

## **GEN IV ROADMAP FUEL CYCLE CROSSCUT GROUP CHARTER – 2/22/01**

Generation IV nuclear energy systems are targeted for deployment in the 2030 time frame; they are to be suitable for widespread application in developed and developing countries alike, and they are to meet broad goals of sustainability,<sup>(8,9,10)</sup> Safety/Reliability, Economics and Public Trust.

Generation IV system encompass the entire energy supply chain – from mining of resources, through energy conversion, to waste management. The Gen IV roadmapping activities – while executed by teams organized on the basis of reactor type – will be conducted within the broad cradle-to-grave fuel cycle context. Different reactor types may employ the same fuel cycle and/or the fuel cycle may become an overarching symbiotic blend of a few cycles appropriate for different reactors.

In order to lay out the fuel cycle backdrop<sup>(1)</sup> upon which the several Reactor Type Technical Working Groups will conduct their studies, a Fuel Cycle Crosscut Group will produce a report early in the Roadmap effort. The report will address:

- (1) Projected demand for 21<sup>st</sup> century energy services drawing from the exhaustive and widely quoted WEC/IIASA report<sup>(2)</sup>
- (2) Projected nuclear energy share of demand as motivated by midrange global greenhouse gas abatement scenarios (see references 2-7), i.e., assuming nuclear fills the demand gap left by fossil and renewables
- (3) Examination of fuel resource requirements and waste arisings from generation iv fuel cycles consistent with the scenarios evaluated above. Fuel cycle systems will include currently deployed and proposed fuel cycles, based on uranium and thorium and including
  - once-through cycle
  - non-recycle resource extension in thermal reactors
  - once/twice-recycle resource extension in thermal reactors
  - non-recycle & once/twice recycle followed by partitioning/transmutation
  - multiple-recycle in fast spectrum reactors
  - multiple-recycle in thermal spectrum reactors
  - waste self-consumption
  - an overview of proposed sustainable cycles based on fast or thermal reactors

The FCCG will assemble its results primarily by drawing on the available and quite extensive literature. Minimal data development or scenario generation will be generated independently by the group. The FCCG will provide input to TWG's early in the roadmap activity.

A few top level fuel cycle figures of merit (metrics) will be developed to characterize the cycles, such as efficiency of resource use ( $MW_{th}$ /tonne of refined ore); waste arisings (mass, long-lived toxicity) per unit of usable energy; duration of supply availability; worker dose per  $MW_{th}$  on a best estimate basis; repository impacts such as volumes, masses, heat load per  $MW_{th}$ , and toxicity duration above background. Salient nonproliferation features will be commented on (e.g., avoidance of separated plutonium, incomplete cleanup of fission products, fissile mass consigned to waste stream, need for enrichment facilities) where they exist, but a thorough cradle-to-grave analysis is beyond the scope of this charter. The figures of merit will be specified early in the FCCG deliberations to provide a uniform basis of cycle comparison.

For the cycles considered in item (3), the FCCG will not only examine mass flows and energy generation achievable within constraints of available fissile and fertile fuels, but will also evaluate, on a best-judgment basis, technical state of fuel cycle technology readiness, concept-independent required R&D, estimated time to feasible cycle deployment, and estimated relative fuel supply and waste management costs.

The membership of the FCCG will be drawn from the reactor-based TWG rosters.

The schedule and deliverables for the cross cutting fuel cycle group are as follows:

- (1) Detailed outline of report prior to March 7th Generation IV Roadmap NERAC Subcommittee (GRNS) meeting.
- (2) Briefings at GRNS meetings of March 7/8, 2001 and May 30/31, 2001.
- (3) Presentations of FCCG approach and draft metrics at the second quarterly TWG meetings planned for May, 2001.
- (4) Interim report – prior to May 30 GRNS meeting.
- (5) Final report – Fall 2001.

## References

1. EPRI Electricity Supply Roadmap, EPRI, Jan 1999.
2. Nakicenovic, Grübler, & McDonald (eds.), Global Energy Perspectives, Cambridge University Press, (1998).
3. A. McDonald, “Transformation of World Energy Supply”, Presented at Center for International Security and Cooperation Workshop: Does Nuclear Energy Have a Role in Climate Change Mitigation? Stanford University, (June 22-23, 2000).
4. International Nuclear Societies Council, A Vision For The Second Fifty Years of Nuclear Energy; Vision and Strategies, Published by American Nuclear Society, (1996).
5. IAEA, Nuclear Fuel Cycle and Reactor Strategies; Adjusting to New Realities; Key Issue Papers, IAEA, (1997).
6. W. Sailor, et al, “A Nuclear Solution To Climate Change?” Science, Vol. 288, pp. 1177-1178, (May 19, 2000).
7. R. Koike, et al., “Analysis of Long-Term Nuclear Perspectives: Environmental Impact and Sustainability,” Proceedings of Global 99, Jackson Hole, Wyoming (Sept 1999).
8. IAEA, Sustainable Development and Nuclear Power, IAEA (1997).
9. IAEA, Second Scientific Forum; Sustainable Development – A Role for Nuclear Power? (Sept 1999).
10. OECD-NEA, Nuclear Energy in A Sustainable Development Perspective, OECD (Dec 2000).