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Keynote Speech

What the Fukushima Daiichi Nuclear Power Plant Accident Asks Us

Mr. Hironori SHINOHARA
Representative
Society for "The Wind Against Nuclear Power in Miyagi" (no pertinent name in English)

I am deeply grateful for this opportunity to speak at this international gathering of globally-active people of faith about nuclear power and the accident at Fukushima Daiichi Nuclear Power Plant.

My father was a Shinto priest at Shiogama Shrine in the city of Shiogama in Miyagi Prefecture, which neighbors the prefecture of Fukushima. I grew up on the shrine grounds and considered it my playground. I believe that the religious environment in which I grew up played a large role in the development of my humanity.

My humanity was shaped during my adolescence – an era of recovery and high economic growth after Japan's defeat in World War II. Voices that critically questioned responsibility for the war and meditations that delved deeply into the tragic experiences of Nagasaki and Hiroshima tremendously affected my formation. The words of Japanese authors that I read voraciously at that time are etched into my memory; Makoto ODA's "Venturing outas an obligation" and Kenzaburo ŌE's "Enduring volition" are words on life that remain in my heart.

Meanwhile, people in general were talking about the hopes of economic growth; as I entered university, nuclear power was particularly at the forefront as the dream energy of the future. That was 1966, the year that they brought Tokai Dai-ichi Nuclear Power Station, the first nuclear plant in Japan, on line.

With the thought that I too wanted to contribute to the technology behind the dream of peaceful use, I chose a major in nuclear power under the department of nuclear engineering. As I studied this technology, however, I came to understand the potential danger of an irreversible large-scale accident, one much like that in the Fukushima Daiichi Nuclear Power Plant disaster. Not only that, but I also came to realize that as long as fissuring was used a large volume of radioactive materials that are not found in nature would be created, requiring strict, long-term management in order to protect the future of human life from that danger. I also learned that the inside of a nuclear power

plant is contaminated with radiation, opening workers to the possibility of exposure and the risk of developing radiation-induced injuries. As I learned more during my studies, I came to believe that I personally could not bear responsibility for this technology.

However, after going back and forth several times, I decided that because I had at one time held the dream of nuclear power and chosen to devote my life to the technology, I needed to follow through with that responsibility. Friends of mine who were also studying nuclear power at university soon joined power companies and nuclear reactor manufacturers; but I threw myself into the popular movement against nuclear plants while earning my living in construction work. Forty years have passed since I made that decision.

I've lived this lifestyle out of the desire to somehow prevent a large-scale nuclear power plant accident. So it was with shock and horror that I watched the events at Fukushima Dai-ichi unfold on television last March. I was left speechless as images of the reactor building being torn apart by a hydrogen explosion played across the screen, its steel frame bent and misshapen. The regret I felt that the irreversible had happened filled me completely.

I speak to you today with that feeling of regret in my heart.

Diagram 1

The human race was introduced to nuclear power at the end of the 19th century, starting in 1895 with the discovery of the X-ray in Germany. Following this were the discoveries of radiation and electrons, and through other breakthroughs such as Madam Curie's discovery of the new element radium, there came a gradual understanding of the world of the atomic nucleus. Then, in 1938, Hahn, Meitner and Strassman found that bombarding a uranium nucleus with neutrons produced nuclear fission. After this discovery (as well as its timing right in the midst of World War II), scientists and engineers lost all sense of self-restraint and delved straight into the production of the nuclear bomb. On August 6th, 1945 Hiroshima was bombed, and on August 9th, Nagasaki. In one moment, roughly 260,000 people lost their lives in Hiroshima, and 160,000 were injured; in Nagasaki, roughly 74,000 people died and 70,000 were wounded.

Considering the tremendous number of victims and the misery caused, the human race should have taken the time to deeply reflect on the history of atomic energy and learn its lesson. But without even pausing, we rushed right into atmospheric nuclear testing and "the peaceful use of nuclear power" – nuclear power plants. The result has been the plant accidents at Three Mile Island, Chernobyl and, now, Fukushima.

Whether nuclear weapons or nuclear power plants, in reality, the essence of nuclear power is as an energy of destruction. Nuclear power is produced by destroying the molecules that build our world and the atoms that are their building blocks. So, essentially, whether it's radiation or nuclear fission, it harms and then destroys this life-giving world. Thinking that we could dominate and control this energy of destruction through human intelligence and technology, humankind has proceeded with the development of nuclear power. However, because humans are neither omnipotent nor perfect, whether it was the intention or not, there are times when the destructive energy of nuclear power wreaks havoc on humankind. Nuclear weapons and power plants are classic examples.

As Japan was the victim of the world's first atomic bombing, some postwar reflection and discussions on the direction of the country should have taken place. But, in 1951, when the San Francisco Peace treaty was concluded and nuclear power development was allowed to start, serious discussions by conscientious scientists were ignored and decisions were made by the actions of politicians seeking enormous concessions from nuclear power. The development of nuclear energy was resumed leaving post-war Japan with this unhappy history. Specifically, *while* the Science Council of Japan deliberated on the guarantees needed to ensure the non-transference of nuclear power research for use in military purposes and *before* it decided on the three principles for the peaceful use of nuclear power (independent safety tests, democratic management, publicized results), a nuclear energy budget devoid of either concrete plan or target was suddenly submitted to the Diet in 1954 in the form of a joint proposal by the three conservative parties. This was the start of Japan's post-war development of nuclear power. The time to have rational discussions was lost. Focus was entirely shifted to seeking concessions, thereby moving along the creation of the "nuclear power village*" that even scientists became caught up in. The result – the Fukushima Dai-ichi Nuclear Plant disaster.
[*A term referring to the collusion of nuclear industry officials, bureaucrats, politicians and nuclear experts promoting nuclear power.]

Despite the 1979 accident at Three Mile Island Nuclear Generating Station in the U.S. and the 1986 disaster at Chernobyl Nuclear Power Plant in the former Soviet Union, the "myth of safety" that proclaimed that a large-scale accident releasing massive amounts of radiation would not occur at Japan's nuclear plants was incessantly repeated, crushing all criticism. Therefore, when a large-scale accident did happen, there had been no consideration of countermeasures or procedures to minimize the spreading of damage; when massive amounts of radiation were released there had been no preparation of radiation monitoring systems or evacuation methods; and, when a serious leakage of radiation occurred there had been no consideration of the need for regulations or damage prevention. This was the state of affairs when the accident struck Fukushima Dai-ichi. Because

none of these systems were in place, there are numerous examples where situations ended up being exacerbated and measures to minimize damage were not taken.

I'd like to talk about one specific example.

Newspaper Article 1
Photograph 1

This photograph was taken in the town of Onagawa, home to Tohoku Electric Power Company's Onagawa Power Plant. In the foreground is the nuclear energy disaster prevention center, the response center intended in case of a nuclear plant accident (in other words, the *off-site center*); in the background is Miyagi Prefecture Nuclear Power Center. Both were completely destroyed by the massive tsunami that hit Onagawa. The headline (Newspaper Article 1) reads, "Accident Response Center Destroyed." The response center served no purpose. The adjacent article says, "4 Measuring Instruments for Radioactive Substances Found Inoperative – Miyagi Prefecture Nuclear Power Center." Because Miyagi Prefecture had left all of the measuring instruments it owned in the Nuclear Power Center, they were all lost.

When a nuclear plant accident involving the release of massive amounts of radiation takes place, the most important thing to do is to take the essential steps of measuring and recording data on radiation levels in the environment as well as the concentration of radioactive material, and then monitor developments. But at this critical moment, all of these measuring devices were lost because they were concentrated in on place.

Since operation started at Onagawa Power Plant in 1984, each time our group has had a discussion with Miyagi Prefecture we have asked for the implementation of a nuclear power policy, our position being the protection of all prefectural residents from the risks of nuclear plants. However, authorities have not even pretended to listen to us, simply replying that nuclear power issues were the problem of the local government and that an 8 – 10 kilometer disaster range was sufficient. This is why measurement devices that should have been deployed in such a way that radioactivity could be measured in all regions of the prefecture were left at one location in Onagawa, and consequently lost in the tsunami. The means to grasp the effects of the Fukushima Dai-ichi accident at the most critical moment were lost. These facts eloquently speak to the inability of members of the nuclear power village to imagine the dangers of nuclear power.

Diagram 1

I'd like to now take a look at the way in which radiation released from Fukushima Dai-ichi spread and contaminated the environment. This is a contamination map made by the Ministry of Education, Culture, Sports, Science and Technology in which in-air measurements of radioactivity concentration were taken by aircraft. It was released when the studies of Miyagi Prefecture, where I live, and Fukushima Prefecture were completed; the contamination levels are categorized by color.

Portions in red, yellow, green and blue denote zones with contamination at or exceeding 300 kilobecquerel(kBq)/m^2, which is comparable to levels in areas of Chernobyl that are designated as evacuation zones (185 kBq and above). Presently in Japan, the policy is to return evacuated residents to their homes in these highly contaminated areas. Considering the experiences of Chernobyl, I believe that it would be better to switch to an alternate policy and give up the idea of going home for a substantial period of time.

Large cities such as Fukushima, Nihon-matsu and Kōriyama show blue areas of 300 – 600 kBq, with continued high air dose rates. But no evacuation orders were given immediately after the Fukushima Dai-ichi accident, nor have they been given since.

Japan's "Laws Concerning the Prevention from Radiation Hazards due to Radioisotopes and Others" designates areas with radiation contamination at or exceeding 40 kBq/m^2 as *radiation monitoring districts*, with a stipulation that the general public must be prohibited from entering without permission. 40 kBq/m^2 is third from the bottom on this diagram and is in the dark green 30K – 60K group. Therefore, contaminated regions in or above the third group from the bottom should legally be designated as *radiation controlled areas*. In Miyagi Prefecture's towns of Kessennuma, Kurihara and Ōsaki, more than 100 kilometers away from the Fukushima plant, regions that are comparable to the dark green radiation controlled areas also exist. Almost all of Fukushima and a portion of Miyagi should be in controlled areas (such areas can also be found in other prefectures). This leaves a huge number of people having to live in radiation-contaminated conditions. Although Japan is a nation ruled by law, it is permitting a violation of the law.

The damage all of this will inflict in the future is of great concern.

Diagram 2

Next we take a look at the flow of the radiation. Diagram 2, by Mr. Yukio Hayakawa, a specialist in volcanology at the University of Gunma, shows the spreading of radiation. There were chiefly three paths by which radiation spread from Fukushima Dai-ichi.

The first path is from when a hydrogen explosion that took place in Unit 1 on March 12th. A wind was blowing along the coast to the north, pushing a radioactive plume out over the Pacific Ocean for a period and then on to Oshika Peninsula, home to Onagawa Power Plant. It then moved on up toward Ichinoseki in Iwate Prefecture. You can see highly contaminated zones in southern Iwate.

The second path is from the hydrogen explosion at Unit 3 that occurred from about the afternoon of March 14th to the morning of March 15th. This time, the radioactive plume traveled on southern winds over the Pacific Ocean and then on to Ibaraki Prefecture, next moving inland, going over Chiba Prefecture and toward Tokyo and Kanagawa. This flow caused much alarm as reports showed radioactive iodine had contaminated Tokyo's tap water and radioactive materials were detected in Kanagawa's tea leaves.

The explosion at Unit 2, regarded as the largest release of radiation, took place from 6:00 on the morning of March 15th and continued through the afternoon. This third path saw the radioactive plume move inland to the northwest over the village of Idate and toward the city of Fukushima, the areas with the highest contamination. About the time the plume was over Fukushima, the wind changed direction and moved southwest, contaminating the cities of Nihon-matsu and Kōriyama, and reaching all the way to Nasu-Shiobara in Tochigi Prefecture and the borders of Gunma and Nagano Prefectures.

If monitoring posts and other radiation monitoring equipment had been comprehensively positioned along these contamination paths, the flow of these radioactive plumes could have been recorded over a period of time. However, because it was deemed that a nuclear plant accident that released radiation would not occur in Japan, no such network was maintained. The result being that these paths are the assumed radiation flow based on post-accident measurements taken in each area.

Please now take a look at another of Professor Hayakawa's maps in Diagram 3.

Diagram 3

Diagram 2, the previous map, was released on April 21, 2011, forty days after the Fukushima Daiichi accident. The present map in diagram 3 was made public almost one year after the accident, on March 2nd. In comparing the two maps we can see that radioactive flows shown in paths 2 and 3 are virtually unchanged. However, there are significant changes in path 1. From Fukushima Daiichi, this radioactive plume was reported to have traveled north over Oshika Peninsula

contaminating that area and onward toward Ichinoseki, however, it was revised to show that Oshika Peninsula was its final stop. Additionally, the flow reported to have headed toward the city of Fukushima after contaminating from northern Miyagi Prefecture to southern Iwate Prefecture was modified to show a route contaminating a section along the Ōu Mountains as it headed toward Ichinoseki. The forest connecting Miyagi's Mt. Funagata in the south to Mr. Kurikoma in the north "retroactively" became contaminated with high levels of radiation. Those locally involved in the green tourism movement, which gives children an opportunity to play freely in the great outdoors, are left in the frustrating position of not knowing exactly what they should do.

As I have previously mentioned, the reason for these types of modifications is the fact that there is no recorded data that clearly identifies the radiation dispersal path because there was no measurement network in place to monitor radiation. This has left no other means then to make inferences based on air dose data measured in each region after the accident.

This is another example of the results from the lax attitude that "a large-scale accident will not happen at Japan's nuclear plants."

I'd like to also touch on one other important issue – that of the confusion over radioactivity concentration and radiation exposure dosage.

Previous to the Fukushima Daiichi accident, the legally mandated radiation exposure limit in Japan was 1 millisievert (mSv)/year for a member of the general public and 20 mSv /year (that is, 100 mSv in five years, but not exceeding 50 mSv in any one year) for those employed in radiation-related work. This is based on the 1990 Recommendations of the International Commission on Radiological Protection (ICRP) and stipulated in the Laws Concerning the Prevention from Radiation Hazards due to Radioisotopes and Others

After the accident, we were told that because of the urgent situation, dose limits would be raised to 20 mSv for the general public, including children, and 250 mSv for radiation workers. This dose limit of 20 mSv/year became the designated standard for evacuating residents as well as the criterion for returning home those who had been forcibly evacuated.

Not only that, but a great number of experts and researches, including Vice President of Fukushima Medical University and current Radiation Health Risk Management Advisor to Fukushima Prefecture, Mr. Shunichi Yamashita, have publically stated that "There is no damage to your health as long as you are not externally exposed to 100 mSv or over at one time." Similar statements have been issued by committee members to the "Council of Advisors on Health Effects on

Radiation in Miyagi Prefecture," a panel of five experts organized by Miyagi Prefecture.

Such statements and policies that make the population think that there could not possibly be a "threshold" for radiation are due to a political decision not to stir the public into a panic and, therefore, have no scientific basis.

From the end of the 19th century when the human race first encountered nuclear power until this very moment, there have been many incidents and numerous investigations and research concerning the impact of radiation and radiation exposure on human life. In the beginning, when we were first getting to know this thing called radiation, we were totally ignorant of its dangers, even touching radioactive material without thinking. Marie Curie's daughter wrote in her biography "Madame Curie" that the famous Nobel laureate had been exposed to radiation when she had carried the radioactive elements that she had discovered, polonium and radium, around in her pocket. Late in life she was confined to a wheelchair and died of aplastic anemia.

There are further cases of exposure – at factories that handled radioactive materials, during nuclear weapons development for the Manhattan Project, at the bombings of Hiroshima and Nagasaki, with the accident at Chernobyl's power plant to name just a few. It is through these experiences that investigations and research on the effects of radioactive exposure have advanced.

From this we arrive at the conclusion that no matter how low the level of exposure, there is no safe level (threshold) of radiation; there are always some health hazards. For example, it is stated in the 2005 BEIR report (Biological Effects of Ionizing Radiation) by the National Academy of Sciences in the U.S. "that the risk of cancer proceeds in a linear fashion at lower doses without a threshold and that the smallest dose has the potential to cause a small increase in risk to humans." (http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/beir_vii_final.pdf)

There is one other illustration that helps to explain this historical background and conclusion that I would like to touch on. The graph in diagram 4 shows the transition of permissible radiation levels, or, scientifically speaking, "maximum exposure."

Diagram 4

Around 1900, just a short time after the human race was introduced to nuclear power, the permissible radiation dose for nuclear workers was 50,000 mSv/year, in other words, 50 sieverts/year. It is shocking to learn this because today we know that 50% of those exposed to radiation will die at

the median lethal dose (half the lethal dose) – about four sieverts.

Later, as investigations and research on radiation exposure advanced, experts gradually came to understand the dangers and the permissible dose was lowered. From 1950, when maximum exposure was set based on International Commission on Radiological Protection (ICRP) recommendations, there was a long interval when levels were set at 50 mSv for workers and 5 mSv for the general public. These were the levels that I was told when I started studying about nuclear power around 1970.

However, as research progressed, it was found that even 5mSv posed too high of a risk for the public. In recommendations from the mid 1980s to 1990, levels were tightened and exposure was lowered to 20mSv for workers and 1mSv for the public. This historical background has been and continues to be ignored since Fukushima Daiichi.

Despite recognition by the scientific community and this history, Japan has been choosing policies that heighten the risk of exposure since the accident. This is being done through using the present urgent situation to ignore scientific truth when what is needed are efforts to lower these risks.

The human body is said to be made up of around 60 trillion cells. A cell's nucleus contains deoxyribonucleic acid (DNA), which is made up of chromosomes that hold information essential to the continuation of human life. DNA chromosomes are made up of four types of molecules (nucleotides) combined in various sequences and carrying information in long chains of over 3 billion molecules. The amount of energy that actually joins molecule to molecule is small, allowing us to feel the gentleness that sustains life.

On the other hand, the radiation released from an energetically-unstable atomic nucleus to be more stable has 100,000 to 1 million times the level of energy as that joining DNA molecules. Therefore, if radiation hits a cell, bonds between molecules can be easily broken, resulting in the alteration of genetic and life-sustaining information. This is what causes various forms of radiation damage as well as the transmission of mistaken genetic information to offspring. The essence of radiation is the brutal opposite of the tenderness of life.

Although already passed away, a close scientist-friend of mine used to call radiation, "active poison." While radiation causes no problems as long as it is contained inside the fuel rods of the nuclear reactor, if fuel rods are not sufficiently cooled, then overheating takes place and a meltdown occurs. Radiation released into the environment breaks down and damages the cells of living organisms. That is what is meant by an "active poison."

This poison was heavily dispersed in the environment thanks to the Fukushima Daiichi accident. In order to prevent radiation exposure and minimize injuries when this happened, measurements and data needed to have been taken in order to determine what kind of radioactive materials were in the drifting radioactive plume and in what quantities, and then countermeasures developed based on this data. Instead, because this accident wasn't supposed to have happened, there was no radiation monitoring network in place and very few nuclear experts aware of the importance of these measurements. For these reasons, there is almost no data from the accident and time has passed without essential countermeasures being taken.

Whether in the prefecture of Fukushima or Miyagi, as the plume carrying elevated levels of radiation drifted through the air, those of us who had been cut off from life's necessities (electricity, gas, water, etc.) by the tremendous earthquake waited outside in long lines for drinking water and other supplies, including gasoline for our cars. If we had had an understanding of data details, we would have been able to send out recommendations to take shelter in order to minimize exposure and have children take iodine tablets. But we were not able to follow most of these countermeasures.

Because of this, there is little post-accident data showing levels of initial exposure in each region, making it difficult to estimate future consequences. And though there are scientist who emphasize that there will be no harmful health effects, in 1990, four years after the Chernobyl nuclear plant accident, data shows the beginning of an increase in cases of childhood thyroid cancer in Belarus, Ukraine and Russia. We have to carefully watch our children for future signs of exposure.

Diagram 5

Currently, it is impossible to confirm the conditions inside disabled Units 1 through 4 of Fukushima Daiichi Nuclear Power Plant because high internal radiation levels continue; they cannot even grasp the type of damage the units have suffered. In the meantime, there are still over 150,000 residents who were either forcibly evacuated or who left voluntarily. The suffering of those who left homes and land that had been in their families for generations continues. There are also many children in areas with high levels of radiation who are growing up with restrictions placed on their freedom.

Japan, the first country in the history of nuclear power to experience the tragic casualties of nuclear weapons, is the one that caused this tremendous nuclear plant accident. The A-bombs dropped on Hiroshima and Nagasaki were inflicted from outside. But the Fukushima Daiichi nuclear disaster was created from within our post-war history. As I stated earlier, Japan's

development of nuclear power after World War II started without placing importance on the earnest discussions of scientists and by submitting a budget to the Diet with only a vague sense of planning and objectives. Lacking a thorough examination of history, this unhappy start moved forward without any later revisions, suppressing the voices of diverse critics along the way to promote nuclear power plants as a national policy. The result of this policy is the disaster at Fukushima Daiichi.

As someone who at one time had dreamed of the peaceful use of nuclear power, I have kept a critical eye on this history from my position as a citizen in order to continue "venturing out as an obligation." I believe that science and technology loves truth and holds its importance above all. Although the human race was introduced to nuclear power at the end of the 19th century, I think it is important to look at the subsequent 100-plus years as a sequential history with no separation between military- and peaceful-use.

The experience of the Fukushima Daiichi accident made me think about the need for reflection dating back to the history of science and technology that preceded the late 19th century discovery of nuclear power and enabled it, for the technology that was derived by scientific theory came into being in the mid-19th century derived from human arrogance.

Until we possessed modern science and technology, humans were in awe of the natural world. The human race has a history of that awe changing to arrogance when we think that we can control nature. I have seen that arrogance in the history of Japan's post-war development of nuclear energy, and have actually experienced some of it. It has resulted in the disaster at Fukushima Daiichi.

That disaster still continues, leaving many to suffer. Those who were exposed to radiation from the atomic bombings of Hiroshima and Nagasaki 67 years ago still continue to suffer. I hope that many people will reconsider this history within these realities and decide to make this a turning point for history. I conclude my talk today with that as my appeal to you.

(September 9, 2012)

原子力発見の歴史

西暦	発見者		出来事
1895	レントゲン	独	X線の発見
1896	ベクレル	仏	放射線ーウランから自然に放射される現象の発見
1897	トムソン	英	電子の発見
1898	キューリー夫人	ポ	新元素ラジウムの発見
1911	ラザフォード	英	原子核の存在の確認
1932	チャドウィック	英	中性子の発見
1934	ジョリオ・キュリー	ポ	人工放射能の発見
1938	ハーン＆ストラスマン	独	核分裂の発見
1942	フェルミ	独	原子炉の築造の成功
1945		米	7月アラモゴードで原爆実験
1945			8月原爆の日本投下（広島・長崎）

History of Discoveries in Nuclear Power

Year	Scientists		Episode
1895	Röntgen	(Germany)	Discovers x-ray
1896	Becquerel	(France)	Discovers phenomenon that radiation emits naturally from uranium
1897	Thomson	(UK)	Discovers electrons
1898	Marie Curie	(Poland)	Discovers radium, a new radioactive element
1911	Rutherford	(UK)	Confirms existence of atomic nucleus
1932	Chadwick	(UK)	Discovers neutron
1934	Joliot-Curies	(France)	Discover artificial (man-made) radioactivity
1938	Hahn, Meitner and Strassman	(Germany)	Discover nuclear fission
1942	Fermi	(Italy)	Successfully designed nuclear reactor
1945		(USA)	July – Nuclear device tested in Alamogordo (White Sands), NM
1945			August – Atomic bombs dropped on Japan in (Hiroshima & Nagasaki)

女川原発

事故時対策拠点が壊滅

検査官、発電所で監視継続

津波で大きな被害を受けた宮城県原子力防災対策センター＝23日

東北電力女川原発（宮城県女川町、石巻市）の事故時などに対策拠点（オフサイトセンター）となる同町の県原子力防災対策センターが、東日本大震災による津波の直撃で使用不能となっていることが23日、分かった。放射線の監視などを行う隣接の県原子力センターも壊滅的な被害で、環境放射線などを監視できない状態。いずれも機能回復のめどは立っていない。

経済産業省原子力安全・保安院によると、自動停止後の女川原発の監視は、仮のオフサイトセンターを仙台市内の仙台第2合同庁舎に置いた上で、国の保安検査官2人が女川原発内に常駐して継続している。

原子力センターの石川陽一所長によると、津波は2階建ての対策センター屋上をのみ込んだ。屋上には石川さんら関係者や住民ら約20人が避難していた。このうち対策センター内にある国の保安検査官事務所の男性所長や県職員ら数人が流され、現在も連絡が取れていないという。

オフサイトセンターは緊急時、国や自治体の関係者らが情報交換や対策を検討する拠点。発電所の状況や放射線測定値を確認できるシステムなどの設備は、津波で使えなくなったとみられる。

原子力センターも周辺に設置している7カ所の放射線測定ポイントの全てが測定不能になった。女川原発周辺の放射線は、東北電力が敷地内で測定しているデータで監視する状況となっている。

宮城県は「女川原発が安定的に停止していることを日々、確認している。福島第1原発事故の県内への影響に関する対応に追われており、女川の監視体制の再構築には時間がかかる」と説明している。

放射性物質測定機器4台が不能

宮城県原子力センター（女川町）にある放射性物質の測定機器4台が、震災による津波被害で使用不能になっていることが23日、分かった。

厚生労働省は同日、宮城など6県に、幅広い野菜品目で放射性物質の検査を強化するよう要請した。県は農産物や飲料水の放射性物質を測定しない方針だが、測定が必要になっても県独自では行えず、国や東北大などに協力を求めるほかないという。

県原子力安全対策室の高橋俊光室長は「空気中の放射線量は低下傾向にあるが、情勢は刻々と変わる。どのような対応を取るべきか、情報を分析している段階」と話した。

Kahoku Shimpō, March 24, 2011

Caption: Miyagi Prefecture's nuclear energy disaster prevention center with severe tsunami damage. (April 23, 2011)

"Accident Response Center Destroyed"

On March 23rd, Miyagi's off-site center for nuclear disaster prevention was found to be unusable; the neighboring Miyagi Prefecture Nuclear Power Center, which monitors radiation, was also destroyed. There is no telling when either will be operational.

According to the Ministry of Economy, Trade and Industry's Nuclear and Industrial Safety Agency, after the Onagawa Power Plant was automatically shut down, monitoring was taken over by a temporary off-site center in Miyagi's capital of Sendai; monitoring has since been conducted by two safety inspectors stationed on the plant grounds.

Systems to verify the status of power plants and radiation levels were rendered useless by the tsunami. All seven radiation measurement points located around the Nuclear Power Center became immeasurable. Radiation around the Onagawa plant is being monitored using on-site measurement data from Tohoku Electric.

Prefecture officials explain, "We are checking that Onagawa has been securely shutdown on a daily basis. Presently we are busy responding to the effects of Fukushima Dai-ichi within Miyagi. It will be sometime before we can rebuild the Onagawa monitoring systems."

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(Article adjacent to above)

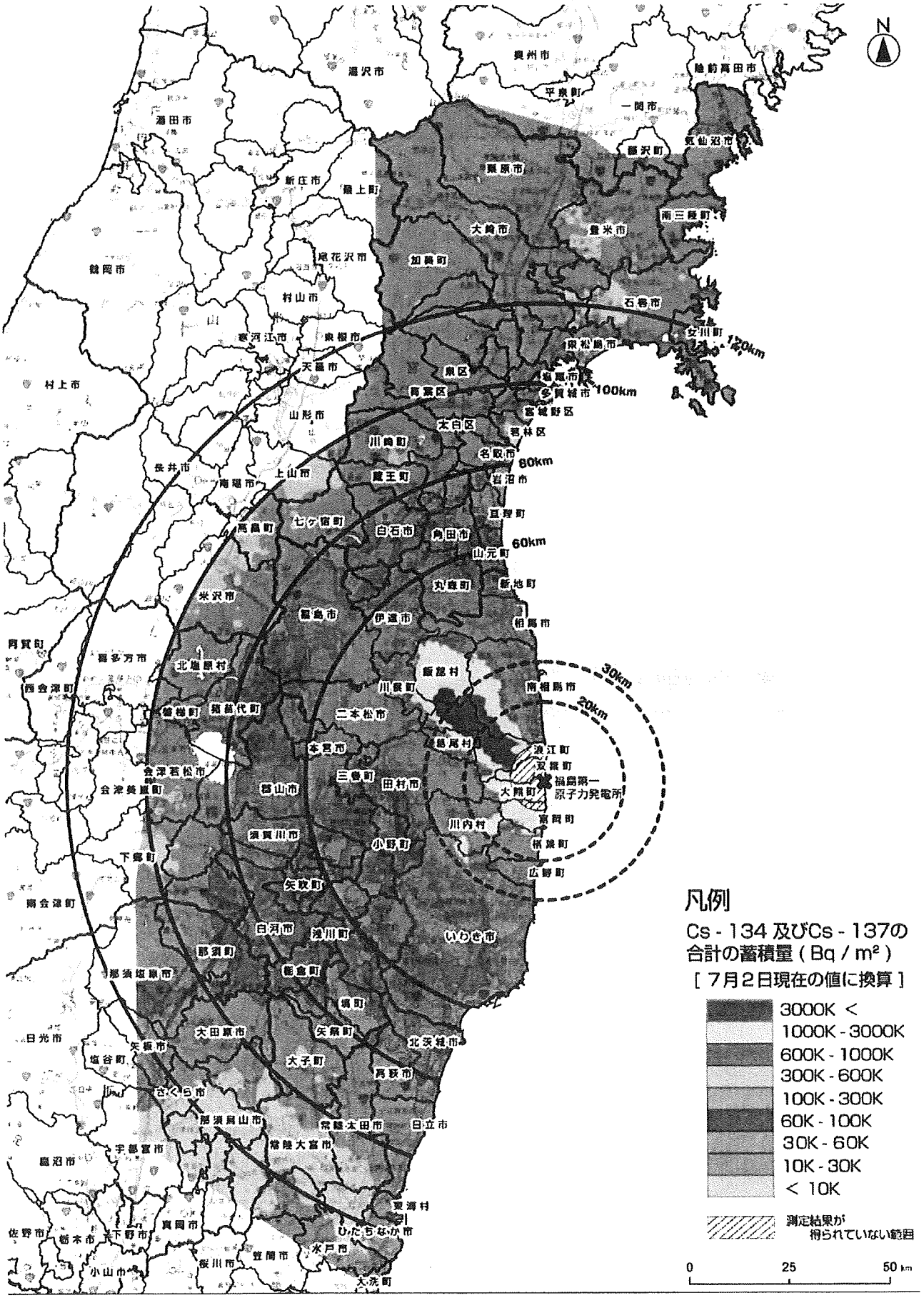
"4 Measuring Instruments for Radioactive Substances Found Inoperative – Miyagi Prefecture Nuclear Power Center"

On March 23rd, the Ministry of Health, Labour and Welfare requested further testing of vegetables for radioactive substances in six prefectures including Miyagi. Miyagi's policy was not to take measurements of agricultural products or drinking water. Even if measurements are required, the prefecture says that it cannot conduct them and that the cooperation of the State, Tohoku University and others will be essential.

Miyagi Nuclear Safety Planning Office commented that, "Though air radiation levels seem to be dropping, the situation changes minute to minute. We are now analyzing data in order to figure out what measures we should take."

別紙4

文部科学省及び宮城県による航空機モニタリングの結果（福島第一原子力発電所から100、120km範囲及び宮城県北部におけるセシウム134、137の蓄積量の合計）



Results of Airborne Monitoring by the Ministry of Education, Culture, Sports, Science and Technology and Miyagi Prefecture

(Total cumulative doses of Cesium 134 and 137 in northern Miyagi Prefecture and in the 100km- and 120km-range from Fukushima Dai-ichi Nuclear Power Plant)

Legend:

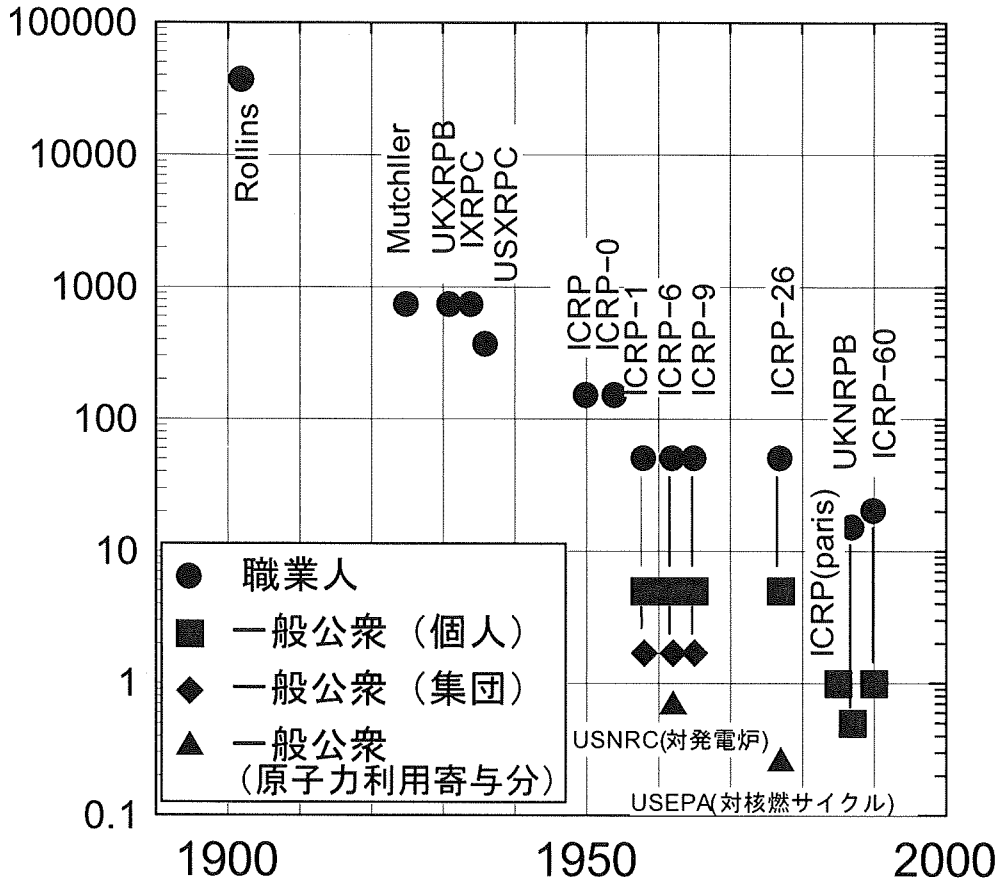
Total cumulative doses of Cs-134 and Cs-137 (Bq/m^2)

(Figures as of July 2, 2012)

Areas where readings were not obtained

いわゆる放射線「許容量」の変遷

[ミリシーベルト／年]



西暦年

放射線や放射能が発見された直後においては、被曝についての知識がなく、
被曝の制限値は著しく高かった。その後、放射線の危険度についての
科学的な知識が蓄積するにつれて、被曝の制限値は、一方的に低下してきた。
一般公衆に集団についての規定があるのは、集団全体の遺伝子プールを
考慮したためである。
Rollins, Mutchller は研究者の個人名。
UKXRPB：英国Ｘ線ラジウム防護庁、　IXRPC：国際Ｘ線ラジウム防護委員会
UKNRPB：英国放射線防護庁、　USXRPC：米国Ｘ線ラジウム防護委員会
ICRP：国際放射線防護委員会、続く数字は勧告の番号
USNRC：米国原子力規制委員会、 USEPA：米国環境保護庁

Transition of the So-called "Permissible Dose" of Radiation

[millisievert/year]

USNRC (power reactors)
USEPA (nuclear fuel cycle)

Radiation workers
General public (individual)
General public (group)
General public (extent of contribution to nuclear use)

Immediately after radiation and radioactivity were discovered, exposure limits were remarkably high due to the lack of knowledge concerning exposure. Since then, as scientific knowledge on the risks of radiation has grown, exposure limits have unilaterally declined.
The reason for a provision concerning "population" for "general public" is to take into account the gene pool of a population

Rollins, Mutchller are the names of individual researchers.
UKXRPB: British X-Ray and Radiation Protection Committee
IXRPC: International X-ray and Radium Protection Committee
UKNRPB: National Radiological Protection Board (UK)
USXRPC: X-ray and Radiation Protection Committee (US)
ICRP: International Commission on Radiological Protection; number represents recommendation number
USNRC: Nuclear Regulatory Commission (US)
USEPA: Environmental Protection Agency(US)

福島第一原発から漏れた放射能の広がり
Radiation contour map of the Fukushima Daiichi accident

この地図は、2011年3月に地表に落ちた放射性物質がそのままの状態で保存されている場所の2011年12月時点の放射線量を示しています。高さ1mでの測定です。
芝生などの草地で測定される数値に相当します。アスファルト道路は、放射性物質が雨で流されたため、この地図に示した数値の4割程度が測られるのが普通です。一方、流された放射性物質が集積している雨どい・軒下・側溝などではこの地図より何倍も高い数値が観測されます。

※単位: μSv/h（マイクロシーベルト／時）

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著者：早川由紀夫（群馬大学）kipuka.blog70.fc2.com
By Yukio Hayakawa, Gunma University

地図製図：萩原佐知子（TUBEgraphics）
背景地図：Google Maps（maps.google.com）
この地図の作成には、文部科学省科学研究費補助金「インターネットを活用した情報共有による新しい地学教育」（番号23501007）を使用しました。

Radiation Contour Map of the Fukushima Dai-ichi Accident

This map shows radiation levels as of December 2011 from radioactive fallout preserved as it fell in March 2011. Measurements were taken from a height of 1 meter.
Figures correspond to measurements taken on grasslands such as lawns. Approximately 40% of the figures shown here are typically measured on asphalt roads where radioactive substances have been washed off. However, figures for radioactive substances accumulated in rain gutters, under eaves and in drains have been found to be several times higher than indicated on this map.

*Unit: Sv/h (microsieverts/hour)