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USA

Country Status: Nuclear Energy in the USA in the Wake of the Fukushima Nuclear Crisis

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Nuclear energy is often falsely promoted as a cure-all: the "Peaceful Atom" was to be the antidote to nuclear conflict, yet massive stocks of weapons-usable plutonium have been generated making electricity;ⁱ then a cure for world poverty was promised from the most costly form of centralized power generation to date.ⁱⁱ Today, nuclear proponents claim a cure for the Climate Crisis, when in fact, nuclear is not carbon-free and new nuclear capacity is one of the least effective investments both in terms of cost and timeline for reducing greenhouse emissions.ⁱⁱⁱ In addition, the Atomic Age has been punctuated by enormously catastrophic events resulting in massive release of radioactivity^{iv} to our environment, exposing human populations and resulting in many additional cancers, more leukemia, birth defects and barriers to reproduction (sterility or spontaneous abortion of a mutant fetus).^v Radiation inflicts disproportionate harm to children^{vi} and women.^{vii} Indeed, there is no safe dose of radiation.^{viii}

The first atomic catastrophes, both in 1957, were secret. That year a Soviet nuclear waste storage tank in Mayak exploded, and in Scotland a tritium-production reactor called Windscale burned.^{ix} The 1966 partial meltdown of Fermi-1, a plutonium breeder-reactor near Detroit, Michigan was also kept quiet.^x The first nuclear meltdown with TV news coverage was the Three Mile Island (TMI) reactor in Pennsylvania in 1979.^{xi} In 1986, the explosion at the Soviet reactor called Chernobyl became the largest industrial accident in history, measured in health consequences, expense, and area impacted.^{xii}

Nuclear accidents have a starting point, but in reality these events have no end; interdiction is permanent. Tragically, the people of Japan bear the burden of both the first atomic catastrophes--the atomic bombing of Hiroshima and Nagasaki--and now the ongoing nuclear disaster in Fukushima.

Military action in 1945, and the subsequent reconstruction-period when US corporations, introduced nuclear energy to Japan (including the General Electric Mark-1^{xiii} design in Fukushima) give the United States of America a causal role in the nuclear events in Japan. This Chapter will focus on nuclear energy in the USA, so the global dimension of US nuclear operations will not be expanded further, but must be acknowledged. Reactor designs by General Electric (GE) and Westinghouse remain key products in global nuclear sales.

Radioactivity is routinely released from all industrial nuclear sites even during non-accident operations. Massive new radioactivity is generated by "24/7" fission at power reactors and accounts for more than 95% of the hazard in total US radioactive waste.^{xiv} It is our view that nuclear energy has already inflicted more harm than cure.

I) The Roller Coaster of Atomic Power Development in the USA

President Nixon in 1973 predicted 1000 nuclear power reactors would be operating in the USA in the year 2000. A total of 132 power reactors have been tied to power grids in the US; in the year 2000 only 103 reactors had operating licenses. In 1973 the last order was made for a new reactor that actually came on-line. The US nuclear industry has been at a standstill; in fact, it has been shrinking since 1974, when the first of ninety-eight nuclear construction permits, including many partially constructed units was canceled. Billions of investment dollars were lost. In addition, twenty-nine operating nuclear reactor licenses were terminated before the 40 year expiration including 26 closed by aging and/or economic concerns, 1 by voter referendum and two (Fermi 1 and TMI) due to core melt. Communities in New York^{xv}, New Jersey and Vermont^{xvi} are working hard to close three more aging reactors at the end of the 40 year operating license.

What caused the nuclear downturn? Primarily this: corporate financial officers had hard data from the first decade + of nuclear operations showing that nuclear is not a viable way to make a profit. Three Mile Island, where a reactor turned to nuclear waste overnight and many people were exposed to radiation,^{xvii} was a forceful illustration of this point. TMI also brought additional federal safety regulations that further increased the cost of reactor operation.

In 1985, a Forbes Magazine cover story entitled "Nuclear Follies"^{xviii} argued that nuclear energy is the largest managerial failure in human history, with a price tag on the first round that has been estimated at more than \$100 billion. Public Service Co. of New Hampshire went bankrupt trying to build the Seabrook nuclear complex, Washington Public Power Supply System defaulted on billions of dollars of bonds, and several utilities were forced to eat billions in "imprudent" costs. Unprofitable reactors were written off, or with very little disclosure under electricity deregulation laws, "socialized" by spreading the "stranded cost" across a larger consumer base than was ever served by the facility.

While TMI helped turn the energy industry, it did not (as sometimes alleged) trigger the civil society "No Nukes" movement in the US. In 1977, two years before the TMI meltdown, 1414 people were taken into custody for non-violent refusal to break camp on the construction site of the Seabrook reactor in New Hampshire.^{xix} Group incarceration was used by these activists to organize a network to promote non-nuclear energy policy through the end of the 20th Century. Grassroots groups in impacted communities remain actively engaged to phase-out nuclear energy today, particularly those living near the twenty-three GE Mark-1 reactors (Fukushima Daiichi^{xx} clones) and on known fault lines.^{xxi}

Energy development is largely a matter of money, while there are even more real costs. In many reactor communities the latency periods for cancer are up and house after house has cancer victims. It's been 30 years since the one (and only) US government study of public health around commercial nuclear power reactors was published. This 1988 poorly-defined National Cancer Institute study^{xxii} failed to identify effluent pathways and used downwind and downstream

sectors as part of the control groups. It is perhaps no surprise that no correlation between reactor location and cancer was found.^{xxiii}

Today the aging reactor fleet is generating cash due to a variety of cost-cuts and the write-down of debt, but most of the major impacts like water displacement, thermal pollution, health and reproductive consequences and long-term waste consequences are externalized. Large reactor components including steam generators and even reactor vessel heads have been replaced due to aging, substandard materials and corrosion.

Wall Street investors and credit agencies remember the enormous losses of the 1970's, '80's and '90's and are not planning to invest in more nuclear development.^{xxiv} The large energy companies themselves also will not risk their own assets to build new nuclear, so nuclear expansion in the US, if it happens will be publicly funded.

II -- The Enduring Product of Atomic Power

Splitting atoms results in two categories of fission products--smaller radioactive atoms formed from the fragments of the original atom and also bigger, heavier elements formed when a particle is absorbed and the uranium does not split. These bigger "transuranics" include weapons-usable plutonium and other elements that are not found in nature. The smaller atoms are a long list of elements like Cesium and Strontium and are much more radioactive than the pure uranium fuel that the process begins with.

Routinely, even without an accident the fission products leak out of the fuel rods contaminating everything in the reactor system with high-levels of radioactivity. Any part that must be replaced is considered by US regulations, so-called "low-level" waste even including items so radioactive that a lethal dose can result in minutes.^{xxv}

In the US, "low-level" waste may be sent to "processors" for treatments, including incineration. Burning does not reduce radioactivity, but does compact the waste, releasing radioactivity to our environment in the process. Some of the processed waste may be deregulated and sent to ordinary municipal landfills, or even recycled into consumer products.^{xxvi} Regulated waste is routinely buried in un-lined trenches, resulting in ground water contamination at these sites.^{xxvii}

Irradiated (also called "spent") nuclear fuel is the most concentrated form of radioactive waste. In the USA it contains nearly all the radioactivity from all sources, including nuclear weapons production. The US has no permanent facility for this deadly waste. Like "low-level" waste, it presents a health hazard for hundreds, even thousands of millennia.^{xxviii} For twenty years the plan was to send this waste to Yucca Mountain on traditional Native Land in Nevada. Nevada and the Western Shoshone people fought this plan and won in 2009 when the US Department of Energy withdrew the license application for this \$10 billion boondoggle. Now a Presidentially mandated Blue Ribbon Commission (BRC)^{xxix} is making recommendations for new policy. The same safe energy advocates working to phase out nuclear energy offered the BRC recommendations, posted at: <http://www.nirs.org/radwaste/hlw/finalbrcanswers111610.pdf>.

Today nuclear constitutes about 20% of total US electric power generation. This year (2011) renewable generation exceeded nuclear in terms of share of overall energy production.^{xxx}

III-- New Generations

Advertised as a "nuclear resurgence," 29 proposed new nuclear licenses are now pending before the US Nuclear Regulatory Commission (NRC).^{xxxii} Nonetheless, no new license has been granted in the eight-year period since the first new sites were announced (2003). All of these new reactors have been challenged legally on the basis of potential personal harm by people that would be impacted, many represented by non-government organizations (NGOs).^{xxxiii}

If economics drove the first round, this round is no different. Now reactor construction costs have accelerated to more than \$10 billion per new reactor unit on average. The only change is that the federal government has decided to help "restart" this industry.

The Energy Policy Act of 2005 changed the terms of US nuclear development by providing federal loans with a guarantee to cover any default (initial allocation, in 2007, was \$18.5 billion dollars). In the same year the Congressional Budget Office projected that such loans had a 50% chance of default.^{xxxiii} This is the first time that federal dollars have been offered for civil power plant construction. The 2005 law also created a limited tax credit for new nuclear generation and new forms of insurance to cover cost of any delays. Both the Bush and Obama administrations have sought (so far unsuccessfully) to expand government support for new reactors to as much as \$50 billion in guaranteed loans.

The federal nuclear insurance program known as "Price-Anderson" was also renewed in 2005. This amendment to the Atomic Energy Act creates an initial pool of self-insurance and a mechanism for charging every US reactor owner for a grand total of about \$12 billion. Price Anderson then provides a "liability cap" to the industry, beyond which the situation is referred to Congress. There is no coverage at all for "acts of war." Given the hundreds of billions of damage caused by the Chernobyl^{xxxiv} explosion and fire, in a nuclear world, a \$12 billion fund likely means that large portions of the damage would be borne by the victims, much like the true costs of hurricane Katrina and large oil spills.

These provisions substantiate that nuclear energy cannot survive or grow in an open market, requiring the externalization of most real costs, and also effective "socialization" through direct government support. Most analysts agree that new nuclear energy will not be possible in the USA without such government support.^{xxxv}

Even with such support, the nuclear "renaissance" may not be achieved in the U.S. In 2010, Constellation Energy rejected a proposed federal loan for its proposed Calvert Cliffs-3 reactor (a joint project with Electricite de France) in part because it felt the loan terms were too stringent, and dropped out of the project. (EdF is still trying to continue it, but has been told by the NRC that it cannot obtain a license unless it can find a U.S. partner). Yet the Congressional Budget Office said in August 2011 that loan terms offered so far by the Department of Energy (one loan has been accepted by Southern Company for two new reactors at its Vogtle site in Georgia) are too lax.^{xxxvi}

And the CEO of Exelon, the nation's largest nuclear utility, said on August 15, 2011, that the economics of new nuclear construction have gotten worse over the past two years.^{xxxvii}

The Fukushima accident already has claimed one proposed nuclear project in the U.S. Shortly after the accident, NRG Energy abandoned its proposed two-reactor South Texas project (considered a frontrunner for the next federal loan). Tokyo Electric Power was a major investor in that project.

The basic technology of new reactor designs being considered for construction in the U.S. remains the same as the past: low-enriched uranium fuel, pressurized or boiling water reactors. Elaborate "passive safety" systems also introduce new risk factors.^{xxxviii} Fundamentally nothing has changed, except for the events in Fukushima -- likely the largest nuclear accident to date. It remains to be seen the level of response the US federal^{xxxix} and other regulators^{xl} will make to the lessons from the Fukushima disaster, and how this will impact the attempt to expand nuclear energy in the USA.

Along with a new generation of proposed reactors, a new generation of civil society activists has been "woken up" by the unfolding disaster in Japan to the problems of nuclear energy. In the age of Social Media, the number of sites devoted to nuclear issues has ballooned this year and social engagement on nuclear issues is again on the rise.

We All Live in Fukushima

On August 11, 2011 a coordinated legal action^{xli} was taken by intervenors in each reactor licensing action (both license extensions of aging reactors and proposed new licenses). The action seeks to force the NRC to incorporate information from its own report released by the Near-Term Task Force^{xlii} on the implications of the Fukushima Daiichi nuclear disaster in any (and every) license decision. The Task Force report was written by career NRC staff, appointed by the Commission. The executive summary of the report summarizes the findings in this initial assessment.^{xliii}

Many of the NRC recommendations are common-sense reflecting the events in Fukushima during March, 2011, including a focus on loss of electric power; recognition that multiple reactor units **can** have concurrent accidents (previously assumed too remote a probability to consider); and specific upgrades for flooding and earthquakes. Other findings in the report reflect "histrionic" development of the US nuclear safety program. After the Three Mile Island meltdown, in addition to added federal safety regulations the US nuclear industry instituted its own "voluntary" program--outside of federal regulation. The industry program is not subject to government enforcement action. The report calls this a "patchwork" and recommends that all requirements relevant to severe accidents be incorporated into enforceable federal regulation. While this would be an enormous step forward, local communities and NGOs remain concerned that the NRC does not have a strong track record of enforcing any regulation. And

Unfortunately majority of the NRC Commissioners, over the protestations of NRC chair Greg Jazcko, have been seeking to slow the pace of consideration of the recommendations, much less

their implementation, leaving uncertainty as to whether the U.S. will act to improve nuclear safety.

The NGO community has made its own recommendations this year for how to increase nuclear safety and security in the US^{xliiv} while pursuing a swift, overall phase-out of atomic energy: immediate, permanent closure of the 23 GE Mark-1 reactors, and those built on geologic fault lines; cancellation of all nuclear subsidies, particularly loan guarantees; repeal of the Price Anderson Act; reduction of irradiated fuel in reactor cooling pools; hardening, increased security and local community participation in dry fuel storage at reactor sites; no nuclear license extensions; no new licenses including for nuclear fuel chain activities or any style of new (or old) reactor; expansion of emergency evacuation zones out to 50 miles; safety review of Station Blackout; update of US radiation standards reflecting Chernobyl's consequences in radiological impact assessment (internal exposures); end import of foreign radioactive waste; stop incineration of radioactive waste; ensure that all radioactive materials remain regulated. This program has endorsements from more than 80 NGOs.

It is the deep hope of this author that the people of the world, including top-level decision makers will understand the fundamental truth: we all do live in Fukushima. The people in Japan are suffering orders of magnitude more harm, and yet, the radioactivity from TEPCO's reactors has traveled around the Northern Hemisphere several times. We all have an opportunity to be impacted, some of us fatally, by that radioactive fallout. We are one world, and together we must move, peacefully, out of the Atomic Age, together.

ⁱ Plutonium generation is discussed in section II, an extensive review of civilian plutonium and the challenges it presents: 2001. Makhijani, Arjun, "Plutonium End Game" Institute for Energy and Environmental Research, available online in full: <http://www.ieer.org/reports/pu/>

ⁱⁱ For critique of impact of nuclear, including on emerging economies see a special edition of The Nuclear Monitor: Globalization of Nuclear Power published in 2000 and available online: <http://www.nirs.org/mononline/globehome.htm>

ⁱⁱⁱ For a collection of studies on nuclear energy as a false solution to the Climate Crisis see: and also Union of Concerned Scientists report (FULL CITE) and 2003, Makhijani, Arjun, "Carbon Free, Nuclear Free: A Roadmap for US Energy Policy" available online at: <http://www.ieer.org/carbonfree/index.html> and a collection of further papers by Amory Lovins of Rocky Mountain Institute, including the 2005 classic "More Profit with Less Carbon" originally published in Scientific American posted at: http://www.rmi.org/rmi/Library/C05-05_MoreProfitLessCarbon

^{iv} The Chernobyl reactor dumped more persistent radioactivity into the biosphere of Planet Earth than all of the nuclear weapons tests combined. See: 1991. Makhijani, Arjun, et al. "Radioactive Heaven and Earth" published by Institute for Energy and Environmental Research.

^v Radiological harm is the basis of federal regulation of commercial nuclear energy. The US Environmental Protection Agency sets overall goals for protection and the US Nuclear Regulatory Commission enacts regulations (found in Chapter 10 of the Code of Federal Regulations, Part 20) to meet those goals. Critics have found reason to attack those goals and regulations as insufficiently protective. See: 1982. Gofman, John, "Radiation and Human Health." and 1986. Bertell, Rosalie, "No Immediate Danger?" Summertown Books. 1994. Caldicott, Helen, "Nuclear Madness," W.W. Norton.

^{vi} There is a large literature on the greater impact to young bodies where cells are divide more rapidly. The impact of ionizing radiation on cells is not only to the DNA, but long-term health impacts like cancer are primarily related to this damage. The classic work on this focused on the unborn child, where in the late 1950's Dr. Alice Stewart working at Oxford discovered a 400% increase in subsequent cancer in children born to mothers who were X-rayed during pregnancy. An essay recounting this history is posted:

<http://www.ratical.org/radiation/SecretFallout/SFchp2.html> See the sources cited in Note V and also the The National Academy of Sciences, 2006 "BEIR VII" -- Biological Effects of Ionizing Radiation report.

^{vii} Data published in BEIR VII shows that the same dose level of ionizing radiation causes 50% more cancer to women than to men. Likely this is due to the greater amount of reproductive tissue which is more vulnerable to the impact of radiation. These findings are published in Table 12D-3 on page 312 of the National Academy of Sciences 2007 BEIR VII report. The title of the table is *Lifetime Attributable Risk of Solid Cancer Incidence and Mortality*. A briefing paper on these findings will soon be available from Nuclear Information and Resource Service, www.nirs.org.

^{viii} The regulation of nuclear activities is required because there is no level of radiation exposure that does not have the potential to cause health consequences. Even death may result from an atomic exposure so small that it cannot be measured; however, more exposure equals greater chance of problems. The US Environmental Protection Agency acknowledges these facts in its Safe Drinking Water Standards and the US NRC bases its regulations on a "no threshold" -- for zero risk, there must be zero exposure model.

^{ix} Wikipedia has fairly decent accounts of these events: http://en.wikipedia.org/wiki/Kyshtym_disaster and http://en.wikipedia.org/wiki/Windscale_fire there is also a body of literature that includes these.

^x One account of the Fermi-1 partial core melt is by John Fuller, 1975, Reader's Digest Press: "We Almost Lost Detroit."

^{xi} The body of literature on Three Mile Island is large and diverse. As a starting place for NGO information see: <http://www.nirs.org/reactorwatch/accidents/accidentshome.htm>

^{xii} Chernobyl: see also the above link.

^{xiii} See: <http://www.nirs.org/factsheets/bwrfact.htm> and

^{xiv} US Department of Energy Integrated Spent Nuclear Fuel database. 1992 edition contained a pie chart. This percentage is now low since the USA has not been in largescale nuclear weapons production in the intervening years but has continued full-time civilian power production.

^{xv} Many NGOs have been working to ensure that the reactors closest to New York City close. The Governor of New York has recently concurred. See: <http://www.nytimes.com/2011/06/29/nyregion/cuomo-emphasizes-aim-to-close-indian-point-plant.html>

^{xvi} Like New York, many NGOs in Vermont have been working to ensure the closure of Vermont Yankee, lead primarily by Citizen Awareness Network <http://www.nukebusters.org/>. A turning point was the vote by the Vermont state senate reported here: <http://www.nytimes.com/2010/02/25/us/25nuke.html>

^{xvii} Dr Steven Wing did a reanalysis of data collected around TMI five years after the accident. The scientists who did the original work were constrained by a court order and could not freely examine that data or discover any conclusion other than that ordered by the court. Wing was not constrained and found 400% increases in several cancers and all cancers combined in those living where the primary plume traveled. The study is published: Wing, et al, A Reevaluation of Cancer Incidence Near the Three Mile Island Nuclear Plant: The Collision of Evidence and Assumptions Volume 105, Number 1, January 1997 * Environmental Health Perspectives, and reported here: <http://www.unc.edu/news/archives/feb97/wing.html>

^{xviii} February 11, 1985, Forbes Magazine: Nuclear Follies (cover story feature) by James Cook.

^{xix} Documentary footage from this historic event is available from: <http://www.turningtide.com/SEABROOK.htm>

^{xx} See: <http://www.nirs.org/reactorwatch/accidents/gemk1reactorsinus.pdf>

^{xxi} Reactors on Fault Lines Getting Fresh Scrutiny was reported in the Wall St Journal March 17, 2011: <http://online.wsj.com/article/SB10001424052748704396504576204672681780248.html>

^{xxii} See: Wing, Steve, Objectivity and Ethics in Environmental Health Science, VOLUME 111 | NUMBER 14 | November 2003 • Environmental Health Perspectives

^{xxiii} There is a growing body of literature that does link proximity to reactors that have not had major accidents with cancer and other health impacts see: There is of course extensive information on the health consequences of the Chernobyl accident.

^{xxiv} See for instance the 2007 classic: Risky Business, posted:

http://www.iccr.org/news/press_releases/pdf%20files/risky_Jan07.pdf In addition a series of reports from the credit agencies like Standard and Poor and Moody's are available, but not on-line.

^{xxv} See pages 50 - 52 of the Government Accounting Office report: <http://www.gao.gov/corresp/rc98040r.pdf>

^{xxvi} D'Arrigo, Diane and Mary Olson et al, *Out of Control -- On Purpose: DOE's Dispersal of Radioactive Waste into Landfills and Consumer Products*, Nuclear Information and Resource Service, Takoma Park, MD, USA, May 2007 <http://www.nirs.org/radwaste/outofcontrol/outofcontrolreport.pdf>

^{xxvii} See: <http://www.nirs.org/factsheets/llwfct.htm>

^{xxviii} See link in note xxvii (above) and also the Environmental protection agency standard for the now canceled Yucca Mountain repository of 1 million years. Congress ordered a site-specific standard for Yucca since it flunked every other standard available. EPA posts this information: <http://www.epa.gov/radiation/yucca/background.html>

^{xxix} See www.brc.gov

^{xxx} U.S. Energy Information Administration, May 26, 2011, see:

<http://www.eia.gov/totalenergy/data/monthly/index.cfm>

^{xxxi} See: <http://www.nrc.gov/reactors/new-reactors/col.html> and for a map: <http://www.nrc.gov/reactors/new-reactors/col/new-reactor-map.html>

^{xxxii} NRC licensing action and the hearings that result from civil society (and other) interventions, are all posted in the Electronic Hearing Dockets, accessible on this link: <http://ehd1.nrc.gov/EHD/> the following page has a default log-in of "guest" and anyone may enter by accepting option.

^{xxxiii} The default rate is discussed in the 2011 Congressional Budget Office report: Federal Loan Guarantees for the Construction of Nuclear Power Plants, posted at: <http://www.cbo.gov/ftpdocs/122xx/doc12238/08-03-NuclearLoans.pdf>

^{xxxiv} There is a huge literature on Chernobyl, an independent report published on the 30th anniversary is called TORCH (The Other Report on Chernobyl Health impacts) see: <http://www.nirs.org/c20/torch.pdf> and this from one of the "fathers" of the Atomic Age, John Gofman: <http://www.ratical.org/radiation/Chernobyl/>

^{xxxv} A recent addition to the many analyses that make the conclusion that nuclear requires subsidy to be "viable" is from the Union of Concerned Scientists: Nuclear Power: Still Not Viable Without Subsidies (2011) is available on-line at: http://www.ucsusa.org/nuclear_power/nuclear_power_and_global_warming/nuclear-power-subsidies-report.html

^{xxxvi} <http://www.nasdaq.com/asp/stock-market-news-story.aspx?storyid=201108041113dowjonesdjonline000483&title=us-undercharges-for-nuclear-loan-guaranteescongressional-report>

^{xxxvii} <http://www.businesswire.com/news/home/20110815005946/en/Exelon-CEO-Nation-Nuclear-Power-Cites-Economic>

^{xxxviii} For instance, the AP1000 design by Westinghouse creates a "cooling" updraft around the reactor containment, but this same feature may distribute radioactivity faster and farther in the event of containment failure. Arnie Gunderson of Fairewinds Associates has characterized these issues which are pending before the US NRC as concerns in certification of the AP1000 design. See: <http://www.fairewinds.com/content/ap-1000-press-conference-%E2%80%93-technical-statement>

^{xxxix} The NRC Commissioners have not as of August 15, 2011 decided to act on any of the NRC staff recommendations for upgrades in NRC regulations.

^{xl} State regulators have no direct jurisdiction over a nuclear reactor, but the state does rule on the need for energy, and overall energy policy as well as relevant functions like emergency response

^{xli} The edition filed at one site is available at: <http://www.nirs.org/nukerelapse/levy/levyhome.htm>

^{xlii} Recommendations for Enhancing Reactor Safety in the 21st Century, July 12, 2011, the report of the NRC Near Term Task Force Review of Insights from the Fukushima Dai-ichi Nuclear Accident.

^{xliii} Recommendations are offered in the Executive Summary (pages vii - x) of the report noted above.

^{xliv} <http://www.nirs.org/nukerelapse/whattodo/postfukushimaprogram.pdf>