Canadian Coalition for Nuclear Responsibility

Regroupement pour la surveillance du nucléaire

Comments from

The Canadian Coalition for Nuclear Responsibility

regarding

Ontario's Nuclear Emergency Response Plan

prepared by

Gordon Edwards, Ph.D.,
CCNR President

July 28, 2017

Distant Early Warning Signs: Background Facts

In the wake of the Fukushima Daiichi triple meltdown, responsible authorities around the world have come to realize that we must be prepared to "think the unthinkable" when confronting the possibility of a major nuclear reactor accident involving severe damage to the core of the reactor, including melting.

All nuclear power reactors are designed to be shut down within seconds in case of an emergency. The Three Mile Island reactor in Harrisburg, Pennsylvania, was completely shut off hours before it underwent a partial core meltdown in 1979. All three reactors at Fukushima Daiichi whose cores ultimately melted down were also completely shut off before any core damage occurred : shutdown occurred in the time interval between the March 11 earthquake off the coast of Japan and the arrival of the tsunami wave.

Shutting off a nuclear reactor involves stopping the fission process – the splitting of uranium atoms. Nuclear fission makes use of subatomic projectiles called neutrons. A neutron strikes an atom of uranium, the nucleus of the atom splits into two fragments, a burst of energy is released, and two or more neutrons are given off *(see Figure 1)*. The multiplication of neutrons allows for the splitting of more uranium atoms, and so the energy release is multiplied as well. The process can be stopped very quickly by absorbing the excess neutrons, thereby shutting down the chain reaction.

During nuclear fission, however, a great many "fission products" are created inside the fuel. These are the broken pieces of uranium atoms that are left over. Each fragment forms the nucleus of an unstable atom, known as a radionuclide. Many kinds of radionuclides are created – radioactive isotopes such as iodine-131, cesium-137, strontium-90, xenon-133, and hundreds more. *See http://ccnr.org/hlw_chart.html*

Iodine, cesium, strontium and xenon are naturally occurring elements, and as they are found in nature, they are not radioactive. But every nuclear reactor creates highly unstable (radioactive) varieties of these same elements. The radioactive varieties are not found in nature except as a result of nuclear fission. The natural background level of iodine-131, cesium-137, strontium-90, and xenon-133, is in each case "zero". It's all human-made stuff.

Unlike stable atoms, every radioactive atom disintegrates, suddenly and very violently. A disintegrating atom gives off powerful emissions, coming directly from the nucleus, in the form of alpha particles, beta particles, gamma rays, and sometimes neutrons. A single CANDU used fuel bundle just out of the reactor, about the size of a fireplace log, gives off a blast of gamma radiation so strong it will give a lethal dose of atomic radiation to any human being in just 20 seconds at a distance of one metre. That person is dead in two days.

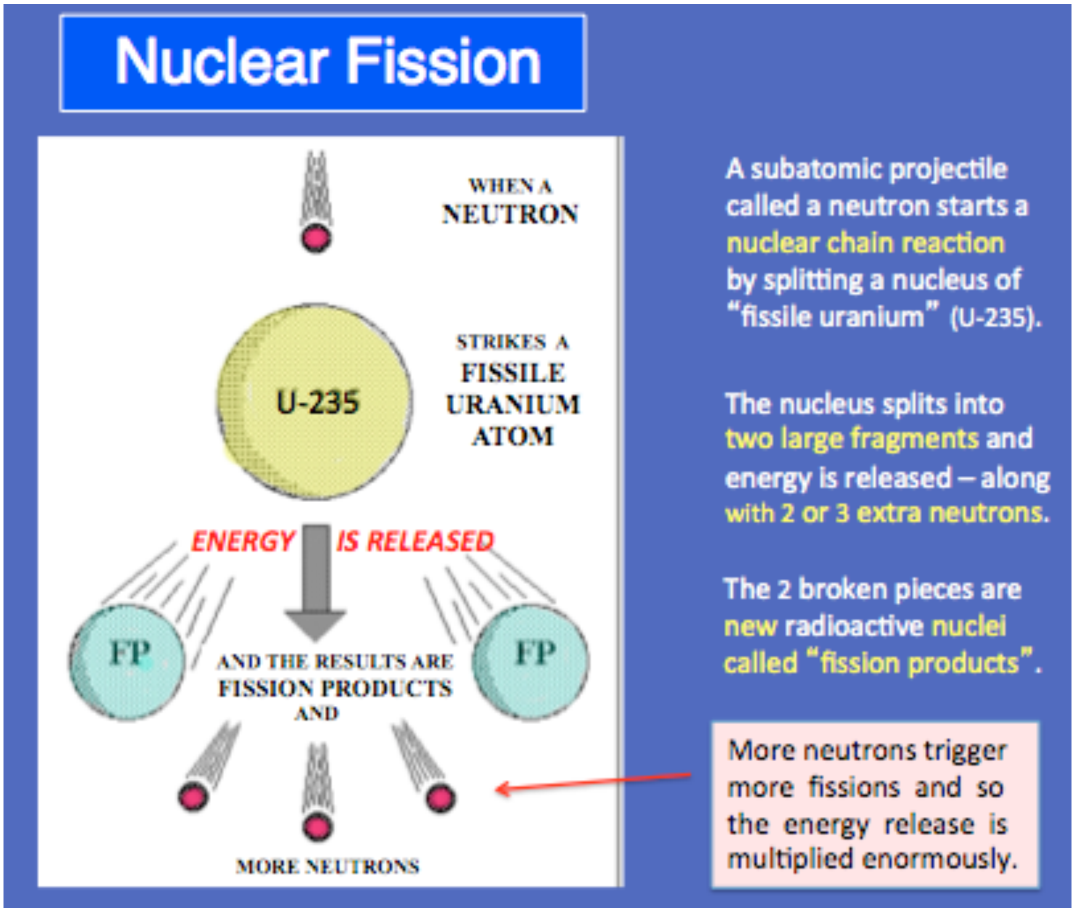


Figure 1: Nuclear Fission

Unlike nuclear fission, radioactivity cannot be shut off. Science knows no way to speed up, slow down, or stop the rate of radioactive disintegration from radioactive materials. That's why we have a nuclear waste problem. Radioactivity is a form of nuclear energy that simply cannot be halted.

The heat generated by atomic disintegrations from the enormous inventory of radioactive materials in the core of a shutdown reactor is more than enough to melt the reactor core at a temperature of about 2800 degrees C. Indeed, unless the radioactive "decay heat" can be effectively removed by circulating water through the core of the reactor, massive core damage accompanied by fuel melting will occur. Emergency cooling systems exist for that purpose.

Even before fuel melting occurs, over-heating will liberate large amounts of radioactive gases and vapours, as well as (non-radioactive) hydrogen gas. Destructive hydrogen gas explosions have occurred during almost all severe reactor accidents, including the 1952 partial meltdown of the NRX reactor at Chalk River, the partial meltdown of the Three Mile Island reactor in 1979, and the triple meltdowns at Fukushima Daiichi in 2011. Such explosions can damage containment structures, resulting in larger releases of radioactivity.

In 1978, one year before the partial meltdown at TMI in Harrisburg Pennsylvania, the Ontario Royal Commission on Electric Power Planning reported as follows:

> "By definition, a major reactor accident would lead to the severe overheating, and subsequent melting, of the nuclear fuel, which would give rise to a substantial quantity of radioactive material escaping, after breaching several formidable barriers, into the environment…."
>
> "When we talk about the safety of a nuclear reactor, we are referring essentially to how effectively the fantastic amount of radioactivity contained in the reactor core can be prevented from escaping into the ground and atmosphere in the event of major malfunctions."
>
> "Clearly, if a major release of this accumulated radioactivity occurred, the consequences would be extremely serious and could involve several thousand immediate fatalities and many more delayed fatalities."
>
> *A Race Against Time: Interim Report on Nuclear Power, pp. 73-76*
> *Ontario Royal Commission on Electric Power Planning, September 1978*

The Select Committee on Ontario Hydro Affairs concluded in 1980, after fifteen weeks of public hearings by an all-party Legislative Committee:

> "It is not right to say that a catastrophic accident is impossible…. The worst possible accident . . . could involve the spread of radioactive poisons over large areas, killing thousands immediately, killing others through increasing susceptibility to cancer, risking genetic defects that could affect future generations, and possibly contaminating large land areas for future habitation or cultivation."
>
> *The Safety of Canada's Nuclear Reactors: Final Report, pp. 9-10*
> *Queen's Printer, Ontario Legislature, June 1980*

Recommendation 1: That the Government of Ontario create educational materials to help citizens understand the nature and the dangers of radioactive materials, as well as the phenomenon of decay heat, with special emphasis on the fact that radioactivity cannot be shut off.

Recommendation 2: That the Government of Ontario create educational materials to help citizens understand the difference between radiation (as invisible rays mysteriously emanating from an external source) and radioactive materials (unstable atoms that are incorporated into the air we breathe, the water we drink and the food we eat).

Underestimating the Danger is Unhelpful

Professionals in the nuclear industry and the nuclear regulatory agency have an understandable tendency to deny or downplay the hazards associated with major reactor accidents because such considerations do not enhance the image of their industry as safe and acceptable. Many industries do the same. Pharmaceutical companies are not always forthcoming regarding the harmful side effects of some of their products. Tobacco companies are unwilling to be upfront about the dangers of smoking. The nuclear industry is no different.

The reluctance of Canadian nuclear authorities to be frank in addressing the topic of severe nuclear accidents was apparent from the very beginning. During cross-examination of the head of AECL's reactor safety and analysis division in 1977 at the Royal Commission on Electric Power Planning, the following exchange took place:

> ***Q****: Could you explain, just for the purposes of clarification, what is meant by the phrase "uncontained meltdown"?*
>
> ***A****: Mr. Chairman, I don't know who has used the phrase "uncontained meltdown". It's not a phrase that I use and I would decline to define it.*
>
> ***Q****: What about the word "meltdown"?*
>
> ***A****: Mr. Chairman, I would hesitate to comment on that.*
>
> ***Mr. Chairman****: But I'm sure you know what's meant by "meltdown"?*
>
> ***A****: Well strictly, Mr. Chairman, the term meltdown in documents as I have seen it, can mean quite a range of things, ranging from centreline melting of fuel elements most at risk, on the one hand, which does not have any significant consequences at all, even to the plant, to, on the other hand, I suppose one would have to agree, that the literal term of meltdown is exactly that: Melt Down. Now having said that, I think a natural question would have to be, well, are these things possible? And of course this is a question that has been posed to reactor designers in many jurisdictions, and they have given answers, which are matters of public record.*
>
> ***Q****: Let me, for the sake of discussion, define what I mean by an uncontained meltdown. I mean a melting of a very large portion of the core, a sizeable portion of the core of the reactor, which by one means or another results in breach of containment and consequent dissemination of radionuclides to the environment, whether that's through explosion, whether that's through melting through at the bottom, or whatever other mechanism. Has Atomic Energy of Canada Limited ever undertaken to conduct a study*

> *specifically aimed at determining whether or not such an uncontained meltdown is possible in a CANDU reactor?*
>
> ***A**: Mr. Chairman, now we are getting into questions that are getting out of the airy-fairy, if I may say so, and here I have something that I can answer in concrete terms. It is one of my responsibilities, and the responsibilities of my group, to theorize about the consequences of various hypothesized events. Now clearly, Mr. Chairman, you will gather from my answers to previous questions, that we have not theorized about hypothetically uncooled situations in hypothetically strong boxes.*
>
> See https://www.youtube.com/watch?v=kpCJz4wKp4Y

Following months of testimony and cross-examination in nuclear matters, the Royal Commission concluded that the probability estimates for a nuclear meltdown in a CANDU reactor provided by intervenors were more credible than the estimates provided by the nuclear establishment:

> *"Assuming, for the sake of argument, that within the next forty years Canada will have 100 operating reactors, the probability of a core meltdown might be in the order of 1 in 40 years, if the most pessimistic estimate of probability is assumed."*
>
> *A Race Against Time: Interim Report on Nuclear Power, pp. 78-79*
> *Ontario Royal Commission on Electric Power Planning, September 1978*

Realizing the inherent conflict of interest that exists for nuclear promoters and supporters, the Select Committee issued the following recommendation:

> *"The AECB should commission a study to analyze the likelihood and consequences of a catastrophic accident in a CANDU reactor. The study should be directed by recognized experts outside the AECB, AECL and Ontario Hydro. It should be funded by a special grant from the federal government. If this study is not commissioned by July 31, 1980, the province of Ontario should ensure that it is undertaken."*
>
> *The Safety of Canada's Nuclear Reactors: Final Report, pp. 9-10*
> *Queen's Printer, Ontario Legislature, June 1980*

Such an independent study has never been carried out. Instead there have been carefully crafted studies prepared by the nuclear establishment, or based on data provided by the nuclear establishment, that systematically downplay the magnitude of the potential hazards. Such studies are not helpful. They mislead decision makers into believing that even an uncontained meltdown can be managed with only modest precautions in place. Given the shock and confusion that results when radioactive releases turn out to be far more significant than anyone ever anticipated, as at Chernobyl and Fukushima, there is no point in fooling ourselves. Ontario deserves better.

In 1997, Ontario Hydro's Board of Directors brought in an outside team of nuclear experts to advise them on the safety of Ontario's fleet of nuclear reactors because the Board was unable to get a clear picture of the true state of affairs from the people in their own nuclear division, or from the Atomic Energy Control Board, the precursor of the Canadian Nuclear Safety Commission. The outside team reported that all of Ontario's reactors (Pickering, Bruce and Darlington) were "minimally acceptable" in terms of safety. As a result seven reactors were shut down for more than six years as safety-related maintenance problems were addressed. The report said:

> *"... staff at every level are reluctant to ask difficult questions of themselves and others. Failure to establish a questioning attitude is a primary cause of the reduction in the 'defence-in-depth' concept."*
>
> *Independent and Integrated Performance Assessment, 1997.*
> *Executive Summary. http://ccnr.org/hydro_report.html#iipa*

In planning for nuclear emergencies, the Ontario Government would be well advised to take note of weaknesses in the safety culture of Canada's nuclear establishment by noting that hazard estimates are likely to be understated.

A case in point is the 2015 CNSC ***Study of Consequences of a Hypothetical Severe Nuclear Accident and Effectiveness of Mitigation Measures.*** By definition, CNSC says, a severe accident is one that results in a large release of radioactivity to the environment. In paragraph one of section 3.1, the authors of the report state that, by definition, a "large release" is any release containing more than 100 terabecquerels of cesium-137. But then, in the second paragraph, they select the lowest possible number, namely 100 terabecquerels, as their assumed large release – ignoring the fact that their own definition states that most large releases will be greater than that. See http://www.nuclearsafety.gc.ca/eng/pdfs/health-studies/Severe-Nuclear-Accident-Study-eng.pdf

(A becquerel is a unit of radioactivity, indicating one radioactive disintegration per second. A terabecquerel is a million million becquerels, indicating that a trillion radioactive disintegrations take place every second. The authors of the CNSC report write 1×10^{14} becquerels, which is 100,000,000,000,000 becquerels [with 14 zeros] – i.e. 100 million million becquerels, or 100 terabecquerels.)

The CNSC's habit of understating radiological hazards is well illustrated by its misleading description of the highly radioactive liquid being trucked from Chalk River to South Carolina over public roads and bridges. In a 2014 document entitled "Technical Assessment Report: NAC-LWT Package Design for Transport of Highly Enriched Uranyl Nitrate Liquid" CNSC consistently describes the liquid as Uranyl Nitrate – a specific chemical compound involving only one radioactive constituent, namely uranium. But Table 2 on page 9 of the report confirms that the liquid contains dozens of other radioactive materials, mainly fission products, and that each and every litre is 17,000 times more radioactive than the uranyl nitrate mentioned by CNSC.

There are 23,000 litres of this highly radioactive liquid stored in a single tank at Chalk River. That tank contains over 1600 terabecquerels of cesium-137. That is 16 times greater than the amount of cesium-137 CNSC chose as its "major radioactive release" from a severe nuclear accident! Indeed just one litre contains 70 billion becquerels of cesium-137 : more than enough to ruin the drinking water of any city in North America. This is not uranyl nitrate!

See http://ccnr.org/GE_CRL-SRS_pack.pdf

The Government of Ontario has become implicated in disseminating misinformation on this very subject by repeating uncritically the misleading description provided by CNSC. Three documents were sent out to Emergency Management Officials throughout the province, describing the liquid being trucked over Ontario roads as Highly Enriched Uranyl Nitrate. That is untrue and mischaracterizes the risk completely. In fact the uranium content of the liquid is the least concerning constituent from a health, safety and environmental point of view. The 3 Ontario gov't documents are linked below:

1. http://ccnr.org/TRM_Transport_Ontario_ltr.pdf
2. http://ccnr.org/TRM_Transport_Ontario.pdf
3. http://ccnr.org/HEU_Fact_Sheet.pdf

The Government of Ontario has an obligation to its own population and its own first responders to stop relying uncritically on one-sided misinformation about nuclear hazards from the CNSC, from OPG and from AECL. Of course their expertise is useful, but their public pronouncements are undeniably self-serving and must be tempered with advice from other quarters. Every independent nuclear expert that I have consulted has said that the figure of 100 terabecquerels of cesium-137 released from a severe nuclear accident (i.e. a meltdown at a CANDU) is much too low, by orders of magnitude.

Recommendation 3: That the Government of Ontario hire an independent nuclear expert, or experts, not connected with the Canadian nuclear establishment, to examine the hypothesized "large release" of 100 terabecquerels of cesium-137, in order to determine whether such a release might reasonably be expected to be 10, 100 or 1000 times larger than the CNSC estimate.

Recommendation 4: That the Government of Ontario draft not one, but several emergency plans, each one depending on the magnitude of the radioactive release from a severe nuclear accident at a CANDU nuclear power station. These plans should be able to take into account orders of magnitude differences in the so-called "source term".

Emergency Planning Goes Beyond Evacuation

Evacuation planning is a very important component of emergency planning for a severe nuclear accident. The extent of the evacuation will depend in an important way on the source term (i.e. the magnitude of the radioactive release) and the proximity of the nuclear station to the affected population, as well as the weather conditions (e.g. wind direction and precipitation).

But there are other considerations that are of great importance too, especially since the major health impact of such an accident will be delayed cancers and leukemias that depend on the total accumulated radiation exposures at the time of the accident and during the post-accident period.

Containment of Contaminated Water

The radioactive heat generated by irradiated nuclear fuel continues long after the fuel is removed from the reactor. Normally the used nuclear fuel is stored in a pool of circulating water for ten years before being moved to dry storage containers. If the newer irradiated fuel is not actively cooled (i.e. if there is no water in the pool) it will overheat, the metallic cladding on the fuel elements will fail, and radioactive gases and vapours will be released into the atmosphere from the intensely radioactive fuel.

When severe core damage caused by core melting occurs, the fuel elements lose their geometric integrity and cannot be moved to a spent fuel pool. But they still have to be cooled to prevent further overheating and further radioactive releases. At Fukushima Daiichi, about 400 tonnes of water were pumped down into the melted cores of the reactors on a daily basis, and then were pumped back to the surface. All this water becomes heavily contaminated with fission products flushed out of the molten cores, and so it cannot be released into the environment.

TEPCO, the owner of the crippled reactors, had huge steel tanks built to hold the highly contaminated water for eventual treatment. More than a thousand such tanks were built. An expensive and laborious procedure for removing 62 varieties of radionuclides from the contaminated water was employed. Some radionuclides, however, such as tritium (radioactive hydrogen) cannot be removed. Now TEPCO wants to dump some 800,000 tons of tritium-contaminated water into the Pacific Ocean. The plan is strongly resisted by Japanese fisherman and other parties.

The volume of the Pacific Ocean is approximately 30,000 times the volume of the Great Lakes. Evidently if the contaminated waters resulting from the Fukushima Daiichi disaster were to be released into the Great Lakes it would be an international incident of gigantic proportions. Ontario must plan now to be prepared to deal with such an emergency on very short notice later.

Recommendation 5: That the Government of Ontario plan for the rapid and secure containment of large volumes of highly contaminated water resulting from a major core meltdown accident at any one of the existing nuclear power stations in Ontario, with special consideration to the space required for such storage and the technologies needed to remove radionuclides from the huge volumes of contaminated water.

Identification of Contaminated Foods and Beverages

Many of the fission products in irradiated nuclear fuel pose special threats.

Iodine-131 gives off both gamma radiation and beta radiation. It is released as a vapour that turns into a solid and deposits on soil and grass. When it is deposited on pastureland the concentration of iodine-131 is increased by a factor of about 100 than when it is hovering in the air. When cows eat the contaminated grass they concentrate the iodine-131 even further in their milk, and if a child drinks that contaminated milk the iodine-131 can be further concentrated by a factor of about seven times in the child's thyroid gland. Over 5000 children in Belarus had to have their thyroid glands surgically removed because of damage caused by radioactive iodine from the Chernobyl accident over 30 years ago.

Cesium-131 enters the food chain readily, being easily concentrated by mushrooms and leafy vegetables like spinach. Cesium-137 also concentrates in the fleshy areas – the meat – of many animals, leading to radioactive contamination of beef, pork, lamb and mutton. For two decades after the Chernobyl meltdown in the Ukraine, sheep farmers in Northern England and Wales were not allowed to sell their meat for human consumption until it was monitored for radioactive cesium contamination from the Chernobyl accident. To this day, wild boars in Germany are too contaminated with cesium-137 from Chernobyl to be safely consumed, and the German government pays cash compensations to hunters because they cannot consume their meat; the same thing is now happening in Japan, with wild boars in the Fukushima area.

It is very important, following a severe nuclear accident, that people are given clear and healthy suggestions as to what foods and beverages should be avoided, and what other dietary precautions should be followed. For example, if the milk supply is contaminated, powdered mild can be used safely for a period of time provided the powdered milk was prepared before the nuclear accident. This kind of information is crucial so that people can make informed choices.

Recommendation 6: That the Government of Ontario set up a body of nutritionists and other biomedical specialists, independent of the nuclear establishment, to prepare guidelines for Canadians to follow in the aftermath of a severe nuclear accident, and to recommend procedures to be followed by consumers, farmers, food processors and retailers following a severe nuclear accident.

Decontamination of Buildings and Soil

Cesium-137 does not disappear. It has a half-life of 30 years, meaning that it will remain in the environment for centuries. After 300 years, the original 100 terabecquerels of cesium-137 assumed by CNSC will have been reduced to 100 gigabecquerels (billions of becquerels) of cesium-137 – still a very large amount.

Cesium-137 is a gamma-emitter, so it irradiates anybody in the vicinity. It is known that children and women are much more susceptible to the harmful effects of gamma radiation than adult males. So radioactive cesium is an external radiation hazard as well as an internal radiation hazard. One good thing is that cesium-137 can be easily detected with a Geiger counter.

Other materials, like strontium-90 (also with a 30-year half-life like cesium-137) do not give off any gamma radiation but only beta radiation. Beta radiation is much harder to detect. It is mainly an internal hazard. But it is very important to prevent people from tracking these materials into their homes on their shoes, hair, skin and clothing. Inside the body strontium-90 is stored in the bones, in teeth, and in mother's milk, because it is chemically similar to calcium. Strontium-90 is known to cause bone cancers and various blood disorders including leukemia.

Cesium-137 is a metallic vapour. It plates out on cool surfaces of all kinds. It contaminates the surfaces of roofs, the sides of buildings, and particles of soil. At Chernobyl, it was discovered that 25 years after the accident, cesium contamination was still found to be almost completely retained in the top 3-5 centimetres of soil.

In Japan, in the years following the Fukushima Daiichi disaster, an army of workers had to be deployed to scrub radioactive contamination from houses and other buildings, one structure at a time. Of course scrubbing radioactive contamination from roofs and walls just moves the contamination from one place to another. It doesn't disappear; it gets packaged up and moved off-site.

They also had to remove contaminated soil from playgrounds, parks, gardens, even forest floors (but only within 200 metres of a residence). Individual rocks in household gardens were scrubbed to remove cesium contamination, and a lot of garden topsoil was removed as well. Millions of plastic bags had to be filled with contaminated soil. These were stacked up in huge mounds in many different locations stretching over 200 kilometres between the Fukushima Daiichi site and the borders of Tokyo. [See Appendix A]

Scrubbing surfaces to remove contamination is only partially effective. In 1958, after a three-foot section of uranium fuel caught fire and spread radioactive contamination inside the NRU reactor building at Chalk River, some 600 men – mostly teenaged cadets from Camp Petawawa – were issued respirators and protective rubberized clothing and sent into the reactor building to scrub the walls. After repeated scrubbings, some contamination still remained. The walls had to be covered up with radiation-resistant paint.

Recommendation 7: That the Government of Ontario prepare a number of detailed training manuals, drawing on the experiences of the Japanese cleanup after the Fukushima Daiichi disaster, spelling out how to carry out various kinds of decontamination procedures bearing in mind the need to prevent contamination of the workers and to avoid spreading contamination through careless practices.

Respectfully submitted by
Gordon Edwards, Ph.D., President,
Canadian Coalition for Nuclear Responsibility.

July 28, 2017.

Annex A
Lessons from Fukushima

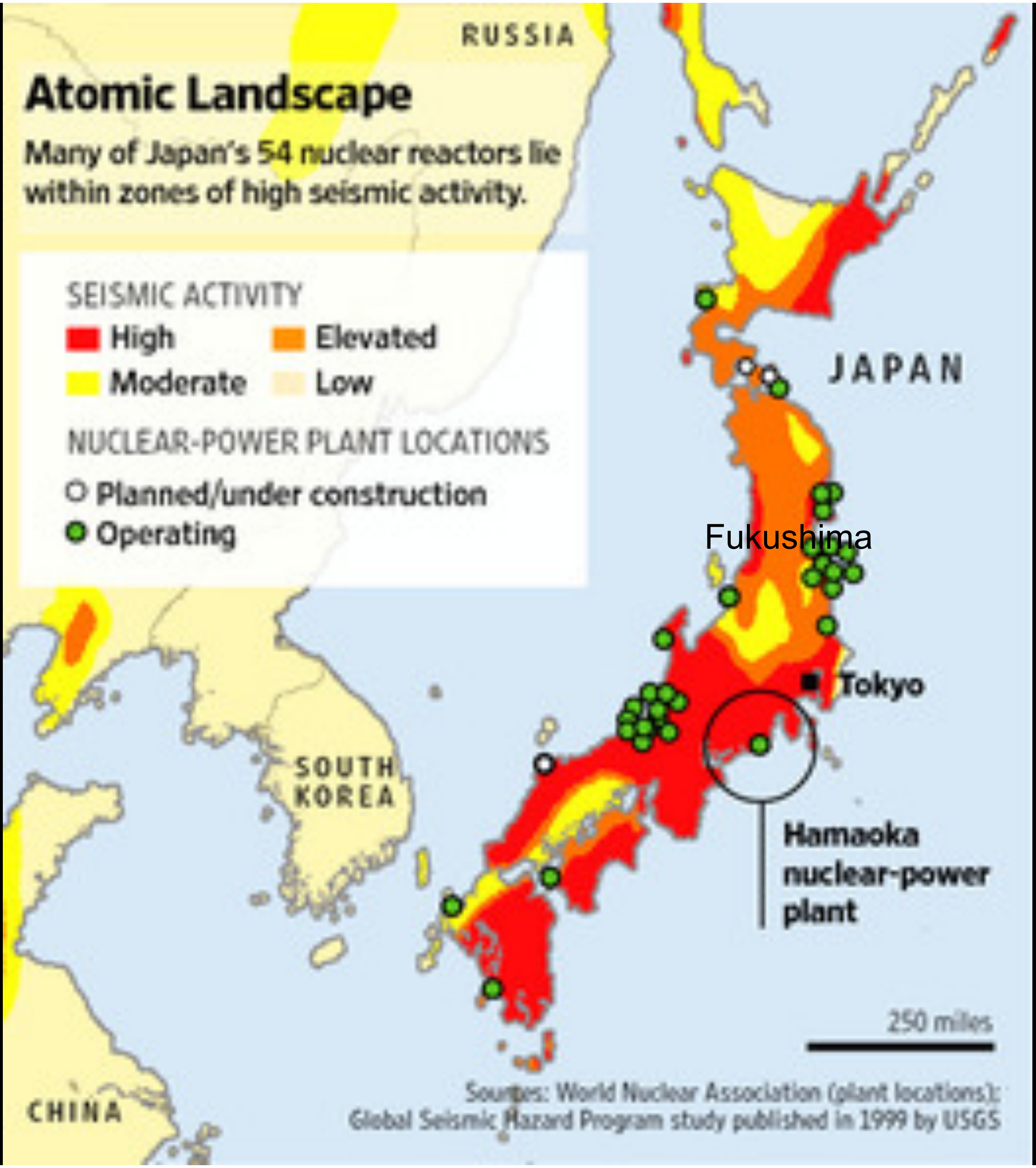
Remediation Efforts in Contaminated Areas

A Slide Show Presentation by
Gordon Edwards Ph.D.
CCNR@WEB.CA

July 28 2017

When the 2011 earthquake hit, Japan had 54 reactors. Today only five of them are operating.

This 1995 map shows that the Fukushima Daiichi reactors are not even sited in the riskiest part of Japan for earthquakes.



Unit 1-4 reactors at Fukushima before – and after – the earthquake & tsunami

There was no visible damage done to the reactors by the earthquake or tsunami

Two days after the tsunami the reactors started exploding – four of them !

The damage is all self-inflicted; the reactors did it to themselves !

The radioactive waste inside the reactor core is what caused the damage.
The reactors themselves were shut down, but you can't shut off radioactivity.

Chain of Events

1. *Earthquake.*
2. *Reactor shutdown (immediate).*
3. *Tsunami – backup generators flooded: blackout !*
4. *Temperature rises due to radioactive decay heat.*
5. *Steam pressure rises – hydrogen gas is generated.*
6. *Steam vented; hydrogen explodes; roof blown off.*
7. *Escape of radioactive gases and vapors.*

Meanwhile the Reactor Cores are Melting Down.

What is a Meltdown?

Fission products produce decay heat due to radioactivity

Decay Heat cannot be shut off – it has to be removed by pumps

Loss of power idles the pumps and results in rising temperatures

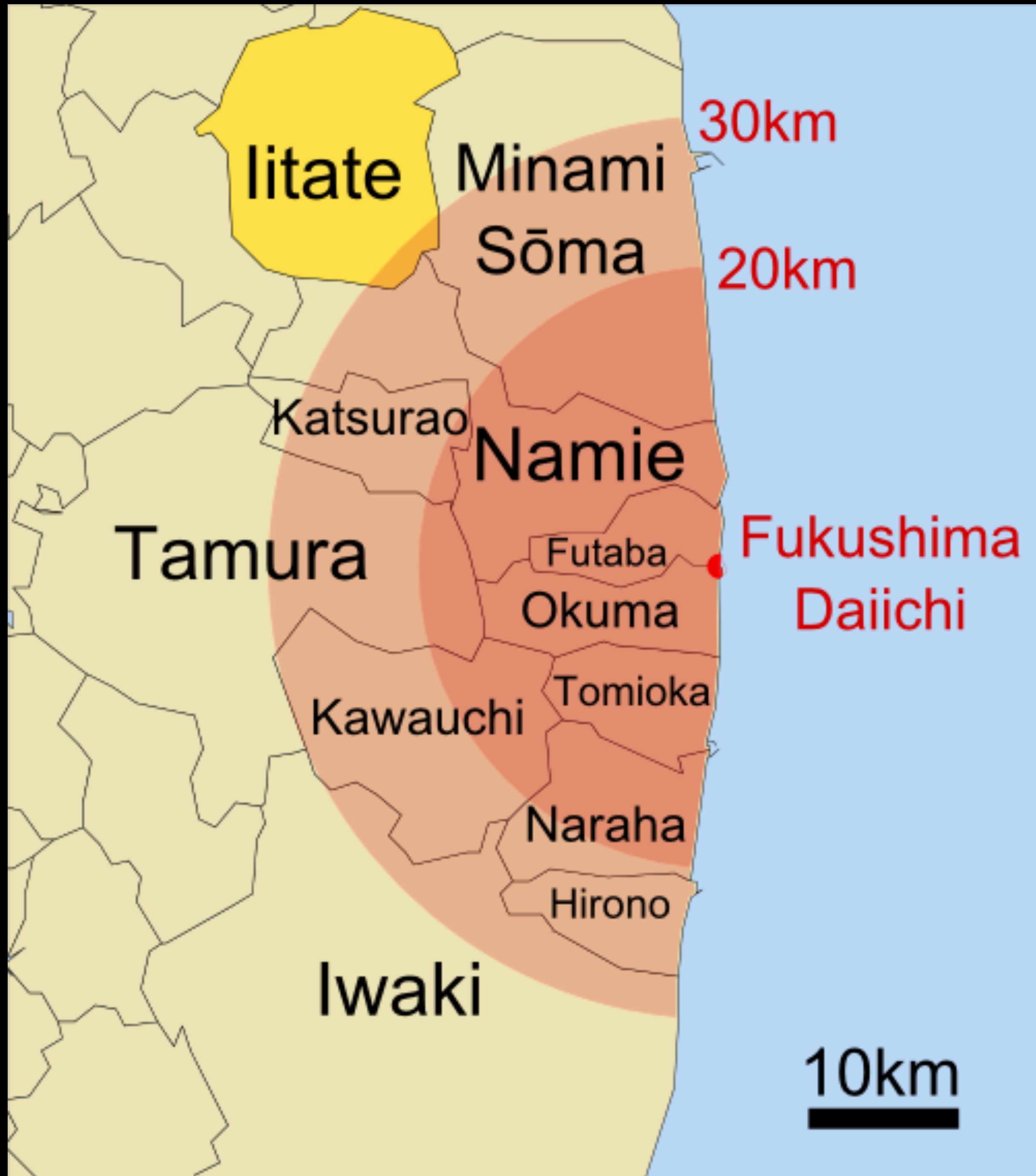
At 1800 degrees C, cladding 'burns' and releases hydrogen gas

At 2800 degrees C, the ceramic fuel melts – meltdown is underway

Within 20 km :
evacuated

Within 30 km :
"evacuation readiness"

Town of Iitate,
> 30 km away :
evacuated



radioactive cesium

(August 2011)

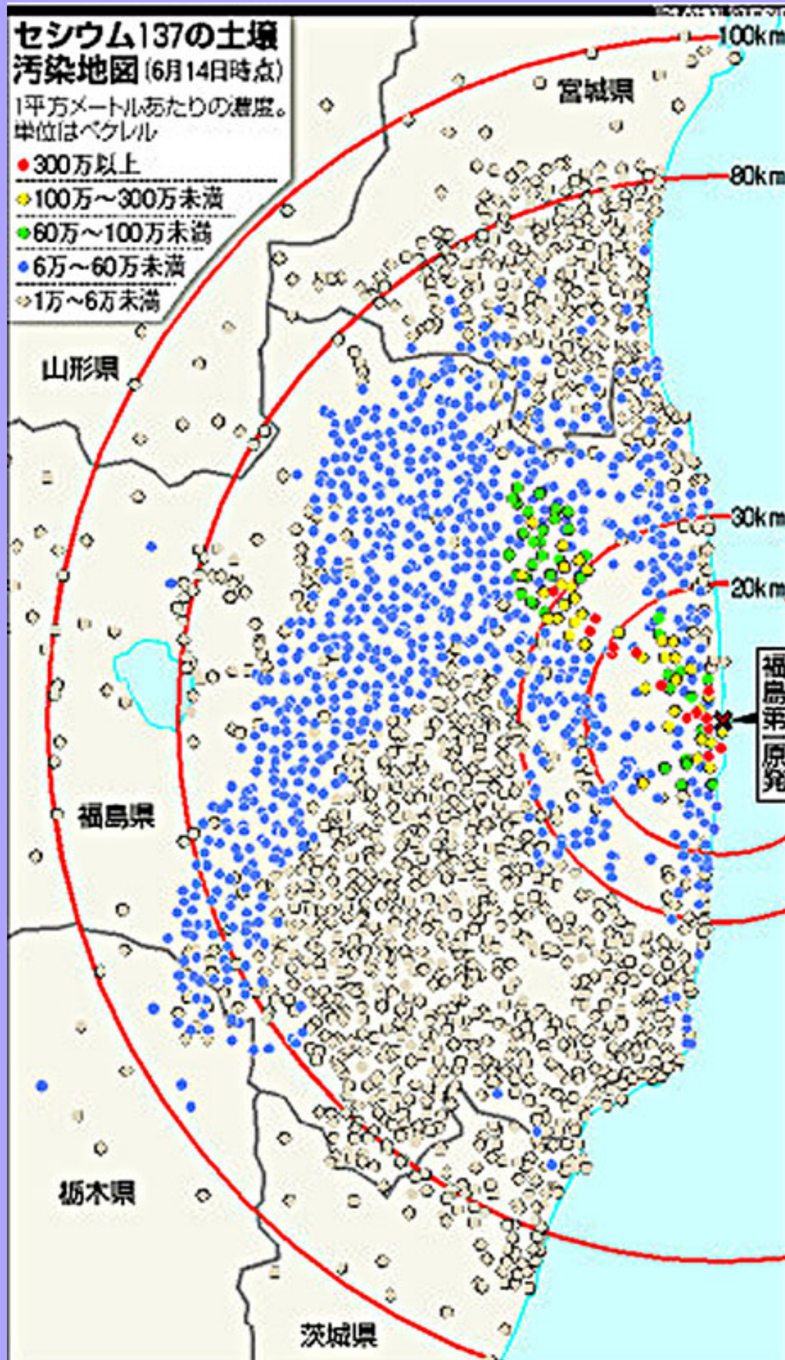
red = over 3 million Bq/m^2
yellow = 1 to 3 million Bq/m^2
green = 600,000 to 1 million
blue = 60,000 to 600,000
grey = 10,000 to 60,000

maximum = 30 million Bq/m^2

August 29, 2011

Chernobyl evacuation criterion:

555,000 becquerels/m^2



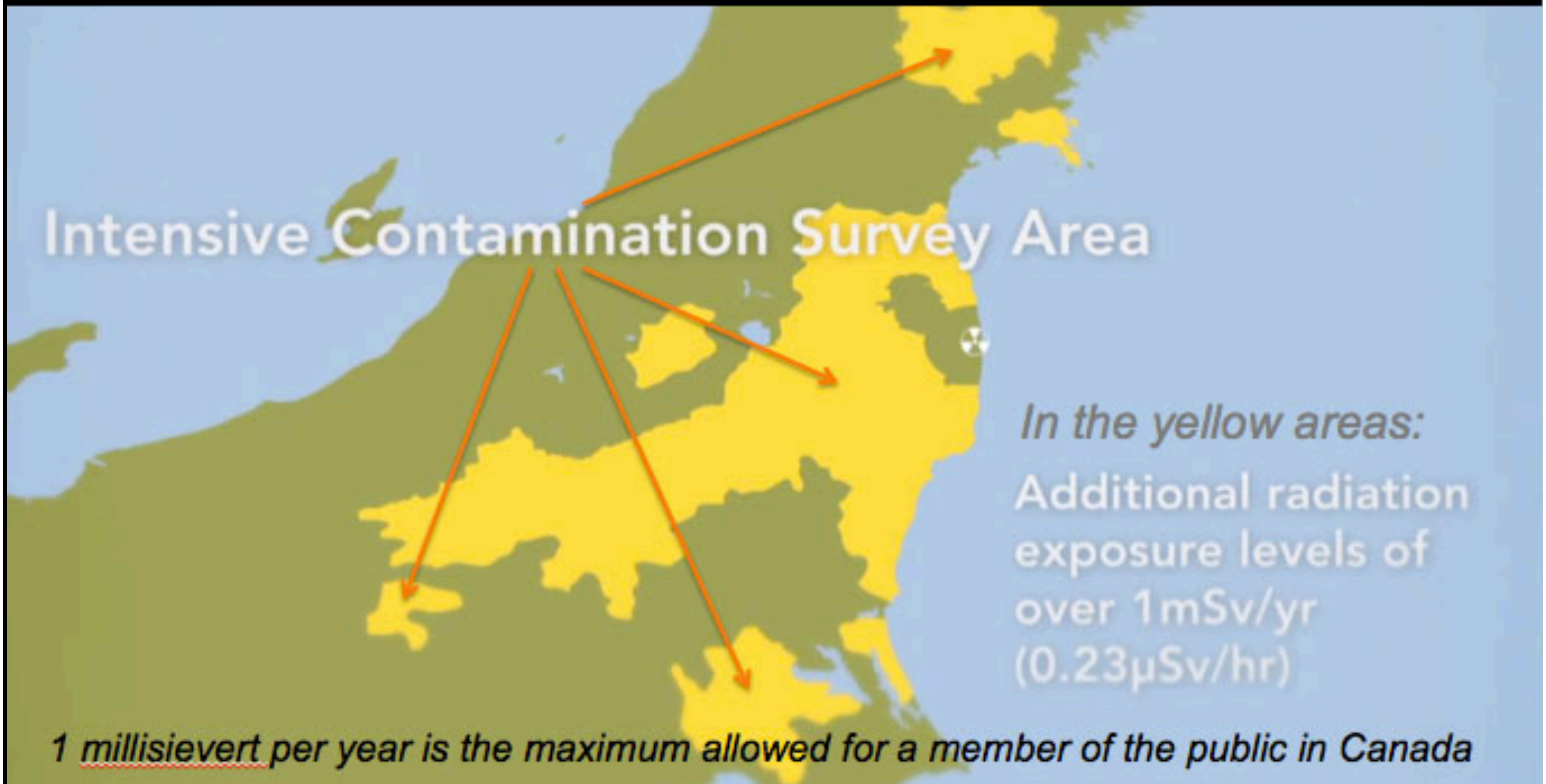
Extensive cesium contamination within 100 km

Red & yellow : high degree of contamination

Blue : borderline for evacuation


In yellow area: these exposures exceed limits for atomic workers
Special Decontamination Area
This is the original 20 km semi-circular evacuation zone
Target Goal:
To get Additional radiation exposure levels to below 20mSv/yr
20 millisieverts per year is the maximum allowed for atomic workers in the EU

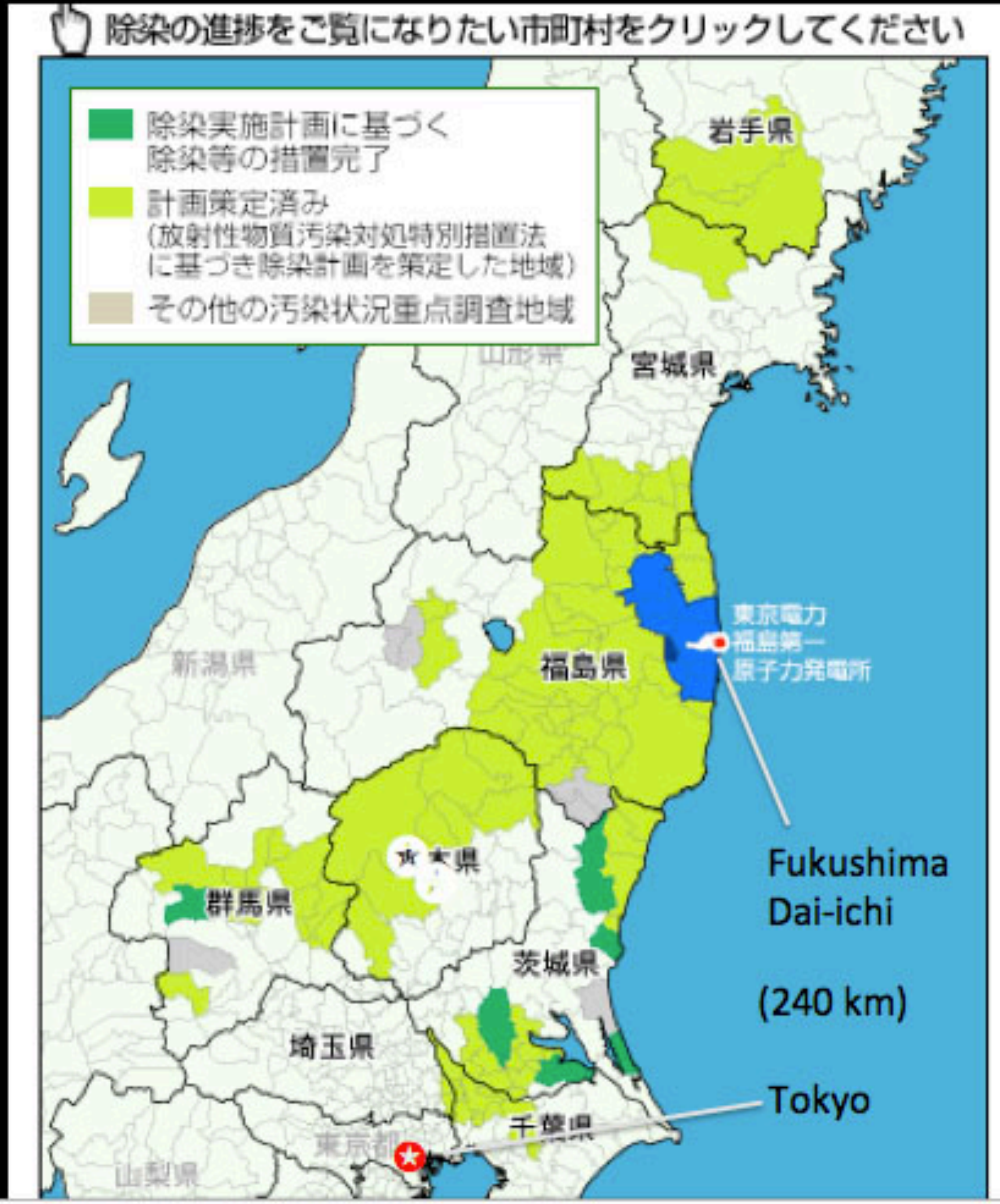
Inside the large yellow areas there was no evacuation but radiation levels are rather high and decontamination efforts are underway.



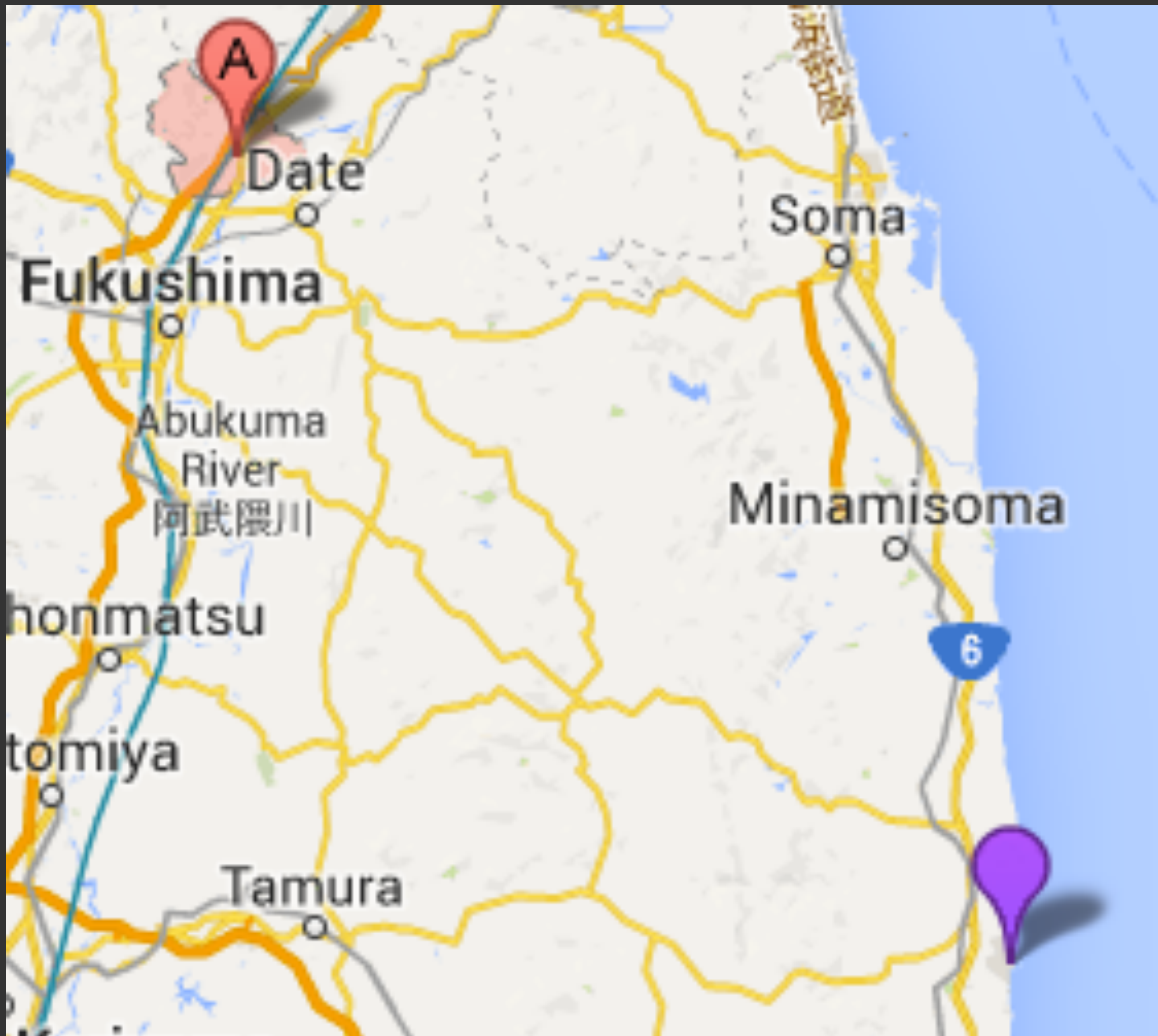
The green areas correspond to the yellow areas in the previous map.

The evacuation area is in blue.

Tokyo is shown as unaffected, but Arnie Gundersen took soil samples from Tokyo that would be classed as radioactive waste in the USA.



RED MARKER = TOWN OF KOORI ———— 65 km **PURPLE MARKER = Fukushima Daiichi**




This gentleman is from the Town of Koori, 65 kilomtres Northwest of Fukushima Daiichi
This, and the following images, are from an August 2013 video put out by Japan’s Ministry of the Environment.
The caption below is part of the government video.
I have been furious at TEPCO and the Japanese government.

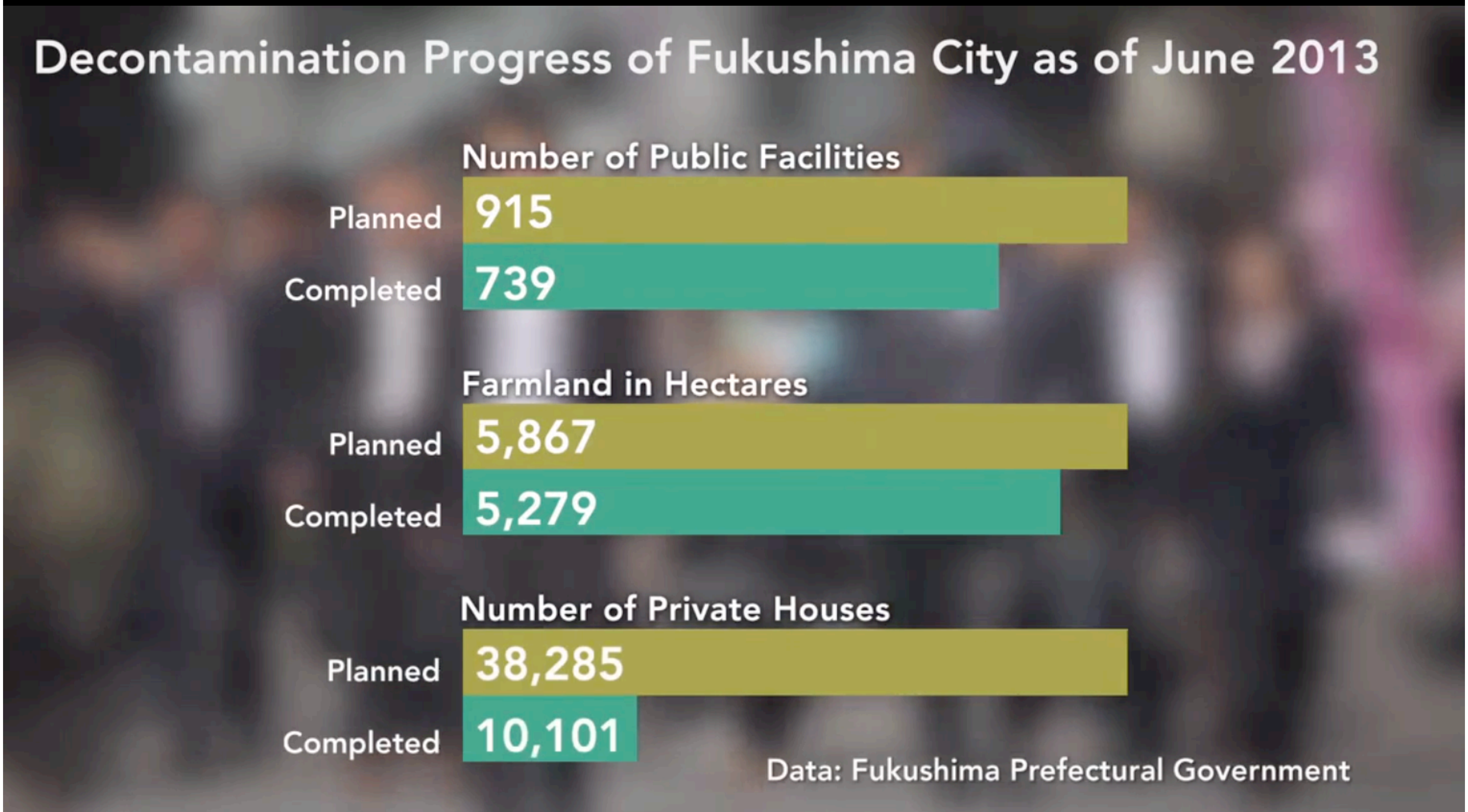
Despite his anger, he wants to help gov't officials with decontamination efforts.

Radioactive soil must be removed; forest floor is stripped only within 200m of homes.


once you step outside
the levels are still high.

Garden soil is also removed. Radioactive moss is even scrubbed from garden rocks.

Decontamination of a home takes days or weeks. Two years after the disaster, only 1/4 of homes in Fukushima City had been decontaminated.

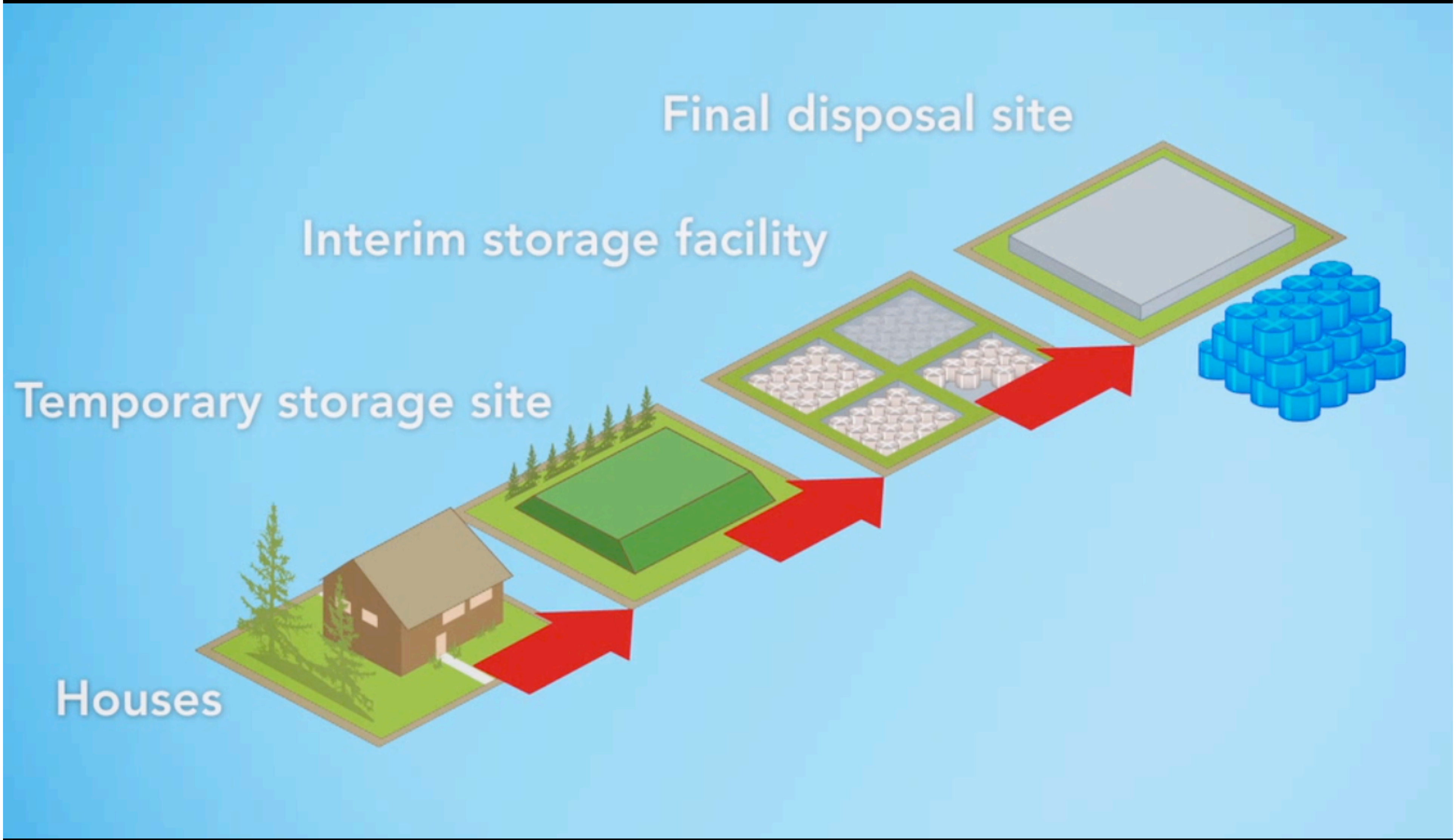


Sacks of contaminated materials are stored in the town, against the wishes of many residents – but better this than nothing. Here we see 4 "layers" of sacks.

Another local storage area for sacks of contaminated material that will remain dangerous for several centuries (cesium-137 has 30 yr half-life).

Behind this retaining wall are many more sacks of radioactive waste.
(Let’s hope they don’t get washed away by a typhoon.)

Eventually all these sacks in all these towns will got to an interim facility, but That's still a long way away it seems. Japan has no final disposal site either.



Meanwhile, contaminated water is accumulating – and leaking -- at Fukushima Daiichi

400 tons of water per day are pumped through the 3 molten cores to prevent them from over-heating; the water ends up so contaminated it must be stored in tanks.

More than 1000 tanks are already filled with more being added all the time.

A forest has been cut down to make room for more tanks.

Equipment removes 62 different varieties of radionuclides but some (like tritium) cannot be removed at all.

Meanwhile contaminated groundwater enters the Pacific at 300 tonnes per day.