Working Group 3

Low Output Reactors

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April 24, 1998

Low Output Reactors

- Provide electricity, process heat, isotopes, radiation or research capability for a number of applications such as:
  - Low power, including remote stationary or mobile
  - Medical
  - Desalination
  - Hydrogen generation
  - Space power
- We feel that space power, while important, should not be part of NERI because of the potential harm from crossing budget lines and environmental concerns. NERI technology may be applicable to this problem.

Low Output Reactors - Issues

- The presence of nuclear technology raises a number of issues:
  - Proliferation
  - Safety
  - U.S. economic competitiveness
  - U.S. role in international activity (policy, standards)
- There is an opportunity for innovation with focus on the development of enabling technologies.
- It is in the U.S. interests to encourage economic development in the rest of the world and nuclear technology is part of the portfolio!

Low Output Reactors - Concerns

Many of the technology issues here are similar to or the same as for other applications (Topics 1,2, and 5)

- Low output may be better defined as small, possibly compact, and easily deployable reactors
- Is the driver problem for the RFP (mission) pull or technology push?
  (We believe it needs to be both in concert)
- Can we prioritize the missions? Probably not.
- Can we prioritize the technologies for the suite of missions?
  (We think so, for any specific concept.)

LOW OUTPUT REACTORS

Characteristics We Look for in Defining an RFP

- R&D sought in systems concepts and identification of key research areas.

- Proliferation resistance, e.g.:
  - No refueling (long-lived fuels)
  - Low-fertile fuel
  - Harden fuel design to increase difficulty in reprocessing
  - Integrate remote monitoring into design - improve transparency
  - Cradle-to-grave integration (including D&D)

- Robust Safety Features, including
  - Hardening against sabotage
  - Innovative passive features

- Ease of operation
  - High reliability
  - Low demand on operators
  - Minimize maintenance

Characteristics We Look for in Defining an RFP (Cont.)

- Minimize life-cycle impacts
  - Minimize high-level waste
    - High burnup
  - Minimize low-level waste
  - D&D technologies

- Favorable economics
  - Easily deployed
  - Alternate power conversion systems
  - High performance
  - Cost reduction features; e.g. modularity, factory assembly technologies

- Want concepts with promise to give birth to the development of deployable technolgy

Low Output Reactors
Process Questions

- Should be a flexible system that allows for individuals and groups

- Should not prescribe limits but normal effort would be in the $100,000 to $1 million range, influenced by the number of participants, scope of the proposals, and subject to annual reviews (less than 4 years total)

- Time-frame for impact should be by 2020 for everything

- Peer reviews
  - Get a pool of reviewers (including PI suggested)
  - Be careful about how to review the reviewers (be consistent)
  - Use NERAC to guide this process

- Relevance review criteria
  - Develop technology roadmap for crucial areas
  - Establish goals
  - DOE led/assisted by others (top down)

Low Output Reactors
Process Questions (Continued)

- Encourage Collaborative proposals and student participation but do not give extra credit (encourages the wrong goals)

- Accept international proposals only on a cost-sharing basis

Suggested Science & Engineering Areas

Suggested Science & Engineering Areas	Prolifer-ation Resistance	New Design	Lower Output	Waste Storage	High Efficiency
A. Chemistry ✎ Separations science ✎ Actinide chemistry ✎ Geochemistry ✎ Single isotope components ✎ corrosion					
B. Materials Research **B1. Structural Materials** ✎ Radiation damage and embrittlement ✎ Irradiation assisted stress corrosion cracking (aqueous systems) ✎ Non-destructive evaluation (NDE) **B2. Fuel Materials** ✎ Fuel thermodynamics ✎ Fuel structure & composition (e.g. non-fertile) ✎ fuel modeling **B3. Waste Materials** ✎ Waste host materials ✎ Predictive modeling for long-term integrity of waste-hosts ✎ transmutation					

Suggested Science & Engineering Areas (Cont.)

C. Basic Thermal Fluids Research ✎ Multiphase non-equilibrium systems ✎ Flow-induced vibrations ✎ Heat and mass transfer ✎ erosion					
D. Simulations and Modeling ✎ neutronics ✎ integrated systems ✎ very long-term behavior ✎ parallel processing ✎ thermal hydraulics ✎ stability ✎ basic nuclear data and modeling					
E. Systems Engineering & Safety ✎ Risk-based design tools ✎ System control ✎ Component monitoring ✎ Safety (inherent & engineered) ✎ instrumentation and controls ✎ human factors ✎ health physics (ALARA) ✎ "Cradle-to-Grave" design					
F. Severe Accidents ✎ Assessment/ methodology ✎ Phenomenology, models, tools, data					
G. Safeguards R&D ✎ Information technology ✎ Transportation					