ESP-8

Methodology for Estimating Fuel Cycle and Transportation Environmental Impacts for Early Site Permit Applications

December 5, 2002

ESP-8 Objectives

- Update NRC staff on industry's Tables S-3/ S-4 initiative
- Original update intended to provide preliminary results
- Due to revised (earlier) meeting date, this briefing provides additional details regarding methodology
- This briefing also describes approach if certain assumptions in existing tables do not initially bound new technologies

Proposed Methodology for Determining Fuel Cycle Environmental Impacts

- Determine fuel cycle requirements [uranium, enrichment, transportation] for range of technologies considered by ESP applications
- Compare fuel cycle requirements to those used to develop Tables S3 and S4
- Where the fuel cycle requirements are lower than the conditions assumed to develop Tables S3 and S4, use the current table impacts for the environmental evaluation
- Where any fuel cycle requirements are higher than the conditions assumed to develop Tables S3 and S4, evaluate potential impacts along with other fuel cycle technology changes that may have reduced environmental impacts

NEI

10 CFR 51.51, Table S-3

- Table S-3 developed based on fuel requirements for a model 1000 MWe LWR
- Uranium, SWU, and transport requirements will be compared with the values used as basis of current Table S-3 for the same energy output
- Technology improvements that have tended to reduce environmental impacts may offset any increase in fuel cycle and transportation requirements

Fuel Cycle Technology Changes

- Higher fuel burnup
  - Reduces average annual fuel loading [lower number of fuel assemblies at higher enrichment]
  - Generally reduces average annual uranium ore requirements, but may slightly increase SWU
- Higher Operating Plant Capacity Factor
  - Increases both energy production and fuel requirements
- Improved enrichment processes
  - Lower emissions from electric generation
  - Improved energy efficiency [especially for centrifuge enrichment technology]
- No spent fuel reprocessing expected

10 CFR 51.52, Table S-4

- Current Table S-4 is based on the transportation of fuel and waste to and from a 1100 MWe LWR subject to the following conditions
  - Core power not to exceed 3,800 MWt
  - Uranium dioxide pellets of less than 4% enrichment encapsulated in zircaloy rods
  - Average irradiation of no more than 33,000 megawatt-days per metric ton, and no assembly shipped until at least 90 days after discharge

10 CFR 51.52, Table S-4 (cont.)

- The number, modes, types and radioactive inventories of shipments of spent fuel and wastes will be determined for a range of reactor technologies and compared to the values used as a basis of current Table S-4 for the same energy output
- Any increases of these values will be evaluated
- Technology improvements have tended to reduce transportation environmental impacts and may off set any changes in transportation conditions

Changes in Fuel Cycle Transportation Technology

- Higher fuel burnup reduces spent fuel generation and reduces quantity of spent fuel to be shipped
- New fuel types do not all use zircaloy rods
- Longer cooling time after discharge [minimum of 5 years - average of over 10 years] reduces source term at transport
- Transport casks for new fuel types and higher burnup fuel must meet same normal and accident dose limits