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Subject: FW: Comments on Docket ID No. NRC-2012-0246
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From: Dennis Nelson [mailto:dennis_nelson@att.net]
Sent: Thursday, December 12, 2013 2:59 PM
To: RulemakingComments Resource
Subject: Comments on Docket ID No. NRC-2012-0246

Attached is a Microsoft Word Document containing my comments on Docket ID No. NRC-2012-0246, Waste Confidence Generic Environmental Impact Statement. I hand delivered a paper copy of these comments to a public affairs person at your Rockville Pike office but I am not confident that it will find it's way to the proper office. I am therefore sending a second copy by email. Please let me know if you receive this message and are able to open the attachment.

Thank you,

Dennis Nelson

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Public Comments by Dennis P. Nelson, Ph.D.
Director, SERV (Support and Education for Radiation Victims)
Waste Confidence Generic Environmental Impact Statement Draft Report
Docket ID No. NRC-2012-0246

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The NRC has prepared a draft Generic Waste Confidence document and has solicited comments from the public under Docket ID No. NRC-2012-0246 on the particulars of that draft report. This reply contains my personal comments as well as the position of my organization SERV (Support and Education for Radiation Victims) on the adequacy of that document.

First, I wish to state my observation that the draft report is massively redundant with much mind-numbing repetition. It seems to have been assembled on a word processor with a few "boiler plate" phrases and paragraphs repeated hundreds of times. I estimate that two-thirds to three-quarters of the report could safely be deleted without any loss of information content at all. A report loaded with so much excess verbiage is not more credible just because it is longer. Instead it buries the significant facts in a mountain of refuse. The report should rather focus on presenting and developing the factual content in the analyses, by examining scenarios from all sides, and refrain from generalized statements of opinion. Second, the risk analyses in the document are very weak and cannot be supported by the facts. As a whole, the analyses appear to show a strong NRC bias in favor of the nuclear power industry. That bias is not surprising given that 90% of the NRC operating budget is provided by the same industry it purports to regulate. Although the NRC is supposed to be an agency of government (which is assumed by most to have as its principal role the protection of the public health), this does not, in fact, seem to be the case. Rather, the NRC seems to be a promoter of nuclear power and a cheerleader for the nuclear industry. The clear preference of the NRC for the "rule making" option in the GEIS, even though it will have the effect of excluding the public from many future licensing decisions, shows that it does not have the genuine interests of the public at heart. This position is in direct contravention of the intent of Congress when it divided the AEC into two parts: the DoE with a mission to promote all things nuclear, including nuclear weapons and reactors; and the NRC whose mission was to act as a brake on the uncontrolled exuberance of the nuclear physicists and to ensure that the public health was not threatened by excesses in that industry, as it had been in the past.

Although the nuclear enterprise is only about 70 years old and the commercial nuclear power industry is only about 60 years old, there is quite an abundant history from which to draw observations and conclusions as to the risk and safety of the enterprise. We are informed by catastrophic nuclear "accidents/events," both intended and unintended, with widespread radiological contamination of the environment, which have impacted the health, homes, property, livestock, livelihoods, and the pursuit of happiness of millions of people in scores of countries. Most of those losses were incurred by ordinary people, who happened to be in the way, and occurred almost entirely without compensation. These past actions have not shown responsibility on the part of either the nuclear industry or their governments in the conduct of this enterprise. Instead, they demonstrate a reckless disregard for ordinary citizens. To be fair, some government

"compensation" programs have been created many years after the events; but they were generally too little, too late. Some examples are: Radiation Exposure Compensation Act (RECA) administered by the Department of Justice which provides limited "compensation" payments to Downwinders, uranium miners and millers, and on-site participants at the nation's nuclear tests; Energy Employees Occupational Illness Compensation Program (EEOICP) administered by the Department of Labor which provides payments to ill workers in the nation's nuclear complex; and the Department of Veterans Affairs which provides some payments to atomic veterans. The US Government has also negotiated a Compact of Free Association with the government of the Marshall Islands which includes some limited payments to residents of certain islands who were displaced or injured when the US Pacific nuclear tests were conducted. All these payments total in the billions of dollars but still represent only a small fraction of the total damages incurred by the victims. Private insurance policies also exclude damages from radiological and nuclear events, so there does not appear to be any compensation program in place in this country to reimburse the victims of a potential nuclear accident at a nuclear power plant or fuel storage facility for their losses. This has certainly been the case for the more than one hundred thousand people in Japan displaced by the Fukushima disaster. In the USA there is not even a true national health care system to take care of people injured by radioactive contamination. This amounts to a transfer of costs in the event of an accident from the nuclear operators to the victims, since they must pay for their own medical care.

Almost every facility in the nuclear complex has experienced at one time or another, during its operation, a radiological release off-site of greater or lesser magnitude. Transport of radioactive isotopes has occurred by air, ground and water. Some radionuclides have been absorbed by plant life and concentrated in the food chain and so have contaminated food and livestock. During the atmospheric nuclear bomb testing era, some pathetic countermeasures such as the iodination of table salt and the promotion of baby formula over breast feeding were attempted to mitigate the effect of iodine-131, (a short-lived environmental and food contaminant); but the majority of contaminants were simply ignored even though they most certainly caused harm. Scores of radionuclides of varying half-lives and activities combined in hundreds of chemical compound variations are produced by nuclear fission in both bombs and reactors. Although many of these decay quickly, others persist long enough to be incorporated chemically into animal and plant tissues, through a myriad of physiological and biochemical pathways to become constituent building blocks of cells. These incorporated radioisotopes can cause mutagenic and oncogenic transformations in the host or adjacent cells. Each compound can be metabolized by a variety of anabolic and catabolic pathways with different biological outcomes. The simple-minded approach used by the NRC to estimate risk is almost entirely based on the external fluence of gamma and beta radiation, distributed uniformly over large areas, and largely ignores the multitude of specific risks due to in-situ radionuclide incorporation. Unlike other toxic biochemical reactions which require a certain minimum concentration of reactants (toxicants) or activation energy to proceed, nuclear processes emit particles or photons with sufficient energy to precipitate a chemical reaction from the decay of a single nucleus. Thus, there is no threshold concentration for nuclear induced chemical processes as there is with chemical toxins. In fact, some radionuclides such as polonium-210, which can be present in waste fuel, are lethally toxic even in the sub-microgram range. Analyses of the radioisotope composition of the waste from each kind of starting fuel mixture, while taking into account the degree of fuel burn-up and the stage in the cooling/aging process, is essential to fully evaluate the toxicity of all the different radioisotopes in the waste fuel in the event

of an accidental release. The NRC assertion that spent fuel from mixed-oxide fueled reactors is "substantially the same" as that from uranium fueled reactors shows that they have ignored the isotope composition of the waste fuel in their risk estimations.

Ideally, when dealing with intact spent fuel elements shielded by water in pools or in steel and concrete casks only the fugitive gamma and x-radiation is of health significance; but we know from experience that the fuel doesn't always remain clad and in place and that fissionable elements, fission products and activated reactor components often end up contaminating the surroundings. We also know from experience that radioactive contamination is not distributed uniformly as the NRC has assumed. The NRC classifies the risk of catastrophic accidents as "small" not because it believes that widespread radiological contamination is not a catastrophic event; but because it assumes the likelihood of such an event to be vanishingly small. Unfortunately, history shows us that this assumption is flat-out wrong. History shows that catastrophic nuclear accidents with widespread contamination, (with various combinations of land use sacrifice and large population relocations), have occurred about every 20 to 30 years. Examples include the reactor accidents at Fukushima and Chernobyl and the radiological waste accident at Kyshtym/Mayak/Techa River. Other intentional releases and contaminations, some with widespread dislocations, have occurred at Bikini, Mururoa, Eniwetok, Hanford, Nevada, Semipalatinsk, Lop Nor, Novaya Zemlya, Maralinga, Christmas Island, North Africa, etc. Serious accidents with major releases of radioactive materials off-site have occurred approximately once every decade. Some examples include: Windscale, Fermi and Three Mile Island in addition to the above incidents. Accidents at a military reactor in Idaho and a research reactor in Yugoslavia, as well as several lethal and non-lethal criticality accidents like the one at Tokaimura, which usually affect only workers, happen with about the same frequency. Near misses include numerous "excursions," an electrical fire at a Browns Ferry plant and a near perforation of the reactor vessel at a Davis-Bessie plant. All these demonstrate the extreme risks and perils of the nuclear enterprise. There is no reasonable expectation that in the future we will be any more clever or lucky than we were in the past.

Nuclear reactions are so dangerous because they are fundamentally uncontrollable. There is no off switch! Once enough purified, fissionable material is collected into a small enough space it achieves a life of it's own. After a chain reaction has been initiated and the fuel has burned up to a certain degree it also becomes so radioactively and thermally hot that it is very difficult to handle. The reactor operator attempts to limit run-away chain-reactions using cadmium, boron and other neutron scavengers in control rods. Sometimes control fails because it depends on the physical integrity of the reactor. If the process gets outside of its design parameters, fuel assemblies and control rod channels can bulge, warp or distort in such a way as to prevent the proper insertion and operation of the control rods. This can lead to a rapid increase in the chain-reaction, a temperature excursion, further disruption of the reactor components and an eventual meltdown of the core. Even if the chain-reaction can be stopped the fuel components continue their radioactive decay and this keeps the fuel elements incredibly hot. If the cooling system fails to remove the decay heat from the rods and provide replacement water for that which evaporates, the rods can become exposed to air and can self-ignite burning the zirconium metal cladding. Zirconium is pyrophoric, i.e., will self-ignite and burn in air if the temperature becomes high enough. Uranium and plutonium metals are also pyrophoric and so will ignite and burn in air at high temperatures. Small modular reactors which can use metallic fuels are therefore fundamentally much more dangerous than the metal oxide fuels in common use today in large commercial reactors.

Fuel rods in cooling pools suffer from the same vulnerability as those in a reactor accident. Any sustained loss of electrical power could result in a loss of cooling, evaporation of the cooling water, exposure of the fuel assemblies to air, spontaneous ignition of the zirconium cladding and widespread dispersion of radioactive particles. Once contamination of the surrounding area has occurred it becomes virtually impossible to perform damage control to prevent further escalation of the event and to conduct remediation and clean-up efforts because of the high ambient radiation levels. This is particularly problematic if there are several contiguous facilities which may contaminate each other when impacted by the same event. Different radioisotopes have different volatilities and therefore different propagation characteristics in the event of a fire. The size of the particles also determines the distance they travel in the event of an accidental release. The draft report contains some serious estimated consequences for the volatile ruthenium group of radionuclides in fuel newly removed from the reactor if it should be released by a spent fuel fire. The NRC attempts to rationalize this into a less serious event by postulating an early and complete evacuation of people after the accident. Unfortunately, history shows us that early post event evacuations are the exception rather than the rule. It seems to be human nature for nuclear managers to attempt first to cover-up the incident and only later reluctantly agree to evacuation. No mention is made in the report of how an emergency evacuation would be carried out to avoid the radioactive hot spots in the contamination plumes. In Fukushima, for example, some people were actually evacuated from an area of lower radiation level to an area of higher radiation because there was a failure to monitor the plumes and coordinate the evacuation based on the monitoring data.

Fuel rod storage under water in fuel pools also has the problem of radiolytic hydrogen generation which can react with the zirconium cladding and other metallic components to cause hydride embrittlement. This creates problems for the future handling of the rods in the dry cask systems because the fuel elements become fragile and can break during transfer or repackaging, thereby releasing their contents. It is unclear whether the embrittlement gets worse with continued aging in dry storage. The NRC states that the Fukushima disaster proves the design strength of spent fuel pools, in that all pools survived the tsunami and reactor explosions virtually intact. They do not mention the fact that these pools are now perched precariously six stories above the destroyed reactors and are almost impossible to access. Removing the spent fuel to a safer location would expose workers to high ambient, perhaps lethal, radiation levels. Photos of the pools in news reports from the site appear to show debris lying in the pools although the water level seems to be maintained. Two and a half years after the accident TEPCO has only just now begun to deal with this spent fuel and the outcome is still far from certain.

Fuel tank radiation leaks can occur, sometimes unnoticed, through corrosion of the stainless steel liner caused by pool chemistry and emissions from the fuel elements, as well as micro-cracks in the concrete support structure. On-site discoveries of boric acid penetration as well as large tritium contamination outside the pool structures have been reported, which prove silent pool leakage. The problem with tritium is that it migrates relatively easily off-site with the liquid drainage from pool leaks or by evaporation as water vapor. Tritium is a strong biological toxin because it is readily incorporated into biological tissues. It doesn’t even require a chemical reaction since an organic molecule can incorporate tritium through an exchange mechanism between tritiated water and the hydrogen atoms of organic compounds by simple incubation in aqueous solution. Thus tritium can be absorbed from the environment by both ingestion and inspiration.

Once incorporated into the body, tritium is particularly dangerous because hydrogen is ubiquitous in biological tissue. Tritium decays at a high activity rate but emits a low energy electron. Low energy electrons have a high linear energy transfer to their surroundings and therefore cause maximum biological damage in a small volume of tissue. This energy deposition in a very small area of an organ results in a very high micro-dose to specific cellular and tissue components, which can lead to cancer or mutation if a cell is transformed and not cleared by the immune system. Therefore, micro-dose calculation is important for assessing the carcinogenic potential of tritium decay, in situ, and this micro-dose is much larger than what would be expected if the dose were to be distributed uniformly throughout the organ.

Other radionuclides present in spent fuel are also selectively incorporated into certain biological tissue because they mimic some essential biological elements. For example: radioactive cesium and rubidium mimic potassium and so are concentrated in the muscles where they can cause wasting disease such as polymyocytis, or contribute to autoimmune disorders like multiple sclerosis or even heart disease. Plutonium and strontium mimic calcium and so concentrate in the bones near the bone marrow which can cause leukemia and disorders of the blood forming units. Some alpha emitters in the circulatory system damage the vascular lining causing inflammation resulting in calcified arterial plaques which can cause infarcts and heart disease. Radioactive noble gases dissolve in fatty tissues and so concentrate in tissues like the brain, breast and bone marrow, causing cancers in these organs. A variety of radionuclides mimic iron and so are transported and stored in the body by transferrin and ferritin. Radio-iodine concentrates in the thyroid, but can also be incorporated into radioactive thyroxin which can damage the thyroxin receptors in the tissues. (Dioxin is so chemically toxic precisely because it disrupts this thyroxin/receptor binding site). It is not enough to say that these atoms are simply radioactive but one must also know where in the body they are concentrated and how their decay affects the adjacent tissue and its biochemistry. These pathways are so complex that it is virtually useless to attempt to predict biological risk based on the decay properties of radioisotopes themselves outside the body. Most of the NRC risk analyses are clearly done by physicists with limited knowledge of biology or biochemistry and so lack the insight of the biological disciplines. Physicists concentrate on the external radiation component of dose, in most cases, while ignoring the subtleties of the tissue doses at the molecular level. Radiation has also been shown to have other demonstrated statistical effects besides increasing cancer rates, such as depression of the normal bodily immune response mechanisms against pathogens and a non-specific life shortening in irradiated populations.

The NRC has used an artificially inflated number of 350 mR per year for natural background radiation (NBR). The tacit assumption here is that this “natural” level of radiation exposure results in no deleterious health effects. In the GEIS draft report the NRC constantly compares the “permissible” dose/exposure level for members of the general public (up to 500 mR/yr) to this “natural” level. They assume that if this natural level is “safe” then it must follow that exposure to man-made radiation in this same range must also be “safe.” No account seems to be taken of the fact that the natural and man-made doses are additive. There is no threshold safe dose of radiation so any additional level of exposure can be expected to cause additional damage to health. Problems with this analysis also arise when one recognizes that the actual natural level of background radiation is about 81 mR/yr at sea-level with an average terrestrial radiation component (about one quarter the NRC’s estimated value). Most other NRC analyses of “dose” are based on external radiation sources and the effect of penetrating radiation on biological systems. It is therefore

curious that the NRC has chosen to add an internal radon dose to their estimate of NBR. This "radon" dose cannot even be generalized since it depends on so many factors such as smoking habits, house ventilation/air exchange systems and the composition of the underlying bedrock and soils. The NRC uses this approach when it suits their purpose of inflating the background dose for comparison purposes against NRC allowed exposure limits; but they ignore internal doses when they go against their otherwise optimistic risk projections. It is also curious that they add a significant dose due to medical procedures which are clearly not "natural" at all. In the USA, per capita expenditures for medical "care" are more than twice as high as the next highest developed country. Total radiation exposure due to medical procedures is also much higher in the USA than in other countries. Unfortunately this excess expenditure for health care and the excess radiation exposure from medical treatment does not translate into better health. The USA ranks low compared to other countries in such objective measures of health as life expectancy.

Prior to the nuclear age an estimated one person in ten died of cancer, now it is about one in four. Clearly environmental contamination with radionuclides and chemical toxins has effectively quadrupled the overall cancer rate between 1940 and 1980. The NRC "permissible" dose from man-made radiation (500 mR/yr) is about four to five times higher than the true level of external NBR. This would suggest that the cancer rate in people subjected to the NRC allowed exposure level to man-made radiation might be four to five times higher than the natural rate. Although the average exposure to man-made radiation during those same years probably did not reach the maximum level, it is still possible that the roughly four-fold increase in cancer rate during this period might be explained by the significant radioactive contamination of the environment due to nuclear bomb testing and radioactive emissions from power plants and the rest of the nuclear complex. The overall cancer rate post 1980 appeared to be leveling or decreasing slightly as the radioactive contamination of the environment, (after the cessation of atmospheric nuclear bomb tests) was slowly cleared and the latency period for radiogenic cancers had run its course. Unfortunately, the reactor accidents at Chernobyl and Fukushima, once again added a considerable new radioactive burden to the planet so I expect that cancer rates will hold steady or increase again in the near future. One event which happened in 1953 is illustrative of the danger posed by radioactive contamination of the environment. Earlier in that year several above-ground nuclear bomb tests had been conducted at the Nevada Test Site, which dropped significant fallout on the downwind areas. Later in the year Hollywood filmed a movie called "The Conqueror," starring John Wayne, in Snow Canyon, Utah, about 120 miles downrange from the test site. The particulate radioactive fallout from the earlier tests had mixed in with the soil in the canyon and the horses and wind machines stirred up large amounts of dust, together with fallout, during the filming of the movie. Years later it was observed that of the approximately 220 cast and crew members on the movie set more than 90 including John Wayne himself had contracted cancer. This is a cancer rate of nearly one person in two, a rate so far above the national average that it is statistically impossible to explain by chance.

The NRC evaluates the effect of fuel storage on aquatic organisms. Spent fuel pools continue to be cooled by external sources such as river, lake or ocean water using one-time pass through cooling systems or by recirculated pond water with atmospheric cooling towers. Aquatic organisms sometimes block the circulation and so are killed by the application of pesticides and chemicals. The organisms can also be affected by radioactive materials, such as tritium which contaminates the cooling circuit or simply by heating during transit through the reactor piping. One

unintended consequence of this destruction of aquatic organisms is that many of them are essential to carbon fixation as part of the global carbon cycle. Aquatic organisms with carbonaceous skeletons are required to complete the cycle and permanently sequester carbon dioxide by precipitation to the sea floor. These organisms produce an enzyme called carbonic anhydrase, which catalyzes the conversion of dissolved carbon dioxide into carbonate anions. Dissolved carbonate in equilibrium with carbonic acid then combines with calcium cations in the water to produce calcium carbonate which is incorporated into the organism's skeleton, through biological mineralization, much like the process by which bones are formed in humans or shells in clams. When the organism dies it sinks to the sea floor where the skeleton becomes incorporated into great limestone sheets, which are eventually lifted by geological forces back to the surface to become new land masses and parts of continents. Thermal power plant cooling systems can contribute to global warming both by dumping waste heat into the environment and by killing the aquatic organisms which sequester the atmospheric carbon dioxide. Atmospheric carbon dioxide dissolves in both fresh and salt water. This solution process is reversible and depends on the temperature and pH of the water. At higher water temperatures and lower pH less carbon dioxide can remain dissolved unless it is converted to calcium carbonate and precipitated. The reversible solution of carbon dioxide in water creates a global buffering system which regulates the atmosphere concentration of carbon dioxide. The set-point for this buffering system is the equilibrium constant of the carbonic anhydrase enzyme in these aquatic organisms.

The NRC makes many references to "climate change" both with respect to survivability of storage sites under expected extreme weather conditions, and the release of "greenhouse gasses" from nuclear facilities. One of the many myths about nuclear power is that it is a carbon-free energy source. Unfortunately, the construction of a nuclear plant, together with its containment structures, fuel storage pools, reactor vessels, heat exchangers, casks and storage pads and their replacement every 100 years, etc. requires prodigious amounts of steel and concrete. Steel production requires burning large amounts of coal and coke, concrete requires cement which is made by burning fossil fuels to heat limestone. Carbon dioxide is released both from the fuel combustion and the limestone decomposition. In short, the only energy source which releases more carbon dioxide into the atmosphere, during the construction phase, is hydro-power due to the massive amount of concrete used in dams. Renewable power sources such as wind, solar and biomass have a much smaller carbon footprint than fossil, nuclear or hydro. Another consideration is that thermal energy sources are only about 30% efficient in converting heat into electrical energy. The rest, 70%, of the energy produced must be discarded as waste heat which contributes to the heat load on the planet. Much of the incident radiative energy from the sun is reflected back into space because its visible wavelength remains unchanged on reflection. The waste heat from thermal sources of electricity such as nuclear and fossil fuels, on the other hand, is transmitted in the infra-red and so is mostly trapped in the atmosphere by greenhouse gasses, thus contributing to global warming. Also problematic is the fact that nuclear fuel continues to excrete waste heat into the environment even centuries after the plant has ceased to produce electricity. Fossil fuel plants cease to produce waste heat immediately upon shutdown.

As for dry cask storage, the NRC has proposed basically two scenarios to deal with the political impasse over the Yucca Mountain repository; and to inspire "confidence" that nuclear power plants will be able to continue to produce and dispose of their nuclear waste into the foreseeable future. These scenarios are: (1) continued on-site storage of spent fuel in cooling pools

for the first 60 years after reactor shutdown, after which the fuel will be transferred to dry cask storage on-site, placed on concrete pads in the open air where they are effectively parked for the next 100 years or indefinitely with pad and cask replacement each additional 100 years; and (2) away-from-reactor dry cask storage at independent spent fuel storage facilities yet to be determined, on concrete pads in the open air, with the possibility of indefinite storage by replacing the pad and containers every 100 years. Facilities for dry transfer of fuel assemblies between casks would need to be constructed in both of the above scenarios.

The away-from-reactor analysis in the case of scenario (2) smacks a bit of desperation as the NRC repeatedly uses another politically failed depository as an example of and "proof of concept" that an away-from-reactor consolidated independent fuel storage facility is both feasible and practical. The example used is that of a withdrawn license application by Private Fuel Storage, Ltd., to build a depository on the Goshute Indian reservation in Skull Valley, Utah. Basically, the proposal amounted to relocation of the politically failed national underground repository at Yucca Mountain to an above-ground, open-air, indefinite, storage facility, built to accommodate 40,000 metric tons of the nation's accumulated high level nuclear waste, just 35 miles from Salt Lake City. Not surprisingly this proposal met with considerable resistance. PFS, Ltd. wanted the Goshute land because it was not subject to state environmental regulations. They approached the tribal leaders and made them an "offer they couldn't refuse," namely, give every member of the tribe a million dollars and let them all move away from their reservation, en masse. Some members of the tribe declined the recommendation of their elders and because they refused to leave the reservation, the deal fell through. The Governor of Utah also weighed in on this controversy and threatened to block road and rail transport of high level waste across State transportation corridors into the depository. The proposal became a poster-child for environmental **injustice**, until it was eventually abandoned.

It is disingenuous on the part of the NRC to pretend that spent nuclear fuel storage is just like any other industrial enterprise with similar land and water use characteristics. Nuclear waste lasts "forever" and so will permanently alter the use possibilities of any affected site. It also bears a stigma in the public mind, largely because of its association with nuclear weapons and the proliferation problems that association represents. This perception will psychologically limit proposed future uses of any such site and will attract other equally obnoxious industrial operations. Thus the land must be considered a "sacrifice zone" from the beginning with no pretense that it will ever be reclaimed for general use. The long time period of spent fuel storage presents another problem, that of securing the fissionable material from misappropriation and misuse. As the fuel ages and the radioactivity decreases it becomes more attractive as a target for theft and extraction of its plutonium content. The USA is less than 240 years old so that is all the experience we have as a republic. Over the next few centuries, while the fuel remains "hot," I submit that we have no way of predicting what sorts of situations might occur. We cannot, therefore, be "confident" that the current political and economic systems will continue to provide the physical security, in perpetuity, needed to keep the fissionable materials safe.

Other reasons aside, it is not a good idea to concentrate such a large amount of waste in one place especially if it is stored above ground. This makes it a target for aerial and surface terrorism and creates the potential for a huge accident with widespread contamination of the air, land and water. Since no one wants a high-level nuclear dump in their backyard, or the transport of high-

level nuclear waste through their neighborhood, the acceptance of a "Yucca Mountain" in the backyard scenario is unlikely to happen anywhere in America. Also the very concept of away-from-reactor consolidated interim storage does not meet with the strictures of ALARA, since transporting the waste twice or more in its lifetime greatly increases the risk of accidents and exposure to bystanders. It also unnecessarily contaminates virgin land not currently radioactive. The transport of nuclear waste is also not well controlled. For example, I personally measured radiation emanating from a transport truck on Interstate-40 near Amarillo, TX of several hundred CPM (50 times background) in just the few seconds it took to pass the truck. One can only imagine the exposure level to the driver and anyone parked next to the truck at a café, fueling stop, rest area or motel. The transport also exposes the fuel to the possibility of theft or traffic accidents which is clearly not a trivial risk. For the above reasons I believe that the entire Section 5 of the Generic Waste Confidence draft should be discarded as both imprudent and impractical. There may, however, be some situations where continued dry storage at the original reactor site is so dangerous that moving the spent fuel to an alternate, safer site is possibly justified, but risk versus benefit must be evaluated for each individual situation. Moving the fuel should never be merely for the convenience of the operators.

The NRC analysis of dry cask storage of spent fuel, for decades if not centuries, is totally inadequate. The description of how the fuel canisters are hermetically sealed is not sufficient for the reader to assess risk. The report states that "fuel is loaded into canisters, (presumably steel); the air and water are pumped out; the canister is filled with "inert gas" (what inert gas?); and the top is welded in place" to seal-in the spent fuel and isolate it from the environment. In another section, describing the long-term maintenance of casks at the facility, a comment is made that, during replacement activities, "around 10% of the casks and support pads will need to be disposed of as low-level radioactive waste." There is no explanation as to how the casks and pads can become contaminated since they are supposed to be hermetically sealed. There are two obvious possibilities: (1) there is a failure of containment in the canister with the escape of the "inert gas" and the entry of air and water into the fuel canister with subsequent corrosion. This would compromise the integrity of the containment vessel and result in leakage. Continuous exposure of the canister metal to radiation from the enclosed fuel could also weaken its physical integrity and result in metal failure, corrosion and leakage; and (2) there is neutron activation of casks, canister components and the pads themselves.

In case (1) the NRC presents no history of dry cask storage to support their contention that the risk from loss-of-containment accidents is small, particularly over the super long time frames envisioned. In case (2) we are informed by the statement that "casks are placed 15 feet apart to avoid criticality events." This would seem to indicate that spent fuel in dry casks still emits neutrons at a measurable rate, which are not absorbed by the cask shielding. This presents a problem for evaluation of dose to workers since neutrons have a biological effectiveness 20 to 50 times greater than an equivalent exposure to the same quantity of gamma or x-rays. Also since dry casks are cooled by circulating ambient air through the casks, inside the concrete shield, there is a significant potential for activation of atmospheric nitrogen by neutrons to form carbon-14-carbon dioxide. Since the earth's life forms are carbon based, carbon-14 is a particularly noxious toxicant. Carbon-14-carbon dioxide has a long half-life and is also readily incorporated into the biome by photosynthesis, where it can be assimilated into bio-molecules such as DNA which are vital to life. Carbon-14 decays by beta emission and can cause disruption and mutation of bio-molecules in three

different ways: (1) the emitted beta particle can ionize and disrupt adjacent bonds in the molecule; (2) the beta decay can cause the source nucleus to recoil and be expelled from its position in the bio-molecule causing bond recombination in deleterious ways; and (3) the decaying carbon nucleus can transform itself into a different element with different chemical properties and thus compromise the chemical integrity of the bio-molecule. The NRC does not state how much carbon-14 would be produced and released into the atmosphere by the air cooling of dry casks over decades or centuries or how this would affect future generations. This is not a question of a dose distributed uniformly over the planet affecting everyone equally; but rather the effect of a widespread random distribution of discrete biological disputers into the biosphere, (the biochemical equivalent of "land mines" or "time bombs" in the macroscopic world) each with the potential to cause random disease, mutation or premature death. During the atmospheric nuclear test era the concentration of carbon-14 in the biosphere more than doubled. This is one likely explanation for the large increase in the cancer rate during that same time frame.

The NRC consistently draws overly optimistic conclusions in the draft report as to the safety of the nuclear enterprise while ignoring the disasters. It cites the Fukushima catastrophe as proof that spent fuel pools can maintain their integrity even under great environmental stress and it talks about lessons learned; but it seems to ignore all the human consequences and misery attendant in this tragedy. It also ignores the vulnerabilities in the GE boiling water reactors such as those affected in Fukushima, which need to be remedied. It doesn't even mention the fact that the Fukushima plant was sited in an earthquake and predicted tsunami zone, due to bad management decisions, and that such an "accident" was eventually inevitable. It cites the earthquake at the North Anna facility in Virginia as proof that dry casks can survive an earthquake; but fails to mention that the siting of this reactor failed to even predict such an earthquake in the first place. This type of hubris on the part of the NRC officials shows that their analyses are not comprehensive and cannot be expected to represent the truth, much less to protect the public from such disasters in the future. The NRC draft report does not discuss the important issue of the lack of insurance for radiation damages in the event of a widespread release nor does it explain who will pay to make people whole again afterwards.

The report talks about evacuations but it doesn't say where the people will live and work and what they will do for a living afterwards. It doesn't even consider if an evacuation is possible at all from urban areas in the short time-frame required, or who will pay to set the people up with new lives in their new location. In my opinion, this insurance issue is the most important political consideration in the future siting of any depository; and any truly public process for approving a site is bound to go nowhere without this assurance. Simply stating that the Government will bear the responsibility for compensation is not a convincing argument because of trust issues related to its performance after past contaminations. It was only after many non-productive lawsuits brought by Downwinders, against the Federal Government and after more than forty years of Government denials and stalling; that the Congress finally passed a compensation act which gave a modicum of relief to the victims of US nuclear bomb testing. Acts such as increasing the allowable radiation dose limits in the aftermath of Fukushima, not based on health science but rather on politics and the level of contamination on the ground, only add to this distrust. This was done by the Japanese government in the regions around Fukushima, with the advice of the US Department of Energy, and makes one begin to question whether the same thing might happen here in this country in the event of a serious radiological accident. Even now people in Japan are being told to return to their homes

in the still contaminated zones, against their better judgment and at peril to their health, because they are given nowhere else to go.

Some genetic variations, the so-called inborn errors of metabolism, also confer increased sensitivity to radiation damage on certain susceptible individuals, rendering them much more vulnerable to environmental radiation than others. This means that the same amount of radiation which might be tolerated by one person might cause harm in another. One example is hemochromatosis, a genetic defect in iron metabolism associated with a greatly increased susceptibility to radiation damage. It has also been suggested that the more common heterozygous persons with this trait may also be at increased risk. Many other genetic variations including ataxia telangiectasia also increase the radiation risk in susceptible individuals. It is well known that pregnant women and children are also more sensitive to radiation damage than are adults.

In the end, the number one priority of the NRC should always be the preservation of the health of nuclear workers and the general public. The report mentions nothing in its risk assessment about susceptible genetic variants in the population or the need for increased levels of protection for pregnant women and children. This omission shows a total lack of consideration for the most vulnerable members of society, and a lack of caution in this regard could have devastating effects on the future of our nation since pregnant women and children represent our future. The NRC GEIS Draft Report is, therefore, not a true analysis of radiation health risk and is not based on the entirety of the scientific knowledge.

Thank you for giving me the opportunity to comment on this proposed regulatory action. I hope you will read these comments carefully, objectively and with the constructive spirit in which they are meant and then address these concerns and issues in your final report.