MINUTES

Commission to Investigate the Implementation of Next Generation Nuclear Reactor Technology in New Hampshire

September 18, 2023

Attendance:

Commission Members: Rep. Keith Ammon, Catherine Beahm, Bart Fromuth (remote), Daniel Goldner, Matthew Levander (remote), Christopher McLarnon (remote) Sen. Howard Pearl, David Shulock

Absent: Marc Brown, Rep. Michael Harrington

Public In-Person: Hon. Dick Barry, Rep. Alvin See

Public Remote: Parker Alspach, Doug Bogen, Benj Conway, Ryan Duncan (Last Energy), Andy Freeberg (Zap Energy), Paul Gunter (Beyond Nuclear), Judith Kaufman, Phoebe Lind (Last Energy), Vikram Mansharamani, John Tuthill, Ryan Umstattd (Zap Energy), Gary Woods,

Meeting:

I. Call to Order

- The meeting was called to order at 9:05 AM on September 18, 2023. Rep. Ammon noted that this commission was established by the legislature to study various advanced nuclear technologies and their potential applicability in New Hampshire. The meeting was held in Room 208c of the NH Department of Environmental Services offices in Concord, NH with optional Zoom videoconferencing.

II. Presentations

Presenter: Ryan Duncan, Director of Government Relations, Last Energy

- Mr. Duncan began by providing background on Last Energy. He explained that the company was founded in 2017 under the name Energy Impact Center, originally conceived as a think tank to research solutions to climate change. After exploring various energy options, they determined that nuclear power offered the most potential to make a significant dent in global carbon emissions.
- Over the next few years, Duncan explained that Last Energy consulted with nuclear experts in the US and internationally to diagnose the major obstacles facing the industry. They identified three core problems that traditional nuclear projects consistently run into:
  1. Excessively long construction timelines, often taking over a decade.
  2. Massive cost overruns, commonly billions over budget.
  3. Reliance on government funding and large utilities who can finance billion-dollar plants.

- To tackle these systemic issues, Last Energy developed a new approach combining proven reactor technology with innovative manufacturing and private financing methods adapted from other industries like oil/gas and renewables.
- Mr. Duncan then provided an overview of their power plant design:
    - Uses conventional pressurized water reactor (PWR) technology that has decades of operating experience globally. This leverages existing supply chains rather than inventing new systems from scratch.
    - Modular construction in a factory setting, with the plant assembled on-site from approximately 40 prefabricated modules. Each module is the size of a standard 18-wheeler trailer for easy transport.
    - Digital instrumentation and control systems reduce the staffing required for plant operation. Some passive cooling methods also help minimize active intervention.
    - Compact footprint of about half an acre for the reactor area itself, reducing physical plant size.
    - 42-year lifetime with built-in spent fuel storage. Fuel assemblies are replaced every 6 years and the used fuel is stored on-site underground. This minimizes transportation and handling.
- Mr. Duncan presented a construction animation showing how the plant can be rapidly assembled on-site from the factory modules. He noted construction can be completed in around 90 days thanks to the modular design.
- Regarding projects, Mr. Duncan stated Last Energy is currently focused on Europe, with $25B worth of power purchase agreements signed for 51 units split between the UK, Poland, and Romania. They are in the pre-licensing phase and will soon enter formal licensing in those countries.
- Mr. Duncan noted they continue to monitor the US market but have not seen the same level of demand and favorable regulations compared to Europe at this stage. However, they plan to utilize the advanced licensing framework currently under development by the NRC for future US projects.
- In closing, Mr. Duncan emphasized their goal is to deliver cost-effective clean energy as fast as possible by leveraging proven technology in an innovative way. Their flexible, modular construction model combined with private financing aims to eliminate the pitfalls that have traditionally plagued large-scale nuclear projects.

Q&A:

- Daniel Goldner: What was the cost of the nuclear plants?
  Ryan Duncan: The plants cost around $100 million each.
- Keith Ammon: How do you control the reactor? Is it preset or actively controlled?
  Ryan Duncan: There is some proprietary passive cooling and physics built into the design, as well as physical construction of the core. He offered to provide more technical details later if desired.

- Keith Ammon: When you replace the fuel unit after 6 years, is the previous unit completely spent?
  Ryan Duncan: No, it won't be completely spent. We are looking into reprocessing the partially spent fuel. The 6-year timeframe is more about our operating model than full depletion of the fuel.
- Paul Gunter: Why aren't you going through the US NRC for licensing?
  Ryan Duncan: We believe licensing in Europe will be faster and less costly than the NRC process. But we are engaging with US stakeholders like the NRC and DOE to keep them informed.
- Paul Gunter: What is your backup power plan for grid failure?
  Ryan Duncan: Let me follow up with details on our backup power and shutdown systems.
- Keith Ammon: Could you use this for a single customer with a small energy need?
  Ryan Duncan: Yes, we can work with single customers, including those with needs as small as 10MW.
- Keith Ammon: Does your design fit into the NRC's advanced nuclear licensing process?
  Ryan Duncan: Yes, we plan to use the advanced licensing process if we decide to license in the US.
- Keith Ammon: What types of customers are you working with - municipalities, industries?
  Ryan Duncan: Mostly heavy industries like manufacturing, data centers, and economic zones with multiple industrial customers.
- Daniel Goldner: What motivates your European customers? Cost, coal replacement?
  Ryan Duncan: A mix - high energy prices, decarbonization goals, energy security and independence.
- Daniel Goldner: What is the levelized cost per kWh?
  Ryan Duncan: Around $70/MWh, but it varies by country and customer deal.
- Daniel Goldner: How close together can the modules be sited?
  Ryan Duncan: About 200 meters between modules if sited together.

Presenter: Ryan Umstattd, Head of Business Development, Zap Energy

- Mr. Umstattd began by noting that fusion energy is fundamentally different from fission power. He stated fusion has minimal radioactive waste and does not have the same meltdown risks as fission reactors.
- Umstattd explained that Zap Energy was founded to commercialize fusion energy based on research conducted at the University of Washington using a confinement method called a Z-pinch. This involves compressing plasma by running a pulsed electric current through it.

- He provided a brief overview of how fusion works - light nuclei are fused together to generate energy. Zap Energy uses two isotopes of hydrogen - deuterium and tritium. The resulting reaction produces helium and a free neutron.
- Umstattd explained that one of Zap's founders stabilized the plasma compression by developing a sheared flow technique. This involves flowing the plasma at different velocities within a column, which mitigates inherent instabilities. Their experiments have successfully confined the plasma for significantly longer durations compared to traditional Z-pinches.
- However, Umstattd cautioned that more research is needed to reach a self-sustaining fusion reaction that produces net energy gain. This scientific breakeven point is known as Q=1. He presented results from their latest experiment, FuZE-Q, showing promising increases in fusion output. But he noted they remain far from the reaction rates needed for a commercial power plant.
- Regarding the development timeline, Umstattd stated Zap Energy is targeting construction of a pilot plant at a retired coal generation plant in Centralia, Washington in the early 2030s. The plant would demonstrate their reactor at scale and make electricity available to the grid.
- He presented a conceptual design showing how the core fusion module can be combined with balance of plant components like the steam turbine and electrical generators.
- Umstattd noted they plan to build the plant using a modular approach so the components can be manufactured in factories and shipped to site.
- Umstattd estimated the levelized cost of electricity for their first commercial plants would be in the range of $30-60/MWh. However, he acknowledged substantial uncertainties still remain around their projected cost and timeline.
- In closing, Mr. Umstattd emphasized that rapid fusion progress will come from private efforts like Zap Energy that take a smaller, more agile approach compared to government programs. He reiterated that although significant research is still needed, Zap aims to deliver fusion power on a commercial timescale.

Q&A:

- Keith Ammon asked about the energy breakeven point shown on the graphs presented by Zap Energy and which data on those graphs represented the current status of their fusion experiments.
  Ryan Umstattd provided details on the graphs, explaining that the breakeven point represents when fusion would produce more energy than required for the reaction. He noted that their experiments are nearing the breakeven point scientifically but still have important work to do.
- Keith Ammon asked about the recent fusion breakthrough announced by the Department of Energy and where their result was on Zap Energy's breakeven graphs.
  Ryan Umstattd explained that the DOE result achieved the scientific breakeven line using

high-powered lasers but was not on a commercially viable path due to the very high energy input required by the lasers to initiate fusion.

- Keith Ammon asked about the waste handling processes involved with fusion energy generation using Zap Energy's approach.
  Ryan Umstattd provided an explanation of how they recirculate unreacted fuel from each cycle to reuse deuterium and tritium gases that did not fuse. He noted the small amount of low-level radioactive waste produced can be safely stored on site until ready for recycling or disposal.
- Dick Barry asked what the potential cost would be for New Hampshire to host a sample fusion reactor as a pilot project with Zap Energy.
  Ryan Umstattd discussed potentially attractive options for states like joint development agreements to host pilot plants that could later transition to be commercially operational plants.
- Howard Pearl asked if fusion facilities could be sited at former nuclear power plant locations or co-located with existing nuclear plants, given similar security precautions needed.
  Ryan Umstattd discussed public perception issues related to associations between fusion and traditional nuclear fission, but noted technical feasibility of co-location once fusion is more established. He recommended distinguishing fusion currently before directly siting alongside existing nuclear plants.

III. Public Comment

- Rep. Ammon opened the floor for additional public comments. No comments were made.

IV. Draft Commission Report

- Rep. Ammon noted that a draft report was issued and is available on the commission website (https://nuclearnh.energy/). He plans to use the draft as a starting point for the final report.
- Dick Barry had not seen the draft report yet. Rep. Ammon directed him to the link on the website.
- Rep. Ammon stated he has been in discussions with NEI about policy options to include in the final report. One recommendation was to define advanced nuclear in NH statutes to create a foundation for any future policy changes.
- Rep. Ammon drafted legislation to update the state's atomic energy statutes, including adding the federal definition of advanced nuclear. The bill is still in development.
- Rep. Ammon added caveats to the policy options list in the draft report based on feedback from Rep. Harrington. He also added testimony from the Consumer Advocate on market fit for various options.

V. Seabrook Station Tour Debrief

- The tour of the plant took place on September 5, 2023.

- Dick Barry noted the excess transmission capacity at Seabrook since only one reactor was built. He suggested siting future nuclear plants closer to load centers to minimize transmission needs.
- Dan Goldner relayed that Seabrook's operator, NextEra, was not interested in developing the second reactor site.
- Rep. Ammon and Cathy Beahm discussed NextEra's lack of interest in siting a small modular reactor at Seabrook. Industry may prefer to choose location without nuclear security considerations.
- The group discussed siting reactors nearer to load centers to minimize transmission needs.

IV. Administrative Matters

- The minutes from the August 7, 2023, meeting was approved unanimously by the 6 members in attendance for the vote (Ammon, Beahm, Fromuth, Goldner, Pearl, Shulock). The motion was made by Fromuth and seconded by Goldner.

V. Next Meeting

- The next meeting will be on October 2, 2023, at 9:00am.
- Confirmed speakers so far are ISO New England and Moltex Energy.

VI. Adjournment

- The meeting was adjourned at 10:41 AM by Rep. Ammon.

Submitted by Keith Ammon