
**DEVELOPMENT OF
ELECTROMETALLURGICAL TREATMENT
TECHNOLOGY FOR DOE SPENT
NUCLEAR FUEL**

***Presentation to the U.S. Nuclear Waste Technical Review Board Panel
on the Engineered Barrier System***

June 6, 1995

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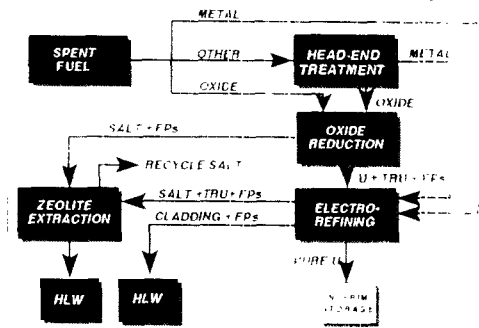
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ELECTROMETALLURGICAL TREATMENT

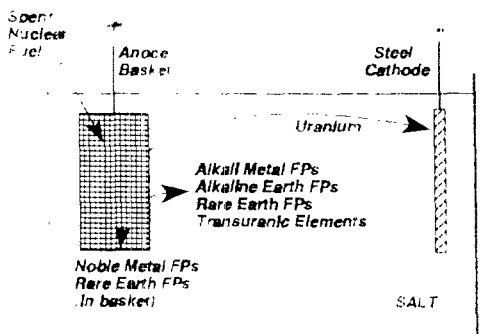
- Non-aqueous process for treating spent nuclear fuel
- Employs electrorefining technique for separating uranium metal from fission products and transuranic elements
- Applicable to a broad range of fuel types
 - Metal, oxide, cermet, graphite, hydride

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TREATMENT OF DIFFERENT SPENT FUEL TYPES

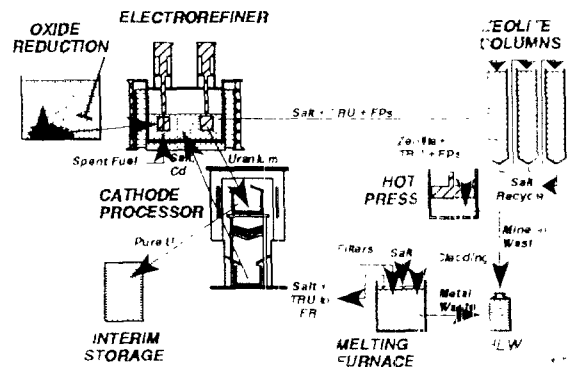


ELECTROREFINING PROCESS



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SPENT FUEL TREATMENT

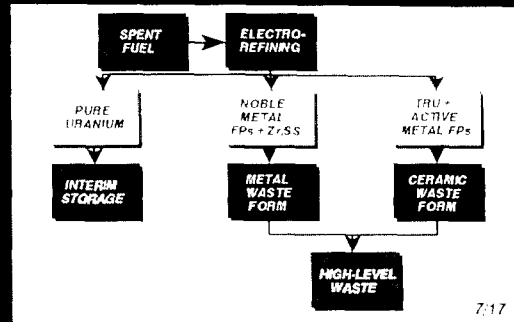


INCENTIVES FOR TREATMENT OF SPENT NUCLEAR FUEL

- Reduce plethora of spent fuel types to a single set of common waste forms
- Place fuel in stable form acceptable for repository disposal; alleviate criticality concerns
- Reduce volume of high-level waste requiring disposal

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ELECTROMETALLURGICAL TREATMENT PRODUCT STREAMS



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PROJECTED WASTE QUANTITIES

(per metric ton, heavy metal, of spent fuel treated)

	OXIDE FUEL TREATMENT	METAL FUEL TREATMENT
URANIUM PRODUCT (LLW)	50 liters	50 liters
CERAMIC WASTE FORM (HLW)	150 liters	15 liters
METAL WASTE FORM (HLW)	55 liters	20 liters
SECONDARY WASTES	None	None

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STATUS OF TECHNOLOGY DEVELOPMENT

- Process has been demonstrated at engineering scale (10 kg/day) with unirradiated fuel and non-radioactive fission product elements
- Process equipment is being scaled up to demonstrate performance at higher throughput rates
 - Electrorefiner: 200 kg/day per module
 - Oxide reduction: 200 kg/day

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STATUS OF TECHNOLOGY DEVELOPMENT (continued)

- **Waste form production processes are being demonstrated at engineering scale (20-50% of production scale)**
- **Waste form performance testing is in progress**
 - **Performance is equal to or better than borosilicate glass**

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EMPHASIS ON MAJOR PROBLEMS

- **Metallic fuels**
 - **N-Reactor: 2100 MTHM; single-pass reactors: 3.4 MTHM; Fermi-1: 38.1 MTHM**
- **Oxide fuels**
 - **Approximately 300 MTHM, >50 fuel types**
- **Molten Salt Reactor Experiment fuel and flush salts**
 - **8 cubic meters, currently unstable**

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PROCESS DEVELOPMENT AND DEMONSTRATION

- **Process technology development is being carried out at the Argonne-East site in Illinois**
- **Process (hot) demonstration is being done at the Argonne West site at the INEL**
 - **Fuel Conditioning Facility**
 - **Hot Fuel Examination Facility**

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TREATMENT OF EBR-II FUEL

- **Hot demonstration of treatment of metallic fuel is to be done with EBR-II driver fuel and blankets**
 - **Applicable to Fermi-1, N-Reactor, and Single Pass Reactor fuels**
 - **Also applicable to metallic product of head-end treatment of other spent fuel types**
- **Treatment to be done in ANL-W Fuel Conditioning Facility**
 - **Operational Readiness Review complete**

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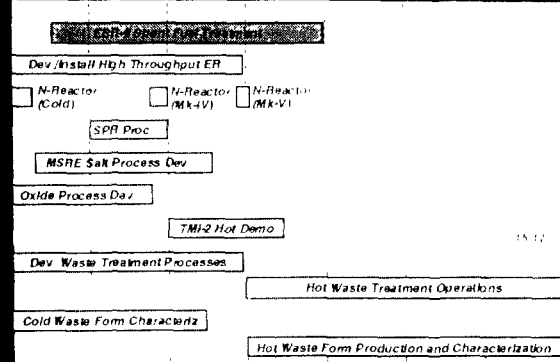
TREATMENT OF OXIDE FUEL

- INEL has the major complement of oxide spent fuel
- Plan is to install oxide reduction system in ANL-W HFEF in FY- 1996 for experiments with spent oxide fuel
 - 20 kg/day Initially, 200 kg/day by FY-1998
- System could be used for treatment of TMI-2 core rubble and demonstration of treatment of other oxide fuel types

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DEVELOPMENT PROGRAM

DEVELOPMENT OF ELECTROMETALLURGICAL TREATMENT TECHNOLOGY
 FY 1995 1996 1997 1998 1999 2000 2001



ELECTROMETALLURGICAL TREATMENT

- Treatment method is readily scalable to fit specific spent fuel treatment requirements
 - Can be tailored to individual site needs
- Equipment is compact and facility requirements are minimal
- Process chemistry is well-established and system affords excellent process control

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ADVANTAGES OF EM TREATMENT

- Single process to treat diverse collection of spent fuel types
 - Commonality of equipment and procedures
- Significant reduction in volume of high level waste
 - Packaged waste volume is 15-20% of packaged spent fuel volume
- Cost of treatment is low
 - Approximately \$250 to \$350 per kg

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