NUKE INFO TOKYO

March/April 2014
No. 159

Citizens' Nuclear Information Center

Akebonobashi Co-op 2F-B, 8-5 Sumiyoshi-cho, Shinjuku-ku,
Tokyo 162-0065, JAPAN Phone: +81 3 3357 3800 Fax: +81 3 3357 3801
URL: http://cnic.jp/english/ e-mail : cnic@nifty.com

Three years after the Fukushima nuclear disaster, we are hoping to see glimmers of hope

Fukushima Daiichi Nuclear Power Station on 21 March 2011, Photo by TEPCO

Three years have already passed since the 2011 nuclear accident at Fukushima Daiichi Nuclear Power Station (FDNPS).

No improvement has yet been made to the situation in which Fukushima residents are suffering from radiation exposure and 140,000 evacuees are still unable to return home. When will "spring" come for these people? No matter if spring comes to Fukushima and the mountains and plains are covered with green leaves and flowers as far as you can see, the invisible danger of radiation continues to exist deep in the heart of the natural environment. This reminds us of "*Silent Spring*."

The whole picture of the nuclear disaster still remains unclear. There are plenty of things that are still unknown, or unaccounted for. Overlooked problems and difficulties are being brought to light one after another. To determine the causes of the nuclear accident, many points need to be clarified; where the problems lie and why they are difficult to deal with. Many of these points still remain unclear, but some of them are becoming apparent.

Contents

Fiscal Year	No. of consultations	No. of people referred for secondary test	No. positively diagnosed with thyroid cancer	No. with possible thyroid cancer
2011	41,561	218	10	4
2012	139,239	987	22	28
2013*	88,554	591	1	9
TOTAL	269,354	1,796	33	41

Table 1. Number of People Diagnosed with Thyroid Cancer, 2011 to 2013
** As of December 21, 2013 (Completed results up to November 15)*
Source: Fukushima Prefecture, Survey of Prefectural People's Health Management

The number of people diagnosed with cancer of the thyroid gland is increasing as the investigation area is expanded. Due to vagueness in the scientific research, it is still impossible to declare that the growing number of cancer patients has been caused by the nuclear disaster. Nevertheless, it is also wrong to say that the nuclear disaster has nothing to do with the increasing number of cancer patients. We must deal with this problem by assuming that the health effects have been caused by the nuclear accident.

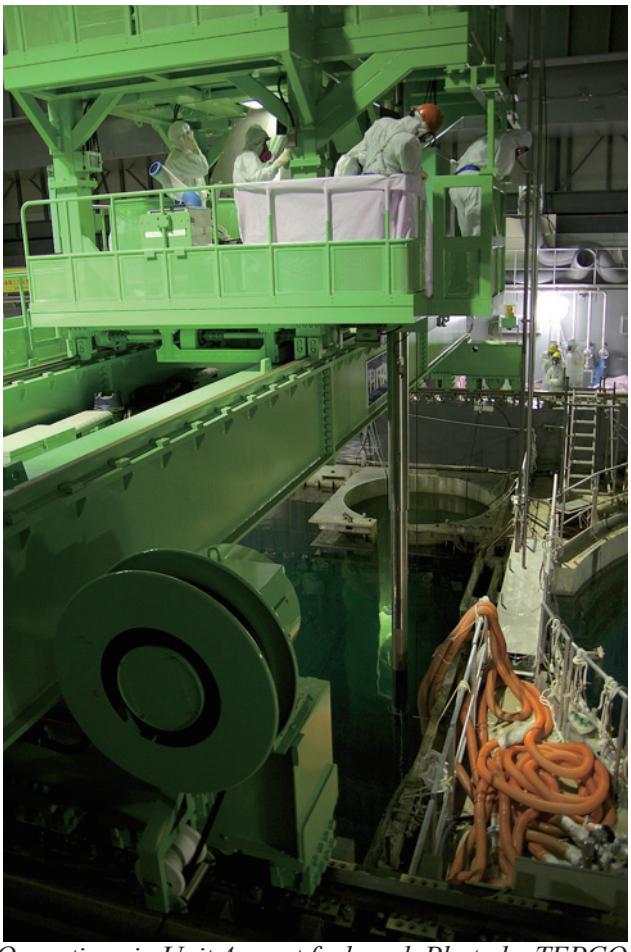
Among people who have not been directly affected by the nuclear disaster and those who wish to imagine that the accident has not inflicted any damage on them personally, we are seeing spreading signs of a desire to forget about Fukushima and a mood for tolerating the restart of nuclear power plants because there does not appear to be any better alternative. However, there is no way to block the popular movement towards the creation of a nuclear-free society. In fact, the situation we have now, where all nuclear reactors are offline, has already been maintained in Japan for as long as six months.

It is well known that some of the crew members of a U.S. aircraft carrier engaged in the "Tomodachi" relief operation in the wake of the 2011 Great East Japan Earthquake were exposed to radiation emanating from the crippled FDNPS. In February, nearly three years after the accident, a total of 79 aircraft carrier crew members filed a class-action law-suit against Tokyo Electric Power Co. (TEPCO), demanding approximately 100 billion yen in compensation.

At the accident site, operations are currently proceeding to cope with several problems.

Transfer of the nuclear fuel from the Unit 4 spent fuel pool to a ground-level pool has been continuing since November 2013 (see NIT 158). TEPCO plans to complete the removal and transfer of all of 1,535 fuel assemblies by the end of 2014.

The transfer of 528 fuel assemblies had been completed as of March 24, 2014. Three damaged fuel assemblies have been stored in the spent fuel pool since the pre-accident period. The task of lifting and removing these fuel assemblies will be a very difficult operation.



Operations in Unit 4 spent fuel pool, Photo by TEPCO

The serious problem of how to deal with contaminated water suddenly emerged in July 2013. This is one of the problems that is making the nuclear accident clean-up very difficult. In early April 2011, it became evident that a great amount of radioactive contaminated water had leaked into the sea from the Unit 2 water intake. The then Democratic Party of Japan government tried to take necessary measures but TEPCO made one excuse after another to ignore the government's instructions.

Storage tanks at Fukushima Daiichi, Photo by TEPCO

Currently, 400 tons of circulating coolant water is daily pumped into the Units 1, 2 and 3 buildings in order to maintain the melted uranium fuel assemblies there in a cool state. Furthermore, another 400 tons of underground water is flowing into the reactor buildings each day, increasing the amount of radioactive contaminated water. The polluted water is currently collected and stored in above-ground tanks, but sooner or later there will be nowhere to place new tanks. Radioactive contaminated water leaks caused by deterioration of the tanks have already occurred at the plant (see NIT 156).

It would be correct to say that the radioactive contamination level of the soil in the nuclear power plant is totally unknown. However, the soil is undeniably severely contaminated. Earlier, in February, the highest-ever level of cesium (134+137) measuring 130,000 Bq/kg was found in a 16m-deep monitoring well located next to the Unit 2 building, near the seashore. There is no guarantee that this record will be left unbroken for long. It will be extremely difficult to block the contaminated water leaks into the sea. As for contamination by beta nuclides, no information has been provided so far.

The water storage tanks contain strontium and other beta-emitting nuclides. It remains uncertain what kind of nuclides and how much of them are contained in the tanks. It was disclosed on January 9 that a non-negligible level of X-rays from the bremsstrahlung radiation*, caused by beta-rays, was detected around the tanks. This means that the workers engaged in the work near the tanks are certain to be exposed to this radiation.

The operation to build frozen walls around Fukushima nuclear power plant to stem leaks of radioactive water from the reactor buildings into the sea began in late January. TEPCO says that the verification test for drilling coolant-filled pipes into the ground will be completed before the end of March. Since this is a huge and challenging operation, there is no guarantee that it will be successful.

At present, the Nuclear Regulation Authority (NRA), without hearing any opinions from the members of the National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (NAIIC), is said to be formulating a conclusion that the nuclear accident at Fukushima nuclear power plant was caused by the tsunami.

The only official panel that is still continuing investigations into the cause of the nuclear accident is the Technical Committee of Niigata Prefecture (see NIT 157). A prevailing view among Niigata residents is that the issue of whether Kashiwazaki-Kariwa nuclear power station can be restarted should be discussed after the committee's investigation is completed. We hope that the view expressed by NAIIC member Mitsuhiko Tanaka, NAIIC cooperative member Yoshinori Ito, and other experts that the nuclear accident was not caused by tsunami, but was in fact caused by the earthquake preceding it, will contribute to the pursuit of truth about the accident.

(By Yukio Yamaguchi, Co-Director of CNIC)

bremsstrahlung radiation
When an electrically-charged particle moving at high speed is obstructed by the electric field from an atomic nucleus and comes to a halt, or when the direction it is moving in is altered, the particle radiates energy in the form of electromagnetic waves. This phenomenon is called bremsstrahlung radiation.

The Current State of Japan's Nuclear Power Plant Export Plans

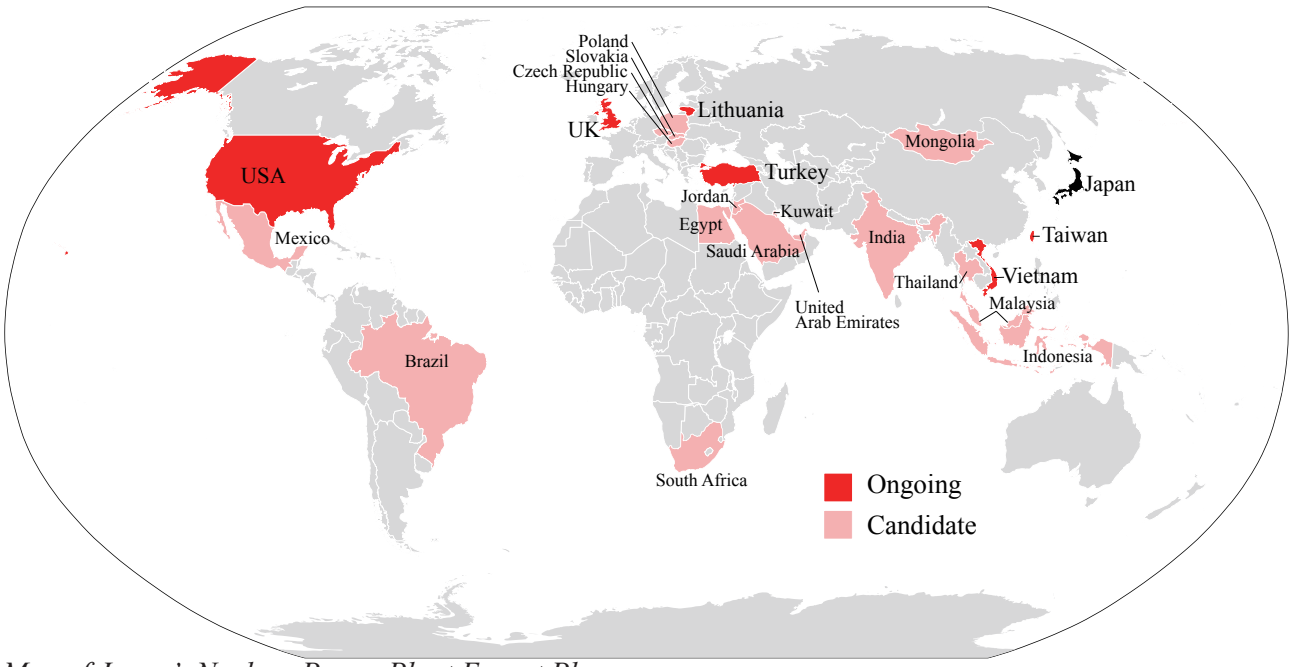
With no prospects for the new construction of nuclear reactors inside Japan, Japanese nuclear reactor makers have turned their eyes overseas in search of a means of survival. This article overviews the current state of the plans by Japan's nuclear reactor makers to export nuclear power plants (NPPs).

1. Ongoing cases

There are now two ongoing plans for the construction of NPPs in Turkey. One is the NPP construction plan in Akkuyu, on the Mediterranean coast, where four Russian Rosatom VVER-1200 reactors (1,200 MW-class Russian PWRs, the first of which is due to come online in 2020) are scheduled to be built. The other is an NPP construction plan for Sinop on the Black Sea coast ordered from an international consortium led by Japanese companies (consisting of Mitsubishi Heavy Industries, Itochu Corporation, GDF Suez, Turkish Electricity Generation Company Incorporated (EUAS), and others). Four ATMEA-1 reactors (1,100 MW-class PWRs, the first of which is due to come online in 2023) are to be built under the plan (see News Watch, NIT159). However, both plans have met with fierce opposition from local residents (see p.6, "Sinop Says No to Nuclear").

Similarly, there are also two ongoing plans to build NPPs in Vietnam. One is for Russia's Rosatom to construct two VVER-1000 reactors (1,000 MW-class Russian PWRs, the first of which is due to come online in 2020), and the other ordered from the International Nuclear Energy Development of Japan* (JINED) to build two 1,000 MW-class reactors (the first of which is due to come online in 2021 despite the reactor type not having been selected yet). Both NPPs are to be constructed in Ninh Thuan Province in central southern Vietnam. It is, however, expected that the construction plans will be delayed since Vietnam's domestic regulations require strengthening.

Lithuania has a plan for the construction of an NPP, which has been ordered from Hitachi-GE Nuclear Energy. Under this plan, one Advanced BWR (1,350 MW-class ABWR, due to come online in 2020) is to be built on the banks of Lake Druksiai in eastern Lithuania. Nevertheless, although not legally binding, 62% of voters opposed the construction plan in a referendum held in 2012, and since there has also been a change in government in the meantime, the future of the construction plan has become uncertain.



Map of Japan's Nuclear Power Plant Export Plans

** The shareholders of the International Nuclear Energy Development of Japan (JINED) include the major Japanese electric power companies, Toshiba, Mitsubishi and Hitachi.*

People opposed to nuclear power demonstrate in front of the Japanese Consulate in Turkey (January 22, 2014), Photo by Anti Nuclear Sinop

In the UK, Hitachi has purchased the NPP construction company Horizon and has two ongoing plans to construct two or three ABWRs (1,300 MW-class) at each of two sites, at Wylfa on Anglesey (Wales) and at Oldbury-on-Severn in South Gloucestershire. Toshiba has also bought 60% of the shares in the NPP construction company NuGeneration and plans to build three AP1000 reactors (1,000 MW-class PWRs, to be constructed by Toshiba's Westinghouse, the first of which is due to come online in 2024) at Moorside in West Cumbria.

Two nuclear reactor construction plans in the USA have gained COLs (combined construction and operating licenses) from the Nuclear Regulatory Commission (NRC). One is for Units 3 and 4 at the Vogtle NPP in Georgia, and the other is for Units 2 and 3 at the V.C. Summer NPP in South Carolina. Both constructions have been ordered from Westinghouse, and are due to introduce AP1000s. In Tennessee, the construction of Watts Bar Unit 2, a Westinghouse 1,210 MW PWR suspended since 1988, has also resumed, and the reactor is now under construction.

Further, Taiwan's fourth NPP, Lungmen, now under construction in New Taipei City, was ordered from GE, but in fact Unit 1 reactor was produced and delivered by Hitachi, Unit 2 by Toshiba, both 1,350 MW ABWRs, and the generators will be provided by Mitsubishi Heavy Industries. However, due to a large-scale citizens' protest movement, there is little expectation for the reactors to actually come online.

2. Other Candidate Countries

The Japanese government is currently giving active support for the export of NPPs and is rushing to conclude bilateral nuclear power cooperation agreements, the prerequisite for NPP exports. Noting only those which have been publically announced thus far, Japan is now engaged in ongoing agreement negotiations with India, South Africa, Brazil, Mexico, Malaysia, Mongolia, Thailand, and Saudi Arabia. Moreover, as Jordan and Kuwait have already concluded agreements, and agreements with Turkey and the United Arab Emirates are awaiting approval by the Diet, these countries can also be recognized as candidates for NPP exports. Japan has also concluded a nuclear power cooperation agreement with EURATOM (the European Atomic Energy Community), and is conducting strong sales activities with the EURATOM member states of Poland, the Czech Republic, Slovakia and Hungary. PM Abe acted as a top salesman for NPPs in talks with the heads of state of these countries in June 2013. Despite the fact that Japan has not yet concluded nuclear power cooperation agreements with Indonesia and Egypt, these two countries are also currently being targeted by the Japanese nuclear industry for possible NPP exports.

However, in Thailand, for example, while a plan for the construction of a two-reactor NPP has been incorporated into the Thailand Power Development Plan 2012-2030, the citizens harbor strong anti-nuclear sentiments and a local activist has commented to the author in an interview that "This project has been included in the plan simply for the purpose of obtaining budget." Furthermore, the NPP construction plan which was scheduled to move forward in Kuwait with the support of Japan was suspended after the Fukushima Daiichi Nuclear Power Station accident.

3. A case in which an order failed to materialize

In 2013, Toshiba acquired the preferential negotiating rights for an NPP to be constructed at Hanhiviki in Finland. The Finnish NPP company Fennovoima later altered the construction plan from the large-scale reactor in the original concept to a medium-sized reactor, and as a result Rosatom is now scheduled to build the NPP.

(Hajime Matsukubo, CNIC)

Report from Turkey

Sinop Says No to Nuclear

Özgür Gürbüz, Anti Nuclear Platform

INTRODUCTION

The idea of building a nuclear power plant in Turkey was first put forward about 60 years ago. Akkuyu in Mersin Province and Sinop have been the two places proposed for building a nuclear power plant since almost the earliest days of the introduction of this idea. Changing economic and political conditions led to the cancellation of the nuclear power plant projects even if the cancellations were for different reasons. Economic and political conditions have changed a lot within the past 60 years in Turkey, but two issues have remained unchanged: Turkey doesn't need nuclear power plants to meet the electricity demand of the country, and the number of those who say no to nuclear power plants is higher than the number of nuclear proponents.

Rally against nuclear power in Sinop

PEOPLE ARE AGAINST NUCLEAR

In a study conducted by Konda Research and Consultancy in April 2013, the percentage of those who responded 'no' to nuclear was 63.4%. This percentage rose to about 80% after Fukushima. Although the government has control over a substantial part of the press, and media bosses have close relations with energy and construction companies, the number of those who say no to nuclear is not diminishing. It appears that even those who have voted for the Justice and Development Party (AKP: *Adalet ve Kalkınma Partisi*), in power for 12 years, do not support the nuclear energy policy of the government. This anti-nuclear attitude can be seen more clearly in Sinop and Mersin. AKP won local elections in 2009 in 45 provinces, 10 of which are metropolitan municipalities. Other political parties were successful in 36 provinces in total, 10 of which are metropolitan municipalities. Among the cities which AKP lost, and it was also outflanked in the county municipalities, are the two cities of Sinop and Mersin. The government is not asking people whether they want nuclear power plants or not. They also avoid coming face to face and discussing the issue with anti-nuclear citizens or their political rivals. We have never witnessed the minister of energy discussing the nuclear energy issue with anti-nuclear citizens on a live broadcast or a panel discussion. Therefore, the question of Turkey's building a nuclear power plant is far beyond a technical issue. We have a large democratic problem ahead. AKP wants to ignore public opinion and build the nuclear power plants. It is clear that this attitude will strike another blow against the already staggering democratization process of Turkey.

The agreements Japan and the Russian Federation signed with the Republic of Turkey show no sympathy to what people think. Neither Sinop citizens nor the people of Mersin have complete information about the content of these agreements. They are against the nuclear power plant but nobody cares about them. Where will the nuclear waste be stored? Who will inspect the power plants? Will there be an independent inspection organization? Nobody answers such questions. In taking a decision to build a nuclear power plant despite the will of the people, the government commits a crime against democracy. Japan and Russia are parties to this crime.

PROJECTIONS FALSE

The most important argument used for justifying the building of a nuclear power plant in Turkey is the rapid increase in electricity/energy demand. The projections made by the Ministry of Energy and Natural Resources show that electricity demand will increase at least 6.4% annually under a low scenario and 7.6% at the most according to the high scenario. The disclosed actual numbers for the past two years have been lower than even the lower scenario. What is more, the reliability of these scenarios is highly controversial. Turkish Electricity Transmission Corporation (TEIAŞ), in its prediction made in 2005, stated that electricity demand would be 262 billion kWhs under a high scenario in 2011. But Turkey's actual electricity demand in 2011 remained at 230 billion kWhs. It is impossible to reach this number even by the end of 2013. TEIAŞ deviated from its 2005 predictions by 12 percent. These predictions were made on the premise that Turkey would continue to develop at high rates, but the economy has decelerated for the past couple of years. These predictions have no credibility. We also know that the predictions mentioned above do not take energy conservation and efficiency into consideration. The 9th Development Plan of the Ministry of Development states that the consumption of both general energy and electricity can be decreased by 20-25% thanks to efficiency practices carried out in buildings and the transportation sector. It is particularly apparent that Turkey will not need nuclear power plants if we will simply place emphasis on energy conservation and efficiency issues.

WE DON'T USE ENERGY EFFICIENTLY

I should underline the fact that we face a government which never considers questioning such an exaggerated increase in demand, and 'is surprisingly slow' at taking several crucial measures ranging from transmission line losses to energy efficiency. Turkey uses two or even three times more energy than many countries in Europe to produce the same product or service. Whereas a tendency to use energy more efficiently is observed all over the world, we witness almost no progress achieved in Turkey since 1990. 242 kgoe (kilograms of oil equivalent) was used to generate 1,000 Euros of economic growth in 1990, and now this number is 233. We face a country which has done nothing to use energy more efficiently in the last 25 years. Even if this seems bad at first glance, it also indicates a serious potential for energy conservation.

CLEAN ENERGY POTENTIAL

Another point on which the government is weak is renewable energy sources. Everybody knows that Turkey is one of the sunniest countries in Europe. Official figures show that the potential is equivalent to 380 billion kWh. Considering that the electricity consumption of Turkey is 240 billion kWh, using even a part of this untouched resource would be enough to shelve the nuclear power plant plans. The total installed power capacity of Turkey is above 60,000 megawatts (MW). The total power of photovoltaic panels used for generating electrical power from the sun doesn't account for even 10 MW. Other energy sources such as wind, geothermal, and biomass are ready to be utilized. Only 2,700 MW of the total of 48,000 MW economical wind potential has been brought into use. Even if we don't list lignite coal and hydroelectric potential, which environmentalists view with suspicion, we can say that the electricity demand of a nuclear-free Turkey will be easily met. Furthermore, it is practical to keep in mind that Turkey is an earthquake country, where control, inspection and transparency policies are highly controversial.

After the Fukushima accident, Prime Minister Recep Tayyip Erdoğan stated "No investment is accident risk free. If so, we shouldn't use bottled gas at home, install natural gas pipelines or have a crude oil line passing through our country." Attempting to build a nuclear power plant in a country where the prime minister compares a nuclear power plant accident with a bottled gas explosion is just like having an accident waiting to happen. The Black Sea region was the region most seriously affected by the Chernobyl disaster in Turkey. Today, whichever door you knock at in Sinop you encounter people inside who have lost one of their relatives because of cancer. The people of Sinop know nuclear energy is the actual reason for their pains and are determined not to allow a new disaster to occur. Having heard the decision of the agreement signed with Japan, the Anti-Nuclear Platform, dozens of non-governmental organizations and political parties assembled and set up a new organization, making a fresh start. The people of Sinop who have recently fought against and stopped the installation of a huge thermal power plant in the city say they absolutely will not allow a nuclear power plant to be built there.

State of Agricultural Research on Radioactive Contamination

The Fukushima nuclear disaster caused radioactive substances to be spread widely throughout the environment, and many foods were contaminated with radioactivity. Currently, even though three years have passed since the accident, the mechanisms of transference of radioactivity from soil to plants are not yet well understood. This paper reports on the state of research on radioactive contamination in agriculture, with a focus on radioactive cesium. Note that radioactive iodine-131 has a short half-life (8.02 days), so it is not being detected at this time, and there are few reports of radioactive strontium.*

Tests for Radioactivity in Farm Produce

From April 2012, the allowable concentration of radioactive cesium in foods has been limited to 100 Bq/kg in general foods. The number of investigations into concentrations of radioactive substances conducted nationwide in Japan and the number of cases exceeding the limit are shown in **Graph 1**.

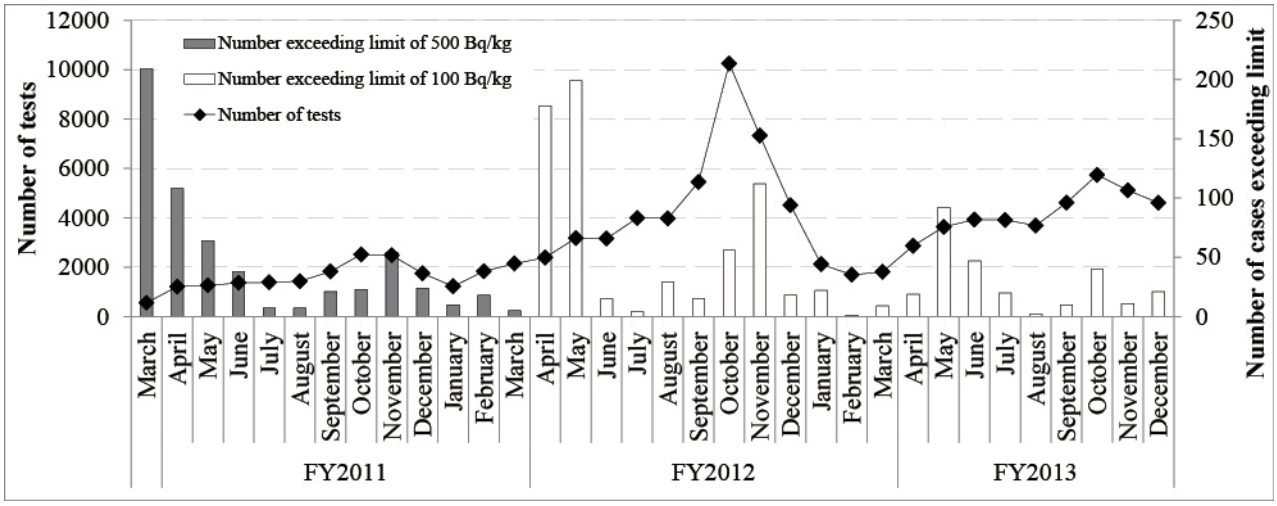
The number of investigations and the number of cases exceeding the limit fluctuate with the harvesting seasons, rising at times when foods that absorb cesium easily, such as edible wild plants in the spring and mushrooms in the fall, are being harvested. Foods exceeding the limit in 2013 were mushrooms, edible wild plants, soy beans, bamboo shoots, brown rice, buckwheat and komatsuna (Japanese Mustard Spinach).[1]

Amounts Transfer from Soil to Plants

There is a transfer coefficient that serves as an indicator of the amount of radioactive substances in soil that will transfer to plants (concentration of radioactive substance in plants ÷ concentration of radioactive substance in soil). Generally, it is high for legumes and root crops, but low for Curcurbitaceae and Brassicaceae.

In FY2011, Fukushima Prefecture found that vegetables with high transfer coefficients when grown outdoors included edamame, with 0.0032 to 0.0040, and sweet potatoes, with 0.0049 to 0.0058. These values indicate that if cultivated in soil with 1,000 Bq/kg, the vegetables produced would contain 3 to 6 Bq/kg. Transfer coefficients for these vegetables were measured again in FY2011 and in FY2012, and the results were reported to have fallen to half what they were.[2]

The transfer coefficient is thought to be predictable to some degree, depending on the type of plant and soil properties, but there have been cases where it was not.



Graph 1. *Number of Tests for Radioactive Substances in Foods (farm produce, vegetables)*
A testing system for rice was instituted in FY2012, when the limit was revised, resulting in a big jump in testing in the fall. (Drawn by CNIC based on results found on the Ministry of Health, Labour and Welfare website.)

**When distributed foods were investigated in Fukushima, Iwate, Tochigi, Niigata, Ibaraki, Kanagawa, Saitama and Kochi prefectures, radioactive strontium was detected in seven of the 20 foods tested. The concentrations ranged from 0.016 to 0.039 becquerels per kilogram (Bq/kg), which amounted to about 1% of the radioactive cesium concentration.*
"Results of testing for radioactive strontium and plutonium in foods (results from Feb-May, 2012)" found on the Japan Ministry of Health, Labour and Welfare website (http://www.mhlw.go.jp/stf/houdou/0000028846.html)-- in Japanese

Occurrence of High Concentrations of Radioactive Cesium in Rice and Investigation into the Causes

--Cannot be Explained by Transfer Coefficients Alone

Graph 2 is a plot of radioactive cesium concentration in brown rice, grown in Fukushima Prefecture in FY2012, versus the concentration in the soil in which it was grown. If in all cases the higher the contamination of the soil, the more cesium was absorbed by brown rice, all of the points on the graph should have been gathered in a line sloping upward toward the right side, but that is not what happened. Even when soil concentrations exceeded 5,000 Bq/kg, the cultivated brown rice was found to contain only a small amount of contamination, while even in fields with soil concentrations of less than 1,000 Bq/kg, highly contaminated brown rice resulted.

--Insufficient Potassium Causes Cesium to be Absorbed

Cesium is chemically similar to potassium, so if a plant has insufficient potassium, it is as if it absorbs cesium by mistake.

Graph 3 shows the relationship between soil potassium concentration and cesium concentration in brown rice, based on a test cultivation of brown rice in FY2012 in an area where brown rice cultivated in FY2011 had been found to have radioactive cesium exceeding 500 Bq/kg. In light of this relationship, it is clear that in soil with plenty of potassium absorption of cesium is impeded, but in soil with insufficient potassium, a high concentration of cesium develops in brown rice.[3]

--Affected by Chemical Form of Cesium

Cesium ions are positively charged, so they are known to adhere easily to the surfaces of minerals or humus from the decomposition of organic matter that is negatively charged. The adhered cesium can be displaced by ammonium or other positive ions, releasing it. Once released, the cesium becomes water-soluble and dissolves. In addition, cesium ions are similar in size to the gaps within molecules of clay minerals, so cesium is known to enter these gaps and get "fixed" to the clay minerals. Once fixed, it is very hard for the cesium to be absorbed by plants.

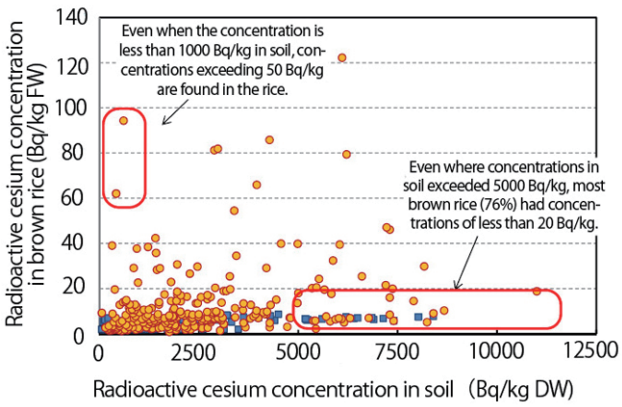
An interesting experimental result was obtained in this regard. When aquatic cultivation of rice was carried out with different concentrations of radioactive cesium, even at a mere 0.1 Bq/liter in water, the cultivated rice leaves had a radioactive cesium concentration of 76 Bq/kg dry weight (**Fig. 1**). This suggests that the ease of transference to plants is strongly affected by the amount of water-soluble cesium, but not by the total amount of cesium contained in the soil.[4]

--The Paddy Environment and Rice Plant Characteristics

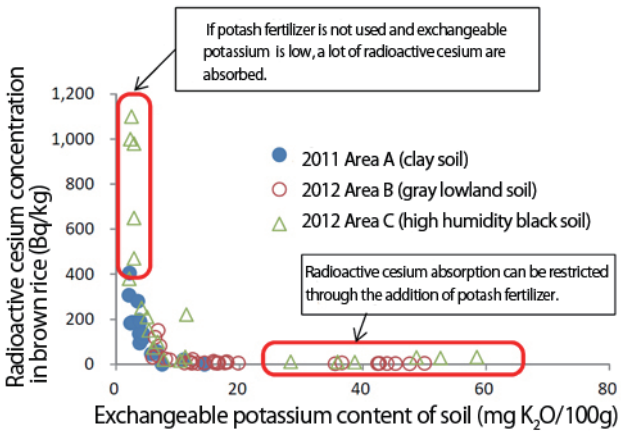
The farming area in Nihonmatsu City in which brown rice was found to have contamination exceeding 500 Bq/kg in September 2011, consisted of valley-bottom paddies surrounded by forest on three sides (with the paddies distributed on terraces along the slopes). The water that the paddies were drawing from the forest contains sufficient potassium and magnesium to grow rice.

A survey confirmed that the soil potassium concentration in the paddies was low, and the clay content of the soil was small.

Although the paddies were receiving water with abundant nutrients, for some reason the soil did not contain sufficient potassium to prevent



Graph 2 *Radioactive cesium concentration in soil versus its concentration in brown rice (Ref. 3). (DW: dry weight, FW: fresh weight)*



Graph 3 *Exchangeable potassium content of soil versus radioactive cesium concentration in brown rice (Ref. 3)*

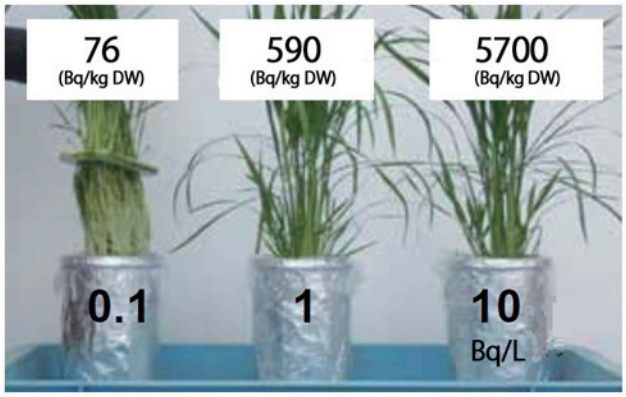


Fig. 1 *Accumulation of radioactive cesium in rice plants grown in water culture medium with different concentrations (Ref. 4).*

cesium absorption. Even in areas where the soil of valley-bottom paddies originally contained too few nutrients, there were agricultural techniques that made rice cultivation possible using water from forests. It is said that the valley-bottom paddy farmers of Nihonmatsu City normally did not use very much potassium fertilizer.[5,6] Therefore, the soil had perhaps been chronically lacking in potassium.

The rice plants themselves were discovered to have differing characteristics. For the most part, the cesium concentration in rice leaves was higher in the lower leaves and lower in the uppermost leaves. In cases in which the brown rice had high concentrations of cesium, however, the upper leaves of the plants had high concentrations. The upper leaves grow during summer, so perhaps there was a particular source of cesium for some reason in those paddies in the summer. After that, the ears must have formed with high concentrations of cesium.

The causes are currently being actively studied, with possibilities noted such as hot temperatures in summer promoting decomposition of organic matter, including fallen leaves containing radioactive cesium, and water carrying that cesium in from surrounding areas.

Airborne Transport of Chemical Compounds of Radioactive Cesium

The chemical form of the radioactive cesium that was carried by winds from the Fukushima nuclear power plant is not well understood. Research has been done analyzing fine atmospheric dust (aerosols) collected in Tsukuba City after the accident. Some of the aerosol particles had diameters of several micrometers, and others, 0.5 to 0.7 micrometers. An elemental analysis detected cesium and sulfate ions together with the latter, smaller aerosol particles. Perhaps the cesium was falling to the ground as a sulfate salt.[6] On the other hand, high concentrations

Fig. 2 *Conceptual diagram of sustainable agriculture (example).*

of radioactive cesium have been detected in spherically shaped particles of several micrometers in diameter in some areas near the Fukushima NPP.

After the accident, many kinds of vegetables were found with iodine, cesium and other radioactive substances sticking to their surfaces and their shipments were halted. Investigations on methods to remove the radioactive substances from the surfaces revealed that about 60% could be eliminated by washing with water, but that the addition of physical stimuli such as ultrasonic cleaning did not change this ratio. The use of acid, alkali or alcohol failed to produce a high removal ratio, but the use of a reducing agent (1% sodium thiosulfate) used as an antioxidant for foods increased the elimination of iodine. This was observed to be due to conversion of the hard-to-dissolve iodine molecules (I_2) to water-soluble iodine ions (I^-).[7]

Investigation of Circular Agriculture

As an example of circular agriculture, hay and other feed is grown in soil; livestock eat that and produce manure; the manure, together with plant and other waste, is used to produce compost; and the compost is added to the soil to provide nutrients for plants, as illustrated by the relationships in **Fig. 2**. After the nuclear accident, the allowable amount of radioactive cesium in fertilizers was limited to 400 Bq/kg, and in feed for cattle, hogs and other livestock, to 300 Bq/kg, and in some cases, the circular relationship was broken.

In FY2011, the muscles of goats continuously given feed with 3,900 Bq/kg were found to contain cesium of 130 Bq/kg, and their manure contained 150 Bq/kg, resulting in compost containing 890 Bq/kg.

Test site	Plow type	Tilling Depth (cm)	Prior use of rotary till (yes/no)	Air dose rate		
				Before plowing (μSv/h)	After plowing and rolling compaction (μSv/h)	Rate of decrease (%)
Flooded paddies						
Iitate Village	Plow with jointer	30	No	1.63	0.52	68
Iwaki City	Plow with jointer	30	No	0.41	0.2	51
Kori Town	Plow with jointer	30	Yes	0.69	0.41	41
Motomiya City	Two-step tiller paddy plow	30	Yes	1.02	0.45	56
Fields						
Minami Soma City	Two-step tiller field plow	45	No	2.13	0.41	81
Tamura City	Two-step tiller field plow	45	No	1.3	0.17	87
Fukushima City	Two-step tiller paddy plow	30	No	0.46	0.15	67
Nihonmatsu City	Two-step tiller paddy plow	30	Yes	0.65	0.34	48

Table 1 *Plow tilling air dose rates and their reduction (at 100 cm above ground surface).(Ref. 2)*

Research findings on plant cultivation using contaminated compost show that cultivation of vegetables solely with compost of about 800 Bq/kg produce eggplant, maize, soybeans and ginger with less radioactive cesium than the detection limit of 20 Bq/kg. In order to produce the highest degree of contamination, the compost was not mixed with soil, but used alone for cultivation.[8] It bears noting that if the compost used is not fully matured, it may contain ammonium ions, which displaces and frees cesium adhering to the soil, possibly increasing the amount of cesium that can be taken up easily by plants, so caution is necessary if using compost that is not fully matured.

Efforts to Curb Exposure During Farm Work

If tilling is not carried out, almost all of the radioactive cesium is fixed within the top 5 cm from the soil surface.[6] In this case, if the surface layer of the soil is removed, the air dose rate decreases, but this requires removal of fertile soil, and it also creates problems on where to put the discarded radioactive waste.

In Fukushima Prefecture, efforts have been made to decrease the amount of radioactive cesium in the surface layer by deep tilling of the soil or by interchanging the upper and lower soil layers. When "plow tilling" was tried, in which the radioactive cesium in the surface layer was plowed into the lower layer, the radiation levels in flooded paddies were reduced by about 50%, and the greatest effects were achieved in fields, where reductions of nearly 90% were reported (**Table 1**).

The natural world is subject to complex influences. Observing nature in detail, following up on slight hints, setting up experiments, and elucidating the mechanisms of radioactive contamination require serious work. In practical field tests, long periods of time are needed between planting seeds and harvesting crops, and in the case of rice, no more than one verification can be accomplished each year. It is thought that a certain amount of time will be needed in order to ascertain the mechanisms of the transference of radioactive substances into food crops. Also, reducing exposures during farm work is considered an issue of importance to the continuation of agriculture.

(Nobuko Tanimura, CNIC)

(1) "Coping with radioactive substances in food" (Shokuhinchu no hoshaseibusshitsu e no taio). Japanese Ministry of Health, Labour and Welfare website. http://www.mhlw.go.jp/shinsai_jouhou/shokuhin.html

(2) "Regarding research on radioactive substances in the field of agriculture" (Nogyobunya ni okeru hoshaseibusshitsu shiken kenkyu ni tsuite). Fukushima Agricultural Technology Centre. http://www4.pref.fukushima.jp/nougyou-centre/kenkyuseika/kenkyu_seika_radiologic.html

(3) "Regarding causes of and countermeasures to high concentrations of radioactive cesium in rice" (Hoshasei seshium nado no takai kome ga hassei suru yoin to sono taisaku ni tsuite). Japanese Ministry of Agriculture, Forestry and Fisheries. http://www.maff.go.jp/j/kanbo/joho/saigai/s_seisan_1.html

(4) Nemoto Keisuke. "New knowledge on absorption by crops" (Sakumotsu no shinchiken). Gakujutsu no Doko, Oct. 2012, pp.22-26.

(5) "Results of an investigation of paddies in Obama-cho, Nihonmatsu City, on Oct. 17, 2011" (Nihonmatsu-shi Obama-cho no suiden ni okeru chosa kekka Heisei 23 nen 10 gatsu 17 nichi). Agriculture, Forestry and Fisheries Industries of Fukushima Prefecture. http://www.pref.fukushima.jp/keieishien/kenkyuukaihatu/gijyutsufukyuu/05gensiryoku/231017_obama.pdf

(6) Nakanishi Yuko (2013), Dojo Osen Fukushima no Hoshaseibusshitsu no Yukue (Soil Contamination: The whereabouts of Fukushima's radioactive substances), NHK Books, 220 pp.

(7) Vegetable Analysis Group, Ad Hoc Committee on Safety Measures for Radioactive Iodine and Cesium, Japanese Society of Radiation Safety Management. "Interim report on methods of removing radioactive substances adhering to vegetables contaminated by fallout from the Fukushima Daiichi nuclear accident" (Fukushima Daiichi genpatsujiko ni yotte osen sareta yasai ni fuchaku shita hoshaseibusshitsu no jokyoho ni kansuru chukan hokoku). Isotope News. 2011, No. 689, pp. 55-58.

(8) Report by Manabe Noboru, et al., at a study briefing session on the effects of radioactivity on agriculture, livestock and marine products, The University of Tokyo School of Agriculture and Life Sciences.

Nuclear Power Plants in Japan

(as of Jan. 2014)

Type of Reactor

PWR (No.) APWR BWR ABWR GCR Others

Status

- Operable 48
- Under construction 4
- Pre-construction safety review 8
- Permanently shut down / under decommissioning 10

Kashiwazaki-Kariwa — 1 2 3 4 5 A6 A7 — Tokyo Electric Power Company

Tsuruga — 1 2 A3 A4 — Japan Atomic Power Company

Fugen — Prototype Advanced Thermal Reactor, Japan Atomic Power Company

Monju — Prototype Fast Breeder Reactor, Japan Atomic Energy Agency

Ohi — 1 2 3 4 — Kansai Electric Power Company

Mihama — 1 2 3 — Kansai Electric Power Company

Takahama — 1 2 3 4 — Kansai Electric Power Company

Shimane — 1 2 A3 — Chugoku Electric Power Company

Kaminoseki — A1 A2 — Chugoku Electric Power Company

Genkai — 1 2 3 4 — Kyushu Electric Power Company

Tomari — 1 2 3 — Hokkaido Electric Power Company

Oma — A1 — Electric Power Development Company

Shika — 1 A2 — Hokuriku Electric Power Company

Sendai — 1 2 A3 — Kyushu Electric Power Company

Ikata — 1 2 3 — Shikoku Electric Power Company

Higashidori — 1 A2 — Tohoku Electric; A1 A2 — Tokyo Electric

Onagawa — 1 2 3 — Tohoku Electric Power Company

Fukushima I — 1 2 3 4 5 6 — Tokyo Electric Power Company

Fukushima II — 1 2 3 4 — Tokyo Electric Power Company

Tokai — Japan Atomic Power Company

Tokai II — 1 — Japan Atomic Power Company

Hamaoka — 1 2 3 4 A5 A6 — Chubu Electric Power Company

Commercial and Research Nuclear Facilities in Japan

(as of Jan. 2014)

Type of Facility

- Research reactor
- B — Uranium fuel manufacturing plant for BWR
- P — Uranium fuel manufacturing plant for PWR
- Mox — MOX fuel manufacturing plant
- Uranium reconversion
- Uranium enrichment plant
- Reprocessing plant
- Others
- Mine

Status

Operable / Under construction / Permanently shut down

GNF-Japan ..... Global Nuclear Fuel - Japan
JAEA ..... Japan Atomic Energy Agency
JNFL ..... Japan Nuclear Fuel Ltd.
NFI ..... Nuclear Fuel Industries, Ltd.
RFS ..... Recyclable-Fuel Storage Campany

Rokkasho Village, Aomori Prefecture

- Mox — MOX Fuel Fabrication Plant (JNFL)
- Reprocessing Plant (JNFL)
- Uranium Enrichment Plant (JNFL)
- Low-level Radioactive Waste Disposal Center (JNFL)
- High-level Radioactive Waste Storage Center (JNFL)

Tono, Gifu Prefecture

- Uranium Mine (JAEA)
- Geoscience Center (JAEA)

Horonobe, Hokkaido

- Underground Reserch Center (JAEA)

Mutsu City, Aomori Prefecture

- Interim Spent Fuel Storage Facility (RFS)

Higashi-Osaka City, Osaka Prefecture

- UTR (Kinki University)

Kumatori Town, Osaka Prefecture

- KUR (Kyoto University Research Reactor Institute)
- KUCA (Kyoto University Research Reactor Institute)
- P — NFI Kumatori Plant

Ningyo-toge, Okayama Prefecture

- Uranium Mine (JAEA)
- Prototype Uranium Enrichment Plant (JAEA)

Yokosuka City Kanagawa Prefecture

- GNF-Japan

Tokai Village, Ibaraki Prefecture

- Mitsubishi Nuclear Fuel
- P — Mitsubishi Nuclear Fuel
- JCO Tokai Plant
- B — NFI Tokai Plant
- Mox — Plutonium Fuel Production Facility (JAEA)
- Reprocessing Plant (JAEA)
- Vitrification Facility (JAEA)
- Chemical Processing Facility (JAEA)
- Reactor Fuel Examination Facility (JAEA)
- Waste Safety Testing Facility (JAEA)
- JRR-3, TCA, TRACY, NSRR
- JRR-4, FCA, STACY
- Yayoi (Tokyo University)

JRR (Japan Research Reactor), JAEA
NSRR (Nuclear Safety Research Reactor), JAEA
TCA (Tank-type Critical Assembly), JAEA
FCA (Fast Critical Assembly) , JAEA
TRACY (Transient Experiment Critical Facility), JAEA
STACY (Static Experiment Critical Facility), JAEA

Kawasaki City Kanagawa Prefecture

- NCA (Toshiba)

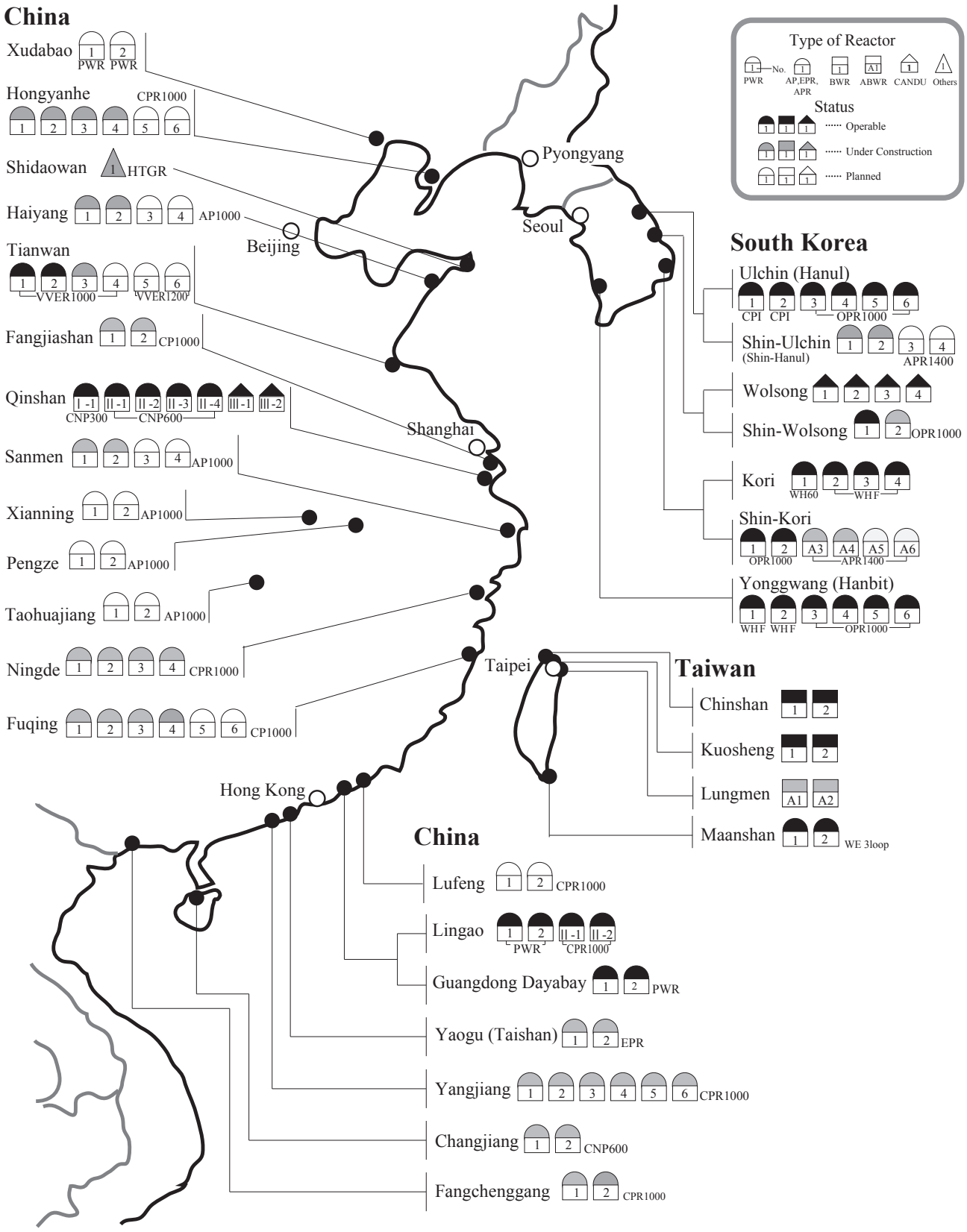
Oarai Town, Ibaraki Prefecture

- HTTR (JAEA)
- JMTR (JAEA)
- Joyo Experimental Fast Reactor (JAEA)

The plan to build Namie-Odaka nuclear power plant was canceled on 28 March 2013.
Decommissioning of Fukushima Units 5 and 6 began on 31 January 2014.

Nuclear Power Plants in East Asia (as of Jan. 2013)

Based on Japan Atomic Industrial Forum, Inc. Report (ISSN 0915-0692)



Group Introduction

"Square"

We do not need dangerous nuclear power plants.
Let's develop our human capabilities and strengths, and let's build ties with each other for the future

Yukinobu Aoyagi, member of "Square"

The beginning of our "Square"

The nuclear accident that occurred at Tokyo Electric Power Co.'s (TEPCO) Fukushima Daiichi Nuclear Power Station in the wake of the Great East Japan Earthquake disaster on March 11, 2011 is causing severe radioactive contamination, not only in Fukushima but also in many other areas of Japan. The problems involving nuclear power plants and nuclear substances are threatening people's lives and their future over an extensive area, and Kyushu is no exception.

Experts have pointed out that the antiquated Unit 1 reactor at Genkai Nuclear Power Station in Saga Prefecture may be damaged if it is scrammed and cooled suddenly (see NIT 148 and 149). This reactor became operational in 1975. Unit 3 is a plutonium-thermal (pluthermal) reactor that experienced a leak of radiation into the primary cooling water system at the end of 2010. Local residents have repeatedly demanded a thorough investigation into the cause of the accident and the disclosure of relevant information, but Kyushu Electric Power Co. (KEPCO), the operator of the nuclear plant, has refused to comply with the demand.

The Fukushima nuclear accident occurred as this situation was continuing. The anti-nuclear citizens called on the utility company to hold a public hearing on March 31, 2011 and to explain about the radiation leak at the Genkai nuclear power plant in the meeting. However, KEPCO failed to respond to the request by April 20, and the hearing was not held.

Since then, the anti-nuclear residents have been staging a round-the-clock sit-in, demanding the shutdown of the nuclear power plant and KEPCO's sincere response to their request. The result of this was that a "square" was created in front of KEPCO's main office, only 10 meters (16 steps) from the building.

The current situation at the "Square"

The "Square," where men and women of all ages can freely come, go and meet has significance in many ways.

1. It is significant as a place where people express their anti-nuclear views by, for example, participating in signature-collecting campaigns, and other anti-nuclear activities.
2. It is also significant as an information center for distributing leaflets and sending out email reports on the anti-nuclear groups' activities and efforts.
3. It serves as a café where anti-nuclear citizens can talk with each other and hold discussions with other people who have different views. (Even the former KEPCO President Toshio Manabe came to this café once.)

Photo of "Square". "Square" is located at: 2-1-82, Watanabe-dori, Chuo-ku. Fukuoka-shi, FUKUOKA 810-8720, Japan

4. It also serves as a venue for ad-lib music concerts, a stage for performers using a microphone, or pot-luck parties with home-made cooking.

Many of the people coming to this Square these days are visitors who are concerned about nuclear power. Participation in Square activities is not limited just to certain members. Anyone interested in nuclear issues can visit the Square and freely take part in the activities.

There were occasions when rightist groups and police obstructed the citizens' peaceful activities in the Square, but the sit-in participants never gave in to this obstruction and marked the 1000-day sit-in in the makeshift tent on January 14, 2014. The citizens are still continuing their activities in the Square today, striving to thwart KEPCO's resumption of the nuclear plant operation and to keep the memories of the nuclear accident alive in people's minds.

The Square is a place that helps people connect with each other and gain various kinds of capabilities and strengths. The creation of human networks and the enhancement of human power and capabilities are necessary for all people. If you are worried about nuclear power, please come to the Square. The people in the Square are always ready to help you. Please also tell future generations about the current situation at the Square. We need new ties with many more people, and want to gain further human capabilities and power in our efforts to create a nuclear-free society.

We have released a booklet to commemorate the 1000th day of our anti-nuclear activities. (Sorry, in Japanese)
It contains 100 color photos and detailed explanations on the history of the Square. If you would like copies of this booklet, please email your name, address, telephone number, and the number of booklets you would like to <y-aoyagi@r8.dion.ne.jp>.

NEWS WATCH

100t highly contaminated water leaked at Fukushima Daiichi

Around 23:25 on February 19, 2014, a worker on patrol found highly contaminated water leaking from a storage tank on the Fukushima Daiichi Nuclear Power Station (FDNPS) premises. 100 tons of concentrated saline water overflowed from the upper part of the tank. The concentration of beta-emitter nuclides in the water was about 240 megabecquerels per liter (MBq/l) and radioactive cesium about 11,500 Bq/l. The leak spilled directly onto the soil outside the embankments by way of rainwater guttering. According to TEPCO, the plan had been to transfer the contaminated water to a different tank, but it was directed to this tank by mistake. There were three acceptance valves in the piping to the tank. Around 0:30 on February 20, two of the three valves that were in the open state were closed, and the rainwater guttering end was covered with plastic bags in order not to allow the contaminated water to leak outside the embankments. As of February 28, about 42 tons of contaminated water had been collected with a vacuum car, and about 100 m3 of contaminated soil had been dug up and collected.

At first the mistaken water transfer was attributed to the failure of the valve that was closed. However, it had actually been opened by someone. It was closed again by someone after the leak occurred. The valves to the tank to which the contaminated water should have been sent had also been opened and closed. It is not known who operated the valves, whether the opening and closing of the valves were mistakes that were later covered up, or whether the actions were intentional. The three valves to the tank that leaked the water were controlled in order to keep them closed. The closure of these valves was not included on the patrol checklist, and this omission was questioned. On February 24, it was revealed at a Nuclear Regulation Authority gathering that in April 2013 TEPCO had instructed that the two valves be kept open for operational efficiency. At 14:01 on February 19, an alarm sounded indicating an excessively high water level. Workers assumed, however, that the alarm had malfunctioned and did not make a visual check of the water level from the top panel of the tank onsite or check the tank water level data that must have been transmitted to the water treatment control room.

This incident once again highlights TEPCO's poor problem management performance. The company urgently prepared an alarm response manual that was introduced on a provisional basis on February 21.

Citizens file for compensation against the suppliers of Fukushima Daiichi nuclear reactors

On January 30, 2014, the Class Action Against the Nuclear Reactor Builders (CAANRB), established in August 2013, filed a lawsuit against General Electric, Toshiba and Hitachi, the suppliers of TEPCO's FDNPS nuclear reactors, at the Tokyo District Court. They claim compensation for emotional distress. All six FDNPS nuclear reactors were boiling-water reactors (BWR), and the prime contractors were GE for Unit 1 (460 MW); GE-Toshiba for Unit 2 (784 MW) and Unit 6 (1,100 MW); Toshiba for Unit 3 (784 MW) and Unit 5 (784 MW); and Hitachi for Unit 4 (784 MW).

The plaintiff team includes 1,058 individuals from Japan, and 357 from 32 other countries. More plaintiffs are expected to join in the second lawsuit. The Japanese Nuclear Energy Damage Compensation Law limits the responsibilities for damages related to nuclear power stations to electric power companies, exempting manufacturers. The lawsuit is an attempt to disconfirm this exemption.

Mitsubishi Heavy Industries establishes new Turkey Nuclear IPP Development Department

On February 1, 2014, Mitsubishi Heavy Industries (MHI) established a new in-house Turkey Nuclear IPP Development Department to reinforce its involvement in the Sinop nuclear power plant (NPP) project planned for the Republic of Turkey. The new department is directly controlled by the company's Energy & Environment domain headed by Senior Executive Vice President Atsushi Maekawa.

The Sinop NPP project is an independent power producer (IPP) project for the construction and operation of four nuclear power reactors in the Sinop area of Turkey's Black Sea coast (see page 6). In October 2013, the Turkish government signed a commercial agreement called a host government agreement (HGA) with the international consortium proceeding with the project, thereby reaching agreement on an overall framework. The project is expected to employ the ATMEA1 model reactor, a next-generation nuclear power reactor developed by ATMEA, a joint venture of the French company Areva and MHI. The ATMEA1 is a 1,100 MW pressurized-water reactor (PWR).

The new department will perform tasks including feasibility studies, negotiations concerning various contract agreements, the preparation of a funding scheme, and the planning for localization and technology transfer.

Japan–Turkey Nuclear Agreement Questioned

The governments of the Republic of Turkey and Japan signed a nuclear agreement in April 2013 on Japan's side and in May on Turkey's side. On January 14, 2014, the Japanese government presented the agreement to the House of Representatives for approval. However, voices opposing the agreement are rising from other countries as well as from the two countries concerned. In November 2013 and February 2014, NGOs in Japan submitted a list of names of groups and individuals who endorsed a statement opposing the agreement to the chairpersons of the House of Representatives and the House of Councilors, and other relevant people. A total of 142 groups and 3,270 individuals (including 1,805 from overseas) endorsed the statement.

Voices of opposition to or concern over the agreement have been raised not only from opposition party diet members but also from those of the ruling parties. The reason why the agreement is controversial is that, compared with Japan's nuclear agreements with other countries, the agreement with Turkey is weak with respect to nuclear nonproliferation. If this agreement is officially approved, other countries may demand changes to incorporate similar wording.

For example, in the agreements with Jordan and Viet Nam, "technology for and equipment for uranium enrichment, spent nuclear fuel reprocessing, conversion of plutonium and production of material and plutonium shall not be transferred under this Agreement ." In the agreement with Turkey, however, the part preventing proliferation reads: ". . . may be transferred under this Agreement only when this Agreement is amended for that purpose in accordance with paragraph 1 of Article 14." The agreement with Jordan states that "nuclear material transferred pursuant to this Agreement and nuclear material recovered or produced as a by-product shall not be enriched or reprocessed within the jurisdiction of the Hashemite Kingdom of Jordan ." The agreement with Viet Nam, which does not entirely ban nuclear proliferation, states: ". . . shall not be enriched or reprocessed within the jurisdiction of the Socialist Republic of Viet Nam, unless the Parties otherwise agree." However, the corresponding section in the agreement with Turkey reads: ". . . may be enriched or reprocessed within the jurisdiction of the Republic of Turkey, only if the Parties agree in writing." The Japanese government has made the excuse that proliferation is not possible without the agreement of Japan, but the nonproliferation clauses in the agreement with Turkey sound more positive about nuclear proliferation.

Revisions to Nuclear Damage Liability Facilitation Fund Law and Electric Utility Industry Law Presented to the Diet

The Japanese government has decided to revise the Nuclear Damage Liability Facilitation Fund Act to reorganize the Nuclear Damage Liability Facilitation Fund in order to enable it to perform decommissioning activities. The government also decided to revise the Electric Utility Industry Act to enable total liberalization of electric power retailing. After cabinet approval, the government presented the two revised bills to the House of Representatives on February 28, 2014. The government aims to have the bills enacted during the current ordinary session of the Diet.

Temporary power loss at Fukushima Daiichi Unit 4 spent fuel pool

On February 25, a subterranean power cable was damaged during earthworks near Fukushima Daiichi Nuclear Power Station Unit 4 building, disrupting power supply. The cooling system for the Unit 4 spent fuel pool was halted for 4 hours and 30 minutes until power supply was restored using another cable. The pool water temperature increase due to the power loss was estimated to be less than 1ºC.

"Remember Fukushima. Goodbye to Nuclear Power Plants Rally"(March 15, 2014)

Nuke Info Tokyo is a bi-monthly newsletter that aims to provide foreign friends with up-to-date information on the Japanese nuclear industry as well as on the movements against it. It is published in html and pdf versions on CNIC's English website: http://cnic.jp/english/

Please write to us at cnic@nifty.com if you would like to receive email notices when new editions are published.

Editor: Nobuko Tanimura
Translators: Tony Boys, Sumie Mizuno, Mayumi Nishioka, Pat Ormsby
Proofreaders: Tony Boys, Yukio Yamaguchi, Hajime Matsukubo