ENERGY AND PUBLIC UTILITIES COMMITTEE

Witness Form

Today's Date 11/30/2020

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Organization Representing: Toledo Coalition for Safe Energy

Testifying on Bill Number: House Bill 104

Testimony: _____Verbal xxxxxxxxxx Written _____Both

Testifying As: _____Proponent xx Opponent _____Interested Party

Are you a Registered Lobbyist? _____Yes xx No

Special Requests: _____

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November 29, 2020

To the Members of the Ohio Senate Energy and Public Utilities Committee:

The undersigned 56 local, regional and national and grassroots antinuclear and safe energy organizations are united in their opposition to Ohio's "Advanced Nuclear Technology Helping Energize Mankind Act" ("ANTHEM Act"), House Bill 104 (HB 104). The sponsors of HB 104 seek to "break the light-water reactor mold and free the market to realize our energy future." We believe HB 104 will break the bank and destroy Ohio's chances for a safe energy future.

Our energy future has no room for another generation of nuclear power plants and their bloated overrunning costs, corporate welfare handouts, health experimentation with whole populations and the natural environment, all in the name of nursing a fragile technology that can only aggravate the expense and dangers of climate chaos. At this pivotal moment when humanity must end its carbon fuels addiction, expand genuine renewable energy sources and maximize efficiency and conservation, betting billions of taxpayer dollars on a governmental nuclear chamber of commerce is beyond irresponsible; it is absurd.

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We oppose Thorium technology because it is already known to be an expensive, dangerous and failed approach. Science and history show that Thorium usage doesn't solve the proliferation, waste, safety, legal liability or cost problems of nuclear power.

HB 104 poses obvious dangers and unconsidered liabilities and accident scenarios that could result in serious economic and personal losses. It is ill-considered nuclear boosterism and should be rejected.

I. The Thorium Fuel Cycle Fuels The Spread Of Nuclear Weapons

Thorium fuel has been proposed as an alternative to uranium fuel in nuclear reactors. There are no "thorium reactors," but only proposals to use thorium as a "fuel" in different types of reactors, including existing light-water reactors and various fast breeder reactor designs. But Thorium cannot in itself power a reactor; unlike natural Uranium, it does not contain enough fissile material to initiate a nuclear chain reaction. It must first be bombarded with neutrons to produce the highly radioactive isotope, Uranium-233 (U-233). In effect, a "Thorium" reactor really is a U-233 reactor. A fissile material, such as Uranium-235 (U-235) or Plutonium-239 (Pu-239) is necessary to kick-start the reaction. The enriched Uranium or Plutonium fuel must maintain the chain reaction until enough of the Thorium target material has been converted into U-233 to take over most of the job.[1]

The proportion of U-235 must be increased to enrich Uranium for use in Thorium reactors. The use of enriched Uranium or Plutonium in Thorium fuel poses serious concerns for the spread of nuclear weapons. Enriched Uranium and separated Plutonium are themselves usable in nuclear weapons. The

[1] Makhijani, A. and Boyd, M., "Thorium Fuel: No Panacea for Nuclear Power," https://ieer.org/resource/energy-issues/thorium-fuel-panacea-nuclear-power/

U-233 isotope that results from these additions to Thorium fuel is as effective as Plutonium for making nuclear bombs. Even worse, during one phase of the Thorium fuel cycle, the U-233 can more easily be extracted for weapons use, when it lacks the hazardous and deadly gamma and neutron emissions that would require sophisticated radiation shielding and remote handling. Shielding and remote handling are necessary for Plutonium extraction from the Uranium-235 fuel cycle.

With an atomic weight below that of U-238, U-233 requires less separative work than does enriching natural Uranium for weapons.[2] And "[c]ompared with naturally occurring U-235, U-233 has a lower critical mass, which means that less material can be used to build a weapon. Compared with weapons-grade Pu-239, U-233 has a much lower spontaneous fission rate, enabling simpler thermonuclear weapons that are more easily constructed."[3] There is just no way to avoid proliferation problems associated with Thorium fuel cycle reprocessing.

HB 104 proponents are especially interested in building next-generation molten salt reactors, which involve Thorium-based liquid fuels containing a Fluoride-based salt. A pyrochemical process uses high temperature oxidation–reduction reactions that involve first, fluorination and then, extraction using molten Bismuth to obtain Protactinium (Pa-233). This technique can even be performed in a laboratory without a nuclear reactor to produce small batches of Protactinium. Pa-233 readily decays into weapons-usable U-233.[4] If generated in a molten salt reactor, Pa-233 can be extracted while the reactor is continuously operating.[5] This can comprise a great advantage in obtaining weapons-usable material and is of concern because the ability to generate Pa-233 (and thus U-233) at will is also the power to create it without accountability, increasing the likelihood that it will be illegally trafficked. "There is little to be gained by calling Thorium fuel cycles intrinsically proliferation-resistant. The best way to realize nuclear power from Thorium fuel cycles is to acknowledge their unique proliferation vulnerabilities."[6] Liquid Flouride-Thorium reactors "present proliferation and nuclear terrorism risks because they involve the continuous separation, or 'reprocessing,' of the fuel to remove fission products and to efficiently produce U-233."[7]

Thus a small laboratory, either with or without a small research reactor, could produce U-233 and escape oversight by the International Atomic Energy Agency, which would have to depend on State of Ohio employees to ensure that nuclear weapons material was not being spread by contractors or employees of the Ohio Nuclear Development Authority.

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[2] *Id.*
[3] Uribe, E., "Thorium Has a Protactinium Problem," Bulletin of the Atomic Scientists https://thebulletin.org/2018/08/thorium-power-has-a-protactinium-problem/#
[4] Ashley, S., Parks, G., *et al.* "Thorium Fuel Has Risks," Nature (December 6, 2012), https://www.nature.com/articles/492031a
[5] Uribe, *supra.*
[6] *Id.*
[7] Union of Concerned Scientists, "Statement on Thorium-Fueled Reactors" (2019), https://webcache.googleusercontent.com/search?q=cache:2pGtSejlNMQJ:https://www.ucsusa.org/sites/default/files/legacy/assets/documents/nuclear_power/thorium-reactors-statement.pdf+&cd=1&hl=en&ct=clnk&gl=us&client=firefox-b-1-d

In addition to the significant risks of domestic proliferation, Thorium fuel cycle activities in Ohio would green light the use and manufacture of nuclear weapons material to the world, increasing nuclear weapons proliferation risks overseas.

No nuclear weapons proliferation safeguards appear in HB 104, nor have any been mentioned in proponent testimony (in fact, there has been *no* proponent testimony in support of the current version of the bill). There is no mention of how security would be maintained by the new state agency to identify illegal weapons material trafficking or to thwart it. Nuclear weapons material commands high prices in illicit global markets; as both spy thrillers tell us, along with sobering IAEA non-fiction incident reports of real life busts, that inspire the fiction. This temptation cannot be ignored and would have to be policed by the NDA. The State would be forced to assemble its own scientists, engineers and security managers to be answerable and accountable under the terms of the global Nuclear Nonproliferation Treaty.

II. Molten Salt Reactors Pose Serious Nuclear Waste Disposal And Contamination Problems

The eGeneration Foundation of Cleveland, which will be the principal beneficiary of HB 104, plans to pursue dirty, dangerous, and expensive molten salt reactor (MSR) technology. The Foundation's consulting economist told the House Committee that "There is a tremendous amount of nuclear fuel left in our high-level nuclear reactor waste. Successful commercialization of MSR technology that consumes high-level nuclear waste instantly transforms this waste into fuel and from a cost center into a profit center."[8] The Foundation envisions the reprocessing of irradiated fuel from the Davis-Besse and Perry nuclear power plants, which is a dirty and dangerous, not to mention expensive, treatment for highly hazardous radioactive garbage.

The "[s]tabilization and disposal of the [irradiated nuclear fuel] remains of the very small 'Molten Salt Reactor Experiment' that operated at Oak Ridge National Laboratory in the 1960s has turned into the most technically challenging cleanup problem that Oak Ridge has faced, and the site has still not been cleaned up."[9] That's a generous way of describing a radiological remediation nightmare. HB 104 does not address the costs or hazards of contamination and remediation of State property as a result of Thorium experimentation.

Any claim by proponents of HB 104 that Thorium fuel significantly reduces the volume, weight, and long-term radiotoxicity of irradiated fuel is false. The waste remains dangerous for hundreds of thousands of years. The fissioning of Thorium creates long-lived fission products like Technetium-99 (Te-99, half-life over 200,000 years). The sought-after U-233 fuel has a half-life of 160,000 years.[10] To determine the hazardous persistence of these radioactive substances, the half-life must be multiplied by at least ten, or even twenty.

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[8] See Testimony of Jon Paul Morrow, eGeneration Foundation economist, p. 9 (10/16/2019).
[9] https://www.ucsusa.org/sites/default/files/legacy/assets/documents/nuclear_power/thorium-reactors-statement.pdf
[10] Ashley, S., Parks, G., *et al. supra*.

While the mix of fission products from Thorium is somewhat different than with Uranium fuel, the same range of fission products is created. This means that certain radioactive substances would be hazardous even into the many millions of years. With or without reprocessing, these products must be disposed of in a geologic repository like that proposed at Yucca Mountain, on Western Shoshone land in Nevada, at great expense. Notably, if the irradiated fuel is not reprocessed, Th-232 is very-long lived (half-life:14 billion years) and its decay products will build up over time in the irradiated fuel. This will make the spent fuel quite radiotoxic. Inhalation of a unit of radioactivity of Th-232 or Th-228 (which is also present as a decay product of Th-232) produces a far higher dose, especially to certain organs, than the inhalation of Uranium containing the same amount of radioactivity.[11] For instance, the bone surface dose from breathing an amount (mass) of insoluble Thorium is about 200 times that of breathing the same mass of Uranium.[12]

Thorium fuel cycles haven't been successful because Uranium-232 (U-232) is created along with Uranium-233. U-232, which has a half-life of about 70 years, is extremely radioactive and is therefore very dangerous even in small quantities: a single small particle lodged in a lung would exceed legal radiation standards for the general public. U-232 also has highly radioactive decay products. As a result, fabricating fuel with U-233 is very expensive and difficult,[13] requiring many safety features and practices.

Thorium is unlikely, despite proponent claims of nearly limitless fuel to generate electricity, to ever be an economical energy source. Compared to Uranium, the Thorium fuel cycle is even more costly. In a once-through mode, it needs both Uranium enrichment (or Plutonium separation) and Thorium target rod production. In a breeder reactor configuration, it would need reprocessing, which is costly (as well as dangerous and highly polluting). And as noted, there is an accentuated accidental inhalation danger from Th-232. The risks of reprocessing Thorium due to the highly radioactive U-232 byproduct makes worker protection more difficult and expensive for a given level of protection.

III. Reprocessing Technology Is Messy, Dangerous, Expensive And Foolish

If the Nuclear Development Authority pursues Thorium fuel usage and reprocessing technologies are invoked to reclaim U-233, Tc-99 or Pu, obstacles of timing, expense and environmental destruction must be factored into the skewed vision of HB 104. All of these probabilities likely will increase real and potential economic and public health and safety burdens upon Ohio taxpayers.

Reprocessing does not reduce the existing volume of radioactive waste at all. In fact, depending on the reprocessing technology used, the volume of highly radioactive waste can be expanded significantly. It increases the need for storage and disposal. Reprocessing could make it easier for terrorists to acquire nuclear weapons materials for "dirty" radioactive bombs, and for nations or sub-national groups to develop nuclear weapons programs. Less than 20 pounds of Plutonium is needed to make a simple nuclear weapon. Separated Plutonium recovered as a byproduct is not highly radioactive and typically is stored in a concentrated powder form, so it can be easily trafficked. Moreover,

[11] Makhijani and Boyd, *supra.*
[12] *Id.*
[13] *Id.*

commercial-scale reprocessing facilities handle so much of this material that it has proven impossible to keep track of it accurately and timely, making it feasible for the theft of enough Plutonium to build several bombs to go undetected for years.[14]

The eGeneration Foundation of Cleveland and its affiliates expect to be principal beneficiaries of HB 104. They look upon high-level nuclear waste -- irradiated nuclear fuel, the radioactively hottest of the hot -- as a commodity to be exploited for its energy.[15] The original HB 104 planned that a nonprofit group, the Ohio Nuclear Development Consortium, would take possession and legal responsibility for all irradiated nuclear fuel waste in Ohio for the purposes of obtaining U.S. Department of Energy (that is, taxpayer) funding to "develop alternative technologies to store, reduce or consume" it. This is industry code for reprocessing; to separate Plutonium and other isotopes from the hottest nuclear waste. It's not an easy, safe or cheap thing to do.

It is unclear whether the U.S. Department of Energy is going to resume reprocessing of nuclear waste after a 45-year suspension, so eGeneration Foundation's fantastic plans may not come to fruition. Several factors augur against it. There is no current shortage of Uranium fuel. The Nuclear Regulatory Commission has assigned little priority to the necessary massive updating of reprocessing requirements. Comprehensive updating of the technical requirements for NRC reprocessing licenses is years from completion. The NRC Staff's plan for resolution of gaps identified in existing NRC regulations for reprocessing sets out multiple, complex steps taking place from now through the year 2032.[16]

Moreover, the resumption of U.S. reprocessing would undermine the U.S. goal of halting the spread of fuel cycle technologies that are permissible under the Nuclear Non-Proliferation Treaty but can be used by other countries to make nuclear weapons materials. The United States cannot credibly persuade other countries to forgo a technology it has embraced for its own use. Use of Thorium fuel would make it more difficult for international inspectors to safeguard because it would be harder to precisely measure the weapon-usable materials during and after processing. Reprocessing technologies are by their very nature far more proliferation-prone than direct nuclear waste disposal.[17]

As mentioned, reprocessing does not reduce the need for storage and disposal of radioactive waste. A deep geological repository would still be required. After reprocessing for Plutonium, which makes up only about 1% of the irradiated fuel from U.S. reactors, the remaining waste material is in solid and liquid form and the total volume of nuclear waste is increased by twenty times or more.[18] Reprocessing would intensify the pressure for precious disposal space, and might drive an expensive expansion of disposal space -- and disposal has already proven elusive for decades.

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[14] Union of Concerned Scientists, "Nuclear Reprocessing: Dangerous, Dirty, and Expensive," (July 15, 2008), https://www.ucsusa.org/resources/nuclear-reprocessing-dangerous-dirty-and-expensive

[15] See Testimony of Jon Paul Morrow, eGeneration Foundation economist, p. 8 (10/16/2019).

[16] https://www.nrc.gov/materials/reprocessing.html#repro

[17] *Id.*

[18] *Id.*

Reprocessing would divert focus and resources from a U.S. geologic disposal program and would hurt—not help—the U.S. nuclear waste management effort. The licensing requirements for reprocessing, fuel fabrication, and waste processing plants that would be needed for a reprocessing leg to the Thorium cycle would dwarf those needed to license a repository, and would provide additional targets for public opposition. Since there will be no reprocessing licenses for more than a dozen years, should the General Assembly commit to taxpayer financing of suspect science and create another bureaucracy with no immediate purpose in these times of austerity?

IV. The Nuclear Development Authority Cannot Serve Both As A Regulator And As A Nuclear Chamber Of Commerce

The contradictory mission of the NDA is a major concern. According to HB 104, the NDA shall both "assume any regulatory powers delegated from the United States nuclear regulatory commission, the United States department of energy, or any branch of the United States military, or similar federal agencies, departments, or programs, governing the construction and operation of noncommercial power producing nuclear reactors and the handling of radioactive materials" (Sect. 4164.11(E)), and at the same time "foster innovative partnerships and relationships in the state and among the state's public institutions of higher education, private companies, federal laboratories, and nonprofit organizations, to accomplish the purposes set forth in this chapter" (Sect. 4164.11(C)). Especially breathtaking is the mandate of Sect. 4164.15 for NDA to "work with industrial and academic institutions and the U.S. Department of Energy and the U.S. military" to approve designs for the commercialization of advanced nuclear reactor components listed in the statute. That lengthy worklist is reproduced here in a footnote.[19]

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[19]"(A) Advanced-nuclear-reactor-neutronics analysis and experimentation, including reactor, plant, shielding, nuclear data, source-program software, nuclear database, conceptual design, core and system design, certification in the phases, core-management and fuel-management technology, modeling, and calculation;

(B) Advanced-nuclear-reactor safety and plant safety, including reactor-system safety standards, accident-analysis software, and accident-management regulations;

(C) Advanced-nuclear-reactor fuels and materials, including long-life fuel, clad materials, structural materials, component materials, absorber materials, circuit materials, raw materials, fuels-and-materials research and development, testing programs used to develop fuels and materials-manufacturing processes, experimental data, formulae, technological processes, and facilities and equipment used to manufacture advanced nuclear-reactor fuels and materials;

(D) Advanced-nuclear-reactor-nuclear-steam-supply systems and their associated components and equipment, including design standards, component, equipment, and systems design, thermal hydraulics, mechanics, and chemistry analysis;

(E) Advanced-nuclear-reactor engineered-safety features and their associated components, including design standards, component design, system design, and structural design;

(F) Advanced-nuclear-reactor building, including containment design, structural analysis, and architectural analysis;

(G) Advanced-nuclear-reactor instrumentation and control and application of computer science, including survey, monitor, control, and protection systems;

(H) Advanced-nuclear-reactor-quality practices, nondestructive-inspection practices, and in-service inspection technology;

(I) Advanced-nuclear-reactor plant design and construction, debug, test-run, operation, maintenance, and decommissioning technology;

(J) Advanced-nuclear-reactor economic methodology and evaluation technology;

All of this activity would be regulated by nine appointed board members, all of which HB 104 would allow to be appointed from the nuclear industry. Even corporations contracting with the Authority could have seats on this board. How could it be expected to regulate its constituent companies?

The NDA's regulatory and commerce-promoting functions are irretrievably incompatible. Situating the NDA in Ohio's Department of Commerce makes clear that the NDA's commercial mission would take precedence. The conflicting roles of the NDA may cause denial of federal regulatory authority to be delegated to it. Public watchdogs will undoubtedly object to NRC, DOE or the Pentagon delegating regulatory authority to the NDA because of the conflicts baked into the bill.

V. A State Agency Partnering With Private Corporations May Be Forced To Share Liability, Jeopardizing Taxpayer Funds

Ohio does not apply the "public-duty rule" immunizing proprietary governmental activities. Once the decision has been made by the State to engage in a certain activity or function, the State may be held liable, in the same manner as private parties, for the negligence of the actions of its employees and agents in the performance of that activity or function.[20] The bill insists that "The authority's exercise of powers conferred by this chapter is the performance of an essential governmental function and address matters of public necessity for which public monies may be spent and private property acquired."[21] But the NDA's joint venture approach and its role of cultivating commercial and nongovernmental activity invite a finding of shared civil liability if things go wrong. The potential financial liability of the State of Ohio has not been addressed in sponsor or proponent testimony, nor is it discussed in the Legislative Service Commission analysis.

That downside liability could be enormous. New York, the state that pioneered in reprocessing, first created an agency to promote nuclear reprocessing. The New York Energy Research and Development Authority oversaw the opening of the only commercial reprocessing plant in the United States at West Valley. From 1966-72 the facility reprocessed 640 tons of radioactive waste before shutting down permanently. In that time, it transformed West Valley into a radioactive waste site, causing the accumulation of over 600,000 gallons of high-level waste in onsite storage tanks. After years of delay, legal disputes, and waste treatment, and billions of dollars in federal expenditures, stabilization of the high-level waste under the West Valley Demonstration Project (WVDP) was completed in 2002, but all of the waste remains onsite. Cleanup of reprocessing activities at the site, including "low-level" waste removal and decontamination, was expected to take 40 more years[22] and was estimated in 2008 to be between $9.9 and $27 billion.[23]

(K) Treatment, storage, recycling, and disposal technology for advanced-nuclear-reactor and system-spent fuel;

(L) Treatment, storage, and disposal technology for advanced-nuclear-reactor and system radioactive waste.

[20] *Wallace v Ohio Dept of Commerce*, 96 Ohio St.3d 266. 773 N.E.2d 1018, 2002-Ohio-4210 (2002) (*Reynolds v. State*, 14 Ohio St.3d 68, 14 OBR 506, 471 N.E.2d 776, syll. para. 1, approved.)

[21] Sect. 4164.04.

[22] "A Brief History of Reprocessing and Cleanup in West Valley, NY," https://www.ucsusa.org/resources/brief-history-reprocessing-and-cleanup-west-valley-ny

[23] http://www.synapse-energy.com/sites/default/files/SynapseReport.2008-12.CEC_.West-Valley-Nuclear-Cleanup

HB 104 appears to confer eminent domain power upon the NDA. Ohio law limiting invocation of eminent domain excludes property condemnation to support proprietary projects. Calling NDA functions "essential" and saying they "address matters of public necessity" is belied by the promotional aims of HB 104. Eminent domain power is to be conferred sparingly by the General Assembly, and the projects envisioned by eGeneration Foundation are not a lawful justification for eminent domain's invocation, no matter how they are packaged.

HB 104 prioritizes profit over the health and safety of Ohio citizens. Sect. 4164.20 directs, "The rules shall reasonably ensure Ohioans of their safety in respect to nuclear technology research and development and radioactive materials." Perhaps HB 104's sponsors expect the State and its private sector partners will avoid liability for causing or allowing harm to workers or the public by this weak standard. But there is much room for weak health and safety regulations to be proposed by a board populated with industry figures who are predisposed toward weak regulations to protect themselves. Poorly-conceived regulations from a self-interested panel of regulators may expose the State to serious financial liability in the event of a serious nuclear reactor mishap or a massive radiological spill. There is no statutory firewall in the bill to mitigate the inevitable conflicts between nuclear regulation and nuclear promotion, nor the distinct possibility that the "regulators" will promulgate only weak standards to further their private economic interests.

VI. Who Pays In The Event Of A Nuclear Catastrophe?

Serious analysis of the State's liability exposure suggests that there would be no NRC-required emergency planning zone/radius around the site of NDA-sponsored nuclear reactors. Even if there is federal Price-Anderson Act governmental insurance available (by no means a given), in practical terms, the State of Ohio still would have to incur possibly significant expense in nuclear emergency preparations and implementation without any assurances of recouping such outlays. While the State under some scenarios might be treated as a joint contractor along with a nuclear reactor developer and thus have Price-Ander- son protection, coverage depends on a declaration by the Nuclear Regulatory Commission that an "extraordinary nuclear occurrence" ("ENO") has occurred. The NRC's legal declaration that an ENO has or has not occurred is final and may not be reviewed by any court. It is entirely conceivable that the NDA and State of Ohio could be jointly liable for a nuclear accident, only to have the NRC refuse to declare the event "extraordinary" resulting in very serious liability for the State. The 1979 Three Mile Island power plant accident was held not to be an ENO. Even if NRC were to declare an ENO, the U.S. Congress would still have to specifically appropriate funding, which is far from guaranteed. There could well be no Price-Anderson insurance and Ohio's taxpayers would find themselves forced to absorb enormous liabilities. HB 104 takes cognizance of none of this, and the Legislative Service Commission undertook no analysis at all. The sponsors of HB 104 appear determined that only "happy news" be considered, instead of pitfalls that might cause hundreds of millions, or billions, of dollars' worth of taxpayer liability.

.06-032.pdf (p. 13).

It is also worth considering, if the State gets into the business of bond issuances for nuclear projects, just how marketable such bonds might be, and whether the State might incur higher borrowing costs because of perceived riskiness.

VII. Conclusion

The multiple changes made in the bill's wording in the House leave HB 104 as a defective conflicted proposal which will put the State in the role of guaranteeing suspect science in the service of profit. Taxpayers, some of whom might also become neighbors of the inherently dangerous technological facilities subsidized by the bill, may find themselves having to pay for losses that were completely unaddressed by the General Assembly.

The ANTHEM Act should be rejected. Ohio deserves a much smarter response to climate chaos than this. A new generation of nuclear experimentation will not benefit the public. At this point, all resources possible must be directed to a swift transition to reliable, renewable energy. HB 104 is an ANTHEM Ohio must not sing.

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