Testimony of Richard D. Andrews to

Colorado Senate, Committee on State, Veterans & Military Affairs

Public Hearing of 8 February 2022, Denver, Colorado, Old Supreme Court Room, Capitol.

SB22-073, a bill concerning feasibility of small modular nuclear reactors and other matters

Introduction:

Thank you to the Colorado Senate Committee for the opportunity to provide public input to the deliberations of the Colorado legislature on a draft bill SB22-073 related to investigating the feasibility of small modular nuclear reactors (SMRs) in Colorado. The bill title implies that such SMRs are a source of carbon-free energy, and apparently seeks to facilitate the use of nuclear power in Colorado.

The bill as written is slanted in only assessing the feasibility of SMRs, but omits a legitimate and needed comparative assessment of alternative energy technologies that are safer, far less expensive per installed MW and operational Kwhr, and do not produce toxic radioactive wastes that persist for hundreds of thousands of years.

I strongly support the urgent need to reduce greenhouse gas emissions in Colorado, however there is no need to engage in the extreme risks of nuclear power to meet this need.

- Nuclear power, including the newer, but unproven small modular reactors (SMR), is not economically competitive with legitimately renewable, already proven and safe technologies including solar, wind, geothermal, and innumerable pathways of energy conservation.

- Nuclear power has actually never been economically competitive compared to other means of producing electrical power. It has always been excessively propped up by governmental incentives and subsidies which distort legitimate economics.

- Nuclear power has always been intimately connected to nuclear weapons, despite many attempts to whitewash and instill the impression that the technologies are distinct. This is true for small modular reactors, which like their predecessor large 1000+ MW existing reactors, also produce nuclear wastes that can be transformed into weapons of mass destruction.

- Nuclear power is the only method of generating electricity that creates dangerous wastes that last for hundreds of thousands of years, and threaten the health of humans and other species of this planet. This time frame is longer than we humans have existed on this planet, massively longer than any human institution has ever existed.

- Our federal government has no solution for safely disposing or even securing the nuclear wastes from nuclear power....despite more than 80 years since the major nuclear technology push of the 1940s. There is not even a target date for beginning a deep geologic repository.

Based on these facts, the SB22-073 bill is unsupportable, and should not be approved. I call on this Colorado Senate committee to not move forward with any further consideration of this bill.

So what should the Colorado Legislature be doing to move our state and nation away from the impending eco-disasters from climate destruction caused by current and increasing emissions of greenhouse gas emissions?

In particular I support and encourage the Colorado Legislature to :

- Replace all existing fossil fueled generation facilities by a combination of solar and wind generation, potentially geothermal, and other true renewables, as well as aggressive energy efficiency improvements, and utilization of only truly CLEAN renewable energy sources.

- The legislature must require that our state become a true leader in rapidly reducing production and consumption of fossil fuels, oil, gas, coal, shale. Notably Colorado must curtail the issuance of extraction of these fossil fuels in our state, and establish meaningful incentives to totally and rapidly transition to carbon free energy across government and industry in our state.

- The legislature needs to support major changes to the infrastructure of Colorado to move rapidly to non-fossil fuel based systems in transportation, incentivize high efficiency buildings, move away from GHG intensive concrete roads and buildings. The legislature needs to reducing the huge embodied greenhouse gases associated with our food systems, support localization of agriculture production, and switching away from fossil fuel intensive chemical agriculture to regenerative agriculture to put carbon from the atmosphere back into soils.

Find ways to support local counties and cities in the transition away from fossil fuels:

While this hearing is ostensibly a specific proposed law, Pueblo County and possibly other locales are worried about the loss of economic activity and local tax income when coal mines and power plants shut down, or when oil & gas production declines.

Pueblo County officials have been actively promoting nuclear power to replace some of these anticipated changes in their tax base, and loss of employment when the Xcel coal fired power plant is retired about 2030. Unfortunately, Pueblo County Commissioners and perhaps other unidentified parties in other Colorado counties are promoting nuclear power plant(s) to be installed as possible replacements for the planned closure of local coal mines and power plants. The local Pueblo officials in particular been involved with NuScale, a developer of a new design for nuclear power plants, often referred to as Small Modular Nuclear Reactors (SMR).

The Colorado legislature needs to carefully assist counties such as Pueblo in this transition away from climate destroying fossil fuels, but only with wise, economical, environmentally sound, and public health safe paths. ***But nuclear power is not an option***.

Nuclear Power Is Not an Option

We simply cannot choose nuclear power as a path to move out of the fossil fuel climate damaging mode of the last century.

We cannot accept replacing one flawed path with an enormously risky and costly path. Nuclear power is not an option. One of the aspects of nuclear power that is often ignored by the promoters is the extreme danger of nuclear wastes:

- All nuclear plants, of any design, are highly vulnerable to terrorist, sabotage or other miscreant attacks with environmentally, public health, cultural and economically devasting public health, environmental, economic and socio-cultural consequences; and
- Any nuclear plants, regardless of older technologies or so-called next generation plants, simply cannot be considered *renewable* or categorized as either *clean* or *renewable* technologies.
- Nuclear power has never been and there are no indications that it will ever be economically competitive with already proven true clean and renewable sources of energy.
- Nuclear power cannot meet or even contribute significantly to the urgency of reducing the climate damaging and disruptions from energy system greenhouse gas emissions.
- Clean and truly renewable options are currently available to deploy, and those technologies are rapidly improving and costs are rapidly falling, making them quick to install, lower in cost and safe to the public and environment.

What is *CLEAN* AND *RENEWABLE*?

- Nuclear energy is the only energy source among the many options that has the extreme public health, environmental and national security dangers due to the operational, production and storage/disposal aspects of nuclear fuels, and particularly the totally open ended perpetually dangerous materials radioactive materials associated with its fuel cycle, notably spent fuel wastes!

- Nuclear wastes from the mining of uranium ores, to the upgrading to fissile fuels, to the spent nuclear fuels are **forever wastes**.

- The toxic and other dangers of nuclear technology and its waste materials have toxic hazard lifetimes longer than the existence of human species and our hominid ancestors. No other energy source has such geologic age hazardous timelines.

- Nuclear wastes, and notably the spent nuclear fuels (SNF) are actually more dangerous than even the original upgraded uranium fuels. The mix of radioisotope elements in SNF are more diverse and public health damaging in accidents scenarios than the fresh fuel pellets.
    - The dominant activity elements in spent nuclear fuel that cause the most immediate health effects include radioactive Cesium-137 and iodine-. Cesium-137 has a half-life of approximately 30 years, meaning it will exist and be hazardous in the contaminated environment for about 300 years or more.

- There are many other radioactive elements in spent nuclear fuel, including transuranics like plutonium and actinides, lanthanides, noble metals, radioactive gases, many with half lives of thousands of years. And plutonium and consequently nuclear power spent fuel wastes are a huge nuclear weapons proliferation risk.

What is safe about nuclear power technology? IT IS NOT!.

- Nuclear technology has always and will always be undeniably linked to valid concerns about proliferation of nuclear materials that can be used in nuclear weapons.
- Spent nuclear fuel can even be a "dirty bomb" weapon without the needed sophistication of constructing a nuclear weapon.
- The potential for loss of inventory of nuclear fuels, their production by-products, and spent fuels is real, and such materials can be used for dangerous purposes.
- Nuclear plants and their on-site storage of spent fuels are actually prime targets for terrorist and saboteur attacks.
  - Such attacks can be readily conducted by low tech methods. Nuclear plants and waste systems are the functional equivalent of sitting duck nuclear weapons, with greater areal extent damages than even many defense arsenal stockpiled nuclear bombs.
  - If a nuclear power plant were attacked by a nuclear weapon, the devastating effects are even further amplified by greater damages over an even larger time and aerial extent.

- Case studies have been conducted about the radioactive releases from terrorist attacks on nuclear power plants, and particularly the spent fuels facilities, documenting the extreme and many decades to centuries long hazards to public health, environment, creating massive non-occupiable lands, social/community/economy destruction, and associated long term to even perpetual costs.
  - Detailed attack and consequence modeling studies have been conducted by this testifying author and by other respected nuclear physicists. See attachments Appendices B and C to this testimony for additional details of case studies and reports. (Not all details are provided due to concerns about national security).
  - As noted in above noted case studies, a single event target on a nuclear power plant could result in hundreds of thousands of damaging human health effects, and deaths, making huge areas of land uninhabitable.
  - One such case study by this author (R Andrews) involved a near New York City nuclear plant, with the uninhabitable and contaminated area from a spent fuel facility attack extending over all of New York city, most of New Jersey and parts of Delaware, all the way to Philadelphia. (see Appendix C for summary excerpts of that study).
  - Another similar modelling study by Princeton University experts for a nuclear plant west of Philadelphia, the Peach Bottom plant, produced similar results, with major population and contaminated lands effects potentially covering all of Philadelphia, and large areas of the Atlantic Seaboard states including Washington DC and surrounding regions. Several model cases illustrate the damages, dependent upon weather patterns and consequent radionuclide dispersion (see literature citations by Professor von Hippel and Schoeppner in Appendix C)

- Regarding the major disaster at Fukushima, Japan, the human health losses were limited simply by luck of wind directions, predominantly seaward during the major radioactive releases, which spared Tokyo, one of the largest cities in the world. Even so, that disaster has not stopped yet, and thousands of tanks of highly radioactive contaminated water are now being planned to dump into the ocean. And the long term management of the destroyed reactors and spent fuel wastes remains totally uncertain, more than a decade since the disaster.
- See detailed reports from the National Academy of Science, Engineering and Medicine (NASEM), *Lessons Learned from Fukushima Nuclear Accident*, Phases 1 and 2)

- Why would any state, county or city want to have such vulnerable targets located anywhere near their people, their communities, their homes and businesses, and the surrounding country?

Regarding the true auxiliary costs of nuclear power

- Use of any nuclear energy sourcing in Colorado's Xcel/PSC system is simply out of step with economic reality or legitimate competitive economic analysis;
- nuclear power has never been economic, despite its proponents' claims, always having been supported by economically distorting subsidies.
- Nuclear power has only ever been justified based on total failure to honestly account for the massive costs and in particular failures to include the public health and socio-economic costs, threats and damages of accidents or even to acknowledge vulnerabilities to intentional attacks from sabotage or terrorists.
- The (ir)responsible federal agencies charged with regulation of nuclear power have never dealt with the proper management and ultimate disposal of either high level or spent nuclear fuels (SNF); and this has been continuing for more than 80 years, since the dawn of the nuclear technology age of the early 1940s.
- And there is still no plan to safely and permanently dispose of these radioactive materials by the DOE, NRC, EPA, NWTRB or any of the military related nuclear wastes. Based upon DOE and NRC documents, there is no established or even firmly projected operational date for meeting their duty for nuclear waste disposal earlier than 2060 or even by the end of this century.

Nuclear energy is not compatible with the urgency to avoid catastrophic global climate damage and environmental, economic, and socio-cultural disruptions:

- To consider nuclear energy as a component in meeting absolutely critical conversion from fossil fuel technology and embodied GHG emissions is a fundamentally flawed concept.
- Nuclear plants simply cannot be designed, licensed and constructed fast enough to meet the needed rapid conversions away from coal, oil and gas-based fossil energy sources to true renewables. And this is particularly true for novel and unverified designs such as NuScale and other so-called small modular reactor designs. The earliest projected operational date for any new nuclear plant is 2030 and likely far beyond for any significant capacity to be installed, far too slow to be replicated, even if successful in operation, not timely to reduce energy system greenhouse gases, compared to other proven solar, wind and other true renewable power systems.

- Coloradans and PSC Colorado should recall the only other attempted entry into nuclear power, the Ft Saint Vrain plant near Platteville, Colorado, a novel nuclear plant technology that never operated above roughly 25 to 50% design power due to safety concerns, and was abandoned by PSC, later partially converted to natural gas. It was a one of a kind plant with graphite moderated core design, in some ways similar to the disastrous Chernobyl plant in Ukraine.
- Newer nuclear power designs are argued to be safer and less expensive, yet the entire history of nuclear power has been massive cost overruns, and ultimately non-competitive with other technologies, even older coal and natural gas fueled plants.

Recommended Experts Colorado Legislature Should Consult:

Many knowledgeable and expert engineers and scientists should be consulted by Colorado officials, to make wise decisions regarding the transition to a safe, economic future of sustaining energy in Colorado. I particularly suggest the following experts and their affiliated organizations:

- Amory Lovins (Rocky Mountain Institute), Aspen, CO
- Edwin Lyman (Union of Concerned Scientists), Washington, DC
- Frank N. von Hippel, Princeton University, Program on Science and Global Security, Princeton, NJ
- Michael Schoeppner, Princeton University, Program on Science & Global Security, Princeton, NJ
- Gordon Thompson, Institute for Resource and Security Studies, Cambridge, MA
- Jan Beyea, Consulting in the Public Interest, Lamberville, NJ
- Allison MacFarlane, Security Studies Program, Ctr for International Studies, MIT, Cambridge, MA (former chairperson of Nuclear Regulatory Commission)
- Robert Alvarez, Senior Scholar, Senior Scientist/consultant, Institute for Policy Studies and other organizations, Wash, DC
- Mark Cooper, Sr. Fellow Econ Analysis, Institute for Energy and Environment, Vermont Law School
- L. Hunter Lovins, Natural Capital Solutions, Longmont, CO.
- Arjun Makhijani, Institute for Energy and Environmental Research, Takoma Park, MD
- Tim Judson, Nuclear Information and Resource Service (NIRS), Wash, DC
- Paul Gunter, Beyond Nuclear, Takoma Park, MD

Closing Comments and Recommendations:

The Colorado Legislature is strongly recommended to:

- Reject SB22-073 as an inappropriate bill to deal with the urgent climate destruction times.

- Reject any plans to include nuclear power as acceptable component of energy generation by any public utility or private power generator in the state of Colorado.

- A definition of truly renewable and clean and safe technologies must be defined carefully for Colorado statutory purposes and built into any legislation to minimize all direct and indirect negative impacts on the total environment and in service to the citizens of Colorado. Such definition must include the application of full and honest full life cycle environmental analysis of the technologies and specific projects, meaning not only internal operating life impacts, but all external, upstream and downstream, near and long term impacts.

- Only approve truly renewable, clean and safe power technologies from this time forward.

- Take expedient actions to support the rapid retirement of environmentally and public health damaging fossil fuel-based energy systems by curtailing issuance of more oil and gas leases, fracturing permits, and permits for coal or shale mines.

- engage compensating rapid approvals of true renewable energy technologies with the lowest possible CO_2 equivalent emissions.

- Encourage energy use efficiency and conservation of resources as paramount means to reduce demand for damaging and non-beneficial energy use.

- Our livable planet is truly threatened by our past and current practices of prolific and wasteful practices that are creating accelerating climate disruption.

- The Colorado Legislature and Colorado state agencies can and should be a key part of the path to a healthy future, driven by respect of the living environment, and departing from simplistic and short-sighted economic analyses that dominate our culture and much public process.

Closing:

I stand ready to assist the Colorado legislature and Colorado agencies with regard to honestly assessing any propositions involving the use of nuclear power in the State of Colorado, all with the purpose of protecting the public health and welfare of our citizens, as well as the essential planetary health and welfare and its life support systems. Please feel free to contact me.

Respectfully submitted,

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Appendix A: Testimony Author's Brief Qualifications Statement

Richard D. Andrews holds multiple degrees in chemical and petroleum engineering, with supplemental education and decades of experience in environmental engineering/sciences. Mr. Andrews is a licensed professional engineer in the state of Colorado since the 1970s. He has been practicing for more than 50 years, initially in the fields of natural gas production and processing; served at the U.S. Environmental Protection Agency (Denver Region VIII) as chemical/environmental engineer in water & wastewater focused on the uranium mining/milling and other extractive minerals and fossil fuel sectors; managed environmental and regulatory affairs/licensing of nuclear fuels in the Rocky Mountain region with Rocky Mountain Energy Company, including responsible for licensing two uranium mining and yellowcake production facilities in Wyoming, including the regulatory/licensing with the U.S. Nuclear Regulatory Commission (NRC), Department of Interior agencies, and many other state and federal agencies. Since 1987 he founded and still serves as President of Boulder Innovative Technologies, Inc. (BIT), an independent R&D and consulting company in environmental studies, including project environmental/regulatory affairs program management/evaluations in Colorado, other states and internationally. He has contracted with numerous state and multi-state agencies including Colorado Dept of Public Health and Environment, Western Governors Association, heavily involving natural resource/mining industries. He founded ZeoponiX, Inc. in mid 1990s, a RD&D corporation involved with high efficiency environmentally responsible agriculture, and commercialization of sales worldwide to agriculture/horticulture/silviculture, including providing technology/products to NASA and European Space agency to grow plants on the International Space Station for closed system life support functions. ZeoponiX is now a wholly owned subsidiary of BIT, Inc. Mr. Andrews is also managing general partner of a private specialty crop organic farm in Colorado.

In private citizen issues, Mr. Andrews is affiliated with Rocky Mountain Peace and Justice Center (RMPJC), 350 Colorado, Center for Food Safety, and numerous other environmental and public health related non-profits.

Appendix B: Summary Impacts of Hypothetical Attack on a Nuclear Power Plant Spent Fuel System

The following "Technical Comments" information is extracted from my full testimony (produced by Richard D Andrews, Boulder Innovative Technologies, Inc.) to public hearings and calls for public comment by the U.S. Nuclear Regulatory Commission regarding their draft environmental impact statement (DEIS) regarding their Nuclear Reactor Spent Fuel *Waste Confidence Rule*, and a court ordered EIS requiring NRC to address its long standing (and still existing) failures to develop with DOE and engage in a program of safe and final long term managed disposal of nuclear spent fuel.

Versions of this technical information have also been submitted to the U.S. EPA, the DOE and the Nuclear Waste Technical Review Board (NWTRB) over recent years. It has also been provided to the National Academy of Science special committee regarding Lessons Learned from Fukushima.

This is an example for similar exposures and the resulting health effects and non habitability of huge areas of land due to radioactive isotope releases from spent fuel handling facilities, even from facilities such as are being considered and promoted by some Pueblo County officials and others.

Similar models can be conducted for any proposed site specific nuclear reactor designs and spent fuel facilities that might be considered for the vicinity of Pueblo, Colorado.

SUPPORTING TECHNICAL COMMENTS from Richard Andrews to U.S. Nuclear Regulatory Commission (NRC):

(1) NRC Risk Methodology is Flawed -

The Nuclear Regulatory Commission (NRC) flawed methodology of determining risk is founded a formula of multiplying consequences times probability of an accident or incident occurring. NRC cannot with certainty define either of these multipliers, and consequently risk is not properly assessed. In many scenarios of accidents or intentional radiological or chemical releases from spent nuclear fuel, the consequences can be defined with more certainty than the probabilities of occurrence. NRC preferentially chooses to assign exceedingly low probability of occurrence to events that have very high consequences. They go on to assert low or very low risk without also assigning a relative probability of accuracy to the product, risk. While the NRC acknowledges that environmental and health and impact consequences may be very high, they state that the probabilities of accident or attack events are very low, and then simultaneously discredit their own methods when a few pages or paragraphs later state they event probability is not quantifiable. Using clear logic one must then conclude that the risk assessment is flawed and risk is also not quantifiable or is subject to extreme uncertainty.

I find that with such circumstances of either unquantifiable impacts and consequences or unquantifiable probability, that risk has to solely relate to the consequences alone as best they can be determined, not relying on unquantifiable probability multipliers. Instead the NRC bluntly asserts very low risk in text and tables throughout the DGEIS to numerous accident events, and notably for the next topic, events of terrorist attacks. Legitimate catastrophe theory and logic reveals this methodology flaw, no matter how entrenched these methods may be at NRC. NRC must correct its methods of risk assessment and more importantly revise appropriate responses, particularly to events with high consequence. Terrorist actions are simply not readily definable by probabilities, being random in nature, and unpredictable, particularly identifying emotional instability of potential actors. Statistical probability values of historical occurrences are not valid predictors for terrorist action, unlike probabilities of such things as home fires, football injuries, or auto accidents. There are very limited measurable factors that may help define probability are such things as terrorism: stimulations to hate and revenge from foreign interventions and wars and repression, and possibly opportunity analysis of means, time and place windows when terror actions will have the greatest impact on the intended target, or the resulting social and economic impacts. But overall, predictability of terrorism is nearly impossible.

Another major flaw with the risk analysis is the handling of duration of risk, the opportunity time interval for an event to occur. Specifically NRC does not accommodate the issue of delays in managing wastes, defined as 60 years post power operation in the short term case, stretching out to indeterminate. Does that instill any sense of "waste confidence"? NO. The longer the period of potential exposure to threats, be they natural or manmade or terror, the greater the likelihood that the catastrophe will happen over the extended interval. Time span is relevant and using only a probability per year factor is simply warping the true expression of risk. Furthermore, given the continued population growth of our country, nuclear power plants and ISFSIs that were once somewhat remote are being and will continue to be encroached upon by urbanization, particularly over the long periods in the three EIS cases of continued on-site storage of SNF (60 years, 160 years, indefinite periods).

(2) NRC Erroneously Asserts Terrorist Attacks & Sabotage as Improbable –

The EIS states that it has only reluctantly considered a terrorist attack threat because of the 9th Circuit court decision. This points to the arrogance or possible ignorance seemingly rampant at NRC to seek to deny the realities of our world where terrorist methods have heavily replaced conventional wars. There is no nuclear installation in the world that is truly secure from terrorists, and particularly not nuclear power plants, and spent fuel or radiological waste facilities. Had those who attacked multiple targets on the same day of September 11, 2001 chosen to hit spent fuel facilities at multiple nuclear plants with the same aircrafts, the losses of life would

have measured in the hundreds of thousands, perhaps millions, the environmental destruction would have affected many thousands of square miles, the lands, lakes, and oceans that would be uninhabitable or otherwise unusable would be even larger due to permanent radioactive contamination, and enormous part of our nation's economic industrial of huge cities and agricultural lands could have been destroyed. Terrorists could have hit the spent fuel pools without any possibility of prevention, then or now. The tools of such possible attacks were readily available then, and remain so now. The 9/11 terrorists simply chose to make their statement elsewhere. As reported in the official 9-11 Commission report, the same 9-11 terrorists that attacked the world trade center towers had conducted aerial reconnaissance of the Indian Points nuclear plant, considering it as a target.

Gordon R. Thompson provides a much more comprehensive analysis and elucidation of these threats than the NRC acknowledges (Gordon R. Thompson, comments on NRCs Draft Consequences Study, Aug 2013). NRC should heed his advice and comments.

The NRC claims in the DGEIS that security measures have improved since 9/11. But no remedial actions have been required to harden or fortify the structures housing SNF, to make them hardened and less penetrable…and that, quite frankly, is not possible to accomplish under a determined attack from terrorists or by sabotage from insiders. Scores of spent fuel pools exist in nothing more than a fragile shell of a building with little more than a thin metal roof, yet contain far higher levels and quantities of radioactive materials than the reactor cores themselves that are shrouded by containment buildings. Scenarios put forth by NRC and national lab publications regarding releases from spent fuel pools have not studied all of these potential modes of attack, and related failure modes of the spent fuel systems. Furthermore, I contest the statements by NRC that airspaces are or can be protected or defended. Hence, waste confidence security certainly does not exist.

The NRC assigns truly understated probabilities to terrorist attacks, simply denying the truth. In numerous tables and text in the DGEIS, the risks are stated as LOW. They apparently do this so they can argue that the risks are low using their flawed formula that risk is the product of consequences times probability. I believe this to be a deceitful representation of risk, and not applicable to high consequence risk. NRC admits in the DGEIS casually perhaps callously that a terror attack could be "significant and destabilizing". Is "destabilizing" a euphemism for immediate deaths and lingering slow deaths of huge numbers of people? Is "significant" NRC code speak for destroying the agricultural lands and businesses and making uninhabitable areas encompassing hundreds or thousands of square miles from a single terrorist attack or spent fuel accident. The NRC argues that nuclear power plants are ((generally) not located near major population centers. This is a flat out lie or gross misrepresentation. Just take a look at the map of the U.S. nuclear power plant locations, nearly all are very close to major metropolitan areas. Waste Confidence is not provided by the flawed and misleading arguments of the NRC in the DGEIS.

(3) NRC Fails to Reveal the Magnitude of Consequences from a Spent Fuel Fire or Release

Even partially loss of cooling water or pool level could create a disastrous radioactive plume, and a zirconium fuel rod cladding oxidation fire releasing far more radioactivity than exists in the reactor core. In NRC reports, as much as 100% of the Cs-`137 is estimated to be vulnerable to release from the inventory of SNF in a storage pool. These are documented facts available in many NRC publications, and in independent studies, including one co-authored by the current chairperson Allison MacFarlane of the NRC (Alvarez et al, 2003). That analysis published in the journal of Science and Global Security included both MACCS2 and Wedge model dispersions of releases of Cs-137 from 10% (3.5 MCi) to 100% (35 MCi) of the then typical 400 ton inventory of SNF at a 1000 MWt USA PWR plant. In that generic case study the area of land contaminated greater than 100 Ci/km2 was found to 5 to 9 times larger than the Chernobyl event affected area for the 10% inventory release case, or 1350 to 2317 square miles (3500 to 6000 km2). For the 100% Cs-137 source term release, the contaminated area above 100 Ci/km2 was 17,375 to 19,305 square miles (45,000 to 50,000 km2). The estimated health impacts to persons living for 10 years in an area

contaminated at these levels (>100 Ci/km2) were an added risk of death from cancer of 1 to 10 percent., as much as 30% overall lifetime risk of cancer death.

In a 1997 NRC study (as summarized in Alvarez 2003) , in a spent fuel fire that released 8 to 80 MCi of Cs-137, the authors described consequences at 54,000 to 143,000 excess cancer deaths, 772 to 2700 (2000 to 7000 km2) of agricultural land condemned, and other economic costs from mandatory evacuations of $117 to $566 billion. An estimated 1.6 to 7.6 million people would be permanently evacuated.

A subsequent report by Robert Alvarez (IPS, May 2011) published shortly after the Fukushima disaster began further supports the potentially disastrous consequences of a spent fuel fire. New modeling was not performed in this report but the reality of Fukushima catastrophe and the actual destruction of the SNF structures and buildings should serve as a lesson. Furthermore, the Fukushima radiation releases from SNF and damaged cores continues and has yet to be resolved, let alone any sense of control, or decontamination, and remediation deemed possible of the contaminated areas. Much like Chernobyl and the USSR, Japan is now exercising a virtual information black out. A factor to consider is that the damaged spent fuel pool inventories at Fukushima were far less than exist at almost all of the USA nuclear power reactor spent fuel pools. As an example, the Vermont Yankee BWR reactor spent fuel pool holds about 100 million Curies, three times the amount of spent fuel that was in the damaged pool of Fukushima Dai-Ichi Unit 4. And the Millstone units 1, 2 and 3 have more than 400 million Curies of spent fuel in storage. Clearly this disaster should be a wake up call to NRC of the potential disasters in waiting in the USA.

Modelling of a Hypothetical Terrorist Attack on Indian Point Nuclear power plant near New York City.

I have recently completed a RASCAL 4.3 computer modeling of a spent fuel pool release for the Indian Point Unit 2 spent fuel pool inventory under a drained-uncovered pool fuel scenario. This plant was chosen as representative of a plant in proximity to a major high population density urban setting. The current inventory of SNF at Unit #1, 2 and 3 of Indian Point is estimated to be approximately 234 million Curies (Alvarez, IPS 2011; Yucca Mtn DOE/EIS-0250), with about 94 million Curies as Cesium-137, approximately 40% of the total radioactive source. My extrapolated estimate of Unit #2 Nov 2013 SNF inventory is about 1487 fuel assemblies, actually 113 more than original design pool capacity, increasing at the rate of about 38 assemblies per year. Status of non-operating Unit #1 spent fuel pool is not known, nor is amount of SNF that has moved to ISFSI dry cask. Total estimated Unit #2 pool radioactive source is approximately 133 million Curies total and 53 million Curies of Cs-137. The RASCAL 4.3 (Sept 2013) database and summary of activity released to the atmosphere by the model is 26 million Curies total and 15 million Curies of Cs-137, reflecting built in model assumptions of release factor reductions from an uncovered and drained pool fire event. In other words the RASCAL model does not assume 100% of the spent fuel radioactive inventory is released in a fire. According to the model documentation the release factor is assumed at 0.3 for Cs and Rb. The model also reduces effective inventory loss and radioactivity by age categories since off loading from the core. For the RASCAL model assumed wind speeds were ranging from 6 to 9 mph, predominantly from north +/- 15 degrees down the Hudson River. A fresh off-load of spent fuel from the core was assumed to have been made. The source term release was assumed to happen over an approximate 24 hour period, zirconium cladding fire and failure assumed to initiate 2 hours after drained pool condition occurred and fuel temperatures reach 1200 F.

Using EPA defined Protective Action Guide (PAG) dose action ranges for Total Effective Dose Equivalents (TEDE), the model impact zone areas were 2475 sq miles (> 2 rem), and 3300 sq miles for >0.2 rem, for 1st year phase. For the 2nd year phase, impact areas were 3,875 and 1,775 sq miles for > zero and >5 rem TEDEs, respectively. For Cs-137 surface contamination at levels greater than 15 uCi/m2 the impact area was 2850 sq miles. For Cs-137 surface contamination greater than 50 uCi/m2, the impacted area was 2,200 sq miles.

To put this in perspective, the Chernobyl permanent evacuation zone of the radiation control area was set at Cs-137 contamination of >15 uCi/m2, and encompassed a land area of approximately 3,860 sq miles (10,000 km2),; calculated out to a radius of 36 miles. For Chernobyl the zone at >50uCi/m2 is reported as an area with >0.7%

chance of radiation caused cancer deaths from a lifetime external radiation exposure. For Chernobyl the area greater than 50 uCi/m2 was determined to be approximately 1,200 sq miles (3,100 km2). This is not understood to include other exposures such as internal ingestion of contaminated foods, or water, so the hazards are much higher. The Chernobyl disaster was actually much smaller in impact contamination and land areas than the possible impacts from a single spent nuclear fuel pool release from any of the U.S. nuclear power plant sites, particularly when one considers the conservative aspects of the RASCAL model regarding reduced magnitude of spent fuel source terms and other model assumptions.

Now consider that this area of CS-137 surface concentrations covers virtually all of New York City metropolitan area, major parts of Long Island, major parts of New Jersey, eastern Pennsylvania, and even Western parts of Connecticut, with significant fallout into the Atlantic seaboard oceans, estuaries, and bays. Slightly different meteorological conditions with more northeasterly winds could blanket contaminate nearly all of New Jersey and Philadelphia as well, or with westerly winds the contamination plume could cover nearly all of Connecticut, Rhode Island, Massachusetts, and the southern parts of Vermont and New Hampshire and Maine. In the present model the plume of greater than 100 uCi/m2 Cs-137 contamination actually goes well beyond the 100 mile radius from the Indian Point plant down into Delaware, but the model cuts off at 100 miles in its calculations. The impacts and consequences from such an event are simply hard to fathom they are so devastating to one of the most dense population areas of the United States. I have not made estimates of numbers of people impacted but it is likely 10s of millions, nor have I estimated the immediate deaths and lifelong health and fatality effects due to insufficient time in preparing this analysis and comments, but this could be done using U.S. census data and local land/property value, and land use data overlaid on the modeled plume contours. In effect, such an event would dwarf most displaced person and refugee events experienced in major wars experienced in the last half century. But the effects of a radiological land contamination event are much longer in duration, certainly many decades long until long half life isotopes decay such as Cs-137, to essentially permanent for some land and human occupancy uses, and for impacts on natural biological systems and agricultural lands.

The wind direction and meteorological conditions, coupled with the immediately fresh off load of spent fuel from the core do make this case study a near worst case scenario, but for an intelligent and committed terrorist, that person may just select his target and timing and weather conditions to do the most damage he can inflict. Due to certain conservative aspects of the RASCAL model on assumed percentage release of SNF inventory from a SNF fire, the actual contamination levels and doses may actually be much larger than calculated by the RASCAL model. Also the duration of the release from such a fire is considered to be relatively brief, measured in a few hours beyond the assumed initial 2 hours to reach zirconium cladding ignition temperatures, and consequently insufficient time to allow for an orderly mass evacuations to occur. The Fukushima disaster involving spent fuel pool at Unit 4 may however lead us to understand that the source material release duration could be much longer, and could involve conditions nearly impossible to bring under any control once initiated for very long time frames, also leading to greater total radioactive material releases to the atmosphere, soil, water, and general environment. As another conservative assumption, this RASCAL modeled case only involves Unit #2 SNF pool at Indian Point, not the SNF stored in Unit #1 or Unit #3 pools, or materials in dry storage casks, nor any releases from the reactor cores. The status of Unit #1 pool is unknown to this author since that reactor discontinued power output in the 1970s.

To illustrate the radioactive dispersion impact areas attached are several of the map overlays of contamination plume patterns for the RASCAL 4.3 model of an Indian Point Unit 2 spent fuel pool fire event and associated radionuclide source term release. Included are maps of total effective dose equivalent (TEDE) zones at various concentration ranges and phases of exposure (immediate, 1 year, 2 year and 50 year), surface contamination (total and Cs-137), and thyroid committed dose equivalent. Please take the time to study these maps and visualize the land areas and people affected.

Had the 9/11 terrorist attackers chosen to fly aircraft into Indian Point, or Millstone or any of the many reactors near major cities such as around Chicago, Atlanta, Miami, Baltimore, or many other major cities, the near term fatalities and lifetime excess cancer death counts would be extremely high, likely in the hundreds of thousands for any single event, far greater than acknowledged by NRC in its undocumented risk and consequence analysis presented in the DGEIS.

Others have postulated and reviewed consequences of various modes of terrorist attacks on spent nuclear fuel facilities, including large and small aircraft, artillery with bunker penetrating shaped charges, truck delivery of explosives, and other scenarios. I will not review those in this paper, but encourage the NRC to heed these documents (see various papers of Gordon Thompson, Robert Alvarez et al, prior risk assessment NUREG documents, e.g. Sailor et al 1987 NUREG-4982 and Collins and Hubbard 2001 NUREG-1738, and the National Research Council report on spent fuel).

The NRC in the Waste Confidence DGEIS further ducks or obscures the reality and magnitude of these catastrophic events by failing to use plain honest language to describe the casualties/deaths and the huge essentially perpetual societal, financial, and environmental damages. Those failings must either be corrected of the DGEIS scrapped as inadequate.

(4) NRC Fails to Provide Valued Policy Advice by Deferring to the Blue Ribbon Commission

The DGEIS, like the so called Blue Ribbon Commission on Nuclear Futures, simply puts off to a distant and uncertain future any solution to the problems of spent fuel. It is ludicrous for NRC to extend the definition of short term to be 60 years, more than 100 years beyond the dawn of the nuclear age. It is even more so with cases 160 years or indefinitely beyond the closure of nuclear plant operation. This posture of the Blue Ribbon Commission, and then repeated by NRC, instills no waste confidence, nor confidence in the NRC as a protector of the public interests, health and safety.

The NRC needs to confront this absurdity of the Blue Ribbon Commission and provide valuable and much needed advice to the administration and to Congress to chart a more aggressive path to properly handling and disposing of spent nuclear fuel and other radioactive wastes. To do anything else is putting at extreme risk millions of people of the USA, as well as our lands and economic systems. A single catastrophic SNF fire or major release event would be devastating.

(5) Unsuitability of and Failed Utility of a Generic EIS for Unique and Site Specific Waste Confidence Management of SNF

The Waste Confidence Draft GEIS itself is overall a dishonest and inappropriate assessment of the environmental impacts of spent nuclear fuel. A broad brush generic assessment, even if done well, cannot deal with individual plant site specific issues. The time frames defined in alternatives of the DGEIS are totally unresponsive to the needs to protect the environment and human health. It is flawed in structuring the alternatives which avoid real solutions to the issues of the extreme hazards and consequences of spent nuclear fuel. Its purpose really seems to be (and was so stated by NRC in its public hearings) to grease and accelerate licensing and relicensing, and avoidance of site specific environmental analysis of SNF. This is subverting the purpose and utility of the NEPA process. Each of the more than 100 nuclear power facilities and ISFSIs is unique and this document cannot possible provide legitimate or accurate assessment of the site specific environments and impacts where these facilities occur.

The only legitimate reply to the courts should have been that NRC has no confidence that waste repositories will ever be available, let alone that an NRC agency will even exist within these long time intervals. Given NRC's flawed use of probabilities in risk assessment, it should also examine the probability of the very existence of a functional regulatory agency within the extended time frames described. This all points to the necessity and urgency for much more prompt solutions to the disposal of these wastes and the cessation of generation of additional wastes. The NRC should simply declare NO SNF WASTE CONFIDENCE and speak the truth about the extreme hazards from nuclear power and nuclear wastes. It should curtail any and all existing and new licensing, except licenses for prompt closure and final disposal of nuclear materials.

Conclusions and Recommendations:

I call on the NRC staff and commissioners to act immediately, taking the following steps:

- Require all reactors to immediately harden all structures housing spent fuel pools since at a minimum SNF will have to stay in the pools for about five years for primary cooling, even after reactor cessation of power operations; and

- Move quickly to remove all possible spent fuel from cooling pools and place SNF into hardened dry casks of small enough size and designs to avoid secondary repackaging and transfer for safe transport; and

- Until final geologic repositories are established and operational, remove all dry casks to remote ISFSI facilities away from populated areas of our country, and placed in dispersed hardened arrays to make them less vulnerable to terrorists attacks, and reducing the consequences if attacked; and

- Discontinue any new licensing or license renewals of any nuclear waste generating plant or facility, including all stages of the fuel cycle. In other words stop permitting additional nuclear waste generation.

- Finally, with full integrity NRC must inform Congress of the untenable hazards of the nuclear industry and advise Congress to authorize prompt cancelling all current nuclear power plant licenses and to accelerate the political and regulatory processes to as quickly as technically possible place all spent fuel and high level radioactive wastes in deep geologic repositories.

Final Overall Comments:

For my entire life, the federal government has been promising the benefits of nuclear technology, but all we really have to show is piles of studies, massive wastes of public funds, a legacy of broken and false promises, while laying all the radioactive waste problems on our children and grandchildren. When I grew up in Kansas in the 1950s the AEC was planning for nuclear waste disposal in Kansas salt mines. That never happened. Nor has anything to resolve this radioactive waste disposal since.

The Draft Waste Confidence GEIS is nothing more than distraction, denial and deception. It should be withdrawn and totally redirected using reality and honest commitment to prompt solutions for ultimate disposal as a guide toward a sane and safe future.

I personally call upon the Nuclear Regulatory Commission and NRC staff to restore the agency to its proper role as regulator of the nuclear industry, not promoter and protector; and to restore its proper role of protecting public health and safety. The AEC was intentionally split up decades ago, to avoid the conflict of being both protector-

promoter and regulator of atomic energy and weapons. NRC's solitary role is serving the public interest, ensuring its security, health and safety. NRC is not the steward of nuclear power.

Thank you for the opportunity to provide these comments.

Richard D. Andrews, President/Founder

Boulder Innovative Technologies, Inc. , Box 19105, Boulder, CO 80308

303 673 0098 (office) rich@zeoponix.com

Attachments:

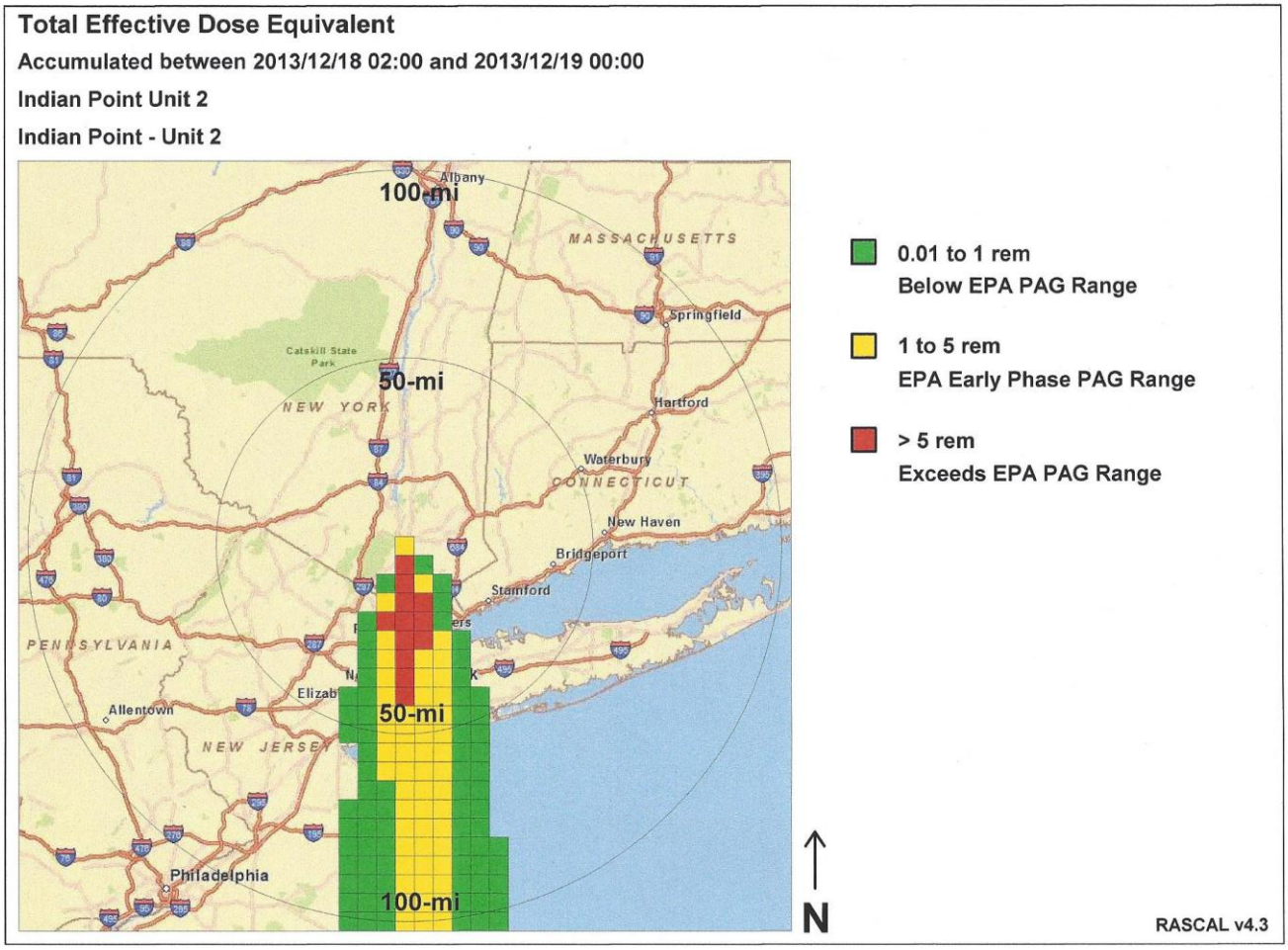
Computer dispersion model charts of irradiated areas from Radiological Assessment System for Consequence Analysis (RASCAL 4.3) for Indian Point Unit #2 Spent Nuclear Fuel Pool fire case are attached:

1. Total Effective Dose Equivalent (TEDE), rem, 0 to 100 mile
2. First Year – Intermediate Phase TEDE, rem, 0 to 100 mile
3. Second Year – Intermediate Phase TEDE, rem, 0 to 100 mile
4. 50 Year – Intermediate Phase TEDE, rem, 0 to 100 mile
5. Surface Concentration of Cs-137,uCi/m2, 0 to 100 mile
6. Surface Concentration, uCi/m2, 0 to 100 mile
7. Thyroid Committed Dose Equivalent, rem, 0 to 100 mile

References, software, and other resources:

1. RASCAL 3.0.5 Description of Models and Methods, NUREG-1887, August 2007.
2. RASCAL 3.0.5 Workbook, NUREG-1889, Sept 2007.
3. RASCAL 4.3, Radiological Assessment for Consequence Analysis, RSICC Computer Code Collection, Oak Ridge National Laboratory, CCC-783, Sept 2013.
4. RASCAL 4.3/CCC-783, Radiation Safety Information Computational Center, Sept 2013.
5. Waste Confidence Generic Environmental Impact Statement (DGEIS), Draft Report for Comment, U.S. Nuclear Regulatory Commission, NUREG-2157, Sept 2013.
6. Thompson, Gordon R., Comments on the US Nuclear Regulatory Commission's Draft Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark I Boiling Water Reactor, declaration of 1 August 2013, Institute for Resource and Security Studies, Cambridge, MA
7. Thompson, Gordon, Robust Storage of Spent Nuclear Fuel: A Neglected Issue of Homeland Security, Jan 2003, Report commissioned by Citizens Awareness Network, Institute for Resource and Security Studies, Cambridge, MA.
8. Alvarez, Robert, J. Beyea, K. Janberg, J. Kang, E. Lyman, **A. Macfarlane**, G. Thompson, F.N. von Hippel, 2003, Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States, Science and Global Security 11:1-51. . **(Note: Co-author Allison Macfarlane is past Chairperson of the Nuclear Regulatory Commission.)**
9. Benjamin, A.S. (ARES Corp., formerly Sandia National Lab), 2003, Comments on: "reducing the hazards from Stored Spent Power-Reactor Fuel in the United States", Science and Global Security, 11:53-58.
10. Anon. (Nuclear Regulatory Commission), 2003, NRC Revies of "Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States", Science and Global Security, 11:203-211.

11. Alvarez, Robert, J. Beyea, K. Janberg, J. Kang, E. Lyman, **A. Macfarlane**, G. Thompson, F.N. von Hippel, 2003, Response by the Authors to the NRC Review of "Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States", Science and Global Security 11:213-223. **(Note: Co-author Allison MacFarlane is past Chairperson of the Nuclear Regulatory Commission.)**
12. Alvarez, Robert, May 2011, Spent Nuclear Fuel Pools in the U.S.: Reducing the Deadly Risks of Storage, Institute for Policy Studies and Project on Government Oversight, 2011.
13. Alvarez, Robert, June 26, 2013, Reducing the Hazards of High-Level Radioactive Waste in Southern California: Storage of Spent Power Reactor Fuel at the San Onofre Nuclear Station, commissioned by Friends of the Earth, published by Institute for Policy Studies.
14. Alvarez, Robert, Jan/Feb 2002, What about the spent fuel?, Bulletin of the Atomic Scientists, 58(1): 45-47.
15. Anon., Health Risks from Exposure to Low Levels of Ionizing Radiation, BEIR VII Phase 2, Board on Radiation Effects Research, Division of Earth and Life Studies, National Research Council of the National Academies, The National Academies Press, Wash, DC.
16. Anon., Safety and Security of Commercial Spent Nuclear Fuel Storage, Public Report, Committee on the Safety and Security of Commercial Spent Nuclear Fuel Storage, National Research Council of the National Academies, the National Academies Press, Wash, DC.
17. Collins, T.E. and G. Hubbard, Feb 2001, Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants, NUREG-1738, U.S. Nuclear Regulatory Commission.
18. Sailor, V.L., K.R. Perkins, J.R. Weeks, H.R. Connell, 1987, Severe Accidents in Spent Fuel Pools in Support of Generic Safety Issue 82, NUREG/CR-4982, BNL-NUREG-52093, Brookhaven National Laboratory, prepared for U.S. Nuclear Regulatory Commission.
19. State of New York, et al., Petitioners vs. Nuclear Regulatory Commission and United States of America, respondents, United States Court of Appeals for the District of Columbia, USCA Case #11-1045, Document #1377720, Filed 06/08/2012.
20. Anon., 1987 with subsequent revision, Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants, NUREG-1150, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research.
21. Multiple authors and papers, Technical Workshop on the Impacts of Dry-Storage Canister Designs on the Future Handling, Storage, Transportation, and Geologic Disposal of Spent Nuclear Fuel in the United States, Nov 16-19, 2013, U.S. Nuclear Waste Technical Review Board, Washington, DC.



Notes: "TEDE" is "**T**otal **E**ffective **D**ose **E**quivalent", measured in radiological exposure units of REM

"PAG" is U.S. EPA designated action zone, or Protective Action Guide (PAG) which dictates the zone for required population evacuations due to excessive environmental radionuclide activity levels.

Each rectangle in the above figure is an area of 25 sq miles or 5 x 5 miles.

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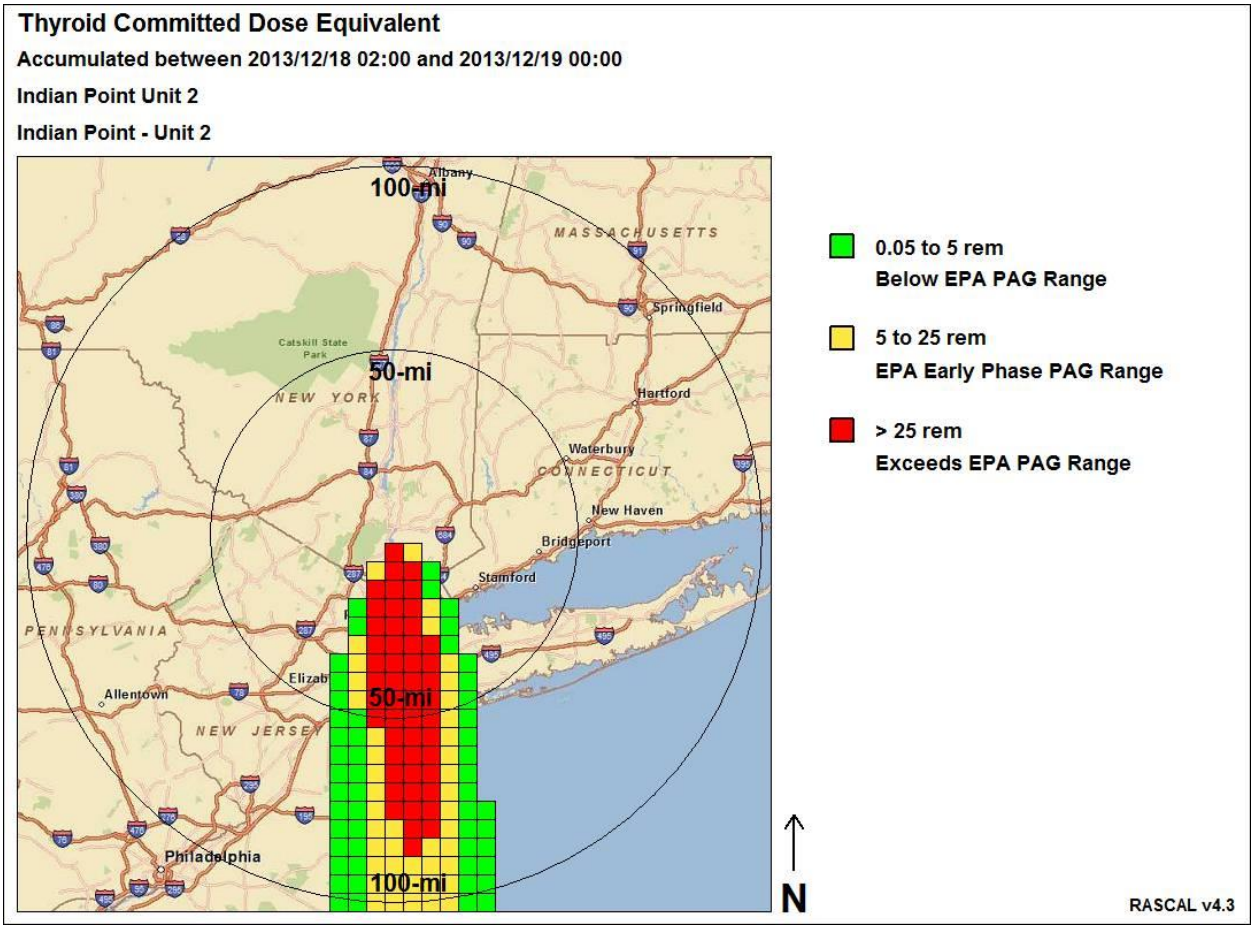
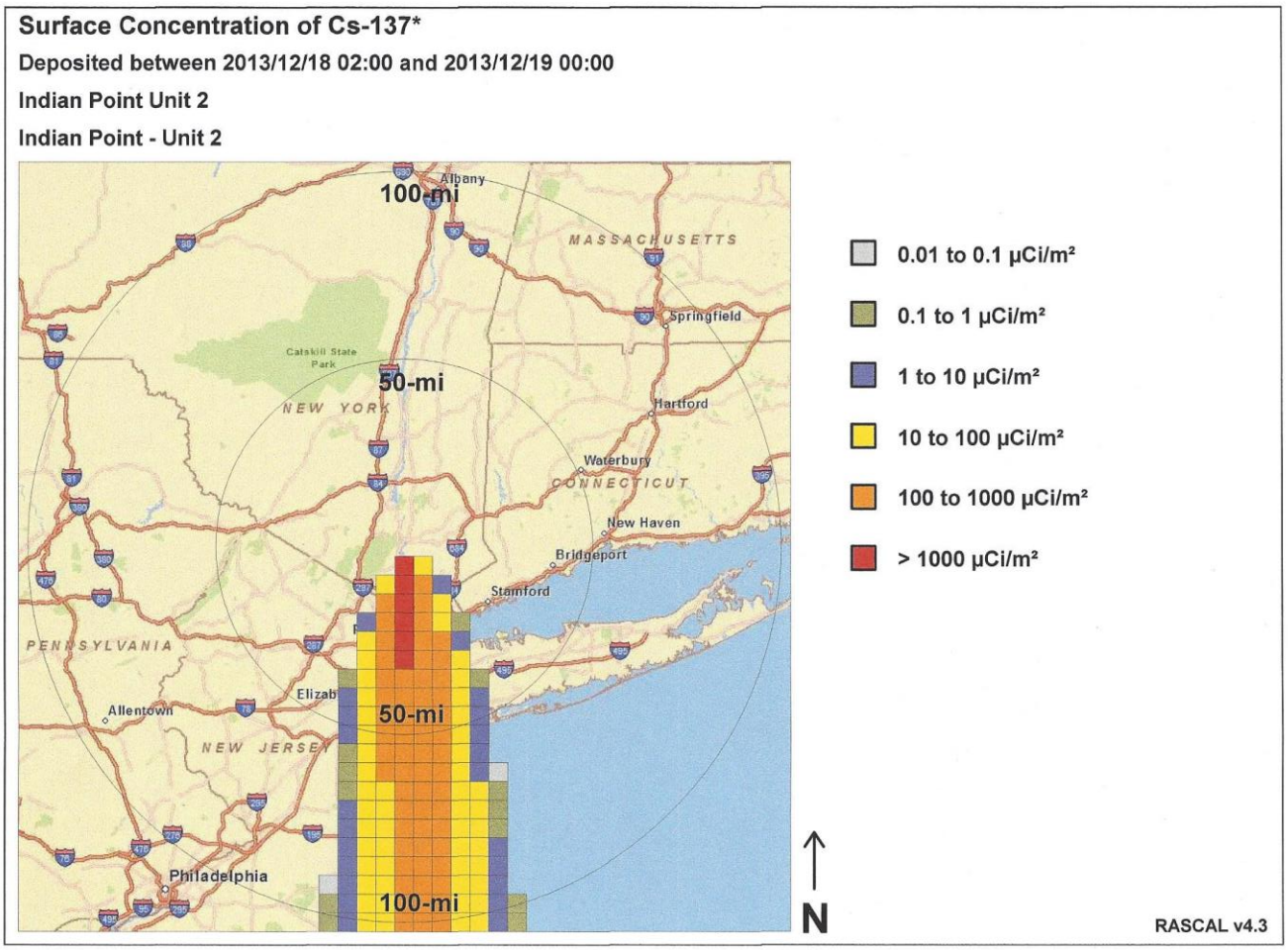


"PAG" is U.S. EPA designated action zone, from the Protective Action Guide (PAG) which dictates the zone for required population evacuations due to excessive environmental radionuclide activity levels.

Thyroid committed dose equivalent is primarily based on the concentration of radioisotope Iodine in the emissions from the source waste, spent nuclear fuels.

Each rectangle in the above figure is an area of 25 sq miles or 5 x 5 miles.

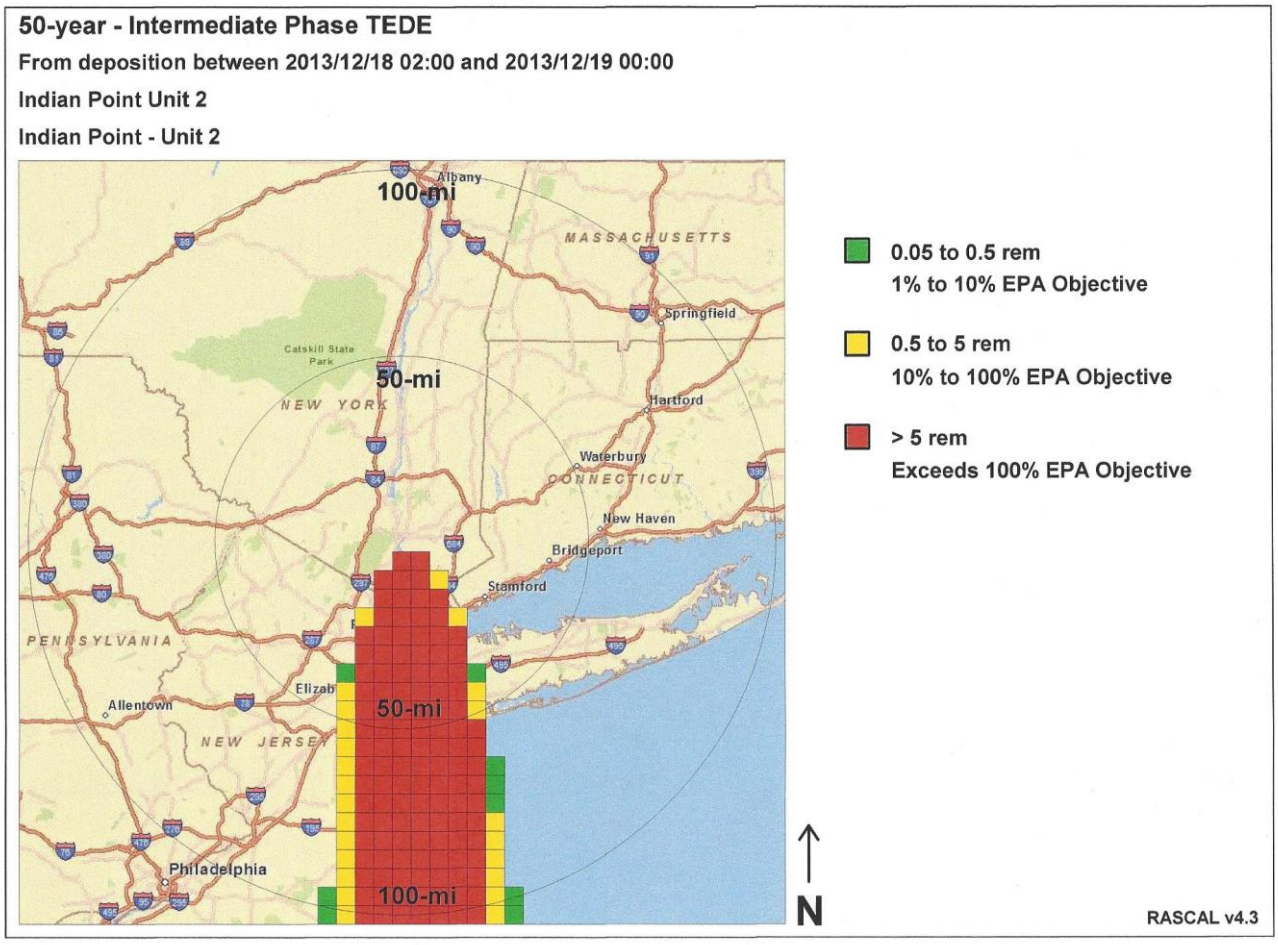


Color coded areas are in units of deposition of the radionuclide Cesium – 137, the primary and most dangerous or highest radiation activity of the releases for the spent nuclear fuel (SNF).

Cs-137 concentration on deposition surface, such as soils, dwellings, etc. is measured in microCuries/square meter.

Cs-137 has a relatively long half life of approximately 30 years, meaning it takes 30 years for one half of this isotope to decay, or approximately 300 years to decay to near background levels or near zero.

Values of Cs-137 higher than 100 microCuries/m^2 are defined as excessive for safe human occupation, as based on soil concentration areas impacted, extending more than 100 miles from the power plant.



Notes: "TEDE" is "**T**otal **E**ffective **D**ose **E**quivalent", measured in radiological exposure units of REM

This figure illustrates the zones of cumulative dose or exposures over the first 50 years after the release of the suite of radionuclides from the release event of the spent fuel facility at the source nuclear reactor, unit 2 of Indian Point plant.

"PAG" is U.S. EPA designated action zone, or Protective Action Guide (PAG) which dictates the zone for required population evacuations due to excessive environmental radionuclide activity levels.

Each rectangle in the above figure is an area of 25 sq miles or 5 x 5 miles.

Yellow and red areas are areas unsafe for occupancy.

Only the Green colored areas are deemed safe for occupancy according to EPA PAG guidelines.

Appendix C: Published Supporting Technical & Peer Reviewed Papers

(full text is available as pdf files for the following documents)

Alvarez, R. et al, 2003, Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States, Science and Global Security, 11: 1-51

Von Hippel, F.N. and M. Schoeppner, 2016, Reducing the Danger from Fires in Spent Fuel Pools, Science and Global Security, 24 (3), 141-173, http://dx.doi.org/10.1080/08929882.2016.1235382

Von Hippel, F.N. and M. Schoeppner, 2017, Economic Losses from a Fire in a Dense-Packed U.S Spent Fuel Pool, Science and Global Security. http://dx.doi.org/10.1080/08929882.2017.1318561

Other recommended and selected reference publications recommended for Colorado legislator and staff review:

Lovins, A. B. and Rocky Mountain Institute, 2011, Reinventing Fire: Bold Business Solutions for the New Energy Era, Chelsea Green Publishing, White River Junction, Vermont.

Lovins, A.B. and H. Lovins, Brittle Power, Energy Strategy for National Security, 1982, Brick House Publishing, Andover, MA.

Alvarez, R., 2011, Spent Nuclear Fuel Pools in the U.S.: Reducing the Deadly Risks of Storage, Institute for Policy Studies, Washington, D.C.

Lochbaum, D. E. Lyman, S.Q. Stranahan, 2014, Fukushima: the Story of a Nuclear Disaster, The New Press, NY.

Cooper, Mark, 2021, Building a Least-Cost, Low-Carbon Electricity System with Efficiency, Wind, Solar & Intelligent Grid Management,: Why Nuclear Subsidies are an Unnecessary Threat to the Transformation, Institute for Energy and the Environment, Vermont Law School.

Makhijani, Arjun, 2007, Carbon-Free and Nuclear-Free: A Roadmap for U.S. Energy Policy, IEER Press and RDR Books, Muskegon, MI.

Gronlund, L., D. Lochbaum, E. Lyman, 2007, Nuclear Power in a Warming World: Assessing the Risks, Addressing the Challenges, Union of Concerned Scientists, Washington, D.C.

Lovins, A.B., 2021, "Low-Carbon" Misses the Point: Arguments favoring Nuclear Power as a climate "solution" are Fundamentally Flawed, see posting of Oct 3, 2021 by BeyondNuclearInternational.

Lyman, Edwin, March 2021, "Advanced" Isn't Always Better: Assessing the Safety, Security, and Environmental Impacts of Non-Light Water Nuclear Reactors, Union of Concerned Scientists, Washington, D.C.

Senate State, Veterans, & Military Affairs
02/15/2022 02:00 PM
SB22-073 Alternative Energy Sources
Typed Text of Testimony Submitted

Name, Position, Representing	Typed Text of Testimony
Sylvia Pelcz-Larsen Against Self	This idea for alternative energy is really dumb. Colorado has enough problems already given the magnitude of wildfires, the waste from Rocky Flats and fracking. Perhaps you guys and come up with a plan on how to put out coal seam fires before starting additional nuclear nightmares. Why can't we pursue clean energy solutions that are void of toxic waste?
Alison Jaggar Against Self	Nuclear power creates waste that remains radioactive for thousands of years. There is no good solution for processing or storing radioactive waste, and most or all of it may be kept onsite. There is no solution for dealing with that nuclear waste anywhere in the world. Nuclear plants use a LOT of water for cooling spent fuel, which then becomes contaminated. Nuclear power plants have been linked to higher rates of cancer.. The damage from an accident at a nuclear power plant would be catastrophic, and the risk is heightened by increasing natural disasters due to climate change. Nuclear plants require highly trained personnel to run them and carry the risk of accidents with a high potential for those accidents to have severe consequences. Due to climate change, extreme weather events are becoming more common, increasing the risks of nuclear plants. A nuclear power plant is an attractive target for terrorists and hackers. The lasting contamination in the case of an accident could make the surrounding area radioactive for thousands of years. Small Modular Reactors are a new, unproven technology. The Union of Concerned Scientists found that the new designs they analyzed “are not likely to be significantly safer than today’s nuclear plants. The smaller reactors produce more nuclear waste per unit of electricity generated. Nuclear power has been getting more expensive, and could increase electric rates in Colorado while decreasing property values for those living near the plant.

Lynn Huber Against Self	Thank you for allowing my testimony! I am unalterably opposed to this bill for more reasons than you can imagine. Below are the most important: Nuclear power will not solve our energy problem, but rather make it infinitely worse, including but not limited to increasing the cost to low income and otherwise powerless Coloradoans. LIFE THREATENING POLLUTION—lasting more or less indefinitely. —No way to store waste safely and no way to safely dispose of it otherwise —Water used for cooling is permanently contaminated, and will contaminate ground water —Extant plants have been shown to increase cancer in humans living nearby —Powerless rural Coloradoans are in most danger (especially Pueblo and the surround.) (Note—I live in Denver—this is not a personal but a social justice issue.) —Not only nuclear plants, but uranium mining impacts marginalized (often indigenous) and rural populations especially. 2) COSTS ARE TREMENDOUS —Radioactive waste lasts thousands of years —No way to process or store radioactive waste safely —Water is already scarce in Colorado, and threatening the remaining supply is stunningly foolish. —Damage from an accident would be catastrophic, with the danger of same drastically increased by our climate-change vulnerability—both fire and flood. 3) THE TECHNOLOGY OF SMALL MODULAR REACTORS IS NOT PROVEN. 4) NUCLEAR POWER IN COLORADO HAS BEEN A DISASTER. The Ft. St. Vrain plant was shut down 10 years after being completed, having functioned ONLY 8% of its lifetime. 5) NUCLEAR POWER CONTINUES TO INCREASE IN COST, so is likely to increase electric rates in Colorado. THE MONEY SHOULD GO TO ENERGY SOURCES THAT ARE DECREASING IN COST AND ARE SAFE—wind and water and solar generated energy. 6) BENEFITS GO TO THE NUCLEAR INDUSTRY, NOT TO COLORADOANS. We however will absorb all the risks, health impacts and environmental contamination.

	PLEASE VOTE NO! Again, thank you for listening; I pray you will help save God's beautiful Colorado and her people. Thank you.
Celeste Dowiatt Against Self	Dear Senators, I would like to save you (us) some money. There is no need to do any feasibility study on bringing back nuclear power to Colorado. The lessons of Chernobyl, Fukeshima, 3Mile Island, and our own Platte Nuclear Power plant are evidence enough that nuclear power is not a safe option. Please vote against SB22-073.
Susan Hurst Against Environmental Information Network, Inc. (EIN)	Environmental Information Network (EIN) Paula Elofson-Gardine, Executive Director Susan Elofson-Hurst, Principle Investigator pjelofson@gmail.com, susandhurst@aol.com 303-233-6677 or 303-601-9271 February 14, 2022 To Whom It May Concern: We are submitting comments for SB22-073 for the public record. We are asking that you respond to our questions and concerns set forth in these Comments from Environmental Information Network (EIN). We oppose/against SB22-073. EIN would like to share lessons learned that apply to this particular situation. It's a cautionary tale from our 30+ years of involvement with the former Rocky Flats Nuclear Weapons Plant that was located west of Denver. We have several items we would like you to include in your Feasibility Study for Small Modular Reactors (SMR's) for Colorado, should you still decide to pursue the SMR's project. • Do not place any of these SMR's close to any: drinking water reservoirs, lakes, streams/rivers, agriculture ~uptake in plants~, cattle ranches ~grazing~, housing developments (present or future), college towns, over fault lines ~R.F. had 5 that converge under the plant ~ in an area with shallow ground water tables, over an aquifer or on a bluff overlooking a large metropolitan area. • Restrict Access: NO hiking, dog parks, trails, biking, or school tours to study the ecosystem native grasses. State and County School Boards should prohibit school kids from touring Superfund sites – as any of your SMR's could become. • How much waste do you anticipate these SMR's to produce working at full capacity? • Where do you propose you will be taking the generated RAD waste to?

	• Top DOE official Robert Alvarez stated in 1986: "Rocky Flats should be a National Sacrifice Zone." EIN agreed. Our opinions are based upon: the Radioecology and Airborne Pathway Report; Actinide Uptake in Cattle Study, Aerial Gamma Survey. •Nuclear is controversial and very unpopular in Colorado. Once the SMR's are on-line there will be RAD waste to consider. It's dangerous and no one can promise that there won't be any accidents that release radioactive waste to the environs.
Celeste Parise Against Self	Perhaps we should focus on cleaning up the deadly mess left behind from weapons manufacturing at Rocky Flats before we speak of bringing additional nuclear risk into this state. The fact that this is considered "clean energy' is a joke.
Nicole Wolf Against Self	My family and I feel strongly that the evidence shows Nuclear Power is a false solution for climate change, and diverts public funds from renewable energy sources like solar and wind power. We are at a crisis point now with climate chaos and every decision made now defines a path for generations. There is no time to play with dangerous options that contaminate, cause cancer clusters, use too much of our precious dwindling water supply. We count on our representatives to act in the best interest of the people and our states natural resources. Nuclear energy corporations and major utility companies will reap enormous profits, while Colorado's communities will absorb all the risks, health impacts, and environmental contamination. Thank you for this opportunity to be heard. Please do the right thing and invest in a green future.

SB22-073 CommentsTom Corlett to: committees.lcs.ga@state.co.us 02/15/2022 12:58 PMPlease respond to "Tom Corlett"

There are many reasons for Colorado to avoid re-introducing nuclear fission, and the two primary from my well informed education on the matter are: Radioactive waste and lack of safe disposability, and the questionable economic viability given cost over-runs and basic high cost.

And, we can do the job with renewables by 2040 cheaper and quicker.

Tom Corlett
Pueblo, CO

Thomas Corlett Sr.
719-330-3360
LEED®AP
LinkedIn

Member: USGBC

Environmental Information Network (EIN)
Paula Elofson-Gardine, Executive Director
Susan Elofson-Hurst, Principle Investigator
pjelofson@gmail.com, susandhurst@aol.com
303-233-6677 or 303-601-9271

February 8, 2022

To Whom It May Concern:

We are submitting these comments for SB22-073 for the public record. We are asking that you respond to our questions and concerns set forth in these Comments (below) from **Environmental Information Network (EIN).** **We oppose/against SB22-073.**

EIN would like to share lessons learned that apply to this particular situation. It's a cautionary tale from our 20+ years of involvement with the former Rocky Flats Nuclear Weapons Plant that was located west of Denver. We have several **items we would like you to include in your Feasibility Study** for Small Modular Reactors (SMR's) for Colorado, should you still decide to pursue the SMR's project.

- Do not place any of these SMR's close to any: drinking water reservoirs, lakes, streams/rivers, agriculture ***~uptake in plants~,*** cattle ranches ~***grazing***~, housing developments (present or future), college towns, over fault lines ~***R.F. had 5 that met under the plant***~ in an area with shallow ground water tables, over an aquifer or on a bluff overlooking a large metropolitan area.
- Restrict Access: NO hiking, dog parks, trails, biking, or school tours to study the ecosystem native grasses. State and County School Boards should prohibit school kids from touring Superfund sites – as any of your SMR's could become.
- How much waste do you anticipate these SMR's to produce working at full capacity?
- Where do you propose to take the generated RAD waste to?
- Top DOE official Robert Alvarez stated in **1986: "Rocky Flats should be a National Sacrifice Zone**." EIN agreed. Our opinions are based upon: **the *Radioecology and Airborne Pathway Report*; *Actinide Uptake in Cattle Study*, Aerial Gamma Survey.**
- Dr. Iggy Litaor's findings after a rare 500-year flood event estimated over 1.5 Curies of Plutonium were redistributed in 1 event. The ***shallow ground water table (5-6')*** rises to the surface, pushing existing contamination up to the surface, as runoff to tributaries, which in the past fed public drinking water supplies. This was prior to the Woman Creek Diversion project, when it flowed directly to Standley Lake.
- In **1995**, **Tomsk, USSR SALT II** inspectors told us through interpreters that they were SHOCKED to see housing built so close to Rocky Flats. They said they would never do that in Russia, that they bused their employees into work, **and** had real time monitors in cities near the facility – 25 years ago! We suggest adopting busing employees and using real time monitors.

EIN would like to direct your attention **to renewable energy** in Colorado. The National Renewable Energy Lab (NREL) is located in Golden and it has had many renewable ideas that EIN urges you to review. Susan worked at NREL in the Alternative Fuels Division and has a pretty good idea there could be several good alternatives rather than using **nuclear which is controversial and very unpopular in Colorado**.

Once the SMR's are on-line there will be RAD waste to consider. It's dangerous and **no one can promise that there won't be any accidents that release radioactive waste to the environs.**

Environmental Information Network (EIN)
Paula Elofson-Gardine, Executive Director
Susan Elofson-Hurst, Principle Investigator
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303-233-6677 or 303-601-9271

We understand that SB22-073 is a bill to study the *feasibility* of introducing nuclear reactors called Small Modular Reactors (SMR's) to Colorado. The SMR's are new, unproven technology. They are "So-called "advanced nuclear plants. A modular design means the plant has several smaller and less powerful reactors instead of one large reactor; **such a design increases the probability of failure in one or more modules**.

The Union of Concerned Scientists (UCS) found that the new designs they analyzed "**are not likely to be significantly safer** than today's nuclear plants. In fact, certain alternative reactor designs pose even more safety, proliferation, and environmental risks."

The smaller reactors produce more nuclear waste per unit of electricity generated. While the Nuclear Regulatory Commission has approved the NuScale design, the NRC is now seeking comments on whether to allow the design to be used in US projects, and **some issues are still to be resolved**. NuScale's first plant is scheduled to begin construction in 2025, the first modules to be operational in 2029.

NuScale persuaded the NRC to allow NuScale plants **to operate without backup electrical power**, **arguing that its design makes it "fail safe" in the case of loss of power**; **we believe that NuScale's imperative to lower costs drives that decision more than an imperative to keep people safe**." ….*Nuclear Free Pueblo*

State Government – Bill Summary
The bill requires the director of the office of economic development (office) or the director's designee to conduct or cause to be conducted a study (feasibility study) regarding the feasibility of using small modular nuclear reactors as a carbon-free energy source for the state and includes specific items that must be included in the feasibility study.

Current law defines recycled energy as energy produced by a generation unit with a nameplate capacity of not more than 15 megawatts. For pumped hydroelectricity generation only, the bill specifies that the energy be produced by a generation unit with a nameplate capacity of not more than 400 megawatt

Thank you for your time in reading this and accepting it into the official public record. We look forward to hearing from you!

Paula Elofson-Gardine — Executive Director
Susan Elofson-Hurst — Principle Investigator

*To learn more, contact us at ***Environmental Information Network (EIN), Inc.,*** EIN is a 501-C-III non-profit organization focused on educating the public about radioactive, hazardous waste, and radiotoxic pollution.

If it hurts our humanity, it hurts our souls ~ Unknown

February 15th, 2022
Testimony to Colorado Senate, Committee on State, Veterans & Military Affairs
Re: Opposition to SB 22-073 (Alternative Energy Sources)

Thank you for the opportunity for public testimony today. I am against this hearing item, SB22-073, because the U.S. government has yet to establish a responsible practice for dealing with nuclear waste. Nuclear waste will be a problem for countless future generations. There is no long-term plan in place to help future generations manage this risk. First and foremost, nuclear energy is not clean energy (due to the nuclear waste byproducts) and it is not renewable energy (due to the environmental costs of uranium mining). Therefore, The burden of nuclear energy will inevitably fall upon future generations through environmental degradation and hazardous waste. It would be terribly irresponsible to lay this burden on future generations.

I have studied nuclear weapons and nuclear energy for the past 7 years while working with Rocky Mountain Peace and Justice Center and the Alliance for Nuclear Accountability. I have learned from experienced scientists, leaders, and activists that we must advocate for the Precautionary Principle. Albert Einstein once said ""The release of atomic power has changed everything except our way of thinking ... the solution to this problem lies in the heart of mankind. If only I had known, I should have become a watchmaker. (1945)"

Nuclear Energy is being promoted irresponsibly by the U.S. Department of Energy, who has not changed their way of thinking. We cannot rely upon an economy of endless resource extraction. In the case of nuclear energy, uranium mining has had serious, underreported consequences on Native American populations and the environment. Nor can we rely upon nuclear weapons which create a national policy based on weapons of mass destruction. The DOE has a poor record with communities who are downwind of their facilities. They have not earned our trust. Downwinders and workers who become ill are offered minimal recourse. A glaring example is right here in Colorado, 16 miles Northwest of Denver, where the Rocky Flats plant operated from 1952-1989. The plant was closed due to an FBI raid investigating environmental crimes, yet a significant amount of the contamination remains in the form of microscopic particles spread through the local environment. The 10 year cleanup between 1995-2005 was insufficient and failed to address major areas of remaining environmental contamination. Plutonium has a half-life of 24,000 years. This will be an environmental hazard for generations beyond our comprehension in the Denver region.

The citizens of Pueblo do not want to add the risk of nuclear energy to their community. The nuclear industry is trying to prey upon smaller communities like Pueblo. However, the citizens are standing up to say "We do not want our community to be a sacrifice zone!"

In conclusion, nuclear energy is not in the best interest of local communities or future generations. Nuclear energy corporations and major utility companies will reap enormous profits, while Colorado's communities will absorb all the risks, health impacts, and environmental contamination. We need to invest in more responsible and renewable sources of energy. Please stand with the community and oppose SB22-073.

Sincerely,

Christopher Allred
Longmont, CO 80501

League of Women Voters of Colorado

1410 Grant Street

Denver, Colorado 80203

LWVCO Testimony regarding **SB 73 Alternative Energy Sources** bill. **OPPOSE**

Dear Representative,
State, Veterans, Military Affairs Committee

The League is **OPPOSED** to SB 73, that requires a $500,000 feasibility study for the use of small nuclear reactors in Colorado as a carbon free energy source. (which it is not)

Nuclear power is a costly source of energy. The waste produced is toxic and hazardous. The need for waste storage sites endanger vulnerable people that is against our JEDI (Justice, Equity, Diversity and Inclusion) beliefs and policy. Colorado does not need the high health cost due to lingering atomic radiation in any accident. Nor do we need the high cost of building reactors.

Time is of the essence to limit climate change impacts. The complete process of government procedures for approval wtih construction of such projects would be time wasted.

League calls for real, immediate climate change solutions and actions that do not require the burning of fossil fuels to operate, which nuclear plants need to do.

The League of Women Voters United States joined 600 organizations urging Congress to exclude nuclear by shifting to 100% renewable power generation and to end their subsidies domestically and overseas.

Thank you for your attention,

Amy Sherwood
League of Women Voters Colorado
Legislative Action Committee