Confirmation of Strategy Needed

- **Baseline strategy**
  - **7 ATW units, staggered startup**
  - **<u>Each</u> processes the equivalent of 240 MTHM LWR spent fuel per year**
  - **Plants operate for 50 years on the average**
  - **<u>Each unit</u> is fed 2.4 MT TRU per year from LWR spent fuel plus <1.2 MT TRU per year from ATW fuel recycle (i.e., >50% burnup)**

Basic Assumptions

- **Centralized facility for treatment of LWR spent fuel; 1,680 MTHM/y total, in modules of 240 MTHM/y**
- **Feed to ATW: 2,400 kg TRU and 230 kg Tc+I per ATW per year, fed to each of the seven distributed ATW units**
- **Each of the seven processing plants for ATW-irradiated fuel will have a throughput of 200 kg/d (total fuel mass)**

Performance Criteria

- **Bulk of fuel volume is uranium; it is to be separated and purified sufficiently that it can be disposed as a Low-Level Waste**
- **Recovery goals:**
  - **Uranium: >99% (to LLW)**
  - **Technetium and iodine: >95% (to transmutation targets)**
  - **TRU: >99.9% (to ATW fuel)**

Three-part Development Program

- **Laboratory-scale R&D (2000-2002)**
  - **Flowsheet development and validation**
  - **Selection of primary and backup technologies**
- **Pilot-scale R&D (2003-2010)**
  - **Demonstration of individual operations**
  - **Use of existing hot cells in DOE complex**
  - **Selection of reference process**
- **Plant-scale Demonstration (2011-2018)**
  - **Full-scale demo of integrated reference process**

Process Selection

- **Proposed R&D program carries a reference process and one backup until 2010**
- **Current reference process is a hybrid aqueous/non-aqueous process**
  - **PUREX (actually, UREX) front end**
    - To facilitate required decontamination of uranium
  - **Pyrometallurgical process thereafter**
    - To exploit lower costs, more compact equipment

State of Technology Development

- **Given the present assumptions for the scale of operations, successful completion of the RD&D program is quite likely**
  - **Aqueous processing methods are well established**
  - **Pyrometallurgical methods are presently in the pilot-scale range of development**
  - **Waste forms are the same as those currently being produced**

Working Group Status

- **No estimates yet for cost of R&D program**
- **Completing first draft of integrated report this week**
  - **Next draft due May 12**
- **Excellent working relationships among members of the Working Group**
  - **Representing ANL, LANL, LLNL, ORNL, SRS, INEEL, TRW**

Plant Cost Estimates

- **Precedents exist for making reasonably accurate estimates of plant construction and operation costs**
- **Major capital expense is likely to be the centralized LWR fuel treatment plant**
  - **1,680 MTHM/y capacity compares to THORP and LaHague at about 800 MTHM/y**
  - **Cost will be several billion dollars; stretch out by modular construction**

Liquid Radwaste Generation

- **Use of the UREX front end will not produce a large volume of liquid waste**
  - **Process can be designed to minimize the amount of solids contained in liquid wastes**
  - **Liquid wastes are concentrated before being directed to pyrometallurgical process steps**

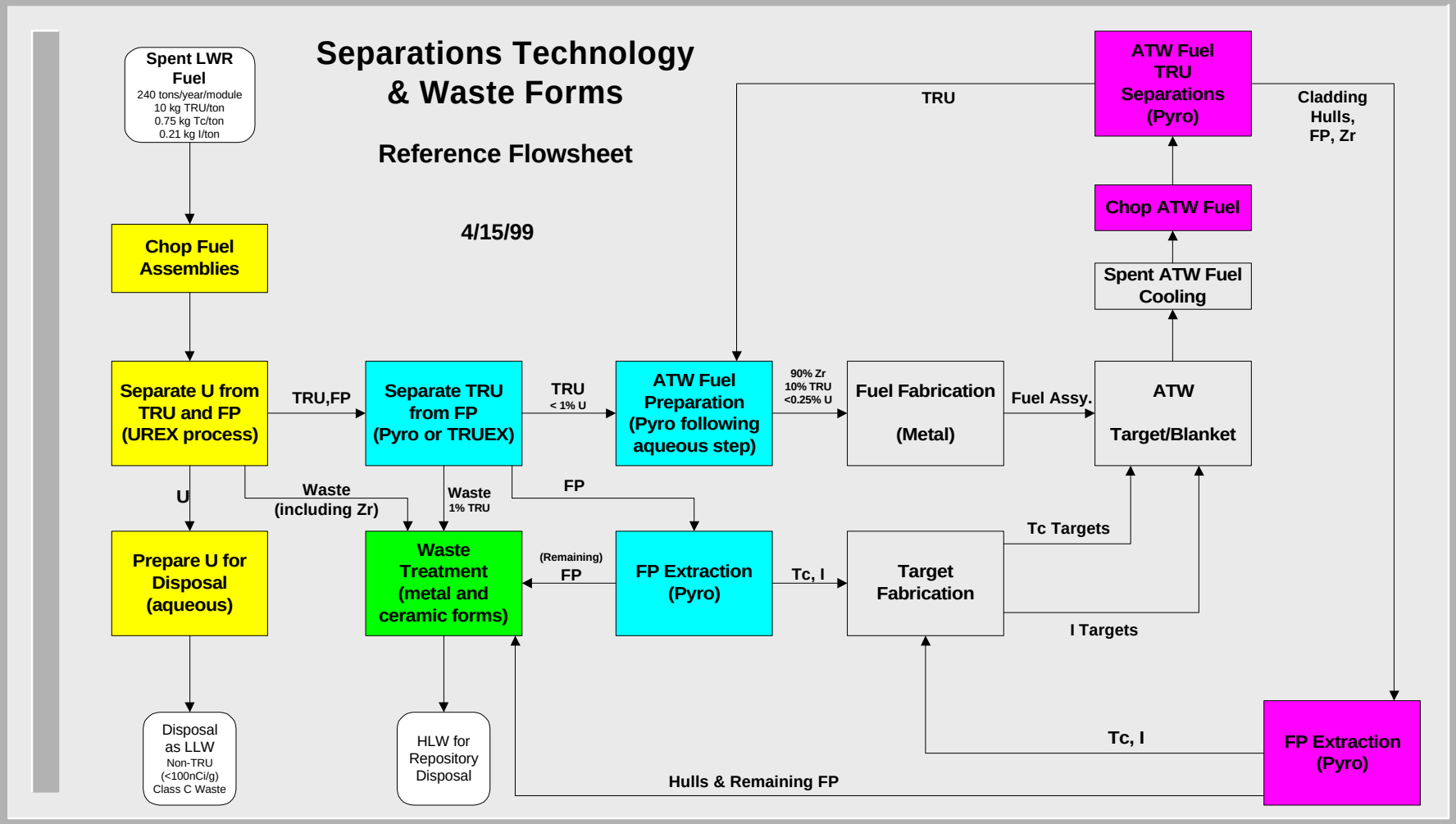
Waste Forms

- **Two High-Level Waste forms will be produced**
  - **Ceramic waste form**
    - Within the defense waste glass composition envelope
    - Immobilizes Cs, Sr, Ba, and other active metal fission products
  - **Metal waste form**
    - Extremely durable non-standard waste form
    - Nominal composition Zr- 8 wt.% Fe
    - Immobilizes Mo, Ru, Sb, and other transition metal fission products
- **Much like today's EBR-II waste forms**

Projected Waste Volumes

- **High-Level Waste**
  - **Ceramic waste form: 60 m^3/year/ATW unit**
  - **Metal waste form: 7 m^3/year/ATW unit**
- **Low-Level Waste**
  - **Uranium trioxide, UO_3: 31 m^3/year/ATW unit**
- **Unpackaged waste volume of 240 MT LWR fuel is about 90m^3**
  - **Significant benefit in repository performance, arguable benefit in reduced waste volume**

Current Reference Flowsheet



Technical Issues

- **Achievable extent of Np and Tc rejection to waste stream (avoiding contamination of uranium)**
- **Completeness of removal of TRU from cladding hulls**
- **Ability to recover iodine and form of iodine target**
- **Efficiency of pyro process for oxide reduction**

Institutional Issues

- **Availability of hot cells in the DOE complex in the period 2003-2010**
- **Public perception issues associated with use of a PUREX-like processing system**
  - **Feasibility of construction and licensing of a large PUREX-like plant**
- **Feasibility of shipment of separated transuranics to distributed ATW sites**