3/31/22

**INTERVIEW WITH**: Caleb Brooks, Nuclear Professor, Involvement with micro-nuclear reactors on campus

**CONCISE SUMMARY:**

On 3/31/22 the team spoke with Dr. Caleb Brook, who is a professor in the nuclear engineering department here at the University. The team spoke to him about the feasibility of using micro nuclear reactors as a power source for the campus. Dr. Brooks is about to start research to determine these exact questions. In his opinion, campuses will be using micro nuclear reactors to power themselves, but it is going to take eight to ten years to get to that point. The research done with micro nuclear reactors has been more theoretical and not applicable at this time. The team still feels that the university should start saving money now to purchase a nuclear reactor once they are commercially available.

**DETAILED INTERVIEW NOTES:**

**Questions:**

1. Should the consultant look at Nuclear, to what scale?
   1. Yes, but it won’t be available for a few years
2. Timeline of reactor
   1. Not easily ready until early 2030s need to get to a commercial price point and make it economically viable
3. Are there any updates on the application for micro-reactor?
   1. The work at U of I will be what makes micro-reactors viable for commercial use.
4. How much power will this reactor provide?
   1. Up to 20 Megawatts thermal energy (for electricity, divide by 3) and the lifetime is up to 20 years
5. How many years of research will be necessary before this could be considered as a solution for the campus?
   1. About 10 years until the technology is easily viable but the plan is to plug in this research reactor into the Abbott power plant
6. What do you think is the biggest setback of micro reactors? Cost? Disposal of Waste?
   1. Fuel and availability. No commercial fuel supplier. The cost primarily comes from the fuel processing to take the fuel and put it into the form that the reactor can take, and it is more from the cost that it takes to regulate the fuel and the regulatory system around nuclear energy.

**General Notes:**

* Is leading effort to prepare campus for microreactor
* His research is in reactor system and safety of reactors
* We are at a research and education mission; once it is commercialized, it may find a market.
* His focus is to deploy a first or second of its kind technology to take steps to seeing its feasibility. Mission is to connect a reactor system to Abbott Power plant
* Would be extremely expensive to change infrastructure
* Steam is most efficient, (wind, solar would not meet this goal). Nuclear provides a carbon-free energy source for hydrogen production, heat, etc.
* His research: reactor systems; safety of reactor systems. We want a commercialize reactor on campus as a research reactor (research reactor energy would generally not be utilized).
  + They are trying to take existing reactor concept which is close to commercialization; they develop around it
  + Micro Nuclear reactors (4–5-year-old, new term): reactor device for generating power that can be fully factory fabricated
    - Traditionally grid scale power plants (centralized power plants): These are extremely costly to construct, maintain and operate
    - Small modular reactor alleviates some of the above challenges by making it modular (can be mass produced and assembled on site)
    - Micro Nuclear reactor: entire unit can be entirely factory fabricated. Can be transported more easily (can fit on a truck, plane). Needs to have *extremely in-depth safety features*. Will produce about 20MW of thermal power. Lifetime = energy available for 10 - 20 years. Would transform to ⅓ of this for electricity
      * Deploy ability/feasibility: Fuel, licensing challenges. Fuel availability and licensing is hard to achieve.
      * Commercial outlook: Early 2030’s for these reactors to appear (due to power purchase agreements); needs a commercial supplier and licensing innovation. Feasible option
* Universities would be great at proving the viability of this technology
* Economics for micro nuclear reactors: they need a certain price point to be met before it is marketable. Timeline for this is ambiguous
  + What factors are holding back this price? Cost of uranium? Cost to create the reactor itself. *Fuel costs are quite reasonable; for 20 years, 15MW, we need 1.5 metric tons of uranium. Costs mainly come from fuel processing: converting raw material to a usable fuel (comes from the costs surrounding the regulatory and policy for nuclear material).*
    - Public perception upcharges the cost; higher rates. Nuclear is not universal because of public perception, it is primarily due to the cost. WASTE IS VERY MINIMAL. “20% of power in the country, only has enough waste to only fill the size of a football field about 10 ft deep. Large power plants take mass quantities of money to get deployed, licensed (lots of factors why “EPA”: they must find a reason why something should be built. The “NRC” does not need to approve anything), and construction.
  + Economics currently make sense for nuclear, ONLY IF people put a premium value on carbon reduction; the state and country does not tax for carbon (look up wind power purchase agreement) “how much are we willing to tax ourselves to use a renewable resource”
  + Heat utilization: near-term markets are competing with diesel. It is hard to bring energy to the arctic (which is generally fueled by diesel). Micronuclear would be very excellent for these communities.
    - Steel manufacturing: example where they need high thermal quantities where renewables are not viable
* “MICRO NUCLEAR REACTORS WILL NEVER COMPETE WITH PUTTING ELECTRONS ON CENTRALIZED GRID against natural gas, coal, etc. (so much cheaper)”
* Can be used for steam
* Can't rely on this project for the master plan now
* Navy is using basically microreactors on a ship

Look up UW Madison project for micro nuclear reactors for federal facilities:

* Shows a lot of numbers and target goals for feasibility. Therefore, it is projected for feasibility at “around 2030”