US Socio-Economic Case for LWR Spent Fuel Treatment

ThEC11 Conference

Tony Favale
& Tim Myers

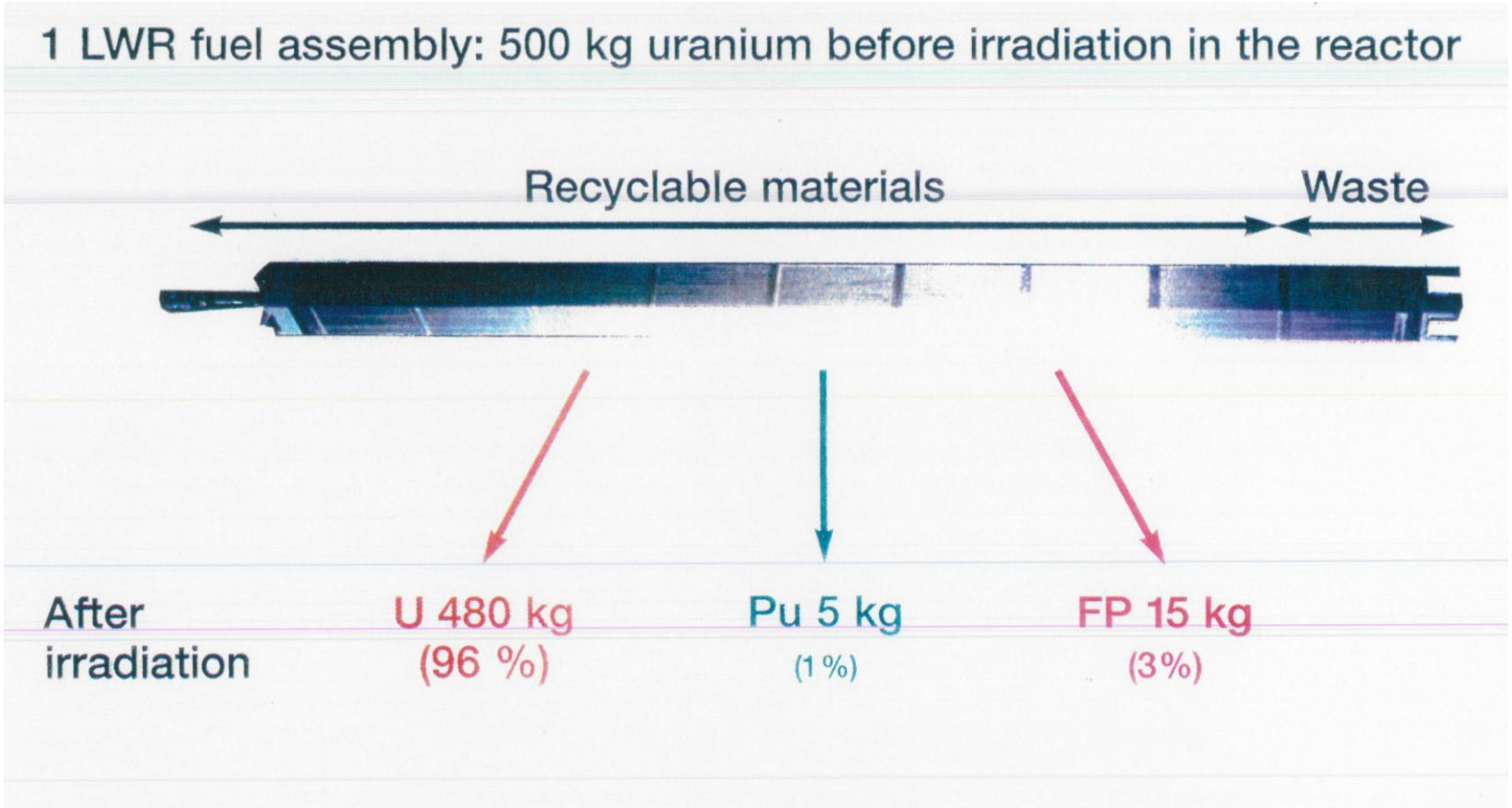
Advanced Energy Systems Inc.
27 Industrial Blvd, Unit E
Medford, NY 11763
Phone: (631) 345-6264 x100
Fax: (631) 345-0458
E-mail: tony_favale@mail.aesys.net

Putting Accelerator Technology to Work

US ADS Perspectives

- Social - In Flux
  - Reprocessing is…..
    - 1954 - essential to economical use of natural resources
    - 1977 - encourages proliferation and must not be supported
  - Spent fuel
    - Waste NOT a resource - “NIMBY” - Not in My Back Yard
  - Japanese Earthquake/Tsunami - rekindling attention on a final solution.
  - Adequate supplies of Uranium
    - No pressure to move to alternate fuel cycles [Thorium]
- Technical/Economic - improving
  - Global advanced in LINAC technology, in connection with active ADS programs in Europe and India, indicate no “show stoppers”

Composition of LWR Spent Fuel Rod



LWR Spent Fuel Rod Effect on Repository

- Actinides, Technetium-99 and Iodine 129 dominate projected aqueous releases from Yucca Mt. repository
- Actinides, Plutonium and Americium, dominate decay heat in a repository which result in perturbing the hydrology, geochemistry, and thermal characteristics of a repository
- Croff and Cowell have shown that the capacity of a repository can be increased by a factor of ~5 if one employs a staggered emplacement and eliminates the long-term thermal power of the actinide waste.

The US Repository Challenge

- Long-Lived radioactive materials in high level nuclear waste (HLW) from either commercial power plants or defense operations can last for many hundreds of thousand years. The present US strategy is to bury this waste in deep geological repositories (Nuclear Waste Policy Act of 1982). Public opposition to this approach has essentially eliminated the Yucca Mt. solution. Revival of the US commercial nuclear power option depends on finding a solution to the waste problem.

- Some peoples problems are opportunities to others.

- Secretary of Energy Chu has formed a Blue Ribbon Commission charged to evaluate nuclear waste options with the constraint that they must be proliferation free.

Chu's Blue Ribbon Commission Recommendations

1. A new, consent-based approach to sitting future nuclear waste management facilities.
2. A new organization dedicated solely to implementing the waste management program and empower with the authority and resources to succeed.
3. Access to the funds nuclear utility ratepayers are providing for the purpose of nuclear waste management.
4. Prompt efforts to develop one or more geologic disposal facilities.
5. Prompt efforts to develop one or more consolidated interim storage facilities.
6. Support for continued US innovation in nuclear technology and for workforce development.
7. Active leadership in international efforts to address safety, waste management, non-proliferation, and security concerns.

Recommendation #6

- The commission discusses 3 options in some detail:
  1) Once-Through with Hi-Temperature reactor
  2) LWR Modified Open Cycle (MOX)
  3) Fast-Spectrum Reactor with Closed Fuel Cycle

- They briefly mention:
  1) Molten salt Reactors
  2) Gas cooled Reactors
  3) Thorium Reactors

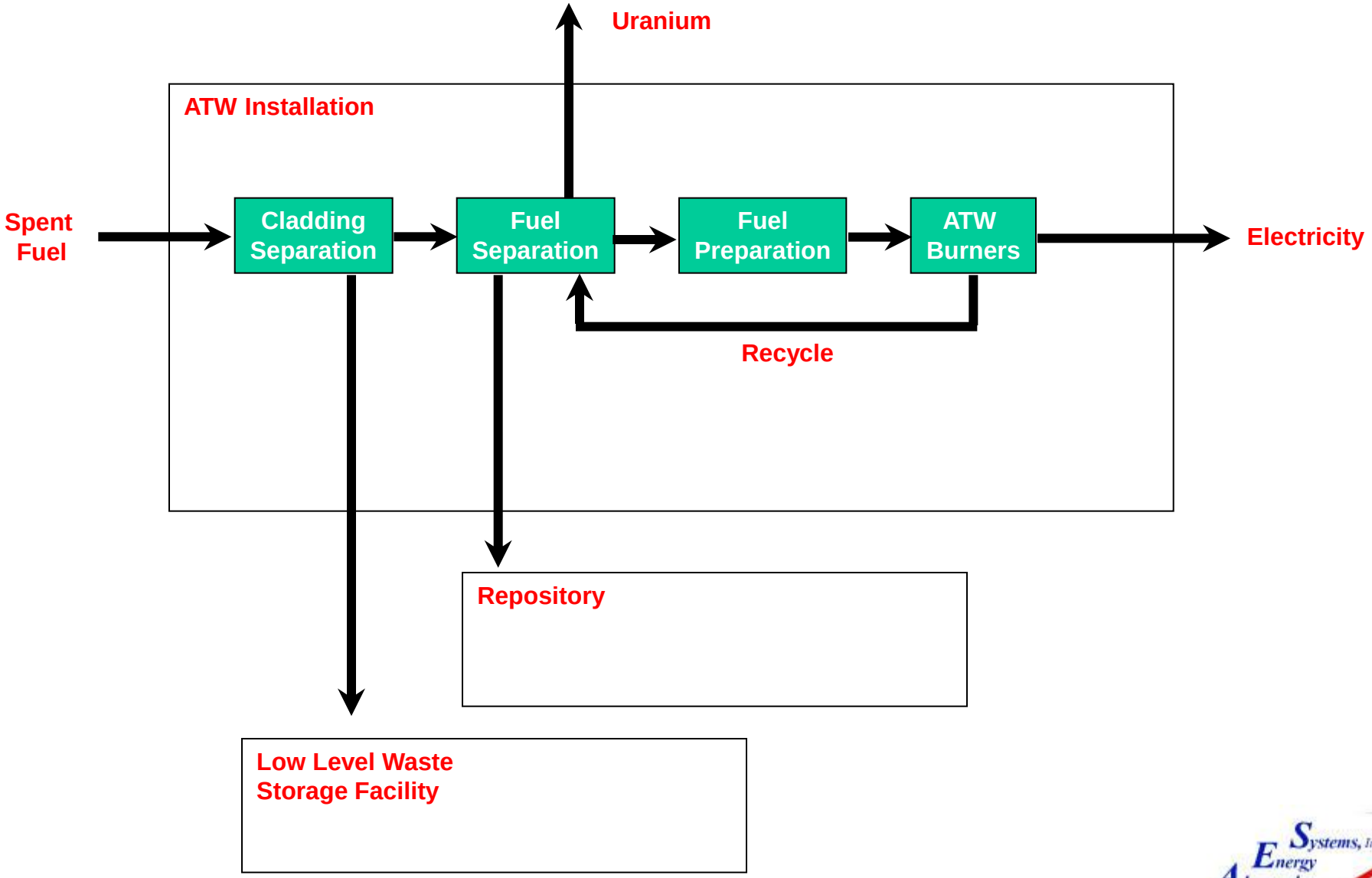
- There is no mention of ADS

Other Potential Solutions

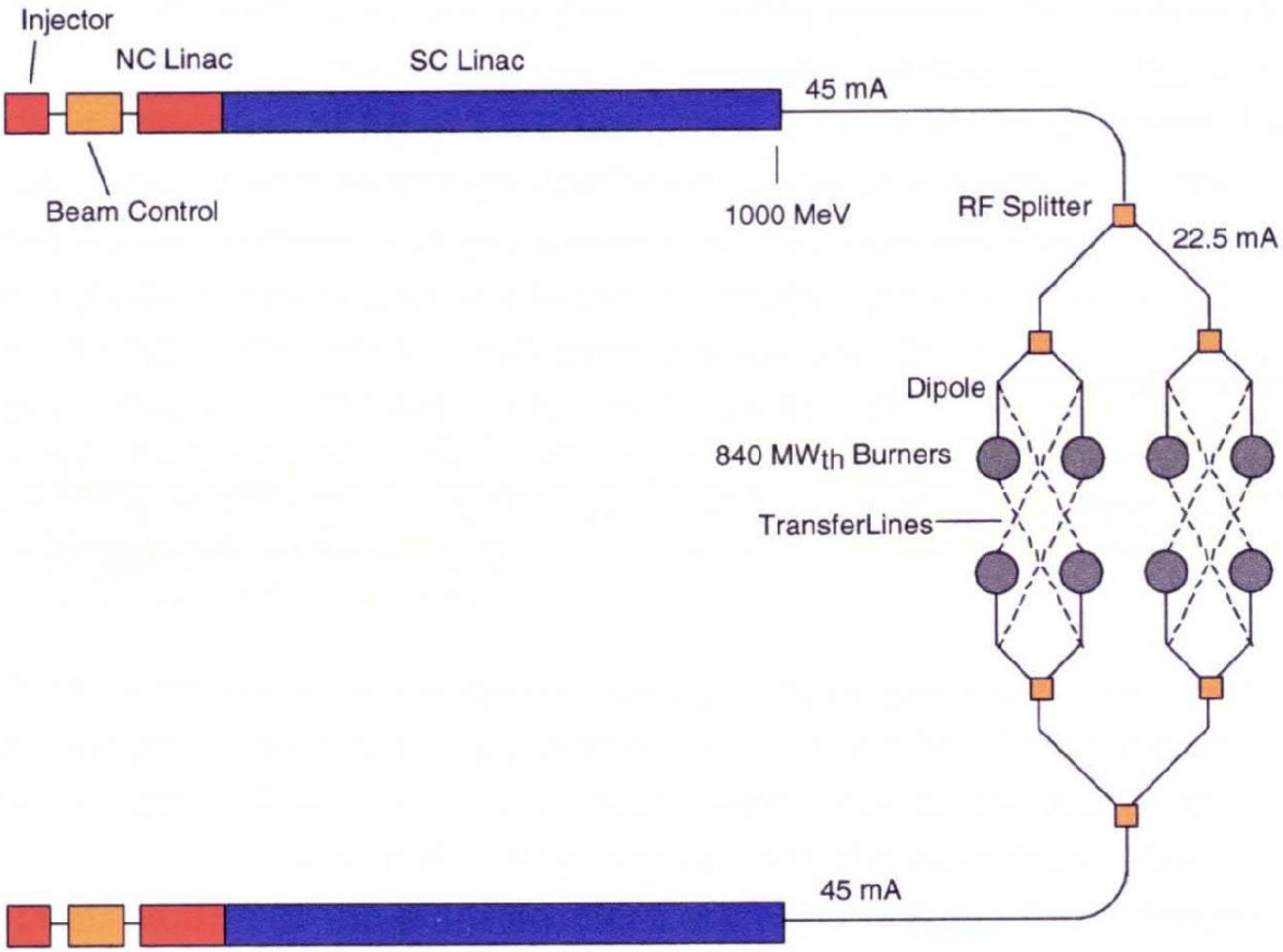
1. The Liquid Metal Fast Breeder Reactor (LMFBR). For example General Electric's S-Prism Fuel Cycle System

2. ADS

Prior US ADS Work - LANL ATW



LANL ATW Road Map "Burner" System



ATW Features

- High System Availability through configuration redundancy
  - For each accelerator system there will be eight subcritical assemblies producing a total 2555 MWe
  - allowing for system electrical needs enables 2175 MWe to be supplied to the grid
  - Ten sites are required to address the US commercial and defense wastes
- Non Proliferating
- Final waste stream result requires segregation for only 300 years

Economics

- **Department of Energy [R&D Costs]**
- **Nuclear Waste Fund [Capital Costs]**
  - $35.8 billion (1/10th of a cent per kWh of electricity generated at nuclear power plants plus interest since 1983). Of the $35.8 billion, $10.8 billion has been spent. Payments to the Nuclear Waste Fund are included in the fuel costs.
- **Sale of Electricity [Operating and D&D costs]**
  - Ten installations with 2175MWe for sale.

US ATW Reviews

- American Nuclear Society
- Massachusetts Institute of Technology

- Both Reviews reported no “show-stoppers” with the approach
  - Substantial development required

The US is Falling Behind

- The US led the world on ATW efforts during the1970's, 1980's and 1990's with studies being carried out by Brookhaven National Lab. (BNL) and then by Los Alamos National Lab. (LANL).
- The LANL effort was the most extensive and was supported by many interested US industries (Bechtel, Grumman, Westinghouse California Power & Light and others) and other labs such as ORNL and ANL. The US DOE work ceased in 2003 due to political reasons one being that work on ATW would delay Yucca. This did not stop the work in other countries.
- Europe has its EUROTRANS program culminating in MARCH of 2010 with the $1.3 Billion funding of MYRHHA.
- Due to large natural supplies of Thorium, India is pursuing ADS as part of a national strategy to increase electricity production.

Perception is Important: Dump or Repository with Benefits

- Very few if any people want a nuclear dump or any dump or source of pollution in their backyard.
- But add some real substantial benefits and you have a chance to convince some people
- Examples:
  - The effect of the Northport Power Plant on property Taxes
  - Discussions with Senator Reid (Nevada) and Governor Miller in 1994 concerning the benefits of an ATW facility at Yucca Mt.

One Path Forward

- The US DOE should fund a systems study which will result in an UPDATED roadmap for developing a unified ADS technology for handling the US LWR nuclear waste that incorporates all the technological improvements to date. A recommended starting point is to revisit LANL's plan published in September 1999 (LA-UR-99-3225)
- The study should involve all eventual stakeholders including National Labs, Universities, Reactor Companies, Utilities, Reprocessing and Accelerator Industries and the NRC.
- The R&D efforts of FRIB, ANL, ESS project in Europe and Project CLEAN at JLAB can address major accelerator issues.
- Accelerator R&D should emphasize mitigating the effect of the trips so as not to cause electrical power interruption; minimizing the beam loss to prevent activation of the accelerator and cost reduction.
- Heavy emphasis should also be directed towards design of the sub-critical assembly with all its issues and the processing facility for the LWR waste plus the pyroprocessing system for the fuel fabrication for the ADS system.

Nothing is Ever Achieved by Those Who Say it Can't be Done