

MINUTES

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

October 2, 2023

Attendance:

Commission Members: Rep. Michael Harrington, Catherine Beahm, Marc Brown, August B. Fromuth, Matthew Levander, Christopher McLarnon (remote), David Shulock (remote), Rep. Keith Ammon

Absent: Daniel Goldner, Sen. Howard Pearl

Public In-Person: Thomas Barrasso, Hon. Richard “Dick” Barry, Douglas Mailly, Rep. Alvin See, Rep. Doug Thomas

Public Remote: Arnie Alpert, Andrea (no surname provided), Doug Bogen, Jodi Grimbilas (J. Grimbilas Strategic Solutions), Paul Gunter, Donald “Gus” Gustavson (USNC), Eric Johnson (ISO-NE), Nathan Raike (ISO-NE), Adam Schmidt (J. Grimbilas Strategic Solutions), Rep. Walt Stapleton, Tristan Jackson (Moltex), John Tuthill, Gary Woods

Meeting:

I. Call to Order

- The meeting was called to order by Commission Chair Rep. Keith Ammon at 9:01 AM EST on October 2, 2023. The meeting was held in person at the New Hampshire Department of Environmental Services Office Building in Concord, NH with additional attendees participating via Zoom video conference.
- Rep. Ammon noted logistical details, such as the use of microphones in the room to facilitate clear audio for both in-person and Zoom attendees, as well as for transcript creation.
- Rep. Michael Harrington interjected briefly to extend congratulations to Mark Cowell on his retirement through Eric Johnson.
- Rep. Ammon welcomed everyone to the meeting and noted that the agenda had been distributed via a link in the Zoom chat. He emphasized that the commission has been highly transparent, with all meetings recorded and materials publicly available on the unofficial information portal.

II. Presentations

A. Presentation: Mr. Eric Johnson, Vice President of System Planning at ISO New England (ISO-NE).

1. Overview of ISO-NE:

- ISO-NE was formed in 1997 during restructuring of the electricity industry to open access to transmission. It is regulated by FERC and has an independent board.

- ISO-NE operates the high-voltage bulk power transmission system across New England, including ties to Quebec, New Brunswick and New York. It does not own any power system assets itself.
 - Its three core responsibilities are: 1) Operating the power grid and maintaining reliability per NERC standards; 2) Administering bid-based wholesale electricity markets for energy, capacity, and ancillary services; 3) Regional power system planning including interconnections.
 - ISO-NE's mission is reliable, cost-effective wholesale electricity approved by stakeholders. Its vision is to enable a clean energy transition using markets and new technologies.
2. Electricity Resource Mix:
- In 2000 at the start of markets, resources were mainly coal, oil, nuclear. Now about half of energy is from natural gas.
 - By 2040/2050, significant renewable expansion will be needed to meet state clean energy goals. One projected scenario shows the nuclear share shrinking while gas stays high, and renewables grow markedly.
 - The generator interconnection queue has over 38,000 MW proposed, mostly offshore wind, battery storage and solar. This is driven by state policies. Not all will necessarily get built.
3. Generator Interconnection Queue Process:
- The queue manages the sequence of projects seeking to connect to the grid. ISO-NE studies the reliability impacts but does not judge technology types or viability.
 - Steps include optional feasibility study, full system impact study, detailed facility study, and executing an interconnection agreement. Average time is 15 months.
 - Resources can enter the capacity market after the queue, where they may receive additional revenues. State-jurisdictional projects follow different interconnection processes.
4. Integrating Renewables:
- Adding significant variable resources like wind/solar will require backup power, adequate total energy supply, and expanded transmission.
 - ISO-NE's 2050 Transmission Study shows major grid upgrades needed to meet state electrification goals and the resulting high winter demand.
 - During extreme winter conditions, a mix of nuclear, gas, hydro imports and storage could provide backup if wind/solar output is very low.
5. Q&A:
- Rep. Harrington: Does the 2040 projection assume no new nuclear plants?
A: Correct, no new nuclear was assumed in that study.
 - Rep. Thomas: Since most queue resources like wind/solar are intermittent, how does ISO-NE factor in reliability when studying proposed interconnections?

A: The queue process itself does not address overall reliability considerations. ISO-NE has ability to forecast wind/solar output and understands their operating characteristics. Backup power sources like natural gas and transmission will be needed to integrate them.

- Rep. Harrington: What will be needed for backup power in 20 years if we have 20 GW of offshore wind but low wind/solar output during a winter storm?

A: A mix of existing nuclear, gas, hydro imports and storage could provide backup during those rare low output periods. The region will need sufficient energy adequacy.

- Rep. Thomas: Why do minor amounts of imported hydro in ISO's projections warrant the siting challenges of proposed transmission line projects?

A: Each new transmission line could import over 1,000 MW, which is significant relative to total regional energy needs.

B. Presentation: Tristan Jackson, Vice President of Corporate Development, Moltex Energy Canada.

1. Introduction

- Tristan Jackson of Moltex Energy presented to the commission about Moltex's nuclear energy technology. He is based in New Brunswick, Canada where Moltex Energy Canada is headquartered.
- Moltex Energy has two entities - Moltex Energy Limited (UK) is developing a small 16MW reactor that uses fresh enriched uranium fuel. Moltex Energy Canada is developing a different waste-burning reactor.

2. Moltex Energy Canada's Waste-Burning Reactor

- The Moltex waste-burning reactor is a Generation IV fast reactor design that utilizes the used fuel from conventional reactors.
- It separates used CANDU or lightwater reactor fuel bundles into three streams via a chemical separation process:
 - 99% becomes low level waste (uranium, zirconium, cladding)
 - 0.5% remains short-lived high-level waste with 300-year half-life
 - 0.6% is fuel for the Moltex reactor
- The fuel for the Moltex reactor is a mixed plutonium chloride salt with other actinides. This makes it unsuitable for weapons use, reducing proliferation risk.
- Moltex plans to build its first reactor at the Point Lepreau nuclear plant in New Brunswick along with a recycling facility. The entire site would fit on 20 acres.

3. Economics

- Moltex projects a levelized cost of electricity of \$51/MWh for its reactor. Tristan estimates more realistically \$70-80/MWh based on experience with large projects. This is competitive with fossil fuels and far cheaper than renewables coupled with storage.

- The technology has support from the Canadian and US governments. Tax credits in the US Inflation Reduction Act make nuclear power more economically viable.
4. Potential in New Hampshire/New England
 - New Hampshire and New England could potentially attract investment from Moltex and other advanced nuclear companies, as the region needs new firm power generation.
 - The region could put out an RFP for nuclear proposals, as Canada has done. This resulted in NB Power selecting Moltex.
 5. Q&A:
 - Rep. Doug Thomas asked whether the recycling facility needs to be co-located with the reactor or if fuel can be transported. Tristan responded either approach could work, but co-location reduces transportation risk and logistical issues.
 - Rep. Michael Harrington asked technical questions about the reactor being fast neutron versus thermal, and how proliferation risk is minimized. Tristan explained the reactor consumes transuranics over time and the chemical separation process results in a mixed plutonium salt unsuitable for weapons.
 - Hon. Dick Barry asked if nuclear was included in recent state energy planning put forward by a previous speaker. Tristan said he didn't believe so, but states could actively solicit nuclear proposals if desired rather than passively accepting developer bids.
 - Rep. Keith Ammon asked to see a diagram and about the small 20-acre land footprint. Tristan shared a diagram of the facilities - reactor, recycling, and grid reserve tanks.
 - Rep. Keith Ammon inquired about the waste streams produced. Tristan explained in detail the three waste streams (low level, high level, and fuel salt) and disposal options for each.
 - Rep. Michael Harrington asked about the projected electricity cost.
 - Rep. Doug Thomas asked if Moltex has any signed contracts. Tristan confirmed contracts with NB Power for the site, offtake, and supply chain.
- C. Presentation: Donald "Gus" Gustavson, Business Operations Manager for the fuels division at Ultra Safe Nuclear Corporation (USNC).
1. Introduction
 - Donald "Gus" Gustavson, the business operations manager for the fuels division at Ultra Safe Nuclear Corporation (USNC), presented to the commission about USNC's micro modular reactor (MMR) design and fuel manufacturing capabilities.
 - Gus provided background on himself, including 4 years as a chemical engineer in oil/gas in Houston, 5 years as an army officer, 2 years in strategy consulting, and now 2 years at USNC. Projections on future energy sources while consulting

convinced him nuclear power is needed to meet carbon reduction goals, prompting his industry shift.

2. USNC Overview

- USNC's mission is to provide carbon-free power for space and commercial applications. Their main focus is the MMR.
- The MMR is a commercial land-based nuclear battery with variable power output from 1-15 MW electric (10-45 MW thermal) and a 40-year lifetime. It uses proprietary TRISO fuel embedded in silicon carbide pellets made via 3D printing, making it meltdown proof. Target customers include remote communities, mining operations, and server farms.

3. USNC Fuel Production

- USNC currently has a pilot TRISO fuel manufacturing facility in Oak Ridge, TN using commercial scale equipment. This strengthens their licensing basis for eventual commercial production.
- Gus explained the decades-long history and inherent robustness of TRISO fuel, which retains fission products through layers of carbon and silicon carbide coating a uranium kernel.
- He noted fuel costs are a much bigger proportion of opex for advanced reactors versus traditional reactors but that the fuel itself shoulders much more of the safety burden for retention of fission products and thereby making the reactor itself less costly and complex.

4. Nuclear Fuel Cycle

- Gus outlined the nuclear fuel cycle steps - mining, milling, conversion, enrichment, fabrication.
- Currently the US imports most commercial nuclear fuel as enriched UF₆.
- Deploying advanced reactors needs HALEU fuel and new TRISO production capabilities, requiring licensing changes at every step of the fuel cycle. There is no current US production capacity for HALEU enrichment or TRISO fuel fabrication.

5. USNC Fuel Partnerships

- USNC has partnered with Urenco for LEU+ enrichment and Framatome for fuel fabrication in a joint venture.
- This partnership accelerates USNC's timeline by leveraging an existing Framatome facility with a current NRC license, as opposed to building a new "greenfield" facility which would require a lengthy licensing process.
- It provides USNC with Framatome's expertise and established infrastructure like material control programs.

6. Licensing Needs

- Gus emphasized that fuel production and transport licensing constraints are often overlooked in advanced nuclear discussions and will require changes to enable commercialization.

7. Q&A

- Rep. Harrington asked about the "chicken and egg" dilemma around HALEU production - would the government need to procure some first to spur private investment? Gus agreed this is the most likely scenario.
- Rep. Ammon asked if USNC's fuel could be used by other advanced reactor manufacturers. Gus said they are vertically integrated and the immediate focus is supplying their own Micro Modular Reactor, but they also plan to sell TRISO fuel to other commercial reactor companies, and have already sold quantities manufactured from their Pilot Fuel Manufacturing facility.

III. Meeting Minutes Approval

- Rep. Keith Ammon presented a change in the minutes regarding Zap Energy.
 - Original Text: "provide electricity to the grid"
 - Modified Text: "make electricity available to the grid"
- Marc Brown motioned to accept the modified minutes. Seconded by Bart Fromuth.
- The motion was unanimously approved.
 - Names for the record: Cathy Beahm, Marc Brown, Bart Fromuth, Matt Levander, Michael Harrington, and Rep. Keith Ammon.

IV. Old Business

- Rep. Keith Ammon mentioned correspondence with Ryan Duncan of Last Energy.
 - Ryan Duncan followed up on a previously unanswered question.
 - The information was or will be forwarded to the commission members.

V. Scheduling Final Meeting

- The final meeting is scheduled for November 6th.
 - The location might change due to facility maintenance.
- Marc Brown offered to invite New Core to talk about their MLU with NuScale.
 - Rep. Keith Ammon requested confirmation within a week.

VI. Miscellaneous Information Sharing

- Michael Vose's link to a webinar on fuel recycling was shared.
 - Rep. Keith Ammon mentioned the \$10 trillion worth of "slightly used nuclear fuel" in the country that can potentially be reprocessed.
 - <https://centerforsecuritypolicy.org/webinar-clean-energy-is-a-terrible-thing-to-waste/>
- Rep. Michael Harrington expressed skepticism on fuel reprocessing due to cost and proliferation concerns.

VII. Future Directions

- Hon. Dick Barry expressed disappointment that ISO New England has not sought nuclear proposals.

- Suggested the commission encourage ISO New England to do so.
 - Rep. Keith Ammon introduced a bill to update RSA (Revised Statutes Annotated) to require periodic studies on advanced nuclear.
- VIII. Other Topics for Information Gathering
- Rep. Michael Harrington offered access to the American Nuclear Society database for topics of interest.
 - Rep. Harrington also referred to a webinar on Oppenheimer that was put on by Los Alamos National Laboratory. <https://www.ans.org/webinars/view-opp2023/>
- IX. Adjournment
- Rep. Ammon requested a motion to adjourn the meeting. The motion was made by Rep. Harrington and seconded by Marc Brown. The meeting was adjourned by unanimous consent. The meeting was adjourned at 12:25 PM.

Submitted by Keith Ammon