Breakout-1 (Group A – Hamilton Ballroom)

Facilitator: Chris Atkinson

Note-taker: Gokul Vishwanathan

Applications

- There was considerable discussion on the need for and focus of a potential ARPA-E program.
- Some debate on why ARPA-E wants to focus on modular nuclear reactors.
- Potential applications: Those where $0.25-1.00 per kWh price is feasible. Single reactors are not recommended as there is no back-up. Small modular reactors are preferable. Factory manufacture and the regulatory environment.
- If the technology can get to ≤ $0.30 per kWh then there is a business case for grid integration.
- Other applications: remote: mining, data-centers, oil & gas extraction and locations where fuel (diesel, natural gas etc.) cannot be delivered.
- General consensus that ARPA-E should focus on semi-autonomous reactors rather than fully autonomous reactors.

General considerations of concepts

- Semi-autonomous vs. autonomous operation: Debate about the need of semi-autonomous and autonomous reactors. General consensus: Semi-autonomous reactors should be the area of focus. Customers want power but do not want continuous onsite expertise to run the system or troubleshoot. (Human presence is required but any presence is expensive).
- Strategy for refueling: Large plants have onsite storage. Cartridge reactor/core was one suggested technology. Shielding was identified as issue for transportation with used fuels (e.g. 6 MW electricity will have 30 MW thermal capacity).
- Delivery time: How long does it take to build a reactor?
- A segue discussion on whether pathway to commercialization must be defined first (requirements generation) before arriving at designs.

General considerations of concepts

- There was some discussion whether DG is the right application for nuclear reactors – economies of scale for maintenance.
- Manned operation may only be economically feasible over the 10 MW level. Lifetime: 10 years may be too long considering the amount of fuel required – issues of proliferation, safety and shielding required for end of life.
- Instrumentation, Controls and Sensors: SOA sensors are needed. Often times, system fails as the controls/sensors fail – self-diagnosis and non-intrusive. Minimum sensor set for safe operation. Can sensors survive 10-20 years?
- Passive cooling will drive a low power density system with a higher surface area – which is a conundrum for physically small systems – Can ARPA-E focus in the area of passive cooling without increasing the size of the system?
- 100% accident proof designs are not possible. Can we focus on accident tolerant designs? We need to get the physics right to allow for self-regulation.

General considerations of concepts

- System control strategy that allows the systems to be operable and stable with minimum intervention and information.
- Security: Innovation is needed to make reactor inaccessible using remote actuation.
- Reactor designs: No consensus. Gas cooled, liquid cooled, water cooled and molten-salt cooled.
- Potential program areas:
  - Innovative power cycles
  - Materials
  - Instrumentation, controls and sensors
- Requirement generation was identified as a critical parameter for program formation – what is the application?
- An issue with the design of any complex system is the TRL level of sub-systems might be immature.

Round table: Each person was asked to pick a technology area that ARPA-E can focus on

- Instrumentation, Sensors and Controls: They are being developed for other technologies but not being embraced as there is no requirement. Overhauling will require huge investment. Potential areas: Digitization of control rooms and outage management. Safety cases need to be proved for sensors, controls and telematics
- Materials – Refractory Metals.
- Regulation
- Molten salt reactor. What is the best method to preheat the plant before hot salt can be added?
- Requirements generation
- TRISO fuels

Round table: Each person was asked to pick a technology area that ARPA-E can focus on

- Autonomous operation for terrestrial applications is a significant challenge area.
- New materials will enable other power cycles. Considerations include temperature of operation and lifetime.