Medicine & Global Survival

M&GS

The Fukushima Nuclear Disaster

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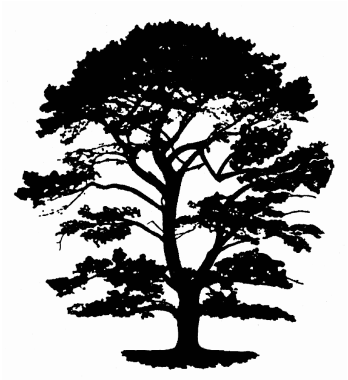

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A complete archive of articles is available at www.ippnw.org.

Editor: John Loretz

International Physicians for the Prevention of Nuclear War (IPPNW) is a federation of national medical organizations in 63 countries, representing doctors, medical students, other health workers, and concerned citizens who share the common goal of creating a more peaceful and secure world freed from the threat of nuclear annihilation. IPPNW received the Nobel Peace Prize in 1985.

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The Fukushima Nuclear Disaster

About this issue

We decided to publish this special issue of *M&GS*—the first since 2002—in order to present in one place the perspectives on radiation and health, the dangers posed by nuclear energy, and the links between nuclear power and nuclear weapons technologies that IPPNW, its national affiliates, and its network of physician experts have made available to the press and to the public since the tragic events in Japan in March.

This is by no means a comprehensive collection, and we refer readers to the IPPNW Peace and Health Blog (peaceandhealthblog.com), where many more resources, including links to audio and video reports in several languages, are compiled.

Introduction

On March 11, 2011, a massive earthquake and tsunami caused extensive and irreparable damage to the nuclear reactors and spent fuel pools at the Fukushima Nuclear Power Plant in Japan, releasing harmful radiation into the environment. Since then, our physician experts have briefed government officials, medical professionals, and journalists in numerous countries about the impact of these radiation releases on public health in Japan and elsewhere.

IPPNW's first concern has been for the people of northeastern Japan, whose health and security have been seriously compromised by a misguided national reliance on nuclear-generated electricity. In the days following the disaster, IPPNW called for an expansion of the evacuation zone around Fukushima to protect the health of children and pregnant women, who are particularly vulnerable to the effects of radiation. That evacuation zone, comparable to the one that has surrounded the Chernobyl reactor since 1986, had been extended to 12 miles by mid April 2011.

IPPNW has been formally opposed to nuclear energy since 1998, when our International Council called for a halt to new plant construction and the phase out of existing nuclear plants because of the insurmountable dangers nuclear energy poses to health, the environment, and security.

First and foremost, we know that there is an inherent link between nuclear power and nuclear weapons. Every commercial reactor produces plutonium and other fissile materials that can be used in weapons programs. The biggest practical obstacle to the abolition of nuclear weapons is the proliferation of nuclear power plants around the world—the so-called nuclear renaissance promoted by the industry and its government proponents.

The nuclear reactors and spent fuel pools at Fukushima and at similar nuclear power stations in the US and in other countries contain thousands of times the amounts of radioactive isotopes released by the Hiroshima and Nagasaki bombs. Isotopes that have been steadily and increasingly entering the air, soil, and water around the plant include iodine-131, which causes thyroid cancer; cesium-137, which causes cancer in the liver and kidneys; strontium-90, which causes leukemia; and plutonium-239, which has a half-life of 24,000 years and causes lung cancer when ingested in microscopic amounts.

The International Atomic Energy Agency and the World Health Organization have estimated that there were 6,000 to 9,000

Rescue workers monitor children for increased radiation exposure after the Fukushima nuclear disaster. Reuters photo.

new cases of cancer—primarily thyroid cancers and leukemias among children—as a result of the 1986 Chernobyl explosion in Russia, but there is good reason to believe that the true numbers are much, much higher. While it is now impossible to reconstruct an accurate data set of exposures and illnesses related to Chernobyl, independent experts have concluded that the IAEA/WHO data itself supports an estimate as high as 25,000 additional cancer deaths, and that the real number of deaths and illnesses is substantially higher—into the tens or even hundreds of thousands according to an assessment published by IPPNW-Germany in April 2011.

In addition to the immediate and long term health dangers from radioactive contamination, the environmental destruction resulting from each major nuclear power plant disaster to date has been enormous. While one of the two reactors at Three Mile Island continues to produce electricity, the area surrounding the plant, which was the site of the first commercial reactor meltdown in 1979, will have to be monitored for hundreds of years after the facility is finally decommissioned. There is a permanent 20-mile "exclusion zone" around the Chernobyl reactor. It is still too soon to assess the full extent of the long term dangers around Fukushima, but there is no doubt that an extensive area around the doomed reactors will be uninhabitable and unusable for generations to come.

IPPNW has additional concerns about nuclear power plants. They are tempting targets for acts of terrorism. Were someone to deliberately fly an aircraft into the nuclear plant at Indian Point, just north of New York City, for example, and rupture the containment vessel around the reactor, the probable result, planned or spontaneous, would be the evacuation of one of the world's major cities, immeasurable damage to the US economy, and ripple effects—more like an economic tsunami—to the global economy.

IPPNW rejects the industry's arguments that nuclear energy is needed to mitigate the effects of global warming. Even if the other risks described above were acceptable, which we believe they are not, the world would need to build hundreds of new nuclear power plants, at an average cost of $8-10 billion each, in order to bring about sufficient carbon reductions to protect the climate. Moreover, it would take decades to bring that number of plants online, by which time it would be too late to prevent a climate catastrophe. As Amory Lovins, Arjun Makhijani, and other energy experts have pointed out, investments in conservation, efficiency, and renewable energy sources such as wind and solar, are dollar-for-dollar more effective in reducing carbon emissions than comparable subsidies to the nuclear industry. As a simple matter of economics, nuclear energy fails every test. That is why IPPNW has joined other NGOs in supporting the International Renewable Energy Agency (IRENA), an intergovernmental body of nearly 150 countries committed to the rapid development and deployment of renewable, non-nuclear energy worldwide.

The attempts to provide security with nuclear weapons and to meet global energy needs with nuclear power share the same flawed premise: that we can prevent the most dangerous technologies ever created by human hands from ever failing. The lesson of Hiroshima and Nagasaki is that nuclear weapons must be abolished before they abolish us. The lesson of Fukushima—and of Chernobyl and Three Mile Island before that—is that we can no longer afford to roll the dice on a technology that cannot be allowed to fail, when failures now appear to be inevitable, with catastrophic consequences.

The Fukushima Nuclear Crisis, Month 1: A Brief Chronology

March 11, 2011—A magnitude 9 earthquake strikes the northeast coast of Japan and is followed 30 minutes later by a tsunami. More than 20,000 people are killed or injured, almost 7,000 more are missing, and hundreds of thousands are forced to evacuate. The Fukushima Daiichi nuclear power plant is automatically shut down, but with no electricity to power the cooling systems, water inside the reactors began to boil off, threatening a meltdown of the uranium fuel in three reactor cores that had been running at the time. The Japanese government declares a state of emergency and advises people living near the plant to leave.

March 12—Tokyo Electric Power Co. (TEPCO) reports rising pressure inside reactor 1, begins to vent radioactive steam containing iodine-131 and cesium-137, and starts to evacuate 20,000 people who live within 10 kilometers of the plant. An explosion tears the roof off the building housing reactor 1; workers begin to pump seawater into the reactor; the government distributes iodine pills to nearby residents.

March 13—The evacuation zone is expanded to 20 kilometers; radiation levels continue to rise; seawater is pumped into reactors 2 and 3, which are also failing.

March 14—A second hydrogen explosion ruptures reactor 3, injuring several workers; evidence begins to appear that the reactor containment may have been breached; cooling fails at reactor 2, exposing the fuel rods to the air.

March 15—An explosion occurs in the building housing reactor 2 and radiation levels increase four-fold; the reactor containment is apparently damaged. A fire in the reactor 4 building, shut down for maintenance at the time of the earthquake, threatens the spent fuel ponds on the building's roof. Prime Minister Naoto Kan goes on television to warn residents within a 30-kilometer radius of the crippled plant to remain indoors. A fourth hydrogen explosion rocks the reactor 4 building. By day's end, radiation levels near reactor 3 reach 400 milliSieverts per hour; TEPCO evacuates all non-essential workers.

March 16—Water continues to boil off spent fuel ponds in reactors 3 and 4 but temperatures and pressures begin to drop at reactor 2, indicating some level of success. Radiation spikes, however, prevent workers from approaching the reactor, and a plan to dump seawater on the reactor by helicopter has to be postponed. Seawater is dropped on the exposed fuel ponds at reactors 3 and 4, but fears of a core meltdown at reactor 3 remain high.

March 17—Military helicopters drop water on reactor 3 building, while fire engines spray water from the ground.

March 18—The Japanese nuclear safety agency declares a Level 5 nuclear emergency on a scale of 7.

March 19—Radioactive materials above "allowable" levels are detected in raw milk in Fukushima Prefecture and spinach in Ibaraki Prefecture; Russian, French, and Finnish experts say Fukushima Daiichi is more likely a Level 6 nuclear emergency.

March 20—Reactors 5 and 6, which had not been operating at the time of the disaster, are stabilized in "cold shutdown."

March 21—Workers are evacuated from reactor 3 after smoke spews out.

March 22—More water is dumped on reactor 4.

March 23—Elevated levels of radioactive iodine are detected in a water treatment plant in Tokyo; the city government warns residents not to give tap water to infants.

March 24—Three workers are exposed to elevated levels of radiation at reactor 3. Water restrictions in Tokyo are lifted.

March 25—The government urges people living within a 20-30 kilometer radius of Fukushima Daiichi to evacuate voluntarily.

March 26—Radioactive iodine at 1,850 times the "allowable" level is found in seawater near the drainage for reactor 1.

March 27—High levels of radioactive water are found in tunnels near turbine buildings for reactors 1 and 3.

March 28—Highly contaminated water is found in the basement of the reactor 2 building. TEPCO announces that during the previous week it had detected plutonium in the plant.

March 30—TEPCO announces that reactors 1-4 have been decommissioned.

April 2—A cracked pit near the seawater intake for reactor 2 is found to be leaking water.

April 4—TEPCO begins dumping radioactive water into the sea, raising serious concerns about contamination of fish and other marine life, and bioaccumulation of radiation up the food chain; 520 tons of radioactive water will leak into the sea before the leaks are plugged.

April 5—Radioactive material is, in fact, found in fish caught off Ibaraki Prefecture.

April 6—TEPCO states that leaks of highly contaminated water into sea have stopped; pumps nitrogen gas into reactor 1 to prevent new hydrogen explosions.

April 7—Major aftershock strikes Miyagi Prefecture.

April 10—Work begins to remove rubble, some of it radioactive, with remote-controlled heavy machines; water in the plant tunnel system is so radioactive—more than 1,000 mSv/h—it must be removed before repair work can continue. Removal of radioactive water will continue throughout April and May.

April 11—The Japanese Nuclear and Industrial Safety Agency (NISA) raises the disaster at Fukushima Daiichi to Level 7 on the INES scale, making the crisis comparable to the Chernobyl disaster 25 years earlier.

April 25 —Japanese government increases the maximum amount of radiation exposure for children to 20 mSv/year, prompting international censure and protests from IPPNW and other NGOs.

Fukushima Radioisotopes
Some Key Facts

Cesium-137, iodine-131, strontium-90, and plutonium have been the principal radioisotopes of concern to physicians, public health officials, and epidemiologists during the nuclear reactor crisis at Fukushima Daiichi. The following facts are drawn from radioisotope profiles produced by the US Centers for Disease Control and Prevention (www.cdc.gov).

Cesium-137 (Cs-137) Half-life: 30.17 years
Mode of decay: Beta and gamma radiation

Cs-137 is produced by nuclear fission for use in medical devices and gauges. Cs-137 also is one of the byproducts of nuclear fission processes in nuclear reactors and nuclear weapons testing. Small quantities of Cs-137 can be found in the environment from nuclear weapons tests that occurred in the 1950s and 1960s and from nuclear reactor accidents, such as the Chernobyl power plant accident in 1986, which distributed Cs-137 to many countries in Europe. External exposure to large amounts of Cs-137 can cause burns, acute radiation sickness, and even death. Exposure to Cs-137 can increase the risk for cancer because of exposure to high-energy gamma radiation. Internal exposure to Cs-137, through ingestion or inhalation, allows the radioactive material to be distributed in the soft tissues, especially muscle tissue, exposing these tissues to the beta particles and gamma radiation and increasing cancer risk.

Iodine-131 (I-131) Half-life: 8.06 days
Mode of decay: Beta particles and gamma radiation

I-131 is produced commercially for medical and industrial uses through nuclear fission. It also is a byproduct of nuclear fission processes in nuclear reactors and weapons testing. External exposure to large amounts of I-131 can cause burns to the eyes and on the skin. Internal exposure can affect the thyroid gland...which cannot distinguish between radioactive iodine and stable (nonradioactive) iodine. If I-131 were released into the atmosphere, people could ingest it in food products or water, or breathe it in. In addition, if dairy animals consume grass contaminated with I-131, the radioactive iodine will be incorporated into their milk. Consequently, people can receive internal exposure from drinking the milk or eating dairy products made from contaminated milk. Once inside the body, I-131 will be absorbed by the thyroid gland exposing it to radiation and potentially increasing the risk for thyroid cancer or other thyroid problems.

Strontium-90 (Sr-90) Half-life: 29.1 years
Mode of decay: Beta radiation

Sr-90 is produced commercially through nuclear fission for use in medicine and industry. It also is found in the environment from nuclear testing that occurred in the 1950s and 1960s and in nuclear reactor waste and can contaminate reactor parts and fluids. Sr-90 can be inhaled, but ingestion in food and water is the greatest health concern. Once in the body, Sr-90 acts like calcium and is readily incorporated into bones and teeth, where it can cause cancers of the bone, bone marrow, and soft tissues around the bone.

Plutonium Half-life: Pu-238–87.7 years; Pu-239–24,110 years; Pu-240–6,564 years
Mode of decay: Alpha particles

Plutonium is created from uranium in nuclear reactors. It is a by-product of nuclear weapons production and nuclear power operations. Because it emits alpha particles, plutonium is most dangerous when inhaled. When plutonium particles are inhaled, they lodge in the lung tissue. The alpha particles can kill lung cells, which causes scarring of the lungs, leading to further lung disease and cancer. Plutonium can enter the blood stream from the lungs and travel to the kidneys, meaning that the blood and the kidneys will be exposed to alpha particles. Once plutonium circulates through the body, it concentrates in the bones, liver, and spleen, exposing these organs to alpha particles. Plutonium that is ingested from contaminated food or water does not pose a serious threat to humans because the stomach does not absorb plutonium easily and so it passes out of the body in the feces.

EDITORIALS

As the nuclear reactor crisis in Japan unfolded in the days and weeks following the earthquake- and tsunami-induced disaster at the Fukushima Nuclear Power Station, IPPNW doctors, medical students, and policy experts wrote numerous editorials and commentaries that were published in newspapers and magazines, online news sites, and the federation's own Peace and Health Blog (peaceandhealthblog.com). Many of these articles are collected here, with the publication date and source noted.

IPPNW has been a constant voice against nuclear energy

For the past six days, IPPNW doctors in a number of countries have been overwhelmed with requests from journalists hungry for information about the health effects of radiation and the potential health consequences of the crisis at Japan's nuclear reactors.

The leaders of IPPNW-Germany, many of them experts on radiation and on Chernobyl-related illnesses, happened to be meeting in Frankfurt on the weekend the disaster unfolded, and have worked around the clock ever since analyzing what information is available and putting it into a medical and public health context (see Xanthe Hall's excellent piece, "Nuclear power—basta!").

> What IPPNW is saying in the midst of crisis, sadly, is no different from what we have been warning for many years.

In the US, PSR has mobilized its own physician leadership to help reporters (who are openly frustrated with the quality of "official" briefings) understand what is going on. A PSR press briefing conducted by telephone from Washington, DC yesterday drew questions from the country's leading newspapers not only about the basic science of radiation, but also about how to interpret and evaluate the information coming from official sources.

Physicians in Japan, Switzerland, Australia, India, Greece, France, and other countries are explaining the biological effects of cesium-137, iodine-131, strontium-90, and plutonium-239 (a component of the MOX fuel in one of the Fukushima reactors) to an apprehensive and confused public.

To take just one example, if you google Ira Helfand, a PSR/IPPNW leader whose skill as an emergency physician is obvious in his clear, calm explanations of complex and terrifying facts, you will find so many print, television, and radio interviews since March 11 that one can only wonder when he has slept let alone treated patients since this started.

What IPPNW is saying in the midst of crisis, sadly, is no different from what we have been warning for many years. A look back through the historical record shows that PSR issued an appeal to halt nuclear energy development in the US in 1979, mere weeks before the Three Mile Island incident.

IPPNW-Germany has made it a special part of their mission to study and document the effects of Chernobyl—an understandable response to the large amounts of radioactive fallout from Chernobyl that landed on German soil. They have held major conferences on Chernobyl over the years, and were planning the next one in Frankfurt when reality intruded.

PSR/IPPNW-Switzerland held its own conference, "Rethinking Nuclear Energy and Democracy After September 11, 2001," in 2003. The conference presentations, some of them calling the whole concept of "nuclear

IPPNW's Peace and Health Blog (peaceandhealthblog.com) contains a special section devoted to the Japan nuclear crisis, including links to online interviews, news articles, and analysis by IPPNW experts.

safety" into question, were gathered into a publication that is still worth reading almost a decade later.)

IPPNW's organizational position on nuclear energy was adopted at the 13th World Congress in Melbourne, in 1998. The vote was not unanimous (the notes from the International Council meeting reflect opposition from the Finnish and Japanese affiliates), but the rejection of nuclear energy approved by a large majority was unambiguous and the reasons given touched on every major concern: the link with nuclear weapons proliferation; the unsolved (to this day) problem of nuclear waste; health and environmental dangers, whether from accidents, terrorist attacks, or "normal" operations; economic costs; and the availability of wiser alternatives.

In the aftermath of Fukushima, the Melbourne resolution sounds even more urgent today than it did some 12 years ago.

—John Loretz
IPPNW Peace and Health Blog
March 17, 2011

Nuclear Energy Resolution
IPPNW International Council
December 9, 1998
Melbourne, Australia

BEARING IN MIND THAT:

- The acquisition of nuclear-weapons-usable materials is the most difficult step in the making of nuclear weapons and the most important obstacle to proliferation;
- Commercial reprocessing produces plutonium that can be used to make nuclear weapons;
- The creation of a technical infrastructure and of plutonium (and/or uranium-233) is an inevitable accompaniment of the use of nuclear energy, and large surpluses of weapons-usable commercial plutonium have been built up as a result;
- Nuclear power makes proliferation more likely and verification more difficult;
- All existing designs of nuclear reactors are vulnerable to accidents and can become targets of attack, for instance in conventional wars or due to terrorism, thereby creating an intolerable risk for health and environment;
- The commercial nuclear fuel cycle creates health risks for many generations in a manner similar to nuclear weapons production;
- There are far more satisfactory ways from the point of view of economy and health to meet the world's energy needs than nuclear energy;
- Unless the industrialized countries of the West make a firm commitment to phase out nuclear energy other countries are unlikely to give it up.

BE IT RESOLVED THAT IPPNW WILL WORK TOWARDS THE FOLLOWING GOALS:

- Reprocessing, both commercial and military, should be stopped.
- No new nuclear power plants should be built or commissioned in any country and existing nuclear power plants should be phased out at most by the end of their current license periods.
- Separated plutonium, whether from commercial or military sources, should not be used in nuclear reactors to generate energy.
- Immobilization of plutonium should be used as a way to put all military and all separated commercial plutonium stocks into non-weapons-usable form.
- The financial, scientific, and technological resources of society should be used to meet energy needs in far more efficient and less dangerous ways than nuclear power.

THE FIRST STEPS TO BE TAKEN SHOULD INCLUDE:

- Informing all IPPNW affiliates about the links between nuclear power and nuclear weapons.
- At this crucial juncture, creating a project to work in coalition with other groups to stop all military and commercial reprocessing.
- Creating a project to analyze the health implications of use of nuclear energy as a power source.

Nuclear power—"basta"!

It really is enough now. Hiroshima, Nagasaki, Windscale, Harrisburg, Chernobyl and now Fukushima. When will it be enough for governments around the world to understand that there is no playing with nuclear fire? The moment that Oppenheimer saw the first nuclear explosion he understood the magnitude of this new and awful kind of energy. Now the raw power of nature meets our technical arrogance and is destroying Japan in the form of earthquakes, tsunami and the unleashing of terrifying quantities of radiation. It hardly bears thinking about. But we must think about it and act upon it.

As I boarded the train this morning in Frankfurt heading back to Berlin, an exhausting day behind me, the news was still totally unclear. Had there already been a meltdown or was it yet to come? Would there be more than one meltdown? How much radiation had already leaked out of the reactor that had exploded and how much had they deliberately released to reduce pressure in the core?

In one of the television interviews I gave yesterday the interviewer began by saying "With what we know now about the accident at the Fukushima reactor, what will be the consequences for the Japanese people?" and I had to ask back "what do we know now? We know hardly anything at all." Impossible to answer other than to say, as our outgoing Chairperson Angelika Claussen did: "we need more transparency." How can physicians even begin to react to a disaster such as this without any real knowledge of the amounts of radiation and measurements of isotopes? It reminded me of Chernobyl where it took days before they even admitted what had really happened.

But here it could be even worse. More than one reactor is affected. Maybe more earthquakes are on their way. Evacuation is hampered by the destruction caused by the earthquake. Presumably medical services are also severely hindered from helping radiation victims and have their hands already full with mechanical injuries caused by the earthquake. It is not over yet, maybe it is just beginning. I fear the dragon has only opened its mouth, but not yet breathed out its horrific fire.

IPPNW-Germany was meeting in Frankfurt this weekend for their annual general meeting. By Saturday morning it was clear that we could not continue with our planned agenda. For the first hour or two a small group tried to gather information and draw conclusions from what had happened or might have happened. Most of the media reports were conflicting. We studied the pictures of the reactor and tried to surmise how big the leak might be and whether we were already facing a meltdown. After a two-minute silence, we then separated into groups to decide how to act, how to react. At the same time, our press officer Angelika Wilmen rang the main TV stations and offered them interviews with our experts. The one good thing was that we were all together: Henrik Paulitz, Angelika Claussen, Reinhold Thiel, Winfred Eisenberg—all experts on radiation and health, or on security deficits in nuclear power plants. The media reaction was nothing short of overwhelming. Other doctors were quickly briefed so they could help in reacting to all the interview requests. All of us, including myself, were called upon to give statements, appear on TV or speak to the radio.

> It really is time that politicians admit that the use of nuclear energy, both civilian and military, starting with uranium mining and ending with a chain reaction, controlled or uncontrolled—contaminates, kills and causes immense suffering.

Meanwhile the other doctors were ready to take to the streets. Equipped with banners, balloons, and "nuclear" umbrellas, we organised a flashmob in the centre of Frankfurt. About 100 of us were there, chanting loudly for the nuclear power plants to be shut down. One group shouted "nuclear power" and the other answered "basta!" The TV filmed us and people around showed their approval. It felt good to be shouting our frustration and anger. No doubt there will be more actions in the next few days and weeks. What else can we do?

The answer to that question was also brainstormed and ideas emerged. More information on radiation and health in short, easy-to-read flyers that can be handed out on the streets is needed. The call for people to immediately change their electricity supplier to one that only provides renewable energy to the net should be insistent, so that money is cut off from the nuclear industry. Moving money from banks that invest in the nuclear industry, asking "how radioactive is my bank?" Flooding the government with letters demanding that nuclear power plants are shut down, right away. Calling worldwide for an end to nuclear power, starting immediately

with all nuclear power plants in regions were there is any seismic activity. These were just a few of the ideas that were voiced.

It really is time that politicians admit that the use of nuclear energy, both civilian and military, starting with uranium mining and ending with a chain reaction, controlled or uncontrolled—contaminates, kills and causes immense suffering. There have been enormous attempts to cover up the data from Hiroshima and Chernobyl so that people swallow the nuclear lie. It is not safe, it is not clean, it is not the answer to climate change, it does not keep the peace. It is our only enemy and it will kill us. Those who are not killed will helplessly watch the others die and not be able to help them. I do not exaggerate. We are doing exactly that right now, watching the people of Japan—already history's hibakusha—dying, and we cannot do anything. We can only raise our voices loud and clear and say—basta!

—Xanthe Hall
IPPNW Peace and Health Blog
March 13, 2011

Nuclear energy is no alternative

The events around the Japanese quake and nuclear-reactor damage are tragic and will be repeated again in some other iteration as long as we embrace nuclear energy as an alternative to fossil fuels. The damage to the nuclear reactor and release of nuclear waste compound the tragedy of the earthquake because they now likely condemn the people of Japan (especially the children) to higher rates of cancer over the following decades as well as an expensive cleanup of waste that has an extraordinarily long half-life.

The Japanese government put down the most sophisticated system possible to prevent this exact course of events and it still happened. As we mourn this catastrophe, I hope we do not forego the opportunity to learn from it as well. We owe it to ourselves and the Japanese people.

—Richard Grady
Letter, Seattle Times
March 14, 2011

A potential source of radiation

Indian Doctors for Peace and Development (IDPD) has expressed its grief over the devastation caused by the tsunami and earthquake in Japan. The blast at the nuclear power plant vindicates the stand of the International Physicians for the Prevention of Nuclear War (IPPNW) and IDPD that nuclear power plants are a potential source of radiation. We doctors have always maintained that the option of producing electricity from nuclear power is dangerous and expensive.

The world still remembers the Chernobyl nuclear accident; an estimated 93,000 people are reported to have perished. The health of the "liquidators" (clean-up workers), engaged in the task of clearing the area, is a matter of serious concern even today.

An accident in a nuclear power plant is almost like an atomic explosion with devastating consequences on flora, fauna and ecology. The Government of India should review its nuclear power policy and use other safe renewable options for power generation. These are widely available alternatives in our country. Japan has the best disaster management capacity; in contrast India's track record is extremely dismal. Our policy-makers ought to derive a lesson from the calamity in Japan.

—Subhas Chakraborty
The Statesman (India)
March 14, 2011

Futility of nuclear energy: Alternatives for Nigeria

The footage of the double sets of tragedy in Northern Japan are a common scene on our televisions screens and internet pages. One set being natural (earthquake and Tsunami) and the second, technology failure (nuclear plant accidents and potential radioactive leakages).

On Friday 11th March, 2011 at 2.46pm (Japanese time) 8.9 magnitude earthquake hit the port city of Sendai in Northern Japan sending severe shock waves across the country and region. As if this was not enough, a heavy tsunami with waves as high as 8-10meters raged across Japan and the Pacific sea at the speed of about 1000km/hr. Tsunami alarm was immediately sounded within Japan and 53 countries on the path of this monstrous phenomenon.

My treatise would be limited to the nuclear plant (NP) explosions and the potential radioactive leakages with reflection on the Nigerian planned Nuclear energy acquisition with the evitable risk such investment present for public health and human survival.

The much talked about reform in the energy sector had been raised as political bait tossed around by government since the return to democracy in 1999. Several solutions to "blackouts" had been promised but *never* delivered. The roadmap to Nigerian's energy sectors should be robustly driven by diversities in clean and modern sources of power production.

Our nuclear energy adventure would be aborted even before take off by monumental bureaucracy and technical challenges; we

have no proven maintenance culture not to think of an uninterrupted electric supply supported by an effective backup to an acquired NP. The NPs at Fukushima Daiichi, Japan had three tiers of electricity supply to the cooling system, all of which failed by forces of nature, the quake and tsunami. Should Nigeria be lucky to have regular electricity supply to power the cooling system, we may run out of water for one phantom reason or another.

The outcome of the failed cooling system at Fukushima-1 NP was a built up of pressure within the reactor and an eventual explosion releasing radioactive substances into the environment- a scary development of an immense historical dimension. However, conflicting reports of the exact amount of radioactivity has deepen the crisis and prompted heighten fears on the Citizens and the Government. The Nuclear watchdog Chief, Ambassador Amano would be travelling to Japan to see things for himself. Fukushima-3 NP exploded on 14 March and Fukushima-2 the following day while fire was reported in Fukushima-4 NP.

Plutonium, a highly radioactive and vital component of nuclear reactors is the element release in the event the core of the reactor is compromised. The risks of exposure of humans include radiation illnesses, future carcinoma and deaths depending of the dose of exposure. However, it is hope that the winds would blow the emissions eastwards to reduce contamination.

Apart from leakages and accidental fallouts, disposal of nuclear waste have always posed a regrettable environmental and health disasters of unimaginable proportion.

Chernobyl in Ukraine is a case in context where effects of radioactive fallout of 1986 are still felt as far as the Nordic countries. Other NP accidents resulting in release of radioactive materials were Windscale, UK in 1957, Kyshtym, Russia in 1957 and Three mile Island, USA in 1979 just to mention a few. Debate has been re-ignited as to the closure of some of the 104 NPs in USA as the result of the current nuclear disaster in Japan.

In 2006, a near meltdown of the reactor occurred after fire broke out at a NP in Ringhals, Sweden few months after a reactor in Forsmark also in Sweden went up in flames. Health and environments campaigners have not ceased advocating for complete elimination of NP in Sweden, Germany and other European countries.

The International Physicians for the Prevention of Nuclear War (IPPNW) for over 30 years have advocated and educated the public on the dangers of eventual radiation fallout from nuclear weapons. It is universal knowledge that nuclear reactors are precursors of nuclear weaponry. An accidental meltdown of such weapons and reactors as currently witnessed in Japan poses an enormous danger to the environment, health of humans and living things. IPPNW's effort was recognized by the UNESCO Peace Education Prize in 1984 and by the Nobel Peace Prize in 1985.

In Nigeria, the affiliate of IPPNW is known as Society of Nigerian Doctors for the Welfare of Mankind with membership all over Nigeria.

There are viable alternatives for power generation in this modern age. Hydroelectricity could be relevant and sustainable in some communities for example, NESCO was efficient at electricity supply to Bukuru and part of Jos in Plateau state from Kura falls when I resided there. Shiroro falls had its area of supply. Qua falls in Cross River state should be exploited to generate electricity for her catchment areas.

Hydropower may be complimented with other sources such as wind turbines that could be conveniently mounted offshore across the vast Bight of Benin to supply electricity to the entire South West, South South and South Eastern zones of Nigeria. Communities in the other zones could also benefit from electricity generated from wind depending on their topography.

What of our God given sunlight? This source is an envy of countries in the northern hemisphere especially those with long dark nights.

A European consortium has planned to tap sunrays from the Sahara desert to supply electricity to most of Europe, a project that if completed would begin shut down of NPs in the subscribed nations. A paradox hits hard on our psyche that is comparable to having crude petroleum oil and refineries but we wait in long queues for its by-products. Countries without crude petroleum oil or refinery have petroleum products 24/7. It would be reasonable that we hide our faces in shame if we cannot use technology to harness the benefit of our abundant sunlight.

Biodegradation has been successfully utilized for energy generation in many communities and countries. Why not in Nigeria? If well utilized, our cities would be rid of waste keeping them clean. Waste would become marketable and employment generated from organized waste collections and disposals through sales to biodegradation plants.

The suggestions above are not new; several commentators had made similar and perhaps better proposals in the past. However, one of the reasons for an apparent disregard to these ideas is situated in the misplaced priorities of successive Nigerian

Governments, corruption and huge governments; a push to satisfy political cronies outweighs instituting a legacy for a modern nation.

Unfortunately, in an event of radioactive accidents, there's just no sustainable remedy; iodine tablets have very limited solution. Evacuations to far distances have mere palliative effect. In case of Fukushima, an initial 20 km was advised and later 30 km safe zone was advocated. Many are impressed by the resilience of the Japanese people and the rescue teams who are searching all nooks and crannies despite unfavorable terrain couple with snow and falling temperatures.

One ponders how we would have managed should such a disaster confront us? What relief can we muster when a dam breaks its banks? Nigerians were stranded in Tripoli for weeks before being evacuated home. The risk of radioactive contamination should be weighed against other electricity generating options before taking a dive to disaster.

—Ime John
Nigeria Plus Citizen Journalism
March 16, 2011

What could be worse?

Each day the news out of Japan is that much worse than the day before. Desperate attempts to scoop loads of water out of the ocean and dump them from helicopters onto overheating spent fuel pools at the Fukushima Nuclear Power Plant failed today. So did a plan to spray the reactor buildings with water cannons normally used for crowd control. Neither the helicopters nor the cannons could get close enough to their targets because radiation levels were too high. The secondary containment around one reactor is now reportedly destroyed.

Thousands of people have been evacuated from around the plant, adding to the hundreds of thousands already made homeless by the earthquake and tsunami—events that would be dominating the news under any other circumstances but now seem almost like afterthoughts (or pre-shocks?). We keep hearing that Tokyo is not in any danger from radiation right now, but our Japanese friends have told us that people in Tokyo are under enormous stress, unsure of how to balance individual and family anxiety with their deeply ingrained sense of collective responsibility.

In less than a week, the Japanese economy, like the tsunami-ravaged coast, has fallen into shambles. Any natural disaster of this magnitude has vast social, environmental, and economic repercussions, and even without the destruction of the Fukushima reactors Japan would have faced a prolonged period of recovery and billions of dollars in costs. The nuclear crisis, however, threatens the very foundation of Japan's economy, which has been organized, for better or worse, around nuclear power.

"Worse" has now arrived. We keep hearing from Japanese leaders (who are in an impossible position) and from "nuclear safety" experts (a term that is now the dictionary definition of "oxymoron"), that this is not the worst case scenario, that full core meltdowns at the plants are unlikely, and that even if one were to occur, there would not be Chernobyl-like consequences.

Is anyone actually supposed to take any comfort from that? Are the Japanese people —or any of us, for that matter—supposed to be reassured that the damage from this incident, if it ends here, will be "limited?" Limited to what? The displacement of and trauma to thousands of people whose lives will never be the same? The creation of an uninhabitable sacrifice zone many kilometers out from the hopelessly contaminated reactor site? Tens of billions of dollars of direct and indirect costs? The devastation of an entire national psyche?

And that's not the worst-case scenario?

The case for nuclear energy, if there ever was one, has now collapsed. Far from being a cheap source of electricity, nuclear power has proven itself to be extraordinarily expensive. It is an ineffective answer to global warming because even if all other restrictions were removed we would not be able to build enough nuclear power plants to make a dent in carbon emissions in time to make a difference. Even worse, the proliferation of nuclear weapons is inextricably linked to the global expansion of commercial nuclear power reactors, which are not themselves bomb factories, but which produce the fissionable materials needed in bomb factories.

And now the things that "couldn't happen," or "couldn't happen here," or were such remote possibilities that they were worth the risk, have happened. There's even an identifiable trajectory. Three Mile Island was a catastrophe narrowly averted; Chernobyl was a "unique" catastrophe unlikely to be repeated; Fukushima was the outcome of overwhelming natural events that could not have been anticipated.

Except, of course, that they could have been—and were—anticipated by opponents of nuclear power who have been aggressively demonized by the nuclear industry and its supporters as doomsayers and fearmongers. Even this week, nuclear energy propagandists on Fox have complained that the world is "overreacting" to Fukushima.

What we have to focus on now (after

helping the victims in Japan get through the acute stages of this crisis as best they can), is the real lesson of Fukushima. The industry—and governments invested in the industry—are already promoting the self-serving message that Fukushima can teach us how to make nuclear power operations still safer and less vulnerable to natural disasters.

The lesson we ought to be learning is that we are finished with this whole misguided enterprise and with the people who persist in promoting it. That it's time (long past time, in fact) to halt the construction of any new nuclear power plants, to phase out and close down the ones that exist as soon as possible (and no later than the end of their current operating licenses), and to accelerate the transition to clean, sustainable, renewable systems for producing and consuming energy.

—John Loretz
IPPNW Peace and Health Blog
March 17, 2011

From Hiroshima to Fukushima and back

Settled agriculture began about 12,000 years ago. If human children are still born and play on a hospitable planet in another 12,000 years, it will be because we succeeded in eradicating the terror of nuclear weapons and preventing runaway climate change. Twelve thousand years is not very long really.

Earth has been around for 4.6 billion years. 400 human generations; one half of one half-life of plutonium-239, among the most potent radioactive carcinogens, produced in every nuclear reactor, present in large amounts in the mixed uranium/plutonium fuel in the Fukushima Daiichi No.3 reactor, and one of the two fuels for nuclear weapons.

If people can look back in 12,000 years, they will scratch their heads at the unrivalled folly of the 20th and 21st centuries. Very cleverly packaging the primordial energy that powers the stars into nuclear weapons in their tens of thousands, about 2,000 still ready to be launched in minutes. Weapons by which a self-selected few claim the right to threaten the birthright of all. Weapons able to unleash temperatures hotter than the sun, and radiation which can deliver a lethal dose with little more energy than the heat in a cup of coffee.

The same awesome power dispersed in hundreds of nuclear reactors to boil water for electricity in the most hazardous way possible, amplifying the radioactivity of the starting fuel around one million times. After a few decades the reactors themselves become radioactive waste, needing absolute isolation for hundreds of thousands of years on a small interconnected planet, with 11 earthquakes of magnitude 8.5 or greater in the 20th century, and 5 in the first 11 years of the 21st, almost all of them followed by tsunamis. More nuclear reactors raising further the danger of nuclear war have been justified on the pretext of slowing climate change.

Our paramount shared responsibilities are clear: first, negotiate an irreversible, verifiable global treaty to outlaw and eliminate nuclear weapons, urgently. This will require enrichment of uranium to be very tightly restricted, and extraction of plutonium from spent nuclear fuel to cease. Second: prevent rampant global warming by massively and speedily scaling up energy efficiency, demand reduction and benign, renewable energy production.

In our ordinary, fallible, uncontrollable world, there are already enough primordial forces capable of great destruction. We don't need any more. The power of nuclear fission and fusion belong in the stars. And that is where they should stay. The recent catastrophe in Fukushima is a strong vindication of this truth.

—Tilman Ruff
Kyodo News
March 19, 2011

The nuclear chain – splitting atoms, hairs and personalities

It is no coincidence that one speaks of the civilian and military use of nuclear energy. There is nuclear energy on the one hand and on the other there is the way it is used. It can create a nuclear explosion or it can be harnessed to make electricity, but intrinsically, it is the same thing.

After the earthquake and tsunami hit Fukushima, many people around the world asked the question: after what the Japanese had suffered from the military use of nuclear energy on Hiroshima and Nagasaki, why did they invest so greatly in the civilian use? Indeed, it is surprising that the original distaste for all things nuclear was lost in the sixties, when Japan began building nuclear power plants to beat the band. More than just about any other country, except perhaps France, the Japanese seemed to think nuclear energy was the best thing since sliced bread. And while just about everyone else (except the Russians) was shifting away from the plutonium economy, saying that it was too dangerous and too expensive, Japan began using MOX and expanding its reprocessing facilities.

Yet this inexplicable splitting of the collective personality into nuclear good and nuclear bad is not just a Japanese phenomena. Attend any Review Conference of the Non-Proliferation Treaty (NPT), you will

hear the same weird belief that nuclear energy is bad in weapon form, but good if you plug it in and run your kettle off of it. A whole institution has been built on this lie that was part of the 50s propaganda "Atoms for Peace", the International Atomic Energy Agency (IAEA).

Nuclear energy is not good or bad, in my view. What I condemn is the human arrogance and ignorance that leads us to think that we can control a force as massive and potentially destructive as this, or that the risks inherent in harnessing it as a source of electricity are calculable. Chernobyl showed us how humans make mistakes. Fukushima has made it abundantly clear that we are not in control, and that we are pitiful in the face of nature's ability to determine our fate. The disaster that hit Japan was bad enough, but did we need to compound it by adding our own stupidity to the equation by building nuclear reactors on fault lines?

It starts at the front end with the mining of uranium. Locked up in rock, uranium was not meant to be taken out of the earth—so we are wisely advised by the indigenous peoples of the world, who have lived on top of uranium-filled rock for centuries. Remove it from its natural habitat and it becomes dangerous, releasing particles that, when breathed in, can cause cancer.

After being processed, the uranium then has to be enriched. Again, the difference is minimal. Once you have the technology to enrich, then you can choose how much you enrich your uranium—roughly, 3-5% for nuclear power, 20% for medical isotopes, 85-90% for weapons. The only thing that stands in your way is the view that there is nuclear good and nuclear bad. And a treaty. But you can choose not to sign the treaty in the first place, or use it to get the nuclear technology and then leave the treaty. So far, so good (or bad).

The chain does split into two different branches when you get to putting your enriched uranium to use—you can put your enriched uranium into a nuclear power plant and make electricity with it, or you can enrich it a bit more and make nuclear weapons. (By the way, you can also use the by-product of the enrichment process, depleted uranium, to make weapons as well.)

When it gets to the question of waste, however, it gets more complicated. What should you do with it all? Rather than just throwing it all away (and where should it go?) you can reprocess it. And because you've successfully made plutonium by burning your uranium in a nuclear reactor, you can separate this out and, bingo, you have the stuff to make MOX. Or nuclear weapons. Japanese politicians have repeatedly reminded the world that they had enough plutonium stockpiled that they could easily make a whole load of nuclear weapons, should they be so inclined. What stopped them? The view of nuclear good and nuclear bad.

When it comes to Iran, there is only nuclear bad in the eyes of the West. It was the conflict with Iran that really started to shake the foundations of Article IV of the NPT that says everyone has a right to use nuclear energy "peacefully." Actually, the discovery in the early 90s that Iraq had hidden a well-developed military nuclear programme successfully behind its "peaceful" programme while remaining an NPT member was the first major wake-up call. Then the lid blew on A.Q. Khan's network and people began to realise that the proliferation of nuclear energy could lead and had led to the proliferation of nuclear weapons. The good, the bad and the ugly.

What we forget is that while the intention may be peaceful, the energy itself is not. The difference between "peaceful" and "military" use is no more than a hair's breadth. From outside, it is hard to see the difference, you have to send in the IAEA to inspect, probe and interrogate. Still, we don't really know whether Iran's nuclear programme is good or bad and the IAEA is still looking for actual (rather than circumstantial) evidence.

Instead of splitting hairs over whether there is a difference between nuclear energy and nuclear energy, we should begin to understand the connection between all the aspects of the nuclear chain. There is an inextricable link that binds uranium mining, enrichment, nuclear power, reprocessing, nuclear weapons, radioactive waste and fallout together. When we talk about one, we should not forget all the others. They add up to make an ugly picture of death and destruction, of incalculable risk and contamination.

—Xanthe Hall
IPPNW Peace and Health Blog
March 21, 2011

Just in case you missed it, here's why radiation is a health hazard

The March 11 earthquake and tsunami in Japan and complicating nuclear crisis throw into sharp focus concerns about exposure to ionising radiation. What is it, how is it harmful, how much is too much?

Inside a nuclear reactor, the radioactivity is increased about a million times as some of the uranium or plutonium is converted to a cocktail of hundreds of different radioactive elements.

There are many different pathways through which people can be exposed to radiation: inhalation of gases or particles in the air, deposits in soil or water, ingestion of

food, water or dust. Some radioisotopes mimic normal chemical elements in living systems and therefore make their way up the food chain and onto our plates.

Ionising radiation

Radiation is called "ionising" when it has sufficient energy to knock the electrons off atoms to produce ions (atoms which have a net positive or negative electrical charge). Ionising radiation damages large complex molecules either directly or by creating highly reactive chemicals inside cells.

The biological potency of ionising radiation is not related to the amount of energy it contains so much as that this energy is packaged in a form which can reach and damage complex molecules—particularly the DNA that is our genetic blueprint, that is passed on to form each new generation.

A lethal dose of radiation may contain as little energy as the heat in a cup of coffee. Our senses cannot warn us about ionising radiation—it cannot be seen or touched or felt or tasted or smelt.

Levels of exposure

Some effects of radiation only occur above certain thresholds. In the short term, high levels of radiation exposure can cause acute radiation sickness. In the longer term there is an increased risk of cataracts, birth defects, sterility and hair loss.

High doses of radiation can kill cells - this is the reason targeted radiation is used in the treatment of some cancers.

Acute radiation exposure at doses over 100 milliSieverts (mSv), and particularly over 1000 mSv, has most impact on our rapidly dividing cells. These are the blood-forming cells of the bone marrow, lining of the gut, and ovaries and testis. The symptoms of acute radiation sickness therefore include vomiting and diarrhea, bleeding, and reduced ability to fight infection.

The major long-term effect of ionising radiation exposure is an increased risk of a wide variety of cancers. There is no "safe" level of radiation below which there is no increase in cancer risk. The earliest to appear, after around three to five years, are leukemia and thyroid cancer. The 1986 Chernobyl disaster, for instance, has resulted in an epidemic of thyroid cancer with 6,500 children affected so far.

Other cancers begin increasing after 10 years—lung, breast, colon, ovary, bladder and many others. Excess rates of cancer in the Hiroshima and Nagasaki survivors continue to rise.

Sources of exposure

All of us are exposed to ionising radiation all the time - from the stars, from the earth and rocks, from common equipment and appliances. The global average estimated human exposure is 2.4 mSv per year.

The biggest natural source is radon gas produced from radium, part of the decay chain of uranium, which is widely distributed in the Earth's crust. After smoking, radon is the second most important cause of lung cancer worldwide.

The bulk of ongoing exposures of human origin are from medical X-rays, and there is considerable concern about the rapidly rising medical radiation exposures, particularly from the growing number of CT scans being performed. CT scans involve radiation doses of between 3 and 11 mSv.

Exposure to ionising radiation from all sources should be kept as low as is feasible. In Australia and most countries, it is recommended that 1 mSv per person per year be the maximum permissible exposure from non-medical sources for the general population; and 20 mSv per year the annual permissible limit for nuclear industry workers. In Japan the maximum permissible dose for the emergency nuclear workers in Fukushima has been increased to 250 mSv.

Health harms

The most authoritative current estimates of the health effects of low dose ionising radiation are contained in the Biological Effects of Ionising Radiation VII report from the US National Academy of Sciences (BEIR VII). This report reflects the substantial weight of scientific evidence that there is no exposure to ionising radiation that is risk-free. The greater the exposure, the greater the risk.

BEIR VII estimates that each 1 mSv of radiation is associated with an increased risk of solid cancer (cancers other than leukemia) of about 1 in 10,000; an increased risk of leukemia of about 1 in 100,000; and a 1 in 17,500 increased risk of cancer death.

But while radiation protection standards are typically based on adult males, it is important to note that not everyone faces the same level of risk. For infants (under 1 year of age) the radiation-related cancer risk is 3 to 4 times higher than for adults; and female infants are twice as susceptible as male infants.

Females face a lower risk of leukemia, but a 50% greater risk of developing a more common solid tumour, so their overall risk of cancer related to radiation exposure is 40% greater than for males. Fetuses in the womb are the most radiation-sensitive of all.

Over time, estimates of the health risks associated with radiation exposure have inexorably risen. Some of these risks are probably still under-estimated, particularly

the impact of internal contamination, such as from plutonium particles lodging in the lung. Internal contamination may not be picked up by external devices designed to detect gamma radiation alone, such as the hand-held radiation monitors now being widely used to screen people in Japan.

In Germany, a recent national study showed that normal operation of nuclear power plants in Germany is associated with a more than doubling of the leukemia risk for under five year olds living within 5 km of a nuclear plant, and increased risk was seen to more than 50 km away. This was much higher than expected.

The longevity of some radioactive minerals is almost incomprehensible. Plutonium-239 has a half-life of 24,400 years. It will take almost a quarter of a million years for it to decay to less than one thousandth of the starting level. So the same particle inhaled into someone's lung could go on to increase cancer risk for other individuals over successive generations.

—Tilman Ruff
The Conversation (Australia)
March 24, 2011

> Over time, estimates of the health risks associated with radiation exposure have inexorably risen. Some of these risks are probably still underestimated...

There really is no safe level of radiation

As the radioactive contamination of food, water, and soil in Fukushima, Japan worsens, the media is continuously reassuring us that these levels are "safe." But there is no safe level of radiation.

Yes, at lower levels the risk is smaller, but the National Research Council of the National Academies of Science has concluded that any exposure to radiation makes it more likely that an individual will get cancer.

The press is reporting that 100 millisieverts (mSv) is the lowest dose that increases cancer risks. This simply isn't true. According to the NAS, if you are exposed to a dose of 100 mSv, you have a one in 100 chance of getting cancer, but a dose of 10 mSv still gives you a one in 1,000 chance of getting cancer, and a dose of 1 mSv gives you a one in 10,000 risk.

Those odds sound fairly low for one individual, but if you expose 10,000 people to a one in 10,000 risk, one of them will get cancer. If you expose 10 million people to that dose, 1,000 will get cancer. There are more than 30 million people in the Tokyo metropolitan area.

To understand the danger of low levels of radiation exposure, consider several factors.

First, the total dose is the most important factor, not the dose per hour. When you get an X-ray, you're exposed to a one-time burst of radiation. If you work for 10 hours in a spot where the radiation level is 1 millisievert per hour, your dose is 10 millisieverts, and the dose goes up the longer you stand there.

Second, there's a big difference between external and internal radiation. If you're standing in a spot where you're exposed to external radiation, that exposure ends as soon as you move away. But if you ingest or inhale a radioactive particle, it continues to irradiate your body as long as it remains radioactive and stays in your body.

Further, if you ingest radioactive particles, the dose isn't spread evenly over your entire body. It concentrates where the particles lodge. The average total body dose may be relatively low, but the dose at the site may be large enough to damage that tissue and cause cancer.

That's why the radiation being found in Japan in spinach, milk, and other food-as well as water-is so worrisome. If consumed, it will create ongoing radiation exposure and increase the risk of cancer. A large majority of the hundreds of thousands of cancer cases that have occurred in the former Soviet Union because of the Chernobyl catastrophe were caused by people eating radioactively contaminated food.

Finally, it makes a big difference who gets irradiated. Children are much more vulnerable than adults. If a fetus is exposed to only 10 mSv in utero, his or her risk of getting cancer by age 15 doubles. So it's particularly dangerous when children or pregnant women consume radioactive food or water.

Reports indicate that the total radioactive releases in Fukushima have been relatively small so far. If this is the case, then the health effects will be correspondingly small. But it's not "safe" to release this much radiation. Some people will get cancer as a result. Most importantly, we don't know at this point how much more radiation there will be.

That's why the U.S. government has said that people shouldn't be allowed within 50 miles of the plant.

If a comparable accident were to occur at the Indian Point nuclear reactors 24 miles north of New York City, 17 million people would need to evacuate. That's something to think about when we're told everything is OK at our nuclear plants.

—Ira Helfand
CommonDreams.org, widely syndicated
March 28, 2011

Anger is renewable energy

Some weeks ago, I had a 9 year old patient who was suffering from enormous temper tantrums. Whenever he felt overwhelmed and helpless, when it was clear to him that no one would listen to his voice, he didn't know of any better way to deal with his feelings than to hurt himself and everyone around. Kicking, beating, biting and scratching, he tried to gain control of the situation and forced helplessness onto the adults who had been so ignorant before.

When I read about what is going on in Japan now, I somehow feel like this little boy. I feel overwhelmed with anger, but there's no one to address, no one listening to people's questions and concerns. I feel helpless to the point of being paralyzed. Haven't we warned our governments of the hazards of using nuclear power again and again? Aren't there already thousands and thousands of innocent people suffering from the consequences of a man-made disaster, in vast areas around Chernobyl?

Prevention is a medical doctor's most important contribution for securing their patients' well being and survival. In this case, it means putting an end to nuclear technology once and for all. The use of nuclear power, be it civil or military, has brought an intolerable risk upon us. People's health is constantly at stake, so to speak from the cradle to the grave of the radioactive material needed for the nuclear fuel rods.

The tragedy starts with the neglected suffering of the uranium miners in Canada, Australia, Niger, Namibia, India or the United States. Many of them indigenous people who have been tricked into sacrificing their sacred lands for nuclear weapons and the Western world's craving for more and more energy. Those sacred lands have become wastelands, the radioactive tailings making them unsafe for centuries.

It goes on with the children living near one of the many nuclear power plants. Their leukemia risk increases 1.2 fold if their home is located within a range of 5 kilometers around a nuclear power plant. To make myself clear on that point: We speak of the risk emerging under normal operation. Still, politicians and so-called independent scientists do not seem to be concerned. Besides, the World Health Organization, having the mandate to promote and protect the health of all peoples, is subjected to the interests of the International Atomic Energy Agency by a working agreement approved in 1959. Oh, the IAEA's objective is to promote the civil use of nuclear technology throughout the world, right?

In addition, nobody knows how to deal with the radioactive waste adding up with every second of running a nuclear power plant. Burying it in ancient salt mines or using outer space as a nuclear landfill? One solution is more insufficient than the other. Depleted uranium, a byproduct of uranium enrichment for nuclear power plants or weapons, has been used by the U.S. and other NATO forces for developing weapons with unusual armor-piercing capabilities. Dumped on the battlefields in Iraq or the Balkans, the cheap and abundant material threatens the health of everyone living in the surroundings because of its radioactivity and chemical toxicity.

Nuclear power powers the bomb. Research in the field of nuclear technology, even if for medical purposes, always bears the risk of being used for the development and proliferation of the most cruel weapon of mass destruction humanity has ever invented. We won't escape the nuclear vicious circle if we overlook the link between the civil use of nuclear energy and its even more evil siblings, the nuclear weapons still being stored all over the world.

I don't want to silently swallow all that anger and sadness. I want to tell the world about it even if there's this meanly nagging suspicion that no one's really listening. I'm afraid that the world's leaders interest will abate within short notice, that the media will find another topic of urgent interest in no time. Sometimes it is better to be outraged than to be paralyzed. Maybe we should store some of this anger and use it as a renewable source of energy. We'll have to apply it wisely and persistently in order to make sure that the nuclear lobby won't have the final say.

—Ursula Völker
IPPNW Peace and Health Blog
April 4, 2011

Children of Fukushima need our protection

I was dismayed to learn that the Ministry of Education, Culture, Sports, Science and Technology earlier this week increased the allowable dose of ionizing radiation for children in Fukushima Prefecture.

The dose they set, 3.8 microsieverts per hour, equates to more than 33 millisieverts (mSv) over a year. This is to apply to children in kindergartens, nursery, primary and junior high schools. Let me try to put this in perspective.

Widely accepted science tells us that the health risk from radiation is proportional to the dose—the bigger the dose the greater the risk, and there is no level without risk.

The International Commission on Radiological Protection recommends that all

radiation exposure be kept as low as achievable, and for the public, on top of background radiation and any medical procedures, should not exceed 1 mSv per year.

For nuclear industry workers, they recommend a maximum permissible annual dose of 20 mSv averaged over five years, with no more than 50 mSv in any one year.

In Japan the maximum allowed annual dose for workers, 100 mSv, was already higher than international standards. This has been increased in response to the Fukushima disaster to 250 mSv.

The U.S. National Academy of Sciences BEIR VII report estimates that each 1 mSv of radiation is associated with an increased risk of solid cancer (cancers other than leukemia) of about 1 in 10,000; an increased risk of leukemia of about 1 in 100,000; and a 1 in 17,500 increased risk of dying from cancer.

But a critical factor is that not everyone faces the same level of risk. For infants (under 1 year of age) the radiation-related cancer risk is 3 to 4 times higher than for adults; and female infants are twice as susceptible as male infants. Females overall risk of cancer related to radiation exposure is 40 percent greater than for males. Fetuses in the womb are the most radiation-sensitive of all.

The pioneering Oxford Survey of Childhood Cancer found that X-rays of mothers, involving doses to the fetus of 10-20 mSv, resulted in a 40 percent increase in the cancer rate among children up to age 15.

In Germany, a recent study of 25 years of the national childhood cancer register showed that even the normal operation of nuclear power plants is associated with a more than doubling of the risk of leukemia for children under 5 years old living within 5 kilometers of a nuclear plant.

Increased risk was seen to more than 50 km away. This was much higher than expected, and highlights the particular vulnerability to radiation of children in and outside the womb.

In addition to exposure measured by typical external radiation counters, the children of Fukushima will also receive internal radiation from particles inhaled and lodged in their lungs, and taken in through contaminated food and water.

A number of radioactive substances are concentrated up the food chain and in people. As a parent, as a physician, the decision to allow the children of Fukushima to be exposed to such injurious levels of radiation is an unacceptable abrogation of the responsibility of care and custodianship for our children and future generations.

—Tilman Ruff
Kyodo News
April 26,2011

The writers

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COMMENTARIES

In addition to articles written for the press, IPPNW and its affiliates published their own statements about events at Fukushima; recommendations for action by the Japanese government, their own governments, and interntional agencies; and the need to phase out and end reliance on nuclear energy around the world. A number of those statements are reproduced in this section.

IPPNW-Germany demands the closing of all nuclear power plants worldwide

25 years after Chernobyl, and on the day of the catastrophe in Fukushima that resulted in an uncontrolled release of radioactivity, the German affiliate of the International Physicians for the Prevention of Nuclear War (IPPNW) demands that all nuclear power plants worldwide should be closed down. The risks of nuclear technology are uncontrollable even for allegedly safe nuclear power plants of the western world.

IPPNW points out that the population density in Japan is about 15 times higher than it is in the Chernobyl region. (Japan: 337 inhabitants/square kilometre). Depending on the direction of wind and weather situation the health consequences in Japan may be dramatic.

As physicians we wish to emphasise the global health risk that is a result of this catastrophe.

The radioactive cloud will not halt at Japan's borders. Increased levels of radioactivity were detected after Chernobyl even several thousands of kilometers away in Japan.

The time has come for politicians to prevail against the mighty lobby of the nuclear industry.

It is irresponsible to endanger us citizens for the profit interest of a few companies.

—IPPNW-Germany
12 March 2011

Medical specialists urge full information on Japan health risks

Specialists from the Medical Association for Prevention of War today lamented the lack of accurate information about the continuing nuclear crisis in Japan. It is deeply concerning that our government has now advised that Australian citizens should evacuate 80 km from Fukushima, having only yesterday reassured Australians that the 30km Japanese evacuation zone was adequate.

"We call on the Australian Government to seek and distribute comprehensive information from Japanese authorities about radiation releases from the ailing Fukushima reactors," said MAPW President Dr. Bill Williams.

"We are gravely concerned for those emergency workers on-site at Fukushima, and the hundreds of thousands of desperate people now sheltering or fleeing from radioactive fallout. Without accurate data, it is impossible to accurately assess risk levels."

MAPW notes that the lack of detailed data has already led to mischievous claims from industry representatives that people are at no risk. Equally disturbing has been the trend in some official statements trivialising the risks associated with lower level exposures.

"The current scientific understanding of the health risks from ionising radiation exposures are based on decades of research," said Dr Williams." The worldwide expert consensus conforms with the so-called 'Linear No Threshold' model: this means there is no safe dose of ionising radiation."

While it is essential that a calm and rational approach is adopted in advising the public, it is equally important not to give false assurance or to trivialise the dangers. Because of the chromosomal disruption caused by the radioactive matter being released from the damaged reactors and spent fuel ponds, inhalation or ingestion can lead—even at low doses—to cancers. This is

particularly so for children, babies and of course developing embryos. Many of the cancers caused by radioactive fallout from the Chernobyl accident were due to relatively low levels of radiation in the form of ingested I-131 in children drinking milk from cows which ate contaminated grass.

"We hope and pray that the Japanese emergency response averts the danger of larger releases over the coming days," said Dr Williams, "but the environment has already been contaminated, and people will be at risk of exposure to radioactive agents like iodine-131 and caesium-137 for many years to come."

—Medical Association for Prevention of War, Australia
March 17, 2011

India Should Use Renewable Resources for Power Generation; Shun Nuclear Power Plants

While expressing solidarity with the people of Japan at the devastation caused by Tsunami and Earthquake, Indian Doctors for Peace and Development (IDPD) has demanded that India should shun the pursuit for nuclear power plants and instead look forward to utilize renewable energy resources like, wind power, biowaste, microhydel and solar which are in plenty in our country.

We demand the government to immediately put moratorium on all ongoing nuclear activity.

Events in Japan are very shocking and vindicate the stand of International Physicians for the Prevention of Nuclear War (IPPNW) and IDPD that nuclear power plants are a potential threat of radiation. The cost of producing electricity from nuclear power is fraught with dangers and is 2-3 times more expensive than from conventional sources like coal and gas. There cannot be any comparison with the renewable resources which are totally non hazardous.

It is pertinent to note that US has not built any nuclear power plant since the 3 Mile Island incident and France which pioneered the nuclear technology and nuclear power plants have not built one in the last 25 years. The nuclear plant can never be dismantled as the half life of Uranium in the reactor is 24000 years that means the danger is reduced to half 24000 years and they have to be kept for an eternity, literally, before the spent fuel (the used Uranium from reactors) for it to become safe completely.

More over the cost of dismantling is much more than the cost of installation. The track record of safety in the nuclear facilities in India is far from satisfactory.

According to reports an estimate 300 incidents of serious nature have occurred causing radiation leaks and physical damage to the workers. But these have remained official secrets so far. During Tsunami water had entered the Kalpakkam Nuclear Plant in Tamil Nadu. The people around Uranium mines in Jadugoda are total unprotected. As per the reports the technology being used by the French company, Areva, which is building the world's largest nuclear power plant in beautiful coastline of Ratnagiri (Jaitapur Town), India has not been completely tested.

The world still remembers the Chernobyl nuclear accident where about 93000 people are reported to have died. Health of liquidators (cleanup workers) engaged in the job of cleaning the area is a matter of serious concern even today. An accident in a nuclear power plant is almost like an atomic explosion with serious consequences on flora & fauna and ecology. We demand that the Indian government should review its nuclear power policy and use other safe renewable options for power generation which are available in abundance in our country. Japan has the best disaster management capacity but in contrast our country?s track record in disaster management is extremely dismal.

The explanation by some of our nuclear lobbyists that our country falls in the low seismic zone is unfounded and ignoring the reality as next time the disaster may not be due to earthquake but due to terrorism, climate change, technology failure, proliferation of plutonium or human error.

IDPD is writing a letter to Prime Minister and all MPs in this regard.

—Indian Doctors for Peace and Development
March 17, 2011

PSR Statement on Radiation Exposure in the United States from the Japan Nuclear Accident

The unknown and changing situation in Japan regarding radiation releases is continuing to cause concern and confusion here in the United States. PSR National and our Chapters are receiving many questions regarding radiation effects and requests for medical advice. It is not possible for PSR to provide specific case-by-case medical advice. This should be given by individual health care providers and public health officials.

Currently, the primary public health risk from radiation exposure is to people closest to the plant site in Japan and in particular the workers. At this time, it is not known how much radiation may reach the US. It will depend on the amount of radiation released

and how the wind blows. Given the long distance across the ocean between the US and Japan, much smaller amounts are likely to reach the US and will likely not require any special treatment. However, avoiding radioactively contaminated food and water is strongly recommended.

For those people who are close by and directly affected by the radioactive plume, protective measures include staying indoors, moving to safer areas, and having children, pregnant women and lactating mothers take potassium iodide (KI). Pregnant mothers should do this only in consultation with their physician. Patients with known thyroid disorders should also consult a physician.

At this time, we do NOT recommend that people in the US purchase or take potassium iodide (KI). We do not recommend further preventive measures at the present time. We will continue to monitor the situation as best we can.

—Physicians for Social Responsibility
March 21, 2011

Physicians for Social Responsibility Deeply Concerned About Reports of Increased Radioactivity in Food Supply

Physicians for Social Responsibility (PSR) expressed concern over recent reports that radioactivity from the ongoing Fukushima accident is present in the Japanese food supply. While all food contains radionuclides, whether from natural sources, nuclear testing or otherwise, the increased levels found in Japanese spinach and milk pose health risks to the population. PSR also expressed alarm over the level of misinformation circulating in press reports about the degree to which radiation exposure can be considered "safe."

According to the National Academy of Sciences, there are no safe doses of radiation. Decades of research show clearly that any dose of radiation increases an individual's risk for the development of cancer.

"There is no safe level of radionuclide exposure, whether from food, water or other sources. Period," said Jeff Patterson, DO, immediate past president of Physicians for Social Responsibility. "Exposure to radionuclides, such as iodine-131 and cesium-137, increases the incidence of cancer. For this reason, every effort must be taken to minimize the radionuclide content in food and water."

"Consuming food containing radionuclides is particularly dangerous. If an individual ingests or inhales a radioactive particle, it continues to irradiate the body as long as it remains radioactive and stays in the body,"said Alan H. Lockwood, MD, a member of the Board of Physicians for Social Responsibility. "The Japanese government should ban the sale of foods that contain radioactivity levels above pre-disaster levels and continue to monitor food and water broadly in the area. In addition, the FDA and EPA must enforce existing regulations and guidelines that address radionuclide content in our food supply here at home."

As the crisis in Japan goes on, there are an increasing number of sources reporting that 100 milliSieverts (mSv) is the lowest dose at which a person is at risk for cancer. Established research disproves this claim. A dose of 100 mSv creates a one in 100 risk of getting cancer, buta dose of 10 mSv still gives a one in 1,000 chance of getting cancer, and a dose of 1 mSv gives a one in 10,000 risk.

Even if the risk of getting cancer for one individual from a given level of food contamination is low, if thousands or millions of people are exposed, then some of those people will get cancer.

Recent reports indicate the Japanese disaster has released more iodine-131 than cesium-137. Iodine-131 accumulates in the thyroid, especially of children, with a half-life of over 8 days compared to cesium-137, which has a half-life of just over 30 years. Regardless of the shorter half-life, doses of iodine-131 are extremely dangerous, especially to pregnant women and children, and can lead to incidents of cancer, hypothyroidism, mental retardation and thyroid deficiency, among other conditions.

"Children are much more susceptible to the effects of radiation, and stand a much greater chance of developing cancer than adults," said Dr. Andrew Kanter, president-elect of PSR's Board. "So it is particularly dangerous when they consume radioactive food or water."

All food contains some radioactivity as a result of natural sources, but also from prior above-ground nuclear testing, the Chernobyl accident, and releases from nuclear reactors and from weapons facilities. The factors that will affect the radioactivityin food after the Fukushima accident are complicated. These include the radionuclides that the nuclear reactor emits, weather patterns that control the wind direction and where the radionuclides are deposited, characteristics of the soil (e.g., clays bind nuclides, sand does not) and the nature of the food(leafy plants like spinach are more likely to be contaminated than other plants like rice that have husks, etc.).However, radiation can be concentrated many times in the food chain and any consumption adds to the cumulative risk of cancer and other diseases.

"Reports indicate that the total radioactive releases from the Fukushima reactor

have been relatively small so far. If this is the case, then the health effects to the overall population will be correspondingly small," said Ira Helfand, MD, a member of the Board of Physicians for Social Responsibility. "But it is not true to say that it is "safe" to release this much radiation; some people will get cancer and die as a result."

—Physicians for Social Responsibility
March 23, 2011

Nuclear catastrophe in Fukushima: extend the evacuation zone

The physician's organisation IPPNW-Germany and the President of the German Society for Radiation Protection (GfS), Sebastian Pflugbeil, believe that an extension of the evacuation zone around the damaged Fukushima nuclear plant is urgently needed. They call on the Japanese government to evacuate the population promptly from a much wider area, in particular to ensure the protection of children and pregnant women.

The recommendation of the US Nuclear Regulatory Commission (NRC) and the Australian Radiation Protection and Nuclear Safety Agency that the evacuation zone be extended to 80 kilometres could be a helpful first step, say the two organisations. Evacuation zones, however, are only a method of helping to roughly mark out a possible area of contamination and in reality the radioactive exposure depends on wind direction, strength and precipitation. Twenty-five years ago, when the Chernobyl disaster occurred, there was an irregular distribution of contamination and "hot spots" emerged, where the Soviet authorities found contamination of more than 555,000 becquerel per m^2.

Reinhold Thiel, member of the German Board of IPPNW, is especially worried about the danger posed by unit 3: "This unit is run on MOX fuel which contains plutonium and black smoke is billowing out of it. I am concerned that large amoungts of plutonium are now being released into the air." IPPNW calls on the German government to press for an immediate publication of all existing measurements of plutonium levels . "It could be, however, that Chancellor Merkel already has that information" said Thiel.

Plutonium is a highly toxic emitter of alpha radiation which does approx. 20 times more biological damage than the same dose of gamma emitting radionuclides such as Cesium-137. Breathing in plutonium easily leads to bronchial and lung cancer. If plutonium is taken into the body via food and drink, it concentrates in the liver and bones and has a biological half-life of 40 years in the liver, 100 years in bones.

According to IAEA, high levels of beta-gamma radiation were found at distances between 15 and 58 km away from the nuclear power plant. The measured levels were between 200,000 und 900,000 becquerel per m^2. This means, according to Prof. Edmund Lengfelder of the Otto Hug Institute on Radiation, that the Fukushima disaster has evidently reached the same dimensions seen in Chernobyl. After the Chernobyl disaster, contamination reached more than 555,000 bq/m^2 (Cesium-137) in Ukraine, Russia und Belarus.

Japanese authorities have found up to 55,000 bq/kg iodine-131 in spinach from the Ibaraki prefecture. These levels are way above the acceptable levels for Japan for consumption (2,000 bq/kg).

IPPNW and GfS call on foreign minister Guido Westerwelle to actively pursue the publishing of the radiation measurement data that the Comprehensive Test Ban Treaty Organisation (CTBTO) has collated through its global network of monitoring stations. The CTBTO shares this information with the WHO and IAEA but has not yet made this data public.

—IPPNW-Germany; German Society for Radiation Protection
March 24, 2011

MAPW President Bill Williams
YouTube video posted on March 29, 2011

Noting that Australia is a major source of the world's uranium for nuclear power plants, Dr. Bill Williams, President of IPPNW's Australian affiliate, MAPW, said "the Tokyo Electric Power Company is buying about a third of their uranium from us. Think about it. That cloud of radioactive gas and other materials that's depositing over Japan right now, some of that actually started here in Australia....On a good day for the nuclear industry, that uranium ends up as radiaoctive waste and we don't know what to do about that. But on a really bad day for the nuclear industry and for the rest of us, it ends up as radioactive fallout."

—www.youtube.com/watch?v=LziwRNUivPM

IN THE NEWS

Reporters and editors looking for an independent perspective on the health implications of the Fukushima nuclear disaster called upon experts at IPPNW and its affiliates to explain the dangers of rising radiation levels for the people in contaminated areas, and the potential dangers for those in other parts of the world should the radiation spread as it did after the Chernobyl explosion. A representative sample of quotes and citations from the international press are reproduced in this section, in chronological order.

"It is not known how much radiation has been or will ultimately be released from the damaged Daiichi nuclear reactor in Japan, but as found by the National Academy Sciences, any exposure to radiation increases a person's risk of cancer. No one, including the plants operators, can say what is going to happen, and potentially millions of people are in harm's way. The Japanese government should be preparing for the worst-case scenario. After one year of operation, a commercial nuclear reactor contains 1,000 times as much radioactivity as was released by the Hiroshima bomb. From a public health perspective, the most important isotopes are short-lived isotopes of iodine (like Iodine-131), Cesium-137, Strontium-90, and possibly Plutonium-239. Radioactive iodine caused thousands of cases of thyroid cancer in children after the Chernobyl accident. Cesium and strontium cause a number of different kinds of cancer and remain dangerous for hundreds of years; plutonium causes lung cancer as well as other types of cancer and remains deadly for hundreds of thousands of years."

—Ira Helfand, Physicians for Social Responsibility
Coal Geology
March 12, 2011

"I really cannot understand how such a number of nuclear reactors is built along the east coast [of Japan] which is known for danger of earthquakes, and we have seen now what has happened. Even here with us in Germany, we have minor earthquakes and nobody knows if one day they may be more severe and damage one of our reactors. So we think all reactors should be closed down as soon as possible and we should get our energy from renewables."

—Winfried Eisenberg, IPPNW-Germany
Interviewed by RT (Russia Today) TV,
March 12, 2011

"The accident in Japan could lead to a major rethink in Europe. And not before its time. Governments have not been transparent enough about the safety levels of the nuclear power sector."

—Henrik Paulitz, IPPNW-Germany
New York Times
March 13, 2011

"Each reactor has the radioactivity of 1,000 Hiroshima bombs," said Ira Helfand, MD, an expert on radiation exposure in Leeds, Massachusetts, and a board member of the group Physicians for Social Responsibility, referring to the atomic bomb dropped on Hiroshima, Japan, during World War II.

—Medscape Medical News
March 14, 2011

Radiation fears for residents near nuclear plant

The International Atomic Energy Agency says radiation levels around the plant are now 400 millisieverts an hour. That's eight times the amount, every 60 minutes, that nuclear workers are normally sup-

posed to absorb in a year.

Ira Helfand: That means that somebody who is exposed to this for a couple of hours would develop radiation sickness. This is a very, very large increase from the radiation readings that have been recorded just a few hours before the most recent explosion.

Bronwyn Herbert: Ira Helfand is a medical doctor based in Washington, DC who has written extensively on the impacts of radiation.

Ira Helfand: Well there are two different kinds of harm. If you get a high enough dose of total body irradiation you'll develop something called radiation sickness and you, over the course of a period of days to weeks, develop nausea, vomiting, suppression of your bone marrow which allows you to become susceptible to infections which promotes bleeding and you become weak, dehydrated. And if you absorb a large enough dose you die from this over a period of several weeks.

But even if you don't get that kind of large total body dose of radiation, if you inhale or ingest radioactive nuclides like radio-iodine or caesium or strontium or plutonium you can develop cancer subsequently and this is a second distinct danger that people will be facing if there is a very large release of radiation in this disaster.

—Australian Broadcasting Corporation
March 15, 2011

Health Risk Fears Escalate as Japan Nuclear Plant's Radioactive Release Remains Uncertain

Although the most pressing immediate health concern is the powerful direct gamma radiation that threatens workers at the plant, "we need also to focus on the radioactive isotopes that are being dispersed at some distance from the plant," Ira Helfand, a former president of Physicians for Social Responsibility, said at a Wednesday news conference organized by that group, which is opposed to nuclear power. ...

Some nuclear experts are concerned that "even if the total radiation dose is not real high downwind from a plant, the concentration of these isotopes can pose a very serious health problem," Helfand said. ...

The clean "linear relationship between your dose of total body radiation and the effect on your health is really lost when you're talking about low-dose radiation at some distance from the source," Helfand said. "You can have a very small total body radiation dose and end up getting thyroid cancer, or ingest some radioactive strontium and end up getting leukemia."

—Scientific American
March 18, 2011

IPPNW-Germany participated in a spontaneous demonstration against nuclear energy in Frankfurt on March 12, 2011—one day after receiving news of the disaster at the Fukushima Nuclear Power Station in Japan. IPPNW-Germany photo.

Radiation might affect Japan's youngest

You can't smell it, you can't taste it and you can't feel radioactive materials in the air. But exposure to it can affect the health seriously.

For normal adults, depending on the amount of radiation, exposure might cause cancer, premature aging, organ diseases or even acute poisoning which usually ends in death, explains Dr. Winfrid Eisenberg from IPPNW, a German working group on nuclear energy.

He also points out that radiation is a particular threat to unborn children. The young embryos, especially in the first three months of pregnancy, are the most susceptible to radiation damage, much more than born children or adults, he says. "An embryo grows very fast and it means that cells are dividing all the time," he explains further. "These cells are more sensitive to the effects of radiation than older cells."

Eisenberg says even a very small elevation of radioactivity or ionizing radiation may be harmful to embryos or fetuses.

—Deutsche Welle
March 18, 2011

"The nuclear lobby, after being silent for about 15-20 years, once again has begun to provoke discussions in favour of nuclear energy, arguing that 'oil prices are rising,' 'this is the only solution to the economic cri-

sis,' and that 'lignite is also dangerous for human health.' These people managed to impose the perception in the European Union that this [nuclear] energy is 'green,' which is a big lie. I'll explain why. Although the nuclear power plant does not contribute to increasing carbon dioxide in the atmosphere during its operation, very large amounts of carbon dioxide are produced during the stages of its construction, the extraction of the nuclear fuel and the destruction of the nuclear reactor. So, it is wrong to say that this is 'green' energy.

"The most negative is that all these nuclear power plants are associated with nuclear and radioactive weapons. Governments of countries that need nuclear weapons always strive to have nuclear power plants. This connection makes the companies and people who build them even more powerful. Of course, since people were afraid in recent years and governments have required very high security specifications, the construction cost of a nuclear power plant, which is half the value of its destruction cost, has become very high. For this reason, renewable energy sources began to compete with nuclear technology on price basis and they should be preferred....

"As I said, I was concerned about the ongoing discussion in Greece on the good side of nuclear energy. Even a political leader argued some time ago: 'when our neighbours build nuclear power plants, why don't we?' This is crazy. We think that we should exert pressure and we should do it again just like we stopped the construction of the Akuyu nuclear power plant in Turkey the first time, and just as we could 'freeze' the construction of Belene NPP we should not allow it to start again. We do not want the countries to lose their energy independence, but to provide the funds they spend now for making safer nuclear power plants for alternative energy development."

—Maria Arvaniti-Sotiropoulou, IPPNW-Greece
Interviewed in GR Reporter
March 18, 2011

U.S. radiation-safety experts said that, based on radioactivity levels detected in Tokyo's tap water, health risks for most people generally were slight.

Government officials in Tokyo urged special precautions with drinking water after detecting traces of radioactive iodine-131 in the water supply that were twice the acceptable level of exposure for children. The material was below the government's exposure limits for adults.

Radioactive iodine is especially worrisome to pregnant women and children because the body naturally concentrates the isotope in the thyroid gland, where it quickly can affect growth.

"The reason that iodine-131 is so dangerous in children is that their normal growth and development, especially of the brain, depends on the thyroid gland," said University of Buffalo Medical School neurologist Alan Lockwood, who sits on the board of Physicians for Social Responsibility, a nonprofit group that advocates against nuclear proliferation. "And if there is exposure as a child, the risk of developing thyroid cancer later in life is higher."

—Wall Street Journal
March 23, 2011

"Plutonium is a very dangerous and harmful substance. Even in small quantities, plutonium, if ingested by the human body, almost certainly leads to the development of cancer. There is no concept for how to monitor and how to store the radioactive fuel, which will radiate for many, many thousands of years. According to the information provided by the IAEA last week, already a significant amount of radioactive substances such as iodine-131 and cesium-137 will be released; it might lead to a situation where we might compare Chernobyl and Fukushima if it comes to the release of the radioactive substances. Plus, at this time there is a danger of a release of plutonium."

—Lars Pohlmeier, IPPNW-Germany
Interviewed by RT (Russia Today) TV,
March 29, 2011

Indian Doctors for Peace and Development (IDPD), IPPNW's Indian affiliate, held a press conferenceon March 17, 2011 to express "solidarity with the people of Japan" and to demand that India "shun the pursuit for nuclear power plants and instead look forward to utilize renewable energy resources." IDPD photo.

"Monbiot's assumption ignores all that is known about the health effects of previous nuclear accidents, particularly Chernobyl. Leaving aside the deaths of workers killed either by the initial explosion or through exposure to dangerous levels of radiation during the clean-up, the impact on health from nuclear accidents continues—25 years and more than 6,000 cases of thyroid cancer later, the effects of Chernobyl are still being felt in the UK. Today, more than 300 farms remain contaminated and are still under food restriction orders.

"Supporters of nuclear power often fail to address the threat to the health of future generations by the unsolved problem of nuclear waste. Buried in the ground, it remains radioactive for tens of thousands of years, and is vulnerable to climate change and natural disasters. What right do we have to dump this lethal legacy on future generations?

"Monbiot worries about the impact of wind farms, pylons, power lines and reservoirs on the landscape. Can we really balance the altered appearance of the landscape with the impact that drinking water contaminated by radiation would have on children's health? Given the potentially devastating impact on the health of future generations, the cost of nuclear power is just too high."

—Marion Birch, Medact
Letter to the Editor, The Guardian
March 29, 2011
(in response to an article by George Monbiot arguing that the Fukushima disaster had shown that nuclear energy, even in the worst of circumstances, was less dangerous to public health and the environment than the alternatives)

"The discovery of plutonium in the area around the Fukushima plant is another indication of the seriousness of this accident. The dangers of such a release, to public health and the environment, cannot be overstated. If a minute amount of plutonium is trapped in the lung, it will deliver an intense dose of radiation to a very small volume of tissue for a very long time. This makes it highly carcinogenic."

—Alan H. Lockwood, Physicians for Social Responsibility
eNews Park Forest, Illinois
March 30, 2011

"Japan's government and TEPCO must be completely transparent about the facts of this situation....In order to properly protect the public and our precious natural

Medact director Marion Birch calls for an end to nuclear energy in Britain during a demonstration in London to commemorate the 25th anniversary of the Chernobyl disaster on April 26, 2011. Campaign for Nuclear Disarmament photo.

resources, it's vital that they give us a full accounting of what they've discovered around the plant."

—Jeffrey Patterson, Physicians for Social Responsibility
eNews Park Forest, Illinois
March 30, 2011

"[T]here's a current major controversy in Japan because the government has decreed that the maximum permissible limit for children in Fukushima will be not one millisievert, which is the normal standard internationally and in Japan, but 20 millisieverts. Now that involves significant risks. That means that if you say that there are two million people living within 80 kilometres of Fukushima, if you say roughly half a million of them might be under 20 then you're talking about potentially 3,000 or 4,000 additional cancers per year in those from 20 millisieverts. So that's currently under intense controversy, as it should be, in Japan....

"[R]adiation in foodstuffs is long term a

significant hazard from nuclear fallout from either nuclear weapons or from accidents involving nuclear reactors or spent fuel. That's complicated and exacerbated by the fact that a number of important isotopes...mimic important biological constituents that are normally part of our bodies and how they work.

"So, for example, iodine-131—one of the important particularly early radioactive contaminants released in Fukushima and Chernobyl—has a half life of eight days; it's pretty short. Your body can't tell whether that iodine is radioactive or not, it treats it just as iodine which your body uses to make thyroid hormone—the hormone that's basically the accelerator pedal on your metabolism; it sort of revs you up or slows you down. Now the uptake and the risk from iodine, which is a major cause of thyroid cancer, and this major rise—about 7,000 cases of thyroid cases in the vicinity of Chernobyl so far, an increase that's likely to continue for some decades—is directly related to exposure to iodine because there were not appropriate constraints on eating iodine-contaminated green leafy vegetables or dairy products, where the iodine contaminates the soil and the grass, the cows eat, it gets concentrated in the milk and cheese and then people eat....

"Cesium, another important isotope, behaves chemically like potassium, so your body puts it inside cells, treats it like potassium so it's widely dispersed in the body. Strontium-90, another important nuclear fallout contaminant also with a half life of 28 years—so around for a long time—behaves chemically like calcium, so it's concentrated in bones and teeth. Plutonium is also concentrated biologically. So because these sort of mimic important substances that our bodies use, these can be concentrated in plants and animals and up the food chain...

"...[A] lot of [this information] can be used as a way of helping to minimise people's exposures in ways that make good public health sense and informing people about the risks. Particularly protecting the most vulnerable, who are children and pregnant women, who take up more radiation for example because their thyroids are relatively more active, who are more susceptible to the effects and who may have, in fact, accumulate higher levels in their bodies. So, simply things like avoiding milk in the weeks and months after a release of iodine will avoid the risk of thyroid cancer very substantially.

"So there are significant risks but certainly exposures that would involve small fractions of a millisievert of additional risk are relatively insignificant. But it's also important, I think, to say that what might be an insignificant risk at an individual level—if an individual is exposed to one millisievert extra radiation increases their lifetime risk of cancer by 1:10,000, it doesn't sound like a bit deal. But if you apply a 1:10,000 risk to a million or 10 million or 100 million people then you're talking about thousands or tens of thousands of additional cancer cases. So it's about how that burden is shared as well as the dose itself."

—Tilman Ruff
Interview on Up Close, University of Melbourne
May 17, 2011
[Full interview available at upclose.unimelb.edu.au/episode/144-waiter-theres-cesium-my-soup-health-implications-radioactivity]

A First-Hand Account of Japan's Nuclear Crisis

Katsumi Furitsu

On March 12, 2011, the day after northeastern Japan was struck by an 8.9 Richter-scale earthquake and tsunami, IPPNW began to receive first-person, detailed updates about the crisis at the Fukushima Nuclear Power Plant from Dr. Katsumi Furitsu, a specialist in radiation biology and medical genetics based in Osaka, and a member of the board of the International Campaign to Ban Uranium Weapons. Katsumi's reports, arriving several times a day, provided information and insights into the worsening situation on the ground—information sometimes in stark contrast with what has been reported in the Japanese and global media. Following are all of Katsumi's messages, from the first on March 11 to the last on March 19, with a final reflection on April 22. Katsumi is the first to advise readers that her posts, which were added as they arrived to the IPPNW Peace and Health Blog, were written in haste and amid the confusion of events on the ground. She frequently corrected and revised the information she provided from one update to the next. The real value of these communications—and the reason we include them here unedited—is not only in the information Katsumi provided to those outside Japan who were desperate for information, but also in the sense of immediacy, urgency, sadness, and empathy for the victims and the rescue workers she conveyed to readers who could only observe each day's events from a distance.

March 11, 2011 5:54:29 PM EST
Japan News Update

Dear all,

You might already know the following news.

There is already radioactive leakage from the container of the core.

The TV news has just said radiation level in front of the gate of the plant increased up to the level of 8 times higher than the "normal level" (background? or limit?).

Best,
Katsumi Furitsu in Osaka

[From Reuters/Kyodo—ed] Thousands evacuated amid nuclear leak fears

Japan dispatched around 160 military personnel, sending its chemical corps and an aircraft on a "fact finding mission" to the nuclear plant.

- *Related Story: Residents near nuclear plant told to evacuate*
- *Related Story: DFAT issues Japan travel warning*
- *Related Story: Japan death toll could top 1,000*
- *Related Story: Record quake unleashes tsunami on Japan*
- *Related Story: Millions stranded in Tokyo subway shutdown*

The Japanese government has declared an atomic emergency because of the "possibility" of a radioactive leak from a nuclear reactor in the quake disaster zone.

But operators of the Fukushima No. 1

nuclear plant have warned that radiation could already have leaked.

This morning Japanese prime minister Naoto Kan said thousands of people living within 10 kilometres of the nuclear plant must evacuate.

The amount of radiation reached around 1,000 times the normal level in the No. 1 reactor's control room, the Kyodo news agency reported the Nuclear and Industrial Safety Agency as saying.

Trade minister Banri Kaieda earlier said authorities were nearing a decision to release radioactive steam from the troubled nuclear reactor in a bid to ease a pressure build-up after its cooling system was damaged by the massive earthquake.

"Pressure has risen in the container of the reactor and we are trying to deal with it, "a spokesman for Tokyo Electric Power, which operates the plant, said.

The government had earlier said no radiation leaks were detected among its reactors after the 8.9-magnitude earthquake struck on Friday, Japan's biggest on record, triggering huge tsunamis.

The plant had shut down after the quake, but a reactor cooling system failure had led to the evacuation instruction, a situation the government said was "under control".

Japan has dispatched around 160 military personnel, sending its chemical corps and an aircraft on a "fact finding mission" to the nuclear plant, Kyodo said.

Prime minister Naoto Kan had earlier said no radiation leaks had been detected from Japan's nuclear power stations after the massive quake struck the country.

The IAEA's Incident and Emergency Centre had said that the four nuclear power plants closest to the quake which occurred near the east coast of Honshu, Japan, had been "safely shut down".

According to the industry ministry, a total of 11 nuclear reactors automatically shut down at the Onagawa plant, the Fukushima No. 1 and No. 2 plants and the Tokai No. 2 plant after the strongest recorded earthquake in the country's history.

A fire that broke out in the turbine building of Onagawa nuclear plant in Miyagi Prefecture had been extinguished, the government said. Operator Tohoku Electric Power said there were no indications of a radioactive leak.

Miyagi prefecture was one of the areas worst hit by the tsunami.

Millions of households were without power in north-eastern Japan, according to Tohoku Electric.

Japan - located on the Pacific Ring of Fire, where continental plates meet and create a string of volcanoes and seismic hot spots - records 20 per cent of the world's major earthquakes.

As an industrial powerhouse nation poor in energy resources, Japan also draws about 30 per cent of its total power from its 53 nuclear plants.

March 12, 2011 1:29:04 AM EST
the core is starting to melt down

Dear all,

The news just says that Cs 134 has just been detected surrounding the plant building.

The official nuclear safety committee has announced that it means the core may be starting to "melt".

The government decided to release the air from the containment this morning to reduce the pressure inside. However, it has become clear that they could not open the valve properly and could not actually reduce the pressure.

Then, the cooling water level is getting lower and the upper part of the fuel rods (about 170cm) has come out from the surface of water.

The temperature of the core is getting higher over 2700 degree centigrade.

The radiation level at the gate of the plant is measured to be 90 times as higher than background.

Not all the people from 10km zone has yet evacuated.

I am afraid that the situation is similar to TMI or worse.....

We cannot access to any further information now....

Katsumi

March 12, 2011 1:49:48 AM EST
the core is starting to melt down

They have just announced that they "successfully" opened the valve to reduce pressure of the containment.

They said that pressure inside is getting lower now.

I really hope that the situation is getting better. They are releasing radioactive materials into the environment, though.

March 12, 2011 3:43:29 AM EST
getting worse...

The news is reporting that the radiation level near the plant (?) is measured 1,015 micro Sv/h.

March 12, 2011 3:21:17 AM EST
getting worse...

The reactor (Fukushima I) exploded!
The walls and ceiling have fallen down.
It is just like Chernobyl.....

March 12, 2011 1:47:22 PM EST
cooling with sea water

Dear all,

The government and the company announced that the plant-building was broken (by phreatic eruption) but the containment and the reactor vessel are intact.

It is said that the hydrogen eruption inside the building (outside of the containment) occurred under the high temperature because of the failure of core-cooling-system.

The fuel rods inside the reactor vessel has actually "melted down" to some extent without proper cooling system (the level of cooling water was getting lower).

They decided to cool the reactor vessel and the containment vessel with sea water with boron. The media has reported that a team of the defense force is pumping the sea water and pour into the container now.

As you know, it is unusual decision (or last choice for them) to use sea water for cooling. They seem to decided not to continue to use the reactor after the settlement of critical situation.

It is also reported that the radiation level around the plant is getting lower now.

However, people have already been exposed to radioactive materials to some extent as Ryoma informed. (It is reported that a person with "positive contamination" was exposed at the point 3.7km from the reactor while he/she was getting out of 10km zone. Evacuation zone is now extended to 20km, though.)

We do not know the actual situation of exposure. We have to follow up the situation carefully.

Peace,
Katsumi

March 12, 2011 6:35:44 PM EST
some update

Dear Jeff [*PSR-USA president Jeff Patterson—ed.*] and all,

Thank you for the response and advice.

I do not think that people (children) have already taken iodine. (I know it is most ideal to take iodine before being exposed to radioactive iodine.)

Can you imagine the situation over there? People have such a disaster of earthquake already and, in addition to it, they are facing to the serious danger of nuclear power plants. It is not a "simple" nuclear-power-plant-accident. The traffic is cut off in some places. All the life line is actually stopped. Some people might already got injured.....

We ourselves have some friends who live within 3 km from the plant, but we cannot make contact with them since the earthquake happened. We do not know whether they are safe or not even without the problems of nuclear power plants. We only pray for their safety.

It is said that a team from the National Institute of Radiological Science was sent (or will be sent?) to the area.

I really hope they will make a proper decision to protect people.

(I am personally feeling frustration that I cannot do anything directly right now.)

The news has just reported that they found 160 people are exposed, but another news has reported 15 people are exposed and getting some treatment of decontamination. However, we do not know how they diagnosed the people are exposed.

The chief cabinet secretary, Mr. Makieda, has just announced that 9 people are contaminated. He said, "the 'count' of surface radiation was 1800-40000 cpm." (They seem to use a most simple radiation detector and checked the surface contamination of people's clothes. They do not have any information of internal exposure.) He emphasized again and agin that "the contamination level is not harmful to people".

As far as I understand from the media news, they have just pour sea water into the containment vessel, but not circulate it at this moment. However, the situation is not clear to me. If they circulate the sea water, they have to release the contaminated water into the sea....

Yes, the cooling system has not yet recovered, as far as I understand.

The bad news is that the same process has been going on in another reactor (No.3 reactor) at the same "Fukushima-I" reactor site. They have just decided to release the air inside the containment to the environment again.

It is a release of radioactive materials to the environment to avoid the worse scenario.

We have to follow the things carefully.

Peace,
Katsumi

March 12, 2011 11:44:00 PM EST
all the three running reactors are going though the similar process

The media has reported that the Tokyo Electric Power Company has just decided to release the air from the containment of the No. 2 reactor of Fukushima-I site to the environment to reduce the pressure inside.

Therefore, all of the three reactors (No. 1-3) at the Fukushima-I site, which were running at the time of the earthquake, have been going through the same process.

About 210,000 people in total are already ordered to evacuate from the 20 km zone(180,000) from the Fukushima-I site and 10 km zone (30,000) from the Fukushima-II site. (You might remember that about 120,000 people are evacuated from the 30km zone of the Chernobyl power plant.)

However, it is not still clear that how many of them, 210,000 people, could evacuate.

March 13, 2011 10:30:26 PM EDT
reactor situation

They are now announcing the news: just about 20 min ago, the hydrogen explosion happened at the reactor No.3; the situation is just as the No. 1 reactor.

The building of the reactor has broken. We can see on TV the walls and the ceiling have fallen.

We do not have any further information at this moment. We only hope the core containment would be intact....

March 13, 2011 10:47:41 PM EDT
reactor situation

It is said that there are still 600 people within 20 km, most of them are old people or patients, their families and medical staff. It was not easy for them to evacuate soon.

The Chief Cabinet Secretary is now announcing that the company has reported that the containment is (seems to be) intact.

It is reported that no increased level of radiation is measured at this moment at the boarder of the site.

March 14, 2011 7:32:50 AM EDT
running on the "edge of cliff"

Dear all,

Now the No. 2 reactor is getting into a critical situation.

The company and government announced early in the afternoon that all the cooling system is out of order.

After that the cooling water level inside the fuel vessel went lower. Then they tried to cool the core with sea water, but they could not do so from some reason. Now, it is reported that whole body of the collective fuel rods are above the water surface (or no water anymore in the fuel vessel containment?). They say that the fuel rods might be "melting".

I do not want to believe the situation, though....

They are thinking to cool the containment anyway.

When I have written this message to this point, the announcer of the TV news program has suddenly reported, "The government has just announced that they successfully started to pour the fuel vessel with sea water!"

The situation is still unstable. Hydrogen gas might be accumulating inside the plant building....

We will continue to follow the situation carefully.

March 14, 2011 12:09:45 PM EDT
reactor No. 2/ "heating an empty bathtub"

Dear all,

The electric power company has just had a press conference:

They started to pour the sea water into the core vessel and the level of water surface went up to the half of the fuel rods.

However, they came to fail to pour the water about two hours ago because of a high pressure inside the core vessel. They say that a valve to reduce the pressure has closed. Then the water surface level went down to the "down scale" again and the whole fuel rods are left without cooling water now (as "heating an empty bathtub"). They does not deny the fuel rods has meltdown.

They are now trying to open some other valve to reduce the pressure.

The radiation level at the boarder of the plant was once measured as high as 3,130 micro Sv/h.

I am sorry for such a complicated explanation.

The situation is really unstable and complicated....it is critical situation anyway.

March 14, 2011 7:22:02 PM EDT
a part of containment has broken

The government has just announced:

There was an explosion at the No.2 reactor.

The "Wetwell" (suppression pool- see the figure in a document which Xanthe sent us yesterday) seems to break. The pressure inside the pool has gone down from 3 to 1 atmospheric air pressure.

The radiation level at somewhere at the plant (probably at the gate again?) increased to 965.5 micro Sv/h (later it went down a little bit, they said).

The company has ordered a part of workers to evacuate out side of the plant.

As you can understand, it means a part of containment itself has broken. This is a quite serious situation. The most important barrier to retain the nuclear materials has broken.

I have no words.... the people in the badly affected area by earthquake and tsunami are facing to the danger of nuclear plant.

The government has announced again that the radiation level is not "an immediate danger for public health".

March 14, 2011 8:05:42 PM EDT
8,217 micro Sv/h is measured after 2 hours from the explosion

The company has just reported:The measurement at the gate of the plant was 8,217 micro Sv/h.

It was about two hours after the explosion at the reactor No.2.

It is also reported that about the half of the fuel rods are now above the cooling water surface.

(It was totally above the water surface for some hours during the night, though.)

March 14, 2011 10:27:16 PM EDT
a fire in the reactor No. 4

The government is now announcing:

There is a fire in the reactor No. 4, which was not running at the time of the earthquake.

It seems to happen by hydrogen explosion. They are now working on extinguishing the fire.

The radiation level measured inside the site:

between reactor No. 2 and 3: 30 mSv/h (note it is not micro Sv/h !!)

near the reactor No. 3: 400 mSv/h

near the reactor No. 4: 100 mSv/h

Now, the government is officially saying that the level at the site of the plant is "actually harmful" for people (workers at the site). The workers, except in charge of cooling the plants, were ordered to evacuate.

The people within 20 km ordered again to evacuate completely.

The people within 20- 30 km ordered to be stay inside building.

Katsumi

P.S. An additional information from the news:

The fuel cooling ponds of both (?) reactor No. 1 and 3 are now left without any over after the explosion of the building. It is under the open air. The cooling system is already out of order so it is not actually a "cooling pond". Unbelievable situation, but seems reality.

March 15, 2011 4:51:06 PM EDT
some updates

Dear all,

I am sorry, but I could not follow in detail the situation since yesterday afternoon.

We, some grassroots groups, went to visit the main office of the electric poser company in our region (Kansai, the area including Osaka) to request them to stop all of their nuclear power plants as soon as possible. There are around 10 nuclear power plants about 100 km from Osaka. We requested them to learn the lessons from the disaster which is now happening in Fukushima. We know there is no place in Japan which is completely free from the possible danger of the earthquake and the problems of nuclear power plants.

Anyway.....as far as I have followed the news and statements from the government and company:

#The problem of spent fuel pond in the reactor No.4 is serious:

-They cannot decide yet what the actual cause and process of the fire at the reactor No. 4. Fortunately, the fire stopped spontaneously after some hours.

- They found that the temperature of the water of the spent fuel cooling pond is increasing from 40 to 84 degree centigrade as the cooling system is now out of order. After that they cannot measure the temperature as the meter was out of order. They think this situation might link to the fire and explosion at the plant.

- The hydrogen explosion might happen at the building (hydrogen was generated from the situation of spent fuel pond?). They found two big "holes" (8m x 8m)at the wall and the ceiling.

- The situation of the spent fuel pond is now focused. They considered an idea to pour water using a helicopter from the "hole" on the ceiling. However, the hole is not just above the cooling pond and they has gave up the idea.

- They are still seeking to solve the problem.

- They also reported: the fuel rods complex which was to put into the core vessel is in the pond (it is not a spent fuel) ,as they were just before starting to run the reactor when the earthquake happened.

- They also reported that the radiation level inside the building is too high for workers to work. That is way they are thinking to pour water from outside the building.

#The level of radiation slightly elevated in the morning yesterday, on March 15, in the south area from the plant including Tokyo (around 200km from the Fukushima plant). It seems to come from the explosion at the reactor No.2.

Tokyo (Shinjuku):0.81 (around 200 km)

Tokyo(Utunomiya-shi): 1.318 (around 200 km)

Saitama city:1.22 (around 200km)

Fukushima Iwaki: 23.72 (around 50 km)

The increase depends on the direction of the wind.

#They are now worrying about also the increasing temperature and possible decrease of cooling water of the cooling ponds of reactor No. 5 and 6.

They reported some data about the measurement at the site:

at the gate: 9:00, March 15: 11930 micro Sv/h

15:30 : 596.4 micro Sv/h

inside the site: most recent?, March 16: 200-300micro Sv/h

The government is emphasizing the level is decreasing now.

#The Ministry of Health, Labour and Welfare decided to re-consider the "maximum permissive dose" for nuclear workers at the emergency situation. It is 100mSv at the time of "emergency situation for lifesaving", now in japan. (In usual situation, it is 100 mSv per 5 years, at the maximum limit of 50mSv per year.) However, they has decided to set up the "maximum permissive dose at emergency situation" 250mSv that is 2.5 times as higher than the present limit. They say that under this level, 250mSv, any acute symptoms would not occur. (I do not agree with their idea, though. They might decide it as they think it impossible to manege this critical situation without letting workers work under such a hight level of radiation.)

...

I think you can now read some other detailed media coverage or reports from specialists on these situations even in English, though.

It is really hard for us to see the situation of people who have been suffering from the disaster of earthquake and tsunami, and in addition to it, they have to evacuate again or ordered to keep inside building. They cannot even try to find out their loved ones who are still under such huge wrecks.

Some (or many) people are now trying to leave from the 30 km zone.

I am sorry for I do not cover all the disaster and suffering of the people in the affected areas, but only focusing the issue of nuclear power plants.

I hope you can follow the whole situation, which I could not write here, from the media coverage.

Best,
Katsumi

March 15, 2011 5:55:28 PM EDT
another fire/ No.4

The company has just announced that there was another fire at the reactor No. 4 early in this morning!

We do not have further information now. Hydrogen explosion again??

March 15, 2011 9:45:10 PM EDT
the fire seems to be continuing

It is something like a nightmare...

We are now seeing the video of the Fukushima-I plant site, which was taken from the distance of 30 km.

The image is not clear, though.

We can see white smoke from one of the reactor buildings.

It might be reactor No. 4.....the water temperature of the spent fuel pond with non-spent-fuel-rods-complex might be getting higher or it might be already boiling and in a possible worse scenario, some part of fuels are above the water surface and starting to "melt"....

I am not a specialist of this kind of technical things. So, I should not make comment on this, though.

The site, especially close to the building of No. 4 is now in the very high level of radiation.

It is not easy to extinguish fire. They might send a special unit to do the proper work at the site as they did in chernobyl.....

Please note that it is only my personal "imagination"....

The company have just started to explain the situation:

They are saying that they themselves cannot recognize/confirm the real situation because of the highly contaminated situation inside the site. It seems that the smoke can be seen around No. 3 or No. 4. They are insisting that they do not make any comment as making comments based on speculation might cause more confusion....

We are physicians. When we treat such

serious patients, we usually think about the worst scenario and try to do everything what we could do as soon as possible.....before the situation would get worse. I really would like to believe that they, the company and government, has been working in the same way.

I wonder what we can to protect people...now....

Katsumi

March 15, 2011 10:07:03 PM EDT
the fire seems to be continuing

The company also mentioned that 4 fire engines were sent to the site from the local fire station.

The company also said that the plant workers even cannot confirm the situation because of the high radiation level.

I am really surprised that the local fire station is still working.....well it should be working.....but, I really hope that they are well equipped for the task at such dangerous situation. It reminds me the firemen at the Chernobyl site who worked just at the time of the accident. You all might know what happened to them.

I really hope my imagination would be just an imagination and not real....

March 15, 2011 10:29:49 PM EDT

The Chief Cabinet Secretary has announced:

What we saw in the vide image was smoke/steam from the reactor No. 3.

The radiation level at the gate increased rapidly from around 600-800 micro Sv/h to mSv/h level for a while around 10:00 am.

However, it is getting down at 10:54.

They think that the steam might be coming from a possible leak of the containment of the reactor No. 3, as it happened at the reactor No. 2 yesterday.

The government has been making great effort and some staff from the government has been working at the site together with the company.

So, it was not from a fire of reactor No. 4.

March 16, 2011 8:24:38 AM EDT
The following are some updates:

#The smoke/seam from reactor No. 3:

The company said that the smoke/steam from the reactor No. 3 came from the spent fuel pond (not from a possible leak from the containment).

The cooling system of the pond is out of order and the temperature of the water is getting higher to make steam. As you know, the building of this reactor already is broken down and there is no cover/ceiling over the spent fuel pond. It is open to the air now.

Then, they are planning to drop sea water from helicopters and fill the pond with water to stop the damage of spent-fuel rods.

A team of "Defense Force" started the training to do the task. They are ready to start now.

However, the radiation level over the pond is still high. It was measured "far more than 50 mSv/h". (They actually measured it by a helicopter.) So, they decided not to pursue this operation today. There is no guarantee that the radiation level would become lower tomorrow, though. (The government has decided yesterday to set up the maximum exposure level at an emergency situation from 100 to 250 mSv, as I wrote you yesterday.)

#The reactor No. 4:

The government has just ordered the "riot police" to go to the site as they have a special car which has a "high pressure injection system". (I do not know the proper words for such a car in English. I suppose a car which might be usually used against "riot"....or sometimes against a demonstration, as some of you might know?) They will try to fill the spent fuel with water using the special car. The defense force will lend protective suits to the "riot police". They will start to work tomorrow morning.

#The result of the radiation level measurement today:

Today, a team from the Ministry of Education and Science, measured around the 20-60 km zone:

about 20km: 0.33 mSv/h

30-60 km: 0.0253 - 0.0125 mSv/h

The government and media emphasized, "the level is not a immediate danger for the people's health, though it might be problem to live in such area continuously for a year."

(I agree that it is not an "immediate danger" but it could contribute to cause "late effect" as cancer, leukemia or other disease. It depends on the duration of exposure.)

They do not provide us, people, any information about the concentration of radioactive noble gas, iodine, cesium and so on.

Peace,
Katsumi

March 16, 2011 8:56 PM EDT
They start dropping water.....

We are now watching on TV a helicopter which is measuring the radiation level over

the plants.

The helicopter has just dropped water over the No. 3 reactor.....

The reporter saids: The CH 47 helicopter can carry 7.5 ton of water. Another helicopter is now heading to the site. (9:48 am)

The second one (or the same one? again) has just drop water....9:52 am

The third drop is over No. 4.

I will write further later.....

March 16, 2011 10:19 PM EDT
more information

Just before starting to drop water from the helicopter the government had a press conference.

The following is the information from the conference and the TV media (NHK) report showing the actual operation.

We saw white steam coming out after dropping water. You may see the video later or already seen? Not all the water could drop in pin-pont over the pond unfortunately.

Reactor No. 3:

They will pour the spent fuel pool with water both by helicopters of the defense force and special cars with high pressure injection system of the riot police.

The helicopter, CH 47, can carry 7.5 ton of water. It dips up sea water nearby, flies to the reactor and drop the water over the pond of reactors. Before the operation, they measure radiation level and wind over a reactor and see the feasibility to work.

The defense force (DF) estimated that they have to repeat this procedure more than 100 times to fill a pond.

The reporter said that the maximum radiation limit for DF staff is set up 50 mSv with exception of life saving situation:100 mSV. (So, they seem to keep the present limit anyway....)

On the other hand, they are collecting 11 cars with special injector from all over Japan. All or some of them are now ready to go....they have already headed to the site from 20km zone. They will start to work after the operation of dropping water from helicopters so that (hopefully) the radiation level at the site would reduce to some extent. A car can carry 4 ton of water for each. They will stay about 50 m from the building (as the maximum injection length is 50m), but they estimated only one min. would be allowed for a staff before reaching the maximum exposure level.

They decided to start from the reactor No. 3 as it is more dangerous compared to No. 4. (You may remember that No.3 has the not spent fuel complex in the pool.) It is easier to drop water in the case of No. 3, as it has no ceiling anymore.

They have dropped water four times this morning from 9:48 to around 10:00 am. (So, the exposure dose might become up to 50 mSv for around 15 min inside the helicopter. This is only my guess.) They said that they put a lead plate on the floor of the helicopter and a staff on board is measuring radiation level during the operation. They put on protecting clothes.

#As for No. 4, they will not use helicopters, but only use the cars of the riot police, as a hole on the ceiling is far from the pool. Fortunately (?) it already has a large hole (or holes?) (seeing from the picture, it is not a hole, almost whole side wall facing to the sea has completely fallen down) on the wall. So, they think that they can inject water from the side.

#The reactor No. 5 and 6:

The temperature of the water of spent fuel pons is increasing:

No. 5: 63 degree centigrade (5 degree increased compared to yesterday)

No. 6: 60 degree centigrade (4 degree increased compared to yesterday)

They are preparing to introduce electricity from outside of the plant site and try to recover the cooling system.

The facilities of pumping were destroyed by tsunami.

#The reactor No. 1 and 2 are stable anyway. They continue pouring sea water into the containments and core vessels.

March 16, 2011 10:46 PM EDT
some additional information

#The minister of defense ministry is now at the press conference:

some additional information:

The radiation level measured before the operation:

4.13 mSv/h at 1000 feet

87.7 mSv/h at 300 feet

They did not start the operation, but they decided to do this morning as the situation too critical to wait anymore.

The minister does not yet have the data after the droppings.

The US force will also join the operation later.

March 17, 2011 10:27 AM EDT
30 tons of water was injected into the reactor No.3

#In addition to dropping water from the helicopters this morning, the defense force has injected 30 tons of water in total to the No.3 reactor.

Five special cars were involved in the operation today. They spend around five min for each (7:35, 7:45, 7:53, 8:00, 8:07 p.m.). A pair of personnel worked staying in a car.

We hope the operation was successfully.....we do not know whether or not radiation level has decreased after the operation.

#Prior to the operation by the defense force, the riot police tried to inject water into the No. 3 reactor, but they failed to reach the target.

#It was reported the radiation dose of personnel involved in the operation by helicopter this morning was within the emergency dose limit 100 mSv (max data was 60mSv).

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March 17, 2011 8:09:35 PM EDT
some information/ they are ready to go also today.....

The defense force (DF) personnel who worked for injecting water into reactor No. 3 yesterday:

Dropping water from helicopters:

17 personel were involved in the operation worked around 90 m above the reactor

The exposure dose was officially reported: all of them are under 1mSv

They used a plate of tungsten (not lead, reporter revised the information) for shielding.

Injecting water from cars:

13 personel

The chief of the DF reported: exposure dose of personnel was up to 60 mSv (maximum)

#The company made comments on the effectiveness of the operation yesterday, on March 17:

There was not so much change of radiation dose rate by the operation of helicopters: changed from 3782 to 3752 micros Sv/h (somewhere inside the plant site).

However, they think a spout of steam from the building which can be seen just after dropping water might be an evidence that the operation could reduce the temperature at the fuel pond to some extent. (I also want to believe so....)

As for the injection of water from cars on ground 50m from the reactor building:

The radiation level at the gate of the plant site:

3:30 pm (before the operation): 309 micro Sv/h

11:00 pm(after the operation): 289 micro Sv/h

#The data radiation level measured by the Ministry of Education, Culture, Sports, Science and Technology on March 17:

Max: 170 mico Sv/h (14:00, 30 km northwest from the plant)

They measured at 28 places in 20-60 km zone, 9:20-15:00 : 18.3-1.1 micro Sv/h

The data depends on the direction of the wind.

#Today (March 18), the DF is ready to work for the same operation both from sky and ground.

In addition to the DF, a fire brigade with special type of cars (usually used for a fire of airplane) from Tokyo has already headed to Fukushima at the midnight. They will also join the operation.

Four helicopter will work.

More cars of DF will work.

#More sad stories are reported:

More than 20 patients (old people) passed away who were left in a hospital in the 20 km zone or on the way of evacuation from the 20 zone.

I cannot write all of these stories now, but they must be recorded.

...

We should not/cannot estimate the number of people who might be exposed to more radiation in the case of larger amount of radioactive materials from the nuclear fuel, though. I would say, at least "hundreds of thousands" people....

...

We, who know the danger of radiation, are thinking about those personnel, fire fighter and workers of the company & associate companies and their families. I believe the government and the company also know that the task is really dangerous because of the high level of radiation. However, we also know: without their work, at least several hundreds of thousands people including children, pregnant women..... might be exposed to more radiation.....

It is really sad and complicated situation....

Katsumi

March 17, 2011 9:45:11 PM EDT
30 fire engine has joined the DF

#The 30 fire engine have just arrived at the place (probably 20km from the plant) and joined the DF.

The cars are:

- rudder truck with folding radder of 22m
- large special (chemical?) fire engine which can spray water 5 ton/ min, even while driving
- fire engine which can pump water from 2km distance water source
- fire engine for special disaster which have equipments to clean up radioactive contamination

I do not know what actually they are, though.

I would say that they are really to do their best to avoid the worst case.

Of course, they will be measuring the radiation dose rate at the site and within the "exposure limit"....

I only hope that they could work with minimum exposure, as smaller as possible....

March 19, 2011 1:47 AM
one week has passed.....still in a difficult situation

Dear all,

I am sorry but I do not have time to update the things now.

Many things are happening here. I myself have to deal with the things what I can do here, in addition to my own routine work and activities.

You may see some of the updates on the following site, at least the "official" information.

http://www.ustream.tv/channel/nhk-world-tv

We are still in a critical situation at the nuclear power plant site. Many people, many young skilled workers, fire fighters , engineers and SD staff, at the site have been making great effort to try to stop the situation getting worse. They themselves are already exposed to radiation.....it is really sad, but we know that we cannot get rid of this crisis without their hard work.....

We, anti-nuclear-power-plants activists are staring to discuss concretely the evacuation of children and pregnant women, from the 20-30 km zone. We are afraid of the possibility of the worse situation. (We really hope it would not happen.) It might be too late if we decide after having such a situation. We never want to make people in panic. However, we have to prepare even for the worst scenario. We know that we should carry on such a measurement with an official initiative. The crisis situation makes the government too busy to work on this. They have to focus on the crisis of the plants to avoid the further disaster. It is reality.

Another important thing for us is to request government and companies to release real time and precise information and data of environmental radiation, including the data of isotopes, and the situation of the plants.

We heard that already some or many of them, who have a chance to do so, have already left the areas. However, it is not easy to do so without gas and before preparing proper place to accept them outside of the zone.

I also know that some people even in Tokyo has already left the city and been in a kind of "panic" situation. I really understand their feeling and we cannot blame none of them.

However, we have to focus on the people right now who have been facing to the most "possible" or "realistic" danger to radia-

tion exposure and also the shortage of food, water, medicine, fuel and everything.

The local governments are already starting to accept more than a thousand people from a town which is within 2km, (they evacuated already from their hometown to 20-30 km zone some days ago). Many people, including local authorities, are now trying to do their best.

I am not sure whether or not you who are living away from Japan could understand my complex feeling, sadness and realistic thinking.

Another additional thing is that NHK in Japan has stopped the continuous live news on the affected areas and the nuclear plants today. They might decide to do so as a week has already passed since the earthquake. (Of course, we can get a live image at the site from time to time, when something new happens.) It makes me strange feeing watching sports game, cultural program and other things which do not have any relation to the present disaster. I myself may be in an "unusual" mental a situation.....

I will stop now.

I wish you all have a nice week end. We have no idea about our weekend, though.

Please also continue to work hard to stop nuclear power plants in your own country....

Peace,
Katsumi

P.S. I saw a video of WHO staff who is commenting on the evacuation. I personally thing it very sorry. They are not in a stance of "preventing" possible health impacts on the people who are staying within 20-30km or just out side of the 30km zone. We are not discussing the immediate danger of the people who are living in Tokyo! I hope he will come to Japan and stay with the people in the 20-30 km zone..... I will not say anything further now. We may discuss after we finish this crisis. Sorry in a hurry....

April 22, 2011
Radiation cut off raised for Japanese school children

I have come back from Fukushima late last night. I spent five days there.

I visited some towns and villages over there including Iitate-village, where they have highly contamination even outside of 30 km zone. They have 6,000 residents before the earthquake and accident. Some of them have already evacuated voluntarily even before the government set of the "planned evacuation zone". (You may already read the report on the measurement of radiation dose and radioactive materials in soil in the village.)

It is really urgent to let people, especially children, pregnant women and younger people (who may have children in the future), evacuate from such a highly contaminated area. I met the head of the village and some staff members of the village. I also met with some groups of residents. I told them the real situation of the contamination in their village and explained them that it is urgent to decide to evacuate. (Some residents do not want to evacuate as they have their own life in their beautiful homeland. However, they are starting to understand what is happening in their land.) I also listen to their stories individually and gave them concrete advices as a physician. It is really sensitive situation in many ways, politically, socially and psychologically, so I cannot write all the things at this moment here. You, who are living outside of Japan, might not understand our Japanese culture, though.

It is really sad and terrible for me to see and hear that people, including babies (some dozens of babies, infants, their mothers and pregnant women have already evacuated under a official program of the village, but not all of the babies are evacuated) have been living in such an area where we can measure such radiation level (ex. indoor: 2-3 micro Sv/h, outside: 5-8 micro Sv/h at 1m above the ground, more than 10 micro Sv/h on the ground).

Some NGOs and individuals from outside are now helping people in the village by supplying non-contaminated vegetable, fruits and such fresh food. They need to have non-comtaminated food anyway before evacuation. The evacuation plan takes at least one month.

As you may know that some "specialists" say openly in public that radiation (chronic) exposure below 100 mSv makes no serious health problem. They, together with the local authority, had lectures in many places in the prefecture. They want to avoid the panic situation of people. I understand their concern, though. However, such comments of them influenced people to take their situation easy. Some families who once evacuated outside of the highly contaminated area came back to the village after having lectures and information from such specialists.

I am thinking to visit the area again early next month after the events of 25th anniversary of Chernobyl here in Osaka. I would like to help them as a physician to let them decide themselves what to do. I want to

be with them, as far as I can, and work in cooperation with them. I really do not want to make people in panic. It is important to talk to the people and listen to the people directly and think with them what to do in such a critical situation.

I would add that even outside of the Iitate-village, the radiation situation is still serious.

We can measure 1-3 micro Sv/h radiation rate all around in the center of the city of Fukushima, where 290,000 people are living. The problem is not limited at the schools. The "20 mSv" of radiation exposure (it is only from external exposure) is a serious problem for almost all of the residents in the contaminated cities and towns in Fukushima prefecture. Of course, "20 mSv" is the dose limit for nuclear workers in Japan in accordance to the Japanese radiation protection low. The radiation level above 0.6 micro Sv/h (1.3 mSv of radiation exposure) is the definition of the "radiation control area" according to the law. However, they are now applying the standards of "emergency version" for both workers and public following the recommendation of ICRP.

As many people are already exposed to some extent, proper health following-up and compensation will be necessary in the future.

We also have to think about the influence to the industry, agriculture dairy farming and fishing in the area. Many people are living on that.

We really need to stop all the nuclear power plants in Japan (and everywhere in the world). I know that we cannot stop them immediately, though. We, as citizens groups, will visit the Kansai-electric company to request them to listen our voices on April 26. We have 10 nuclear power plants just 100 km from Osaka, the second biggest city in Japan. We know that there are active faults very close to the plants.

I agree with the idea of Alex to make a kind of appeal from IPPNW on this occasion to support the exposed people in Japan. I think it important to make a critical comments on ICRP and Japanese government's policy of radiation protection at the emergency situation. (Note that Japanese government are following the recommendation form ICRP and many physicians and specialists in Japan have been supporting ICRP. The special adviser for the Japanese cabinet at the emergency situation is a member of ICRP.)

Sorry, but I do not have time to write more in detail now. (I have to prepare the meeting tomorrow.)

The situation is moving here in Japan. I have to work on it, as a physician, in accordance to my conscience.

Thank you for all the support from our colleagues of IPPNW in the world.

Peace,
Katsumi

Katsumi Furitsu speaks about the Fukushima nuclear reactor crisis at IPPNW-Germany's congress, *Timebomb Nuclear Power—25 Years after Chernobyl*, on April 9, 2011 in Berlin. Photo © Jens Jeske/ IPPNW-Germany.

Young doctors speak out on the Fukushima disaster

IPPNW's global network of young doctors and medical students used online social networking technologies such as Facebook, Twitter, and YouTube, which offer the potential to reach millions of users with updates, expert analysis, and informed opinion about events in Japan as they occured. Particularly effective are short, self-made videos that can be posted to YouTube and other video-sharing sites, and then linked to blogs and websites in what is called viral communication. Below are brief excerpts from video messages by young IPPNW doctors from four countries. These and others are gathered on the IPPNW medical student website (www.ippnw-students.org/medicalvoices/voices.html). Links are given to the full versions on YouTube.

Ryoma Kayano—Japan
It is true, nuclear power plants supply us a lot of energy. However, as we see in this situation, catastrophe can occur and we simply cannot control he huge energy....First, we have to recognize that nuclear energy is uncontrollable and dangerous. Second, we have to stop and think. Is it right to use this energy? Are there other ways to solve our energy problems without nuclear energy?
www.youtube.com/watch?v=ktHhBSsGvzs

Alex Rosen—Germany
We're all very worried about the health effects from this catastrophe. ...As we see in Fukushima, nuclear power is never 100% safe; no technology is....We know about the effects of these nuclear particles because we have studied the health effects of the Chernobyl disaster, where we've seen a significant rise of thyroid cancers, a significant rise in childhood leukemia [and other diseases].
www.youtube.com/watch?v=WL_Oew16vIg

Vilena Avaliani—Russia
All stages of the nuclear fuel chain have adverse environmental impacts...If a country has nuclear energy, it increases its capacity to build nuclear weapons....We have good alternatives to nuclear power plants, and they are renewable sources of energy such as sun, wind, biomass and many others....It happened once in Chernobyl; it happened a second time in Fukushima. So what next before we say "no thanks" to nuclear energy?
www.youtube.com/watch?v=RSjFMOmvwRE

Ogebe Onazi—Nigeria
We appeal to policy makers of governments all over the world to deemphasize the need for nuclear energy...Let us put in consideration the generation to come. Let us put in consideration the health of the people of Japan. Let us put in perspective what the unborn babies and their mothers are going through this moment in Japan. We do not have nuclear disasters going on in our country; nevertheless, we feel concern for the people of Japan.
www.youtube.com/watch?v=Hq4EcJXqGeI

Japan's Nuclear Nightmare

Ronald McCoy

Former IPPNW co-president Ron McCoy, a Malaysian obstetrician who, by his own count, has delivered more than 50,000 babies, read the following paper at a public forum entitled "Eleven Days After Japan's Nuclear Fallout: Selangor's Perspective," organized by the Selangor state government on March 22, 2011. For reasons of space and general interest, paragraphs concerned solely with Malaysian policy have been cut. The paper can be read in its entirety on the IPPNW Peace and Health Blog (www.peaceandhealthblog.com].

Since 11th March, Japan has been reeling from an unprecedented natural disaster of awesome proportions, followed by a man-made nuclear crisis. First, a record-breaking earthquake, 8.9 on the Richter scale, off the north-eastern coast of the Japanese island of Honshu. Then, a towering ten-metre tsunami which killed tens of thousands of people and destroyed almost everything in its path. Finally, the release of radioactivity into the environment from a nuclear power plant, damaged by overheating and explosions.

The earthquake had automatically shut-down the six nuclear reactors of the Fukushima Dai-Ichi nuclear power plant, owned by the Tokyo Electric Power Company (Tepco). But it also knocked out the power grid, forcing operators to fall back on diesel generators to keep coolant flowing into hot reactor cores of radioactive uranium and plutonium fuel rods. Then the tsunami swept in, knocked out the generators and cut off power to the plant's cooling systems. All at once, four out of its six nuclear reactors were in dire trouble from overheating. Explosions then damaged fuel rods and the integrity of the primary containment structure, and radioactivity was released into the environment.

There are few environmental dangers more lasting or more fearsome than radiation from a nuclear accident. We saw this in the Three Mile Island and Chernobyl disasters, and now in Fukushima. The truth of Murphy's Law is inescapable: "If something can go wrong, sooner or later it will go wrong."

Public health

The public health implications of nuclear power should not be subordinate to the economic considerations of the nuclear industry and government energy policies. There is a need to review the scientific evidence for public health impacts of nuclear power, to assess occupational hazards faced by nuclear industry workers, and to assess evidence that challenges the legitimacy of the underlying assumptions of nuclear safety.

A common thread running through these health concerns is the risk posed by ionising radiation. There is no safe threshold. Over the past fifty years, the claims of the nuclear industry, that nuclear power is both safe and vital for our future, have proven false and contentious.

Ionising radiation can damage DNA, causing cancer and inherited mutations.

However, whether an individual develops cancer following exposure to ionising radiation depends on whether the DNA is damaged, what part of the DNA is damaged, whether the cell line can reproduce, whether the damage is completely repaired, and whether the cell completes transformations that lead to malignancy.

The most important evidence regarding risks from exposure to radiation comes from epidemiologic studies that examine incidence of cancer in exposed populations, such as children exposed to radiation in utero, people exposed to background radiation, nuclear plant workers, patients exposed to diagnostic or therapeutic radiation, and people exposed to radiation from nuclear explosions.

The risk of mutation-related damage, including cancer, is proportional to the radiation dose. There is no threshold below which ionising radiation produces no damage. This means that background radiation from any source causes cancer and genetic mutations among exposed populations.

There is no threshold below which ionising radiation produces no damage.

What happens in a nuclear accident

When a reactor is operating, fuel rods containing uranium and plutonium pellets produce heat through nuclear fission and get very hot. The fuel is immersed in water and the heat produces steam, which is used to drive a turbine to produce electricity. The water also serves to keep the fuel from overheating and is continuously circulated to carry away excess heat. Even if the reactor shuts down, the fuel will remain hot for a long time and so must still be cooled.

If the pumps that circulate the cooling water are not operating, the water will heat up and evaporate, and the fuel can be exposed to the environment. At this point, the zirconium cladding on the fuel rods will start to heat up, blister, and then rupture. If the fuel is not covered by water and is exposed for a few hours, it will start to melt. The molten fuel will collect at the bottom of the steel reactor vessel, and it will be a matter of hours before the fuel melts through the steel and settles on the concrete floor of the primary containment vessel. In an accident, the amount of radioactivity released into the environment will depend on the integrity of the primary and secondary containments. The radioactive isotopes of greatest concern in a nuclear accident are iodine-131 and cesium-137.

Uncertain geological knowledge

Nuclear power requires stability—political stability and geological stability. Countries considering the option of nuclear power need to soberly assess their plans, particularly if they are located in active volcanic regions.

But geological knowledge is incomplete and imperfect. And we rely on such knowledge too heavily when making policy decisions about locating hazardous technologies.

Designed and built to withstand what is termed "design basis accidents," nuclear power plants are usually sited in geologically stable and physically secure environments, determined by geologists. The possibility of a "design basis accident" is based on "credible events," which are determined by an analysis of probabilities. The Fukushima disaster was a "beyond design basis accident" because the analysis was wrong. It was calculated that the probable "credible event" expected to occur in Fukushima would be an earthquake no greater than a magnitude of 7.9 and a tsunami no higher than 6.7 metres. It was not in the analysis of probabilities that Fukushima would be struck by an 8.9 magnitude earthquake or a 10-metre high tsunami. But geologists and the nuclear industry, like all human beings, sometimes get it wrong.

It is noteworthy that there are a number of unknown geological faults and processes which make it more difficult to accurately predict a "credible event." In other words, it is very much an intelligent guessing game, but guessing it is nevertheless. Incidentally, the recent earthquake in Christchurch occurred on an unknown and unexposed geological fault, and was therefore unpredictable. In fact, damaging earthquakes have been known to originate from unknown faults.

Human error

But earthquakes and tsunamis are not the only causes of a nuclear accident. Human error alone can lead to a nuclear accident. It happened in Windscale (later renamed Sellafield), Three Mile Island and Chernobyl.

I have heard the facetious argument that plane crashes are not sufficient reason to abandon air travel. But the scale of a nuclear accident is incomparable. Radiation could kill and injure thousands, cause cancers, and contaminate and render uninhabitable large tracts of land.

Nightmare at Fukushima

Japan, the only country to have experienced nuclear warfare, now faces another nuclear nightmare. Months may pass before we can fully understand what went wrong

and learn from Fukushima. It is a high price to pay for using potentially dangerous and replaceable technology. It has rekindled fading memories of Chernobyl and shifted the balance in the debate on climate change and the risks and benefits of nuclear energy.

It is forcing many countries to review the safety of their nuclear facilities and their energy policies. Germany has responded to strong public anti-nuclear sentiment by reinstating and accelerating its nuclear phase-out policy, and temporarily shutting down the oldest seven of its seventeen reactors. Both India and China, with their expanding economies and energy needs, are reviewing nuclear safety measures, but have not shelved plans to build more reactors in the next ten years.

A number of studies conclude that nuclear power cannot meet energy needs; that it is excessively expensive; that it is not carbon neutral; that it creates additional environmental and security risks. Most importantly, new evidence indicates that environmentally safe and sustainable energy technologies can be developed to meet growing energy needs.

There is a growing conviction worldwide that nuclear power should be phased out and a serious commitment made to invest in renewable energy, energy efficiency and energy conservation.

Public distrust

The nuclear industry has carried the stamp of secrecy like a birthmark. From its very beginning, the nuclear industry has had a long history of cover-ups and downright deception, with the occasional lapse into silence - the silence of guilt. Public trust in the promoters of nuclear power is almost non-existent. In Britain, America, Germany, Russia, Japan and other countries, people have not been told the truth about the real economic cost of nuclear energy and the health and environmental consequences of nuclear mishaps and near-misses.

The stricken Japanese population is well aware of the culture of nuclear cover-ups. The Tokyo Electric Power Company (Tepco) owns and operates the Fukushima Dai-Ichi nuclear power plant. In 2002, Tepco's chairman and senior executives had to resign when the Japanese government discovered that they had covered up the existence of structural damage to reactors. In 2006, Tepco admitted that it had been falsifying data about reactor coolant materials.

Vexing questions

Radiation is invisible and cannot be recalled. In a nuclear crisis, there will be many questions about radiation. As the Japanese people are now discovering, it is a nightmare trying to make sense of the uncertainties.

- How do you know when you are in danger?
- How long will this danger persist?
- How can you reduce the danger to yourself and your family?
- What level of exposure is safe?
- How do you get access to vital information in time to prevent or minimise exposure?
- What are the potential health risks and consequences of exposure?
- Whose information can you rely on or trust?
- How do you rebuild a healthy way of life in the aftermath of a nuclear disaster?

These questions are difficult to answer, and they become even more complicated when governments and the nuclear industry maintain tight control of information, technological operations, scientific research, and the bio-medical lessons that shape public health response.

Transparency and accountability

Transparency and accountability do not sit well with an industry, addicted to filtering and censoring information. It explains why there is no clear consensus on the local and global health consequences of Fukushima.

There is no safe threshold for radiation. The claim that exposure to low-level radiation does not pose a risk to health is a myth, generated by governments and the nuclear industry. During the nuclear arms race of the Cold War, scientific findings on health risks from nuclear fallout that contradicted the official narrative were censored. Scientists with integrity were discredited, punished or blacklisted. In 1994, the US Advisory Commission on Human Radiation Experimentation concluded that the literature on radiation and health during the Cold War was heavily sanitised and scripted to reassure and pacify public protests.

Decades of official censorship have reinforced the false core message: Human beings have evolved in a world where background radiation is present and is natural, and that any adverse health effect of radiation exposure is the occasional and accidental result of high levels of exposure.

There are other sources of conclusive data that allow a very different interpretation of the health hazards posed by a nuclear dis-

aster. These include several declassified records of US and Soviet human radiation experiments, Atomic Bomb Casualty Commission records, long-term research on Chernobyl survivors, and proceedings of the Marshall Islands Nuclear Claims Tribunal.

From these records, some important facts have emerged. For example, nuclear fallout and radioactive contamination of ocean and land ultimately enter the food chain and the human body, and therefore represent significant health risks. Chronic exposure to radiation does more than increase the risk of cancers. It threatens the immune system, exacerbates pre-existing conditions, affects fertility, increases the rate of birth defects, and can retard physical and mental development.

Japan's ongoing nuclear crisis demonstrates the degree to which the state prioritises security interests over the fundamental rights of people and their environment. Japan's response to Fukushima mimics the responses of other governments to catastrophic events, such as Chernobyl and Katrina. It has been to control the content and flow of information to prevent panic and mitigate the inevitable loss of trust in the government, reduce legal liability, and protect nuclear and other industry agendas.

There are many lessons to be learnt from Fukushima, not least of which is to recognise that nuclear energy is exceedingly dangerous and carries unacceptable, unnecessary risks to human health and the environment. In Malaysia, there must be strong public demand for transparency and accountability and an end to all plans to opt for nuclear energy.

Misleading information

Nuclear energy is not cheap, clean or safe. And yet, vested interests in the government and the nuclear industry are attempting to override common sense and reason. They continue to trumpet the imaginary virtues of nuclear power and play down the enormous cost of nuclear power, the problem of nuclear waste, and the risks of an accident. Nuclear reactors, like nuclear weapons, do not forgive mistakes of judgement, simple negligence, human error or mechanical failure. Malaysia's poor record of industrial safety and its bad maintenance culture underlie concerns about public safety in the event of a nuclear accident.

The nuclear industry has a history of making misleading claims about nuclear safety that have often confused and misled the uninformed. Genuine debate and critical examination have been avoided, evidence ignored, opponents silenced or marginalised, and critical issues of public health and welfare have been answered with standard bland platitudes. Nuclear regulatory bodies have too often acted out of expediency and ignored the health and protection of the public.

Proliferation of nuclear weapons

Nuclear power is directly linked to the proliferation of nuclear weapons. Member states of the Nuclear Non-Proliferation Treaty have the "inalienable right" to peaceful uses of nuclear energy. All civilian nuclear energy programmes provide a convenient cover, as well as the training, technology and plutonium necessary for the proliferation of nuclear weapons. That was the route taken by India, Pakistan, Israel and North Korea to become nuclear weapon states. A typical 1000 megawatt reactor produces enough plutonium each year for 40 nuclear weapons.

Radioactive nuclear waste

Nuclear power plants produce lethal radioactive waste that will remain radioactive for thousands of years. The half-life of plutonium-239 is 24,000 years and that of uranium-235 is 731 million years. We are talking about radiation forever.

No country in the world has been able to safely dispose of its nuclear waste, which is accumulating in pools or casks alongside nuclear reactors in forty-four countries, waiting for a solution. Finding satisfactory underground geologic repositories has proved to be an intractable problem. After twenty years and US $9 billion of investment, the Obama administration has declared that the proposed repository site in Yucca Mountain is "not an option."

When questioned about nuclear waste, the nuclear industry argues that spent nuclear fuel should be reprocessed or 'recycled' into fresh fuel. Only the French experience with reprocessing has been technically successful, but economically it has been a failure.

If medieval man had ventured into nuclear energy, we today would still be managing his waste, assuming we had survived. Nuclear waste is not a legacy we should bequeath future generations.

Cost of nuclear energy

Cheap nuclear power is a myth. "Too cheap to meter" was the false slogan in 1954. Forbes business magazine has described the failure of the US nuclear industry as "the largest managerial disaster in business history."

After fifty years of substantial government subsidies, nuclear power remains prohibitively expensive. Even among business and financial communities, it is widely

acknowledged that nuclear power would not be economically viable without government subsidies.

In the United States, the most important subsidy comes in the form of loan guarantees, which promise that taxpayers will bail out nuclear utility companies by paying back their loans if and when their projects fail.

The nuclear industry's opaque methods of accounting make it difficult to determine the full economic costs of nuclear energy. Costs are often buried in generous government subsidies or conjured into debt legacies for future generations.

Tenaga Nasional Berhad, in Malaysia, claims that it could build a 1,000 megawatt nuclear reactor for RM1 billion, but there is no mention of other costs. Real costs, such as operating costs, accident insurance, maintenance of reactor security, nuclear waste management and decommissioning costs, are buried in the nuclear industry's creative, opaque methods of accounting.

Capital costs remain a critical problem. Objective data on nuclear economics do not exist. Examination of the limited number of published capital cost estimates shows that the estimated capital cost of a new nuclear power plant has escalated rapidly since 2005 and that estimates are largely derived from manufacturers of reactor systems. It follows that it is extremely risky to accept a manufacturer's estimates and to sign a contract that does not specify a fixed cost, and yet some purchasers do exactly that.

The only relatively reliable data on the costs of nuclear power come from the United States, the United Kingdom, France and Finland. Within this limited data base, we know that cost overruns and construction delays are customary and that no nuclear power plant has been built within budget or a contractual time-frame.

The nuclear industry's opaque methods of accounting make it difficult to determine the full economic costs of nuclear energy. Costs are often buried in generous government subsidies or conjured into debt legacies for future generations.

As recent as 29 May 2009, two financial reports in the business section of the New York Times exposed the risky economics of nuclear power by highlighting two fiascos: the virtual collapse of Canada's global flagship, Atomic Energy of Canada Limited and the problems facing the French company, Areva, over the construction of a new third generation pressurised water reactor in Olkiluoto, which is four years behind schedule and more than US$2 billion over budget. Both companies were overtaken by cost overruns, amounting to billions of dollars, and long delays in completion schedules extending into decades.

A recent study in the United States, which focussed on business risks and the cost of building new nuclear power plants, identified several significant risks. The cost of capital for building new nuclear power plants has been rising much faster than inflation. Major construction delays result in cost overruns of billions of dollars. Long lead times for construction also result in a "premium risk" which increases the cost of capital. In the end, to keep afloat, new nuclear plants will have to impose high electricity rates which will make consumers very unhappy and the economy less competitive.

After more than fifty years in the business, the nuclear industry cannot attract private funding or liability insurance, cannot demonstrate an ability to build new reactors within a contractual time-frame and budget, and cannot deal with its radioactive waste.

Instead of investing billions in nuclear power, it would be far wiser and more justifiable to commit our limited resources to research and development of renewable sources of energy, energy conservation and energy efficiency.

"A terribly difficult situation with a lot of uncertainties":

PSR Press Conference

On March 16, 2011, Physicians for Social Responsibility, the US affiliate of IPPNW, briefed reporters on the medical, public health, and scientific dimensions of the unfolding nuclear disaster in Japan. More than 200 American and international journalists participated in a moderated telephone conference call that opened with presentations from three experts on radiation, health, and radioactive waste. The opening remarks were followed by an hour-long question-and-answer period.

The speakers:

Ira Helfand—past president, Physicians for Social Responsibility; North American regional vice president, International Physicians for the Prevention of Nuclear War; board-certified internist in Springfield, Massachusetts.

David Richardson—Associate Professor of Epidemiology, School of Public Health, University of North Carolina at Chapel Hill.

Marvin Reznikoff—nuclear physicist and international consultant on radioactive waste issues.

Ira Helfand

There's been a lot of media attention over the last several days to the ambient radiation in and immediately around the [Fukushima] plant, which is very appropriate, especially given our concerns about the workers who are remaining in the plant trying to bring this situation under control. But I think we need also to focus on the radioactive isotopes that are being dispersed at some distance from the plant, because this is going to cause a whole different set of health problems. We have been told by a number of nuclear experts who've been appearing in the press over the last several days that we will not see the kind of widespread dispersal of radiation that occurred at Chernobyl because there are not graphite bars to burn here, and the graphite fires played a very important role at Chernobyl in dispersing the radioactive material.

But we have had fires already from burning spent fuel rods, and there have also been steam eruptions, explosions—I'm not sure what one would call them—that can play the same role in dispersing the radioisotopes to great distances. And once these are lofted into the air they get carried by the wind. Depending where the wind is blowing, they're going to get deposited, and this could be at some significant distance from the plant site.

We have to be concerned about this because even if the total radiation dose is not real high downwind from the plant, the concentration of these radioactive isotopes can pose a very serious health problem. Some of them are quite long lived. Some of them are shorter lived, like iodine-131. But strontium-90 has a half-life of 29 years, and once it's incorporated into bone it essentially stays with you for the rest of your life, irradiating the bone and the bone marrow and causing leukemia and bone cancer. Cesium-137 doesn't last in your body quite so long, but it has a very long half-life as well. And of course plutonium has the longest half-life of all these elements that we're concerned about at more than 24,000 years.

So the issue is that people at some remove from the plant may be exposed to very powerfully carcinogenic radioisotopes that may enter their bodies through inhalation or through ingestion from water or food, and that land at some significant distance may be contaminated so heavily with these materials that it cannot be used by humans for extend periods of time. There are areas, you know, more than 100 miles downwind

from Chernobyl which are still not safe for people to use, and this is I think an aspect of the situation which we really need to be focusing on. If the winds blow, for example, in the direction of Tokyo, it is conceivable that significant portions of the Tokyo metropolitan area could be contaminated in this way if there is a large release as this situation continues to unfold. And so I think this is something we really need to be focusing some attention on.

David Richardson

I would want to start by underscoring some of the points that were just made. On the one hand we have incredibly valiant efforts that are being made by the workers at the facility to deal with a really complex string of problems that continue to arise related to overheating, not only of the reactors but also of the cooling ponds. The workers are in a situation now where from an occupational safety and health perspective it's really serious. It's daunting. There are substantial non-radiological hazards: they're working in a facility where there are explosions going on and fires and extreme heat. And then we add to this some of the work areas have extremely high dose rates now, where workers have to be moved out of the work areas over short periods of time, I would imagine spanning minutes, in order to avoid problems of acute radiation poisoning. And over the period of time that they're working now they're going to accrue exceptionally high occupational doses of radiation, and this would be the external ionizing radiation which is radiation that's moving in the form of waves through the body, like X-rays, but in this case gamma radiation.

There's been a lot of focus on environmental releases related to the reactors and the question of will or will not the containments around the reactors hold and serve to mitigate the environmental releases. What's got less attention, and I would suggest that the press has taken their eye off the ball somewhat on this issue, is the ponds that are holding the spent fuel—these boiling water reactor designs have a relatively thin amount of containment. And for several of the pools—those have been damaged or entirely blown off—there's a large amount of radiation, radioactive material that's stored in those ponds, and I believe we can—the evidence is that we're having releases from those.

Now that's different than the primary radiological concerns that the workers in the facilities are facing. It's not exposure externally to radiation in the form of radiation waves or a beam of radiation, of gamma rays. It's the concern about the intakes of radioactive particles in the form of gases or dusts, that they may inhale or ingest, or later on if you would get a skin cut you could take it internally through a puncture of the skin. And how much of that's going to be released? We still don't know in the end, and figuring that out is going to be extremely complicated. I think given that most of offsite monitors are not functioning, it may require that we make an inventory at the end of this about what's still left in the plant, and by that we can make a reckoning of what was lost.

[I]t's going to be quite a while before we have anything more than a crude understanding of the magnitude and the distribution of that contamination, but we're going to need to be able to do that in order to help inform people about how to minimize their exposures.

The other question is going to be where will it go, and that's—as people have said before, it's going to depend in part on the winds, whether they're moving out to sea or they're moving over land. And it's unlikely that the radioactive material is going to be distributed evenly in concentric circles; rather it's going to be deposited very likely in narrow bands. So it's going to be quite a while before we have anything more than a crude understanding of the magnitude and the distribution of that contamination, but we're going to need to be able to do that in order to help inform people about how to minimize their exposures. So it's an extremely serious situation.

Marvin Reznikoff

I'm going to try to fill in some of the points that were made previously by the other speakers. Let me start by saying that there are two hazards that have been explained. One is from reactors where there have been steam explosions, and the other is from the fuel pools. The steam explosions have released iodine gas and cesium-137. Cesium-137, because that's a semi-volatile metal, and once the cladding to the fuel is broken that material can be released along with the iodine gas, so when the steam is released then these materials are also released.

I have looked over the NOAA forecasts to see what the wind will be over the next

three days. They actually have forecasts for the next seven days but three days is more reliable. And I think we're fortunate in that much of the wind will be going out from west to east, that is will be going out over the ocean. As was pointed out earlier, the Chernobyl hazard was about a 1,000 mile hazard, but over the ocean to reach the United States is approximately 2,000 miles. So material will be deposited along the way and rain will also take out some of this material, so I think in that sense we're fortunate. But material will also land in the ocean, and that means that marine life will pick up this material. People eat fish, then they will in turn intake this material. Fortunately the Japanese government has evacuated a larger zone, so the hazard is less to people.

Let me say a word about the fuel pools. You've probably seen that these fuel pools are not located on the ground. They are located up near the top of the reactor, so that generally puts them 70 or 80 feet up in the air. With some of these buildings the roofs have been blown off, so the fuel pools are actually open to the environment directly. Also what hasn't been discussed very much is there is a standalone fuel pool at Fukushima that is on ground level and that contains most of the radioactive spent fuel. A lot of it has been shipped to the reprocessing plant at Rokkasho, but a lot of the fuel is actually sitting in this building, which does have windows. And I am not certain what happened when the tsunami hit, and it would be useful to have Tokyo Electric talk a little about that for the media.

Most fuel in the fuel pools, as I said, has been removed, but for Reactor 4 the fuel was removed from the reactor core and put into the fuel pool so that they could examine the reactor. And that fuel is relatively fresh and hotter thermally, so it's not surprising when the water is no longer circulating that it has been speculated that the water was actually boiled off and a zirconium exothermic reaction - that is the zirconium burned. It burns at 1,800 degrees Fahrenheit and releases hydrogen gas at that point. But the material—any material that got into the air would be directly released into the environment. They cannot resupply this reactor with helicopters because part of the roof still remains and they cannot just dump water into the fuel pool.

James Gland, The New York Times

You gave a nice overview on both topics, the issue of exposure near and far from these reactors. Can you give us any numbers, say, in sort of Rems is, I guess, the favorite unit out there, in terms of what you're hearing or have heard are the levels at the reactor and far away from it, and how that turns into levels of danger ranging from radiation sickness to cancer risk? Anything? I'm not expecting an entire numerical overview. I know all these numbers aren't available, but we're having a hard time finding them and then also turning them into meaning when it comes to actual risk.

Ira Helfand

In terms of the doses inside the reactor it seems to be varying dramatically from moment to moment. The highest that I've seen was a rate of about 40 Rems or four-tenths of a Sievert per hour at one point, which would have given people in that - who were working in the reactor site a dose that would cause radiation sickness after two and a half hours of exposure. That level was not sustained for a long period of time.

As you get farther away I think the dose—the total dosage that people are getting—is perhaps in some ways less important for the reasons we were talking about, several of us, during our presentations. It is unlikely, hopefully, that people at some remove from the reactor, say in Tokyo, are going to actually be exposed to high enough doses of total body radiation to cause them to have, you know, radiation sickness. But that doesn't mean that they're not inhaling or ingesting radioactive nuclides which might cause them to have cancer, and the correlation between them is not very good. You can have a very small total body radiation dose but inhale plutonium and end up getting lung cancer from it, or ingest some radioiodine and end up getting a thyroid cancer, or ingest some radioactive strontium and end up getting leukemia. And so this—the assurance that we're given that, well, the total dose of radiation that we're measuring is relatively low needs to be taken with that big grain of salt.

James Gland

The one number we've got from Tokyo, .809 microsieverts, you know, as a reassuring number being given by the Tokyo government, is that a justified stance on that number given this cancer issue you mentioned?

Ira Helfand

And what I'm arguing is that it is not. It's certainly better that the dose there is low than that it were high, but the fact that the total body radiation dose is not high does not mean that people there are not being exposed to an increased risk of cancer.

David Richardson

To follow up on that a little bit, it matters right—there are several things that make

you want to qualify or at least ask a question about what value they're reporting. If they're reporting, let's say, a measurement of gamma radiation activity one meter off the ground, that tells you about kind of the gamma field there at that location. The concern is that what's been released is not simply gamma-emitting radionuclides—there would also be beta emitters, for example—and that once they're taken into the body you're not so much interested in the amount of energy—so these units of Sievert or Rem are giving you a sense of what's the energy deposited per, let's say, kilogram or per unit mass. And we're not interested anymore once there's an uptake of a radionuclide which has proclivity to aggregate, for example, in the thyroid or the bone marrow. You want to know the dose delivered to a specific tissue, not the average dose when you're averaging over your total mass of your body. So there are several issues there. One is what's being measured? Is it relevant to the radionuclides of concern? And then not—no longer talking about the average dose to the whole body, but the dose to a specific organ of interest.

Generally a chest X-ray is a tenth of a millisievert, and we are talking about 400 millisieverts per hour, so that's equivalent to 4,000 chest X-rays per hour.

Marvin Reznikoff

There is another issue involved which is the total dose to the population; not just to the individual, but the total dose to all the individuals that are receiving this dose. When you get out past the 30-mile or 30-kilometer limit, then there are more people out there, and the total dose to the population will really tell you how many cancers might arise in the future.

I wanted to put this 400 millisievert number in another context, which is to compare that to a chest X-ray. Generally a chest X-ray is a tenth of a millisievert, and we are talking about 400 millisieverts per hour, so that's equivalent to 4,000 chest X-rays per hour.

David Brown, Washington Post

My first question, which was actually partially answered, is do you have any suggestions on where the best source for measurements are? Because I'm also having a hard time finding them. So anyway, that's one, but the other one is can you address the risk, at least from—as seen in the Hiroshima—the atomic bomb survivors is surprisingly low in terms of fatal cancers over a long period of time. Between 1950 and '85 among 76,000 people that were followed in the LSS study—life span study—there's 300 excess cancers, which is obviously not a lot, and this is pretty heavy exposure. So can you sort of put your worries within the context of what's known from past high exposures?

Ira Helfand

One thing I think to bear in mind is the enormous difference in scale in terms of the amount of radiation involved. [The Fukushima complex] has as much radioactivity as 1,000 Hiroshima-sized bombs...So the potential amount of radiation that could be involved here if there is a large scale release, which there has not been yet, is literally orders of magnitude greater than the amount of radiation that was released at Hiroshima.[a]

David Richardson

Your first question concerned where are the best sources of measurements. That information has, to my knowledge, been released relatively sporadically, and there's been occasional press conferences noting dose rates in certain areas for workers at the plants. There's not been a lot of information provided on environmental doses, and particularly kind of the information that would help you to understand the characteristics of the different radionuclides.

Marvin Reznikoff

And the reason is the monitors are located right at the site. What monitors are available have been put on the site, and the wind blows in various directions. It's generally from west to east, but you don't necessarily have a monitor where the plume is going. It's not clear that they have monitors located all around the circumference of this 30-kilometer area, so it's not surprising that we're not getting the numbers that we want.

David Richardson

One other follow-up regarding the life span study of atomic bomb survivors. It was—there are several aspects to this study that are important. It's an incredibly useful study for understanding what the risks of cancer are for people who have been exposed to radiation. It's worth noting that the study started in 1950 is when they enumerated a census of survivors, so it's not giving you

[a] Each of the six reactors in the Fukushima complex has the equivalent of 40 Hiroshimas worth of isotopes, while the spent fuel pools each have three to four times that amount.

information about the risks of mortality following an atomic bombing. It's telling you about the risks of mortality among people who survived five years after an atomic bombing and then were subsequently followed. So it's an unusual study in the sense that follow up began quite a period of time after the exposure happened. So you might imagine that there was—there was; you don't have to imagine—an exceptional loss of life between the point of exposure and when the study begins to follow up people.

Another thing to understand is that the design of the study was intentionally over sampling people based on different exposure categories. So while there's 70,000 or actually more people who are enumerated in the cohort, most of them aren't high dose people. In fact, the majority of them are people who had lower doses so that they could have a comparison to draw between people who had higher and lower levels of exposure. So the net numbers of cancers among the five-year survivors of the atomic bombing is in part a function of understanding the dose distribution among those survivors.

Deborah Zabarenko, Reuters News

I'm going to guess that I'm among those who seem rather overwhelmed with the amount of information that we have and underwhelmed with the amount of specificity that we're having. A popular question to ask these days seems to be what the worst-case scenario would be, so let me narrow that down. First, do we agree that the most troubling reactor is troublesome Reactor 4? And if we do, what's the worst-case scenario for what might happen there?

Marvin Reznikoff

Reactor 4 has—all the fuel was taken out of the reactor, was put in the fuel pool. And I'm just looking at it, and the fuel pool contains approximately 135 tons of nuclear fuel right now. It's likely that that material is—apparently there now have been two fires at that particular location and they cannot resupply the water from the air, so it's not clear how they're going to keep that pool cool. So that pool may actually - this exothermic reaction where zirconium actually heats up the area further, workers cannot get close to it because the direct gamma radiation coming off the pool is very high when the fuel is uncovered. Water in the pool serves as shielding and cooling, and when that water is gone the direct gamma radiation is very high. So it's not clear how they're going to recover, you know, that particular situation.

So I would have to go back and do the calculation as to what would happen if 270-some tons of fuel actually began to burn. I don't know the answer to that off the top of my head.

Deborah Zabarenko

I guess I want to make sure that I've heard things right and that that's the most troubling area right now.

Ira Helfand

Well, they're all kind of troubling, and one other that is particularly cause of concern of course is Reactor 3, where the government has reported that there's been some breach of containment. And this is particularly disturbing because Reactor 3 is fueled with MOX fuel, not just uranium, and the possibility of a very significant plutonium release and subsequent plutonium contamination of area around the plant, which would really make this a very, very long term problem, is a big issue at Reactor 3.

Deborah Zabarenko

How long is this likely to play out in terms of fires, in terms of nobody being able to get in to resupply water? Is this a weeks-long problem? Is this a days-long problem? Is this a months-long problem? I guess that's one question I'd like to see answered.

Marvin Reznikoff

Well, this is a several months problem. The heat will be that high for months, high enough to cause an exothermic reaction. So this is not—this is going to be a continual problem for months.

Tom Maugh, Los Angeles Times

You say there's 135 tons of fuel in the spent fuel pool. How much is in a reactor itself?

Marvin Reznikoff

I don't really know the answer, but less than 135. I don't have the answer right in front of me.

Tom Maugh

You say there are not many monitors around the plant. Were they destroyed by the tsunami or were they just not installed in the first place?

Marvin Reznikoff

Again, this is an assumption on my part, that they were wiped out—this is a conjecture—and that they have temporary monitors located there right now. I'm not exactly certain on that.

Hiramati Yoshotomi, Maniti Newspapers

I have a question to Dr. Ira Helfand. You were talking about contamination risk in

terms of isotopes, but Japanese...government says it doesn't affect people's health, but you said [there are] serious potential risks. So could you please elaborate more?

Ira Helfand

Two points I think need to be made. One is that the repeated assurances that this dose is too low to affect people's health simply does not square with what we know about radiation, which is that no dose is safe, that there's no threshold dose, that any dose of radiation increases somewhat your chance of developing a cancer.

The second point is that there is a very poor correlation, as Dr. Richardson was explaining before, between the total body dose of radiation that may be measured and the dose that's delivered to a particular susceptible tissue, so that if you are exposed to a relatively low dose of total body radiation but you inhale some particles of plutonium you can still go ahead and get lung cancer. And obviously if the total body dose is high, the chances of your ingesting or inhaling a radioisotope are greater because there's more of the material in the area. But this sort of linear relationship between your dose of total body radiation and the effect on your health is really lose when you're talking about low dose radiation at some distance from the source, because the internal dose may be very significant even if the total body dose of your entire body is not. Did that explain it?

Hiramati Yoshotomi

[What is] the long term effect [of the isotopes] you were talking about?

Ira Helfand

I mean the various particles of the different isotopes that are released. There are nearly 200 different radioactive isotopes released potentially from the reactor. There are a few of them that are particularly important because of their biological activity and their radioactive properties: iodine-131 because it concentrates in thyroid and causes thyroid cancer, strontium-90 because it concentrates in bone and causes bone cancer and leukemia, cesium-137 because it's very prevalent and is widely dispersed throughout your body in all tissues and therefore can irradiate any part of your body, and plutonium-239 because of its extreme carcinogenicity in very low doses and because of its very long half-life. And that causes primarily lung cancer when it's inhaled; if it's ingested it's usually not a problem. But if it's aerosolized and you inhale the plutonium you are at significant risk for lung cancer at a very, very low dose of inhalation, which would give your—if they were measuring the total body dose from that plutonium might be very low. But the dose delivered to the vulnerable part of the tubes leading to your lungs, the bronchi, would be enough to cause cancer.

Marvin Reznikoff

It's important to point out just so that we're in the same ballpark with units the general background radiation—except for radon—is on the order of 1,000 microsieverts per year. So whatever the Japanese government is telling you, you need to compare it to the microsieverts per year, not the microsieverts per hour.

Jenny Uechi, Vancouver Observer

I've been keeping in contact with Japanese relatives and reading up on the Japanese news as well, but they seem to be quite reassured that it's not going to affect their health at this moment. In your view, would the radiation released at present be affecting the health—you know, is this true, is what I'd like to know. Are they safe in places like Tokyo and in the south of Japan in terms of radiation affecting people's health?

Ira Helfand

The doses of radiation that have been released so far in this accident have been relatively small, and the health effects to people as far away as Tokyo presumably is quite low, but it's not zero. The real concern is that the situation remains completely out of control at this point and that the releases that we might see in the coming days could result in a much higher exposure to populations even as far away as Tokyo.

Jenny Uechi

But the government seems to have been reassuring people that there is no need for leaving Japan or leaving places near that area at this moment, but do you feel that there's been not enough information about the risks in the Japanese media so far?

Ira Helfand

Well, it's very difficult to remove large numbers of people from an area. I think the government has acted prudently in removing people from the evacuation zone out to 20 kilometers and taking additional precautions out to 30 kilometers. Hopefully that will be adequate, and since you don't know which way the wind's going to blow it's hard to know where else you would evacuate beyond the immediate area. The danger, of course, is if there's a major release where the winds are blowing from northeast to southwest. That radiation's going to blow down

onto Tokyo, and we just can't predict that. As Professor Reznikoff was saying, this process, this radiation leak could go on for months. During that time, there may be periods when the wind is blowing in the wrong direction and large amounts of radiation are released. This is a terribly difficult situation with a lot of uncertainties as to how exactly it's going to play out.

Sam Tranum, Nuclear Intelligence Weekly

I noticed that you had a number for the amount of spent fuel in the pool at Unit 4, and I'm just wondering where you got that number. I was hoping to find out how much spent fuel is in the other pools onite.

Marvin Reznikoff

Reactor 1—this is what's in the fuel pool. Reactor 1, 50—this is all in tons—Reactor 2, 82; Reactor 3, 88; Reactor 4, 135; Reactor 5, 142; Reactor 6, 151, and in the separate fuel pool that's sitting at ground level, 1,097 tons. There's also some material in dry storage, I should mention: 70 tons.

Sam Tranum

I also wanted to ask you about the possibility of a zirconium fire. I've heard some people talk about this, but I was reading the NEI fact sheet on the spent fuel pool situation and they said that studies performed by the Department of Energy indicate that it is virtually impossible to ignite zirconium tubing. So where's the disconnect between people talking about how if the pool drains you could have a zirconium fire and the NEI saying that's not possible?

Marvin Reznikoff

It appears possible.

Ira Helfand

The disconnect seems to be reality. It appears that this has happened to some degree already.

Sam Tranum

If there is a zirconium fire, how do you put it out? Does just pouring water on it put it out, if that's possible?

Marvin Reznikoff

Yes, cool it down below the temperature. Yes.

Sandi Doughton, The Seattle Times

You were talking about the kind of lack of monitoring even immediately around the reactors. If there is a large release and radionuclides begin migrating, who's going to be tracking that?

David Richardson

I think that's a very good question. Right now there's - as far as I understand they have malfunctioning monitoring posts, and the Nuclear and Industry Safety Agency doesn't know when they'll be back up in operation. So it would not be monitoring in a sense of having environmental radiation monitors onsite and deriving your exposure estimates from that sort of information. It would be much less ideal than that. As I said, it might require doing an inventory of what was released, trying to figure out the time sequence of releases, and then taking into account the topography and wind and doing kind of local dispersion modeling, which is a long, drawn-out process. It's not something that would be done promptly, which means that you're left with sort of crude estimates of kind of the average - you know, average releases over large kind of circles drawn, concentric circles. And that's not really reflective of the exposure that a particular individual in a particular place may receive. So yes, there's a huge gap right now in the information kind of—as far as I can tell on what can be done to do environmental dose estimation or reconstruction.

Sandi Doughton

Obviously the risk is much less to people in the United States, but in the case of a plume coming across the Pacific Ocean, once again, do you have to wait until it, you know, hits—goes above onshore monitors, or is there likely to be any kind of aerial monitoring at that point?

Marvin Reznikoff

The time for material to get across the ocean is on the order of five to eight days. I don't know whether that's useful to you, but once you begin to see whatever results are coming—whatever material is coming over to the United States in that time period. It looks like from the NOAA maps that Alaska and then Canada will be first, and then - and then as—you'll get down to Seattle. And we should be able to detect what's coming across.

David Richardson

My sense right now is that, I mean, most of our focus of attention and concern is more local than that, and that the exposures and the environmental contamination of greatest concern right now that we're talking about are those that are not distributed globally but those that are distributed locally in Japan.

Ira Helfand

I think it's obviously understandable that people here in the United States are concerned about potential risks here, but I think

the real lesson for us to draw from this is what's happening in Japan, and do we court the same risk here in the United States from a future accident at one of our own plants.

Marilynn Marchione, Associated Press

Dr. Helfand, I find your biography that says you have made a career of writing - you're an internal medicine doctor. You've made a career of writing about the risks of nuclear power, and I just would like all three of you to please state if you have any personal opinions or if Physicians for Social Responsibility has a position for or against nuclear power, nuclear plants—just want to have all this on the table.

Ira Helfand

PSR is very clear in its position. We believe that nuclear power poses an unacceptable risk to public health, both because of the danger of catastrophic accident, which we're witnessing now in Japan, and because of the unsolved problem of what to do with the long-term storage of waste, and perhaps most importantly because of the extraordinary role that nuclear power plays in furthering the proliferation of nuclear weapons. We have been in the United States promoting the dissemination of nuclear power technology around the world, and that technology has been in use in the nuclear weapons programs of a number of countries that we are now very worried about. And for all of these reasons PSR since 1978 has had a clear and explicit position against the further development of nuclear power, which position has been supported by broad segments of the American medical community.

Allison Rose Levy, The Huffington Post

Understanding your point that the most immediate concerns are local and in Japan, but also kind of extending a little bit the question from the reporter from Seattle, if this exposure continues and as we're told over many months, you know, this is going to continue to develop or, you know, if a worst case scenario evolves, would there be - you know, not simply toward the West Coast of the United States, which would be, you know, the most immediate sort of next recipient of plumes or anything coming in via air patterns, but in terms of, you know, the entire globe even, you know, with these kinds of materials and gases circulating, would there be any overall global effect, you know, in terms of water, air, overall radioactivity? I know this is a really big question, but just to ask it, if this process in this location kind of continues unabated or worsens.

David Richardson

I can answer in a sort of historical sense, is that yes, we currently have—some part of what we call our background radiation exposure involves the release of radionuclides from the use of nuclear technologies. So we've had a history of nuclear weapons testing, in a few cases nuclear weapons use in Hiroshima and Nagasaki. We've had unintentional releases of radionuclides at commercial plants and weapons factories, and they've contributed to what you would say are detectable levels, albeit small, of radionuclides in the soil and the air and the water. So yes, presumably we'll make a contribution to that.

I think the primary concern right now is not about kind of the global background level of radiation and an incremental increase in that so much as—from my point of view anyway—the kind of more local concerns in Japan.

Allison Rose Levy

Can I ask a follow up to...the statement that it's not the level but the level of dose that is absorbed by a particular tissue or part of the body? Where would one find some of the scientific research articles that talk about that? Because it seems that part of, you know, the kind of health communication message around all of this is the sense that it has to be a high dose, and—you know, so understanding how a small low dose in the wrong place can lead to a health impact? Where would be the existing body of literature on that?

David Richardson

One place to look would be the National Academies—what's called the BEIR VII report, Health Effects of Exposure to Low Levels of Ionizing Radiation. The most recent one is the BEIR VII, and it would lay out the general principles for understanding that at least the way that we're - most current radiation protection models are developed is with the idea that the carcinogenic risks of ionizing radiation—the probability with the likelihood that you're going to cause a cancer is proportional to the dose of ionizing radiation, so that as you increase exposure to radiation you're going to increase the likelihood that you'll cause damage to a cell, which will be a stepping stone to a subsequent cancer. Now that's sort of the idea that there's not a threshold, that there's a certain level where we say there's no health effect; rather, we say that the risk is proportional to the dose.

The question about whether the proper dose metric to talk about is an estimate of your total dose divided by your total mass as opposed to a dose to a specific organ gets more into a more complicated field, which is

kind of how you describe the radiation doses for internally deposited radionuclides. And there they tend to irradiate locally; that is, they're taking up and they'll reside in a piece of tissue or a target organ and they'll just irradiate locally, or they'll deposit most of the dose to an area that's smaller, and so you want to understand the dose to that organ. And most of the effects will be observed in the organs that have been locally irradiated. Now there are some exceptions to that, things like tritium, which tend to move around like radiated water, and they can, like water in your body, be distributed almost across the whole body. But those are sort of exceptional.

Marvin Reznikoff

Just to add to that, for example, strontium-90 would concentrate in the bone, and then you would be concerned about the leukemia effect. Iodine would concentrate in the thyroid so you'd be concerned about thyroid cancer.

Jesse Emspak, International Business Times

You mentioned earlier the spent fuel pools and how much is in them and that there's a risk of zirconium fire. And we had the question regarding the NEI position that you can't ignite zirconium alloy, and I was wondering is this—and you're saying the disconnect is reality. And I just wanted to make sure that—do we know for sure that that's what's burning, and if so what the evidence was that that's the case? And then the sort of next operative question is how many plants in the US are using a similar design and how many of those are located near fault lines? 'Cause it seems to me that if you've got, you know, what amounts to a great big swimming pool full of spent fuel elevated you need pumps to keep it going. So, you know, how many in the plants here might end up being in a similar situation if they get hit with a very large earthquake?

Ira Helfand

Well, there are 23 plants in the United States that are exactly of the same design as the Fukushima Reactor 1, and I'm not sure which of those are located near identified fault lines. I think that one of the more interesting articles that's appeared in the last couple days was sort of an assessment of which reactors are most at risk of earthquake damage, and it turns out it's not the ones in California. It's Indian Point north of New York City, and then a reactor here in Massachusetts were the two that were felt to have the highest risk of earthquake because of the relatively less strenuous design criteria that they were held to, so—to answer that part of your question.

David Richardson

Regarding the spent fuel pools, I think I would refer you—there's a really useful report called *Safety and Security of Commercial Spent Nuclear Fuel Storage*. It's National Academies, at press in 2006, so it's by the National Research Council of the National Academies. And it's got a chapter—it's the third chapter of that book where they lay out in detail kind of how what they call a cladding fire will evolve, and they describe both the chemistry of it and describe scenarios. So I think it's actually—it's not really contested.

Jesse Emspak

Well, the follow-up I'm going to ask, the situation now then, we've got—you're saying it's going to last for a certain amount - I mean, you have a situation—how long would it ordinarily sort of burn for if you can't put any more water on it? I mean, there's only a limited amount of time I think they can keep the seawater going, and that's pretty corrosive anyway. So the question then becomes what - I guess, again, you're sort of asking worst case. Okay, let the stuff burn. You were saying it's several weeks that that could keep going and releasing stuff into the air?

Marvin Reznikoff

The fuel in the fuel pools in Reactor 4, 5, and 6 is relatively fresh because they shut down those reactors, they removed all the fuel from the reactors and put them into the fuel pool, so that fuel is hotter. If you're asking the question at what point will it not—will the fuel pool not be able to reach a temperature of 1,800 degrees Fahrenheit where this exothermic reaction takes place, I'd have to, you know, do some calculations. I don't know the answer to that off the top of my head. But this fuel is relatively fresh that's in Reactor 4 fuel pool.

Ira Helfand

Part of the problem here is that there might be a sequence of bad events. There could be a fire at one of the reactor pools - one of the storage pools this week, but the need to cool the other pools is ongoing so we could have another problem three or four weeks from now if at that point we lose the ability to adequately cool the pools. And the problems of increasing radiation—radioactive contamination around and within the plant site are going to make it increasingly difficult, not easier, for people to move about in there and do work and continue to control the situation. And I think that's what got everybody

who's working on trying to actually control the situation so disturbed and upset, because there seems to be no way of quickly bringing this to closure, and the longer it persists the more potential problems can develop.

Marvin Reznikoff

The fuel pool is not located at the same level as where they are putting water into the reactor. The fuel pool is located 70 or 80 feet up and not where they're trying to relieve the pressure in the reactors. So it makes a more difficult situation to actually do both.

Nancy Gaarder, Omaha, Nebraska World-Herald

Ira, you said that each reactor has the equivalent of 1,000 Hiroshima bombs, the spent fuel pools several times that, and so the potential release is orders of magnitude. Are you saying that there's a plausible possibility over the next coming months that we could have Hiroshima-type releases of many thousand times? And then if that were to happen, what can we expect in the US and what should we be doing? And how would we know? How would we know that it - you talked about we'd know from Alaska to Canada, but how will we know that?

Ira Helfand

Well, we certainly - we could have releases that are 1,000 times as much as Hiroshima. That's a real possibility. At Chernobyl, I believe it was about 400 Hiroshima equivalents of radiation that were released, and we're dealing here with, you know, four reactors and five storage pools. There is an enormous, enormous inventory of radioactive material here that is potentially at risk. How would we know about it? Well, we will be monitoring—I mean, if there's a major release that's going to be picked up very quickly, as the spikes have been picked up over the last couple of days. And I assume that the United States has the technical means to track a plume of radiation even over the Pacific. We have planes with sensors that are part—and we have the whole system put in place to detect radioactive releases from nuclear tests as part of the regimen that was established to implement the Comprehensive Test Ban Treaty should it ever go into effect. So there are the technical means to monitor and track these releases.

Nancy Gaarder

And then the follow up question would be is there anything Americans should be doing to prepare in any way? I know we hear about people snapping up those pills on the West Coast. And then if you had family in Tokyo, would you ask them to leave?

Ira Helfand

If I had family in Tokyo I'm not sure what I would tell them to do, and I'm not sure where I would urge them to go to. And I know that's a really bad answer to a very legitimate question, but that's the best I can do on that one.

Marvin Reznikoff

Let me just add to what was said. I just wanted everyone to understand why there are so much more inventory in these reactor than released by the Hiroshima bomb. The Hiroshima bomb had fissions on the order of milliseconds, and that produced the cesium and strontium. But these reactors have fuel that's sitting in the reactor for three years continuing to fission, so there are many more fissions and much more fission products than occurred in the Hiroshima bomb.

David Richardson

If I could follow up on that also, I'd like to just make clear we're not saying that a nuclear explosion is going to occur. We're talking about the mass of material which is there, and it would be distributed in a way that would be different than happened in Hiroshima and Nagasaki, where there was a prompt explosion. More likely what's happening here is that there are fires, a lot of the material may stay in place or may burn and some of it aerosolize; the comparison being made is in terms of volume, not in terms of the type of explosion that's going to occur or something like that. These are fires and not nuclear explosions that we're talking about.

Sandi Doughton, The Seattle Times

Do you know if any of the reactors in the United States use the MOX fuel? And the second part of that, how dangerous is even a slight exposure to plutonium? I mean, can you get lung cancer from a single particle?

Ira Helfand

I can answer that second question. You can get lung cancer from a single particle of plutonium, depending on how large it is. The carcinogenic dose is felt to be measured in micrograms, millionths of a gram.

Sandi Doughton

Do we have any MOX fuel reactors in the United States?

Ira Helfand

My understanding is that we do not have any commercial reactors that use MOX fuel. There may be research reactors, but I do

not believe that we have any commercial reactors using MOX fuel. But I'm not 100 percent certain of that.

David Brown, The Washington Post

Just getting back to these estimates of the amount of radioactivity that was released in various events, I have in front of me the Human Radiation Experiments report—the final report of the President's advisory committee in 1996. There's a chart, and it mentions that at Chernobyl approximately 20 million curies were released. And it says in the first A-bombs, Hiroshima and Nagasaki, approximately 250 million curies released. But Dr. Helfand or someone said earlier that Chernobyl was, like, 400 times Hiroshima—so anyway, could you clarify that?

Ira Helfand

I'm not sure of those figures, and I believe that the release at Chernobyl was substantially larger than Hiroshima. Part of the difference is that much of the radiation at Hiroshima was direct radiation emanating from the explosion itself as opposed to the isotopes that were distributed afterwards. There is a direct blast of radiation that comes out when there is a fission explosion, and what we're talking about at Chernobyl is the radioactive isotopes with their longer half-lives that are distributed from an accident of that type. There was not a nuclear explosion at Chernobyl and so there was not that burst of radiation coming out directly from the explosion itself.

Marvin Reznikoff

So the comparison is with the longer lived material, such as cesium, and if you look at that and compare Chernobyl to the Hiroshima blast, then the numbers are greatly different.

What may we learn from Fukushima?

Frank Boulton

Medact's Chair Frank Boulton, the chair of IPPNW's British affiliate, Medact, is a retired consultant physician with the National Blood Service, Southampton University Hospital Trust. The following essay, written in April 2011 while events at Fukushima were still unfolding, considers the implications for the UK's nuclear power industry and revisits the health effects of the Chernobyl disaster 25 years ago.

Our heartfelt sympathies go to all the Japanese people in these most testing of times following the earthquakes and tsunami of March 11th. Indeed, were it not for the impact on their nuclear power industry we would be marvelling at the civilized nature of the way Japanese society has responded to the loss of billions of dollars' investments and thousands of human lives. But the still-unfolding events at Fukushima Daiichi throw a different light, and the global implications from the nuclear disaster are very profound even though the death toll is, as yet, very low. Radioactive materials are still leaking and the calculated amount of released radiation has been revised drastically upwards to about a tenth that estimated from Chernobyl in1986, the biggest nuclear "accident" yet.

Tokyo Electric Power Company (Tepco), assembled in 1951 to help reconstruct Japan after World War 2, is the largest electric power company in Asia and a major component of Japan's very significant nuclear economy.[1] About a third of Japan's energy supply comes from nuclear power. Tepco does not have a sound reputation and questions have been raised about its democratic and societal accountability.[2,3] In 2002, safety reports from three nuclear power stations were apparently faked,[3,4] and in 2007 Tepco was forced to shut the Kashiwazaki-Kariwa Nuclear Power Plant (the biggest complex in Japan) after the Niigata-Chuetsu-Oki Earthquake on the western side of the country caused initially unreported radiation leaks.[5] The plant was off-line until 2009 and Tepco posted losses of 150.11 billion yen in 2007/8 and expected a loss of 280 billion yen ($2.60 billion) for 2008/9.[6]

The video-clips of the blasts in Reactors Nos. 1 to 4 at Fukushima in mid-March this year[a] give some indication of the scale of damage at these old-style 1970s-built boiling water reactors. Nevertheless Tepco continued to issue falsely reassuring reports for several days until human error—in all likelihood brought on by exhaustion—caused them on March 28 to overestimate the radionuclide contamination of the water in the turbine halls by a hundred-fold.[7] The detection of traces of I-131 in the air over the UK reported the same day indicate, however slight these traces were, the degree of atmospheric contamination—enough to spread over 10,000 miles—and that Tepco's control

[a](see http://video.ft.com/v/825918290001/Fukushima-nuclear-plant-explosion)

of the train of events was being tested to breaking point.

The leak of radioactive water into the trenches of Reactor No. 2 (and the surrounding sea) was only plugged on April 6—after great difficulties[8] and as yet uncertain permanence. The "Mark I" container design for these reactors has been criticised as being "weak":[9] these containment vessels deteriorate through continuous radiation exposure and careful monitoring is needed. Furthermore, the local authorities apparently ignored expert warning in 2005 about the dangers of allowing too much spent fuel to accumulate in the plants' cooling ponds.[2] Plutonium now detected in the soil near Reactor No. 3 indicates a melt-down from its fuel, which from September 2010 had been of the "MOX" type[9] (see comment on MOX below). All four reactors must be decommissioned and the fuel rods removed (and reprocessed): but they cannot be dismantled for at least 40 years as too much radioactivity would be released. They may well need to be entombed long-term and at great expense. The fuel rods in reactors 5 and 6 were shut down successfully but there are eventual plans to re-activate them.[8]

How much Japanese society will continue to support nuclear energy remains to be seen but it will be very difficult for Japan to disentangle itself from a rampant addiction which its political system and societal structures seem impotent to control.

Yet advocates of civil nuclear power, who include Barack Obama and George Monbiot,[10,11] persist in promoting greater expansion with new "safer" installations. How much Japanese society will continue to support nuclear energy remains to be seen but it will be very difficult for Japan to disentangle itself from a rampant addiction which its political system and societal structures seem impotent to control.[3]

In the UK, Sir David King—former governmental chief scientific advisor—advocates still expanding our civil nuclear industry and building a new plant at Sellafield (at £3bn) for re-processing nuclear waste into "MOX" (mixed uranium/plutonium oxide).[12] King proposes that the current but defective plant at Sellafield be replaced, and attributes its notorious failures to "faulty design." Spent waste is very hot to handle while MOX is relatively safe and, from the viewpoint of nuclear power advocates, has the added virtue that MOX manufacture consumes spent waste from uranium-fuelled power plants thereby reducing hazardous stocks. King also states—with some, but limited, justification (in that coal mining and drilling for oil at sea are notoriously hazardous)—that nuclear power workers have a much lower accidental death rate than conventional power workers,[12] but he ignores the uniquely silent start and horrifically irreversible nature of radiation poisoning and also the health hazards of uranium mining (which his reprocessing scheme would, at least in theory, reduce).

However, MOX is inherently more dangerous radio-actively than uranium, is readily converted to weapons-grade materials and accurate quantitative accounting for its production is impossible (Barnaby and Kemp, 2007[13]). Thus, large scale MOX production from and for a global "nuclear renaissance" would encourage nuclear weapons proliferation by making it much harder to control unauthorized access to weapons-grade materials. It doesn't even need to be used in a fission explosion as it would make an effective "dirty bomb." Barnaby and Kemp also point out—very tellingly—that MOX-based energy production systems are far from carbon-free.

A MOX-based nuclear renaissance will still produce waste—indeed in vastly increased amounts: to deal with this King advocates disposal through "geological storage."[12] This would be in vitrified blocks trapping the waste and hopefully making it inaccessible to the general environment. Although theoretically attractive, major technical problems have yet to be solved, and vast amounts of industrial energy would be required for the vitrification—either from carbon-intensive combustion or by high intensity (and power-consuming) electric arc furnaces which have other adverse environmental impacts.[14] So any such approach to waste disposal would add great expense and still leave a poisoned legacy for hundreds of generations.

Observers such as Hamish McRae, less obsessed with scientific and technological fixes and taking a long-term financial outlook, offer a different strategy based on non-nuclear renewables and more efficient conservation.[15]

Revisiting Chernobyl

The Chernobyl reactor had no contain-

ment facility[16] so its burning graphite fuel-rods were exposed and ejected more radiation than that so far coming from Fukushima.

In reference 16 there are claims that earlier accounts of the numbers of casualties from Chernobyl following April 1986 were exaggerated. However, two authoritative reports in April 2006 (Fairlie and Sumner;[17] and IPPNW-Germany, updated 8 April, 2011)[18] challenge many of the conclusions of the UN/WHO report on the Health Effects of the Chernobyl Accident[19] which gives a total of 9,000 related cancer deaths compared with 900,000 expected cancer deaths in the affected region over the same period. Fairlie and Sumner predict up to 60,000 excess deaths from cancer, and the IPPNW reports describe many Chernobyl-related deaths and much morbidity not due to cancer. A press release from the International Agency on Research in Cancer (IARC, part of the WHO) of 20 April 2006, stated that "the cancer burden from Chernobyl cannot at present be directly measured" but referred to work on prediction models based on other studies, particularly the survivors of Hiroshima and Nagasaki. The press release went on to predict that by 2065 a mean of about 16,000 cancer deaths—with an "uncertainty interval" of between 6,700 to 38,000—may be expected due to radiation from the Chernobyl accident, and a mean of 16,000 cases of thyroid cancer (most of which would respond to treatment) and of 25,000 for other cancers. It also noted that these figures would represent a very small proportion of the total cancer deaths.[20]

Fairlie and Sumner state that the UN/WHO report was conducted meticulously by respected experts, but they also point out inadequacies—for example restricting the study area to Russia, Belarus and Ukraine and under-quoting the numbers of the "liquidators" who physically cleaned up the reactor site. "Only" 9,000 excess cancer deaths still represent 9,000 avoidable tragedies even though being just 1% of the deaths expected. Bob Gale, the American transplant specialist sent to graft bone marrow to those receiving supra-lethal radiation, such as the helicopter crews dowsing the openly burning Chernobyl core (none survived), gives a valuably informative medical history.[21]

It should be noted that observations on non-human life currently around Chernobyl indicate profoundly adverse ecological effects associated with the excessive radiation.[22]

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All these accounts should be considered afresh when deciding the future of nuclear power. This is even though the reactor at Chernobyl had no "containment" and that lessons may be learnt from the vulnerable "Mark I" container designs at Fukushima. Leaks appear to be continuing which makes it likely that upward revisions of the calculated total radiation exposure from Fukushima will continue. The abysmal reputation of Tepco and the way in which it became a virtually unaccountable independent hegemony to which Japanese society is so dependent is now very apparent, and a profound lesson to all societies of any political persuasion. However, massive and unaccountable irresponsibility is not confined to the nuclear industries—military or civil, banking and the arms trade also exemplify global fields of human endeavour where good regulatory intent has cracked under the pressure of "progressive" instincts and the drive for "growth."

> [I]t is a common experience that no regulatory system can completely protect humankind from even well-established health hazards...

Nuclear advocates will argue that their installations can be regulated into safety. Dr Mike Weightman, the highly respected Head of the UK's independent safety regulator under the Health and Safety Executive, has been charged by the government to issue an interim and then a full report on the implications of Fukushima for the UK and has invited comments.[23] This exercise is not meant to help decide whether the UK has a nuclear future but to define improved control, and as such is very important (see ref 24 for an informative response from a nuclear sceptic organisation). However, although it is perfectly feasible to design much improved systems for nuclear safety—and even putting the costs issue on one side—it is a common experience that no regulatory system can completely protect humankind from even well-established health hazards: oft-quoted analogies in, for example, blood transfusion and the pharmaceutical and airline industries, support this attitude and hence the application of the "precautionary principle."

Hence, while offering our most heartfelt consolations to the Japanese people and recognising that there are no major geological fault-lines in Britain, we need still to heed the

lessons of human frailty and the unpredictability of major events affecting the integrity of nuclear power plants. The better appreciation of 1) the nature of unexpected life-threatening leaks and accidents at nuclear power stations, reinforced by Fukushima; 2) the costs of dealing with all the sequelae of nuclear power including improved safety, build and waste disposal; and 3) the increased insecurity generated from vastly higher global stocks of MOX, provides the framework for a particularly potent case

> **against** a global nuclear renaissance and
>
> **for** a healthy non-nuclear world based on entirely different economies and life-styles.

Even though establishing such a world is probably the greatest challenge yet to face humankind and would entail significant suffering, this would be much preferred to nuclear annihilation.

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Radiation in medicine and in nuclear power plants: the same but very different

Andreas Nidecker

Dr. Andi Nidecker, a specialist in radiology in Basel, Switzerland and a member of the board of IPPNW, was asked to explain for non-specialists how exposure to ionizing radiation affects human health, and what factors need to be considered when radioisotopes are used in diagnostic and therapeutic medical procedures. Dr. Nidecker produced the following fact sheet, which IPPNW made available to its affiliates for public education and to answer questions from the media.

I have been asked to explain as diagnostic radiologist briefly the difference between radiation used in diagnostic x-ray and nuclear medicine studies and the radiation being emanated from a failing nuclear power plant as is unfortunately now happening in Japan.

Different types of ionizing radiations

Radiation is called "ionizing" because it can harm the cell nuclei in living tissues, cause disease and even death depending on the dose. Radiation occurs naturally in certain rocky areas in the world and is being emitted by certain substances called radioactive isotopes . The most powerful of those ionizing radiations is gamma radiation which is used for diagnostic x-ray and for radiotherapy but also in nuclear power plants for electricity production.

Radiation in medicine

As gamma radiation can penetrate tissues, it has the advantage—if used with caution and in reasonably small dosages—to make the inner organs of the human body visible. This is done in two ways: either by using an x-ray tube to send gamma-rays through the body or by injecting into the body very small doses of a short lived radioactive radioisotope, usually technetium. The information compiled through the use of computers will be transmitted via x-ray films or CT sensors or gamma cameras to give information about different organs and measure accumulation of technetium or other radioisotopes in the body.

Being short lived, all injected radioactive material will have disintegrated and been eliminated by the patient within minutes or hours. Whether using external radiation in x-ray machines or CT scanners or whether injecting radioactive substances in nuclear medicine studies, radiologist always use minute doses which are known not to harm the patient. Every patient seen by them needs a diagnosis and radiation may be used if medically justified: the risk of missing a patient's serious disease is much higher than the risk potentially induced to him by the burden of ionizing radiation. Occasionally other non-radiological methods, i.e., non ionizing, such as ultrasound or magnetic resonance imaging, can also be used to render a diagnosis.

Radiation in the nuclear power industry

In a nuclear power plant radiation effects occur in so called fuel rods made by uranium. Uranium exists in different forms and breaks down in the fuel rods by emitting Gamma rays just like in medicine. But this radiation is much stronger and is used to heat water which then produces steam in order to propel a steam turbine which in turn produces electricity. As long as the radioactive fuel roads are covered by water this process occurs in a controlled manner and the water keeps on being heated and produces steam.

So far this was considered an elegant although expensive way to produce electricity. However, there are safety issues involved and this makes nuclear power a potentially risky method to produce electricity. If the radioactive fuel rods are not persistently kept cool, they start to heat up and increase the temperature and pressure in the innermost location of the power plant. This so-called core or inner containment may break under pressure if the cooling is not maintained. The fuel rods then disintegrate and a large amount of radioactivity will be blown out into the atmosphere.

Radioactive isotopes in the fuel rods, such as uranium, plutonium and cesium, are much longer lived than the radioisotopes used in medicine. They will continue to send out harmful radiation as long as they are around. These particles can be blown as clouds over oceans and continents, but once they land somewhere, they still will emit radiation and will do this sometimes for many years e.g. the strontium and cesium isotopes for about 50 years, yet plutonium 40,000 years and uranium over 400,000 years.

As these radioisotopes can penetrate the ground, they will accumulate in the water and will be ingested by humans or animals through plants: once inside the body, they will build up in inner body organs, just like the short lived isotopes used in nuclear medicine studies. However, due to their much longer life, these isotopes may submit the body or a particular organ e.g. the thyroid gland, to continued harmful radiation. Through this process, the cells in the body could experience genetic damage, heart disease and malignant tumours.

Today it is known that even small doses or so called low level radiation, if ingested repeatedly as by the people living in radioactive contaminated regions , can be harmful and lead to disease.

Radiation used in medicine has the beneficial effect of allowing early detection of a serious disease, whereas radiation from the power plant accident had a high chance to produce serious disease and death...

Extremely helpful and extremely harmful

In summary one can say that radiation used in the core of a nuclear power plant is dangerous, obviously more so when set free in an accident: it is produced by highly radioactive corpuscular substances which are long lived. As the radiation comes from particles, these may be blown over large distances and can potentially be ingested , unnoticed by humans, and lead to chronic radiation diseases including cancer. On the other hand, the radiation produced by an x-ray tube affects the body for milliseconds to minutes and that used in nuclear medicine disappears from the body within minutes to hours.

Radiation used in medicine has the beneficial effect of allowing early detection of a serious disease, whereas radiation from the power plant accident had a high chance to produce serious disease and death, depending on the doses experienced. In conclusion, radiation is of the *same* type in medicine and nuclear power but very *different*: small doses are used in a controlled way in medicine and dangerous long lived radioisotopes are blown into the atmosphere in an uncontrolled way in a nuclear accident.

Children, Teens and the Japan Disaster

Harry Wang

Dr. Wang, a child and adolescent psychiatrist in Sacramento, California, is Clinical Professor of Psychiatry at the University of California Davis School of Medicine. He is also the President of the Sacramento chapter of Physicians for Social Responsibility. Dr. Wang said he compiled the following guidelines for possible use by others, because "during this difficult time.... I am dealing with a lot of anxious children and teens."

As we all know, Japan is suffering through a horrific disaster caused by the 9.0 earthquake, tsunami, and probable meltdowns at the Fukushima nuclear power plants. Unfortunately, this crisis will not end any time soon. I have already heard a variety of fears that young clients have expressed as they grapple with this tragedy. Children and teens who have, themselves, experienced traumas and/or losses will be more susceptible to what has happened in Japan. The amount of news that is watched on television may also increase the anxiety level of children and teens.

The American Academy of Child and Adolescent Psychiatry has information on children and news of disasters. "Children and the News" can be downloaded at: www.aacap.org. I have copied their guidelines below (in italics).

Guidelines for minimizing the negative effects of watching the news include:

- *monitor the amount of time your child watches news shows*
- *make sure you have adequate time and a quiet place to talk if you anticipate that the news is going to be troubling or upsetting to the child*
- *watch the news with your child*
- *ask the child what he/she has heard and what questions he/she may have*
- *provide reassurance regarding his/her own safety in simple words emphasizing that you are going to be there to keep him/her safe*
- *look for signs that the news may have triggered fears or anxieties such as sleeplessness, fears, bedwetting, crying, or talking about being afraid*

Parents should remember that it is important to talk to the child or adolescent about what he/she has seen or heard. This allows parents to lessen the potential negative effects of the news and to discuss their own ideas and values. While children cannot be completely protected from outside events, parents can help them feel safe and help them to better understand the world around them.

As adults it is also important that we monitor our own reactions to these events. One's own history, present sense of safety, and anxieties can effect how we interact with our children and other family members and friends. Here are some helpful guidelines to

consider (in italics) from the American Psychological Association found at: http://www.apa.org/helpcenter/distress-earthquake.aspx.

Managing Your Distress About the Earthquake from Afar

For people with friends and family living in regions affected by earthquakes, watching news coverage of the earthquake's devastation can be very distressing, particularly if there is no news on their safety and well-being. Even for those without personal connections to the country, the news coverage can be overwhelming.

APA offers the following tips to manage your distress:

- *Take a news break. Watching endless replays of footage from the disaster can make your stress even greater. Although you will want tokeep informed – especially if you have loved ones in earthquake-affected areas – taking a break from watching the news can lessen your distress.*
- *Control what you can. There are routines in your life that you can continue such as going to work or school and making meals. It is helpful to maintain these routines and schedules to give yourself a break from constantly thinking about the earthquake.*
- *Engage in healthy behaviors. Eat well-balanced meals, engage in regular exercise like going for a long walk, and get plenty of rest. Bolstering your physical well-being is good for your emotional health and can enhance your ability to cope.*
- *Keep things in perspective. While an earthquake can bring tremendous hardship and loss, remember to focus on the things that are good in your life. Persevere and trust in your ability to get through the challenging days ahead.*
- *Find a productive way to help if you can. Many organizations are set up to provide various forms of aid to survivors. Contributing or volunteering is a positive action that can help you to make a difference.*
- *Strive for a positive outlook. Many people who have experienced tragedy find that they grow in some respect as a result of persevering through the hardship. Over time, people can discover personal strengths and develop a greater appreciation for life.*

I hope that these ideas are useful as we interact with children and teens during these difficult times.