circulated water (Reuse of highly radioactive water processing)			
Accumulated contaminated water in RB & TB (as of Nov. 8)	15,060 tons	21,600 tons	22,900 tons	17,900 tons
Recent achievements, current situation (as of Oct.28)	*Cover installed over RB	* Gas processing system in operation at PCV	* Removal of rubble in RB under way ↓ In preparation for removing spent fuel	

(Source; Asahi Shimbun, November 14, 2011)

## 8 Securing the mid-term and long-term safety

### 8.1 Discussions at NISA and JAEC

The government has pledged to complete step 2, in which the reactors at the Fukushima plant would reach a "cold shutdown" state before the end of 2011. After Step 2 of the roadmap, NISA in collaboration with TEPCO has to work on "the concept of securing the mid-term safety" for the stricken Fukushima Daiichi, while the JAEC published the draft long-term road map, outlining the process of decommissioning the stricken Fukushima Daiichi that would take more than 30 years.

### 8.2 Mid-term safety plan discussed at NISA/TEPCO

On October 3, NISA requested TEPCO to submit a report on the assessment results. NISA also requested the operation and management plan of the facility based on the basic targets for facilities specified in "the concept of securing the mid-term safety" for the Fukushima Daiichi plants. This report submission is pursuant to the provisions of the Act on the Regulations for Nuclear Fuel Materials and Reactors (Act No. 166, 1957).

On October 17, NISA received the first part of the report from TEPCO. Subsequently on October 22, NISA held a hearing to present NISA's views on the

report and to obtain opinions from experts, and requested TEPCO to examine their report.

On November 9, the second hearing on "The Concept of Securing the Mid-Term Safety" was held for collecting the views and opinions, and NISA evaluated several issues as follows. The basic targets and requirements are for securing safety during the preparation period (within nearly three years), and specifically to: 1) control and mitigate the release of radioactive materials, 2) properly remove the decay heat, 3) prevent criticality, and 4) prevent hydrogen explosion.

Further hearings are planned to be held under the agenda of the evaluation of the "Report on the Operation and Management Plan of the Facility" of the stricken Fukushima Daiichi. The final report will be completed and submitted to METI in 2012.

### 8.3 More than 30-year process of decommissioning plan

On October 28, the draft road map outlining the process of decommissioning that takes more than 30 years and the dismantling of the crippled reactors at the Fukushima Daiichi was published by the JAEC, as illustrated here below at the Table 2.

After Step 2 of the roadmap toward restoration from the nuclear accident is completed at the end of 2011, the work to remove fuel from the spent fuel pools can start in three years. After the damaged pressure containment vessels (PCVs) are repaired and filled with water, the melted fuel can start to be removed around ten years from now.

**Table 2 Road map for decommissioning reactors**

Road map for decommissioning reactors at Fukushima Daiichi Plants (illustration)	
End of 2011	Bring the reactors under control (through cold shutdown). Start decommissioning; <i>Remove rubble, decontaminate reactor building, install covers on reactor buildings</i>
Around 2014	Start the extraction of fuel rods from spent fuel storage pools: <i>Repair containment vessels, fill containment vessels with water</i>

Around 2021	Start the extraction of melted fuel rods from reactors
Around 2026	Complete the melted fuel rods extractions
2041 or later	Complete the decommissioning of reactors

(Source; Asahi Shimbun, October 30)

## 9 Looming anxiety over restarting the suspended nuclear reactors

### 9.1 PM Noda's stance: first assure safety, then restart

Speaking at an interview with the Wall Street Journal published on September 20, before departing to the United States, PM Noda said in Tokyo, "From spring through next summer, we must try best to restart as many (idle nuclear reactors in Japan) as possible.." PM Noda had stated earlier that he would allow nuclear reactors to be restarted if their safety could be confirmed. This was the first time he mentioned a specific schedule for resuming operations.

### 9.2 Decision-making process: state, prefecture or municipality

NISA and NSC must monitor the results of the tests and NISA will decide whether the reactors with the assurance of advice from IAEA are restarted. Finally, any restart has to be approved by the municipalities that are hosting the reactors.

On September 9, Governor of Niigata Prefecture, Hirohiko Izumida, said that he could not determine whether the reactors should be restarted until the Fukushima accident is properly assessed.

### 9.3 Mixed sentiments by local residents

Of all 54 nuclear reactors in Japan, 11 reactors that are still in operation are due to shut down for maintenance between November 2011 and September 2012. It follows that Japan has no nuclear-generated electricity. It is nevertheless unlikely, given the pro-nuclear sentiment of governors in some prefectures and the intense pressure for restarts from the central government of Tokyo<sup>[2]</sup>, Saga Prefectural Governor in Kyushu island, Yasushi Furukawa, said, "If the government, which is responsible for regulations (on reactor operations), concluded that the No. 4 reactor is safe, we will accept the conclusion as we did before."

(The New York Times, October 10)

### 9.4 Stress test and delay of restart

All utilities must go through stress tests, which the government required for all suspended reactors prior to restart. It is in line with the outlines set by NISA in July<sup>[3]</sup>.

On October 28, Kansai Electric Power Company submitted stress test results on its No.3 reactor at Ohi power plant in Fukui Prefecture to the government to seek permission to restart. This was the first submission of stress test result since the accident at the Fukushima Daiichi occurred. On November 14, Shikoku Electric became the second to submit stress test results on the No. 3 reactor at its Ikata nuclear power plant in Ehime Prefecture. Nonetheless, the prospects for the restart of idle reactors are uncertain. Some nuclear experts voiced criticism over the reactor safety tests at the first meeting of a government committee and discussed ways to evaluate the results. One member said that the stress test should not be the only condition for restarting reactors while the cause of the Fukushima accident has not been identified (NHK).

#### Author's Notes;

In November, NISA announced the comprehensive safety assessment overview to ensure public / resident relief and confidence in improved safety of nuclear power plants, including two approaches in assessment:

Primary assessment: (Decision on whether they can restart operations of nuclear power stations were suspended for the purpose of regularly scheduled checks)

Evaluate safety margins of structures, systems and components important to safety to endure the events beyond design bases, for nuclear power plants under periodic inspection and ready for start-up.

Secondary assessment: (Decision on whether they can continue or should halt operations of nuclear power stations that were in operation.)

Conduct comprehensive safety assessment for all nuclear power plants including those in operation and those subject to primary assessment, considering the status of stress tests in European countries and progress in investigation by the Investigation and Verification Committee on the Accident.

(Source: Web site of NISA publicizes review progress in stress test)

### 9.5 Author's comments:

There was difference of opinions among prefectures that host nuclear plants, between "pro-nukes" group and "anti-nukes" group among residents. It affects on the approval of decision on whether the nuclear reactors that were in suspension would be restarted. Perplexed sentiments for "pro-nukes group" reveal their concerns on economic loss caused by the delay of restarting.

## 10 Electricity shortage and energy conservation for the forthcoming winter

### 10.1 "Cool Biz" campaign in summer

At the first stage of the accident at the Fukushima Daiichi, the rolling black-out program of TEPCO in Kanto area has been activated, and then later suspended due to warm temperature and the slump on economy, as of April 1.

In hot summer season, the government invoked a 15% consumption reduction order for large energy consumers with 500kW capacity or more in TEPCO and Tohoku service areas of eastern Japan, effectively from July 1 through September 30. This order was lifted on September 4.

In addition to the conservation efforts by consumers, owing to the low temperature, the peak electricity demand was lower than last year by 16.3% (10.1MW) for TEPCO and by 19.8% (3.1MW) for Tohoku. As a result, the summer peak demand season ended without any further plans for rolling black-out.

### 10.2 Supply margin will drop by 10% next summer

As of the end of November, of all 54 nuclear power plants installed in Japan, only 11 are in operation. Without resumption of nuclear plants after regular inspection, there will only be 6 reactors operating in January in 2012, and it is likely that there will be none in operation by summer in 2012.

On November 1, the Deputy Chief Cabinet Secretary, Tsuyoshi Saito, addressed at the press conference that as of summer 2012, in the event that peak demand is on par with the previous year and if operations at the nuclear power stations are not restarted,

supply-demand gap of about 10% on the national level is expected to occur. He also stated that as there are still uncertainties, further detailed examination on supply and demand should be carried out with the aim to complete the review by spring 2012.

On November 1, the Japanese government announced the request to Japanese people for electricity conservation during the forthcoming winter season, as the national average reserve capacity would fall within the range of 2.4% for January and 2.2% for February. These figures were slightly below the minimum required 3% for stable supply (Table 3).

Table 3 Electricity Supply and Supply Reserve Ratio

Outlook				
Eastern Japan (50HZ)				
Electric Power Companies	January 2012		February 2012	
	Supply Capacity	Supply Reserve Ratio	Supply Capacity	Supply Reserve ratio
	MW	%	MW	%
HOKKAIDO	650	12.3	649	15.3
TOHOKU	1,342	-3.4	1,364	-0.5
TOKYO	5,457	6	5,375	4.4
Total	7,449	4.6	7,388	4.3
Central/Western Japan except for Okinawa (60HZ)				
Electric Power Companies	January 2012		February 2012	
	Supply Capacity	Supply Reserve Ratio	Supply Capacity	Supply Reserve ratio
	MW	%	MW	%
CHUBU	2,487	6.2	2,487	6.2
KANSAI	2,477	-7.1	2,412	-9.5
HOKURIKU	561	6.2	559	5.9
CHUGOKU	1,146	6.7	1,146	6.7
SHIKOKU	544	4.6	531	2.1
KYUSHU	1,499	-2.2	1,506	2.2
Total	8,714	0.6	8,641	0.4
Grand Total	16,163	2.4	16,029	2.2

Source: Energy-Environment Council, Cabinet Office

### 10.3 Saving target by 10% for Kansai and 5% for Kyushu

For winter season in 2011, the government would refrain from issuing a power-saving order as winter demand peak is different from summer demand peak. However the government has requested the consumers in Kansai area for voluntary conservation with a target reduction of 10% or more, and 5% or more for consumers in Kyushu area. There are no specific targets for consumers in other areas. It is

expected that Tohoku will be able to get through its peak through relief electricity supplied from the neighboring Tokyo and Hokkaido as elaborated at Table 3, providing the electricity supply and supply reserve ratio outlook for 9 EPCs for winter.

**Author's Notes;**  
 Three electric power companies in eastern Japan, namely Hokkaido, Tohoku, and Tokyo adopt 50 Hz, whereas seven electric companies in western Japan, namely Chubu, Hokuriku, Kansai, Chugoku, Shikoku, Kyushu, and Okinawa, adopt 60 Hz.  
 The transmission line interconnects Hokkaido and Honshu, the two main islands of Japan, by 42 km of long submarine cables that carries 250 kV direct current with the capacity of 600MW.  
 For the frequency exchange between eastern and western zones of Japan, frequency conversion stations have been set up by three utilities: J-Power, TEPCO, and CHUBU with total capacity of 1,000 MW. The presence of the two different frequencies can be traced back to the competition between Tokyo and Osaka during the burgeoning of the electric industry in Japan between 1800s and 1990s, according to the *Denki Shimbun* (The Electric News Daily) published in Japan (November, 2011).

**10.4 For warmth in winter: cardigan, lap robes and socks**

Although there are no law-binding compulsory regulations or planned blackout that would be enforced in winter in 2011, METI has announced the “Electricity Saving Menu” to suggest the types of electricity conservation means for consumers with different patterns of electricity use. It is different with the “Cool Biz” daily pattern of electricity in summer season, as illustrated in Fig. 5.

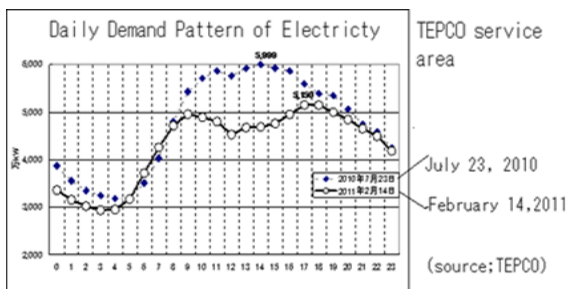


Fig.5 Daily demand pattern of electricity.

The government intends to encourage offices and

households to save power and shift high-demand hours by introducing electricity meters through a charge revision and setting higher fees on high demand hours. It would also promote the installation of power-saving equipments and facilities such as air conditioners and lights that would require less electricity to work and highly insulated double windows. It would also morally support companies and factories to be equipped with private electric generators and secondary batteries, according to Japan Times published on October 31.

METI expects that capacity margin above 3% could be secured through these fine-tuned countermeasures.

On November 14, power-saving efforts have begun in one of cities in the western Japan, Kitakyushu city where the city council launched the 5-month electricity-saving campaign, calling for countermeasures between 8 a.m. and 10 p.m. as follows. Heaters would be set at 19 degrees Celsius at the city hall, and workers at offices and households would conduct energy conservation measures by less use of microwave ovens, air-conditioners, and washing machines.

The Japan Energy Conservation Center recommends sensible temperature by wearing warm clothes at home, effectively saving 2.2 degree for cardigan, 2.5 degree for lap robes and 0.6 degree for socks, in centigrade respectively, as illustrated in Fig. 6.

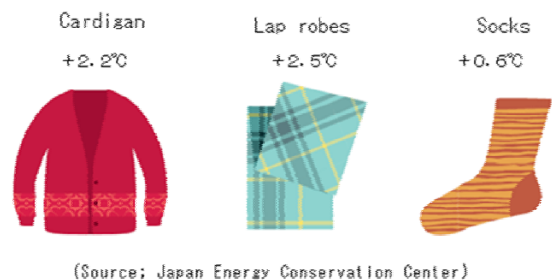


Fig. 6 Warm clothes and their temperature effects.

**11 Closing remarks**

In the event of successful implementation of Step 2 of the near-term road map as elaborated on the above chapters, some residents who are currently living in evacuation areas out of the Fukushima Daiichi may be

permitted to return home.

However the draft long-term road map indicates the process of decommissioning takes more than 30 years for the Fukushima Daiichi. The cost of decommissioning is also a major constraint. Since the decommissioning timescale is very long, there is no clear indication of how things will turn out, while nuclear power would solve near-term energy problems. “The timescales are completely wrong”, according to David Howell<sup>[4]</sup> \*<sup>5</sup>.

Japan stands at the crossroads that would determine whether nuclear energy could remain susceptible in the future at the heart of Japan’s energy policy.

(\*5) Rt Hon Lord David Howell was appointed Minister of State at the Foreign and Commonwealth Office of the United Kingdom, on 14 May 2010. Lord Howell is also in charge of International Energy Policy.

## Nomenclature

AM	Accident Management
ANRE	Agency of Natural Resources and Energy
CEO	Chief Executive Officer
CHUBU	Chubu Electric Power Company
EPC	Electric Power Company
EPZ	Emergency Planning Zone
G8	The Group of Eight industrial countries
GHG	Greenhouse Gas
IAEA	International Atomic Energy Agency
ICRP	The International Commission on Radiological Protection
IEA	International Energy Agency
IEEJ	Institute of Energy Economics of Japan
INES	International Nuclear and Radiological Event Scale
JAIF	Japan Atomic Industry Forum
JAEC	Japan Atomic Energy Commission
KEPCO	Kansai Electric Power Company
KYUSHU	Kyushu Electric Power Company
MAFF	Ministry of Agriculture, Forestry and Fisheries
METI	Ministry of Economy, Trade and Industry
MEXT	Ministry of Education, Culture, Sports, Science and Technology
MHLW	Ministry of Health, Labor and Welfare
MLIT	Ministry of Land, Infrastructure, Transport and Tourism

MOE	Ministry of the Environment
NISA	The Nuclear and Industrial Safety Agency
NHK	Nippon Hoso Kyokai (Japan Broadcasting Corporation)
NPS	Nuclear Power Station
NSC	Nuclear Safety Commission
PCV	Pressure Containment Vessel
PM	Prime Minister
RB	Reactor Building
SPEEDI	Systems for Prediction of Environmental Emergency Dose Information
TB	Turbine Building
TEPCO	Tokyo Electric Power Company
TOHOKU	Tohoku Electric Power Company
UN	The United Nations

## APPENDIX

Updated calendar: September 1 through November 30, cited from NHK and Asahi Shimbun.

September 2	Noda Cabinet starts
September 9	Electricity Usage Restriction Order lifted
September 9	Stress test started at Kashiwazaki-Kariwa NPS
September 12	The Corporation in support of Compensation for Nuclear Damage was established
September 19	IAEA Ministerial Council started in Vienna
September 22	In a high-level meeting on nuclear safety held at the United Nations (UN) headquarters in New York, PM Noda delivered the keynote address
September 30	The Evacuation-Prepared Area in case of Emergency designation was lifted
October 3	NISA announced the mid-term road map of the Fukushima Daiichi plant.
October 3	Report on the TEPCO management and finance investigation was submitted to the PM Noda
October 7	Gvt’s Committee on cost assessment on NPS started
October 14	Decontamination practice report was submitted by IAEA
October 18	Revised Step2 road map was approved
October 28	KANSAI EPC submitted the report on stress test results
October 28	JAEC announced the long-term



November 1	decommissioning road map For winter electricity saving for Kansai area and for Kyushu are requested by 10%, 5%, respectively	www.iaea.org Ministry of Agriculture, Forestry and Fisheries (MAFF); www.maff.go.jp Ministry of Economy, Trade and Industry (METI); www.meti.go.jp
November 1	No.4 reactor of Genkai of Kyushu EPC restarted for the first time since Fukushima Daiichi accident	Ministry of Education, Culture, Sports, Science and Technology (MEXT); www.mext.go.jp
November 14	Shikoku Electric became the 2nd to submit stress test results on the No. 3 reactor of Ikata NPS	Ministry of Health, Labor and Welfare (MHLW); www.mhlw.go.jp
November 17	Revise stpe2 of road map was announced	Ministry of Land, Infrastructure, Transport and Tourism (MLIT); www.mlit.go.jp
November 28	COP 17 started in Republic of South Africa	Ministry of the Environment (MOE); www.env.go.jp The Nuclear and Industrial Safety Agency (NISA): www.nisa.meti.go.jp Nuclear Safety Commission (NSC); www.nsc.go.jp Prime Minister Office; www.kantei.go.jp

## References

- [1] SHIBUTANI Yu: The second update of the Fukushima Daiichi Nuclear Station accident (June 1 through August 31, 2011), Nuclear Safety and Simulation, September 2011, 2(3): 199-200
- [2] *ibid*: 205
- [3] *ibid*: 203
- [4] DAVID Howell, and CAROLE Nakhle: Out of the Energy Labyrinth, I.B.TAURIS, 2008: 31

## Sources

### Chapter 1;

Asahi Shimbun; www.asahi.com/  
Nippon Hoso Kyokai (Japan Broadcasting Corporation) (NHK); www.nhk.or.jp  
Prime Minister Office; www.kantei.go.jp  
Cabinet Office; www.cao.go.jp

### Chapter 2;

Prime Minister Office; www.kantei.go.jp  
Cabinet Office; www.cao.go.jp

### Chapter 3 and 4;

Agency of Natural Resources and Energy (ANRE); www.enecho.meti.go.jp  
Energy-Environment Council (EEC)/ (Cabinet Office; www.cao.go.jp  
International Energy Agency (IEA); www.iea.org  
Japan Atomic Energy Commission (JAEC); www.jaec.or.jp  
Ministry of Economy, Trade and Industry (METI); www.meti.go.jp  
Prime Minister Office; www.kantei.go.jp

### Chapter 5 and 6;

Cabinet Office; www.cao.go.jp  
International Atomic Energy Agency (IAEA);

### Chapter 7 and 8;

Agency of Natural Resources and Energy (ANRE); www.enecho.meti.go.jp  
Energy-Environment Council (EEC)/ (Cabinet Office; www.cao.go.jp  
International Atomic Energy Agency (IAEA); www.iaea.org  
Japan Atomic Energy Commission (JAEC); www.jaec.or.jp  
The Nuclear and Industrial Safety Agency (NISA): www.nisa.meti.go.jp  
Nuclear Safety Commission (NSC); www.nsc.go.jp

### Chapter 9;

Cabinet Office; www.cao.go.jp  
International Atomic Energy Agency (IAEA); www.iaea.org  
Japan Atomic Energy Commission (JAEC); www.jaec.or.jp  
Kansai Electric Power Company (KEPCO); www.kepco.co.jp  
The Nuclear and Industrial Safety Agency (NISA): www.nisa.meti.go.jp  
Tokyo Electric Power Company (TEPCO); www.tepco.co.jp

### Chapter 10;

Agency of Natural Resources and Energy (ANRE); www.enecho.meti.go.jp  
Cabinet Office; www.cao.go.jp  
Kansai Electric Power Company (KEPCO); www.kepco.co.jp  
Ministry of Economy, Trade and Industry (METI); www.meti.go.jp  
Tokyo Electric Power Company (TEPCO); www.tepco.co.jp  
Japan Energy Conservation Center (ECCJ); www.eccj.or.jp