The Proposed Materials Test Station at LANSCE

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The Advanced Fuel Cycle Initiative and GEN IV programs require a fast neutron spectrum facility for fuels and materials testing

- **Advanced fuel concepts (e.g., nitride, metallic dispersion, fertile-free) are proposed for closing the nuclear fuel cycle, as well as for some GEN IV reactors**
- **Nearly all nuclear waste transmuter concepts, and most GEN IV reactor concepts, operate with a fast neutron spectrum**
- **Fuel cladding must be tested in prototypic radiation environments with appropriate coolants (e.g., Pb-Bi)**

There is a clear need for a U.S. fast spectrum irradiation facility

- **With the termination of the FFTF, there is no longer a domestic fast neutron spectrum irradiation facility**
- **There are a limited number of viable facilities abroad:**
  - **PHENIX (France)**
  - **JOYO (Japan)**
  - **BOR-60 (Russia)**
- **Irradiation campaigns abroad are time-consuming and expensive**
  - **Irradiation of eight 11-cm-high fuel pins in PHENIX by AFCI will take four years from initial discussions with CEA to the start of irradiation, with a cost for irradiation services of $5M**

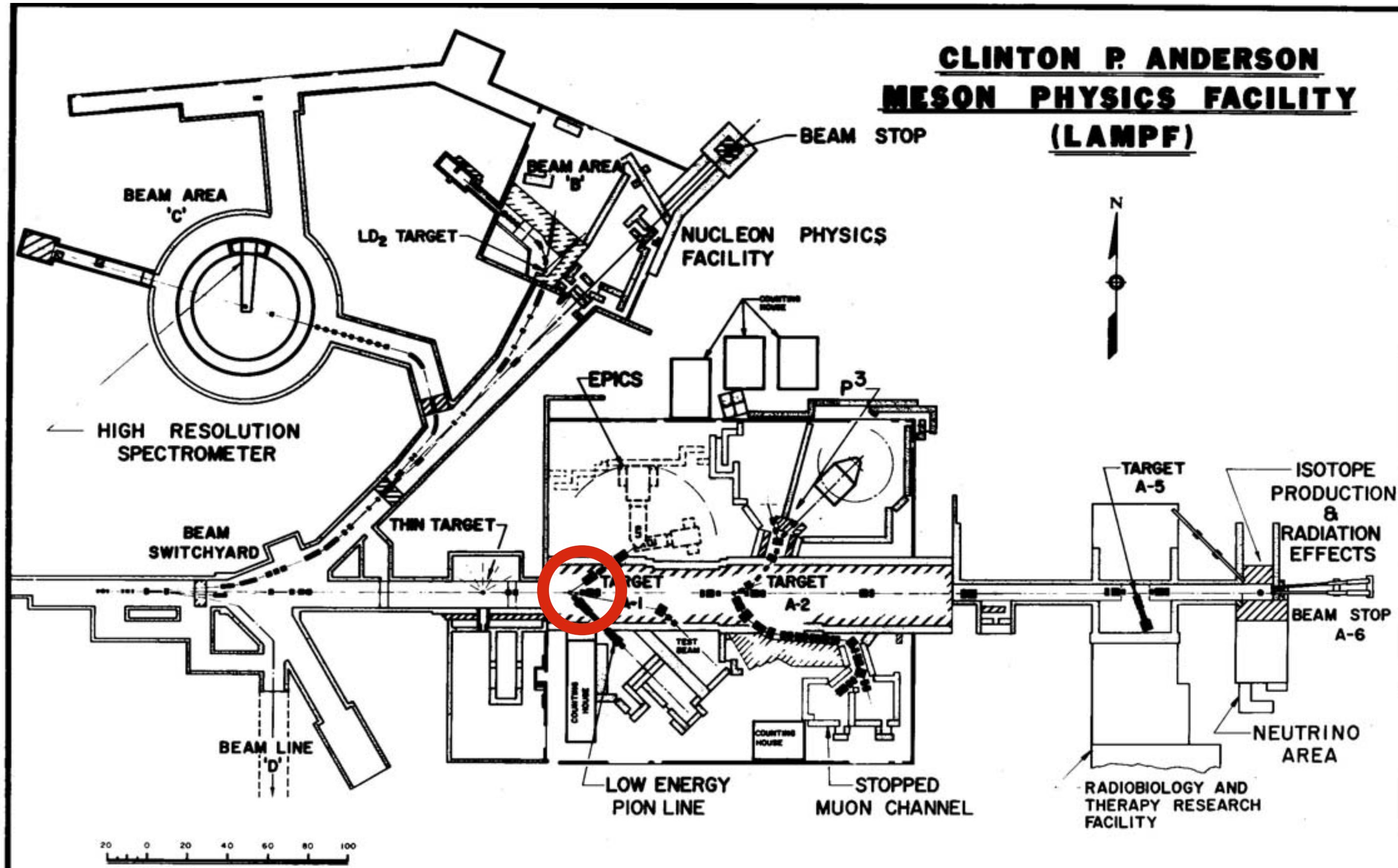
LANSCE is a cost-effective and logical choice for locating a fast-spectrum irradiation facility

- **A new fast reactor would cost at least $800M**
- **LANSCE proton beam power is 800 kW (1 mA at 800 MeV)**

Materials Test Station (MTS) Functions and Requirements

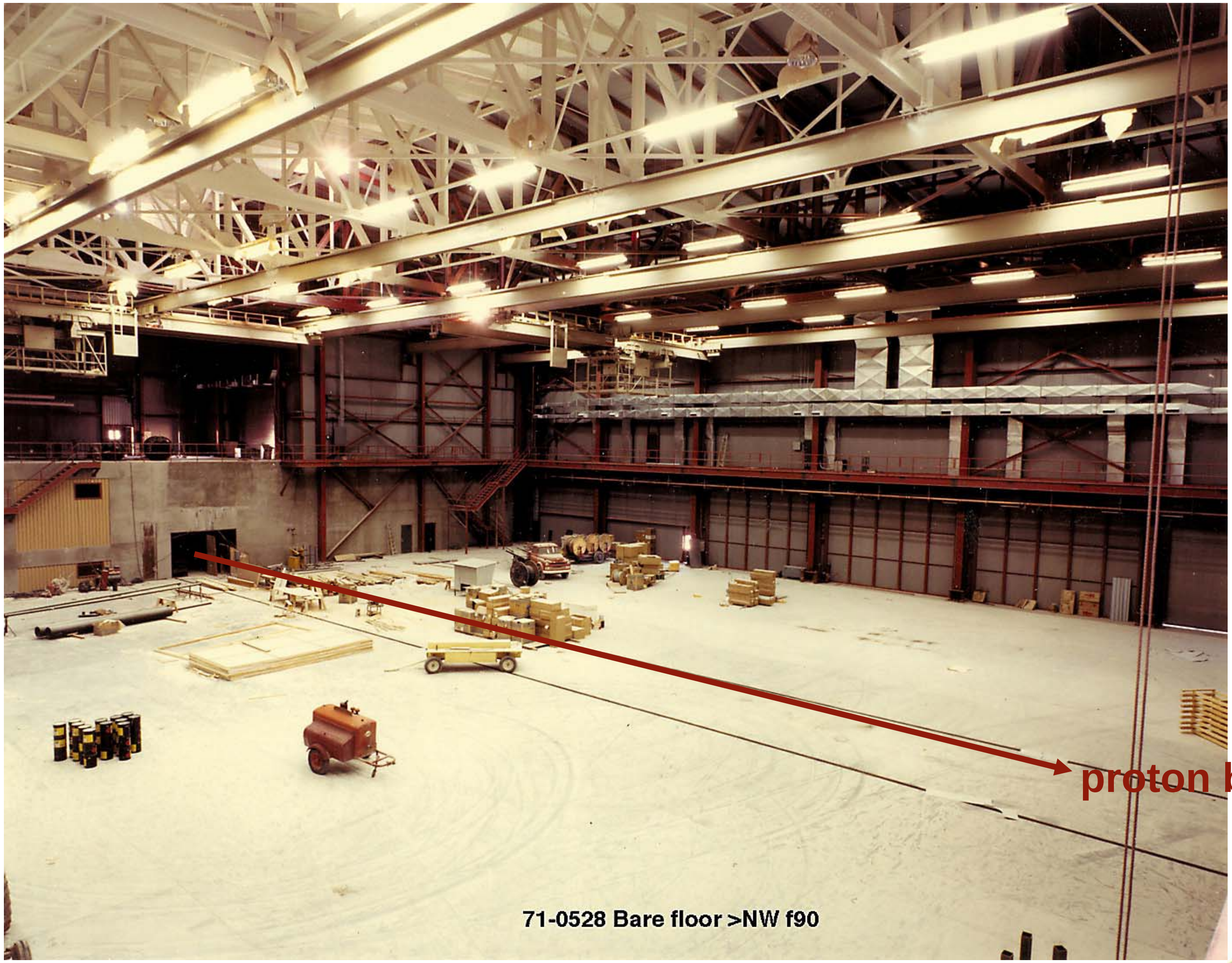
- **Intense fast neutron flux (up to 10^{15} n.cm^{-2}.s^{-1}) over a 1-liter volume with minimal proton flux contamination**
  - **High burnup of fuel specimens (~6%/year)**
  - **High damage rate of materials specimens (~7 dpa/year)**
- **Radiation damage environment similar to that encountered in a fast reactor**
  - **He/dpa ratio near 0.5 appm/dpa**
- **High proton flux for spallation source materials testing**
- **Separate cooling loops for test specimens**
- **Capability of testing to failure**
  - **Negligible reactivity from fuel specimens (deeply subcritical)**

The Materials Test Station will be located in an existing experimental area

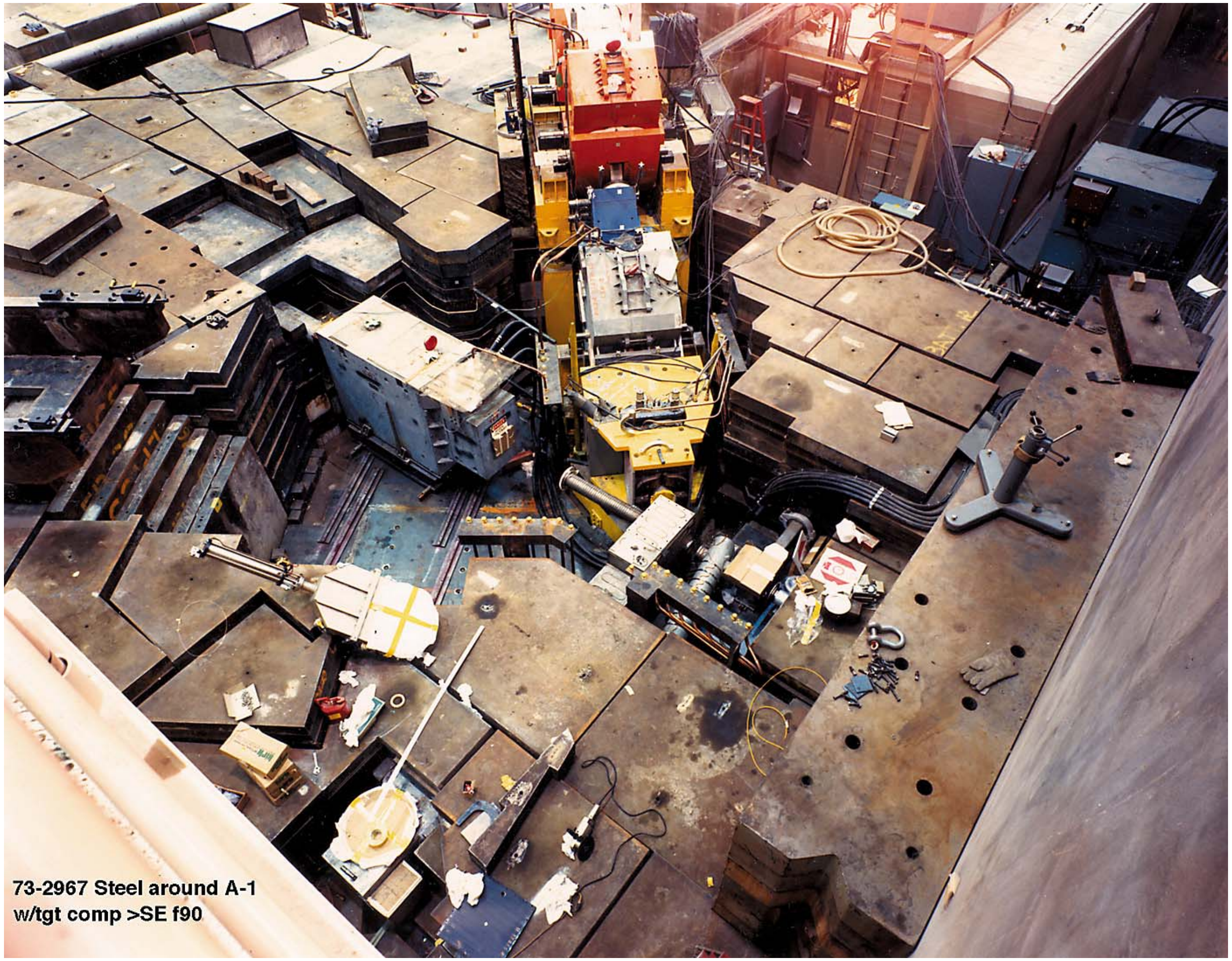


74-8573 1974 Expt areas layout illustration

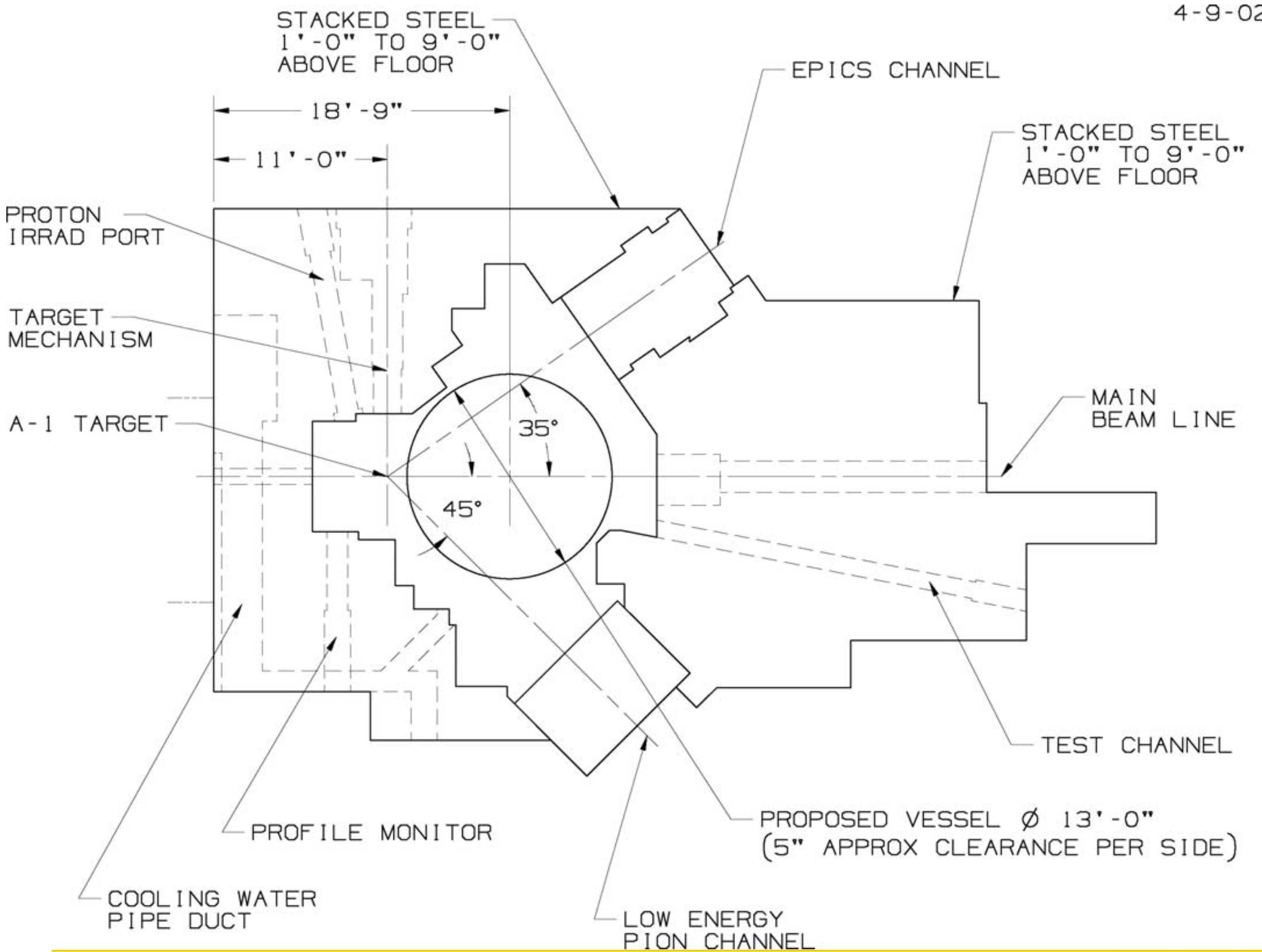
Experimental Area A in 1971



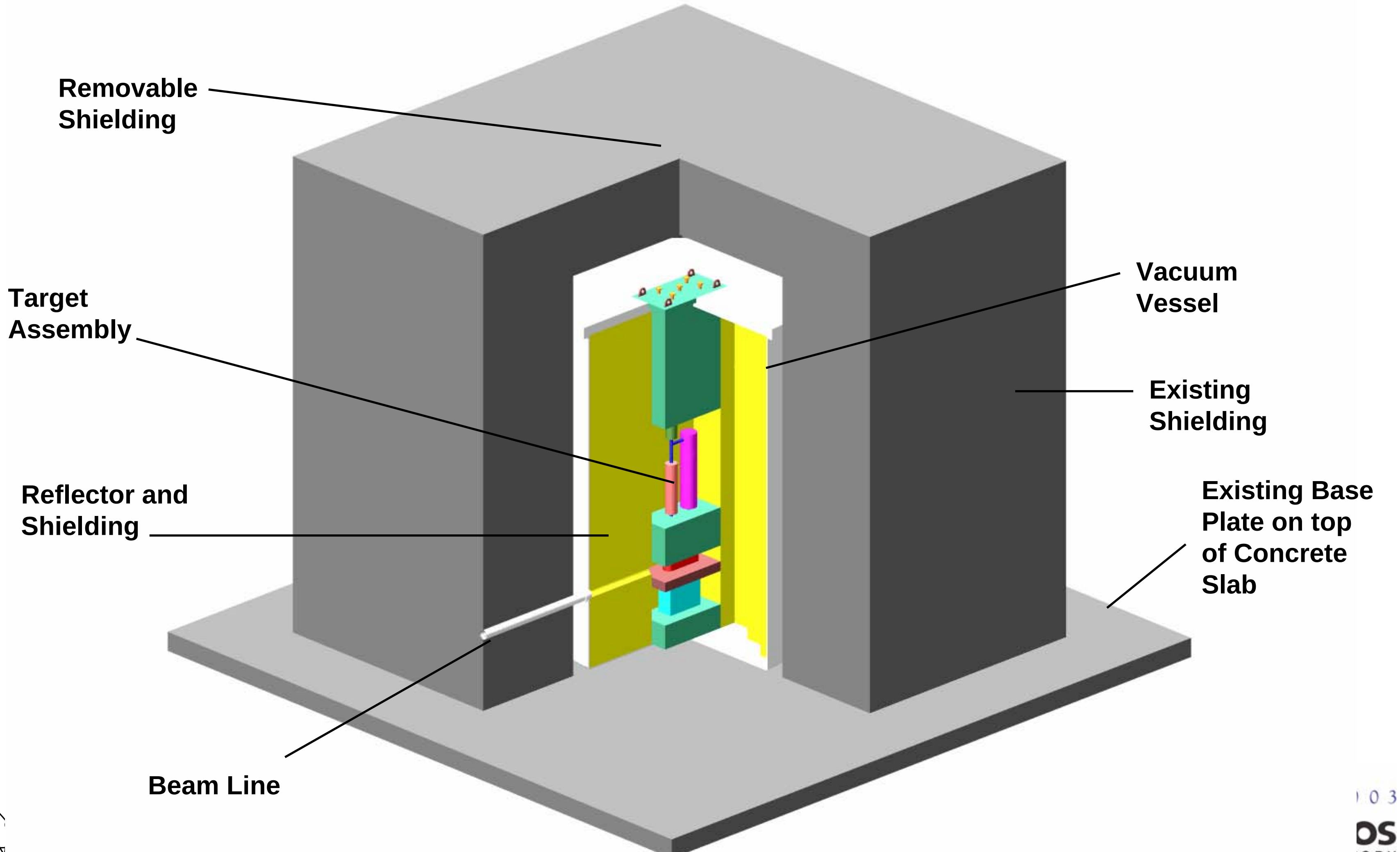
The A-1 target, shown here during construction in 1973, is the proposed location for the MTS



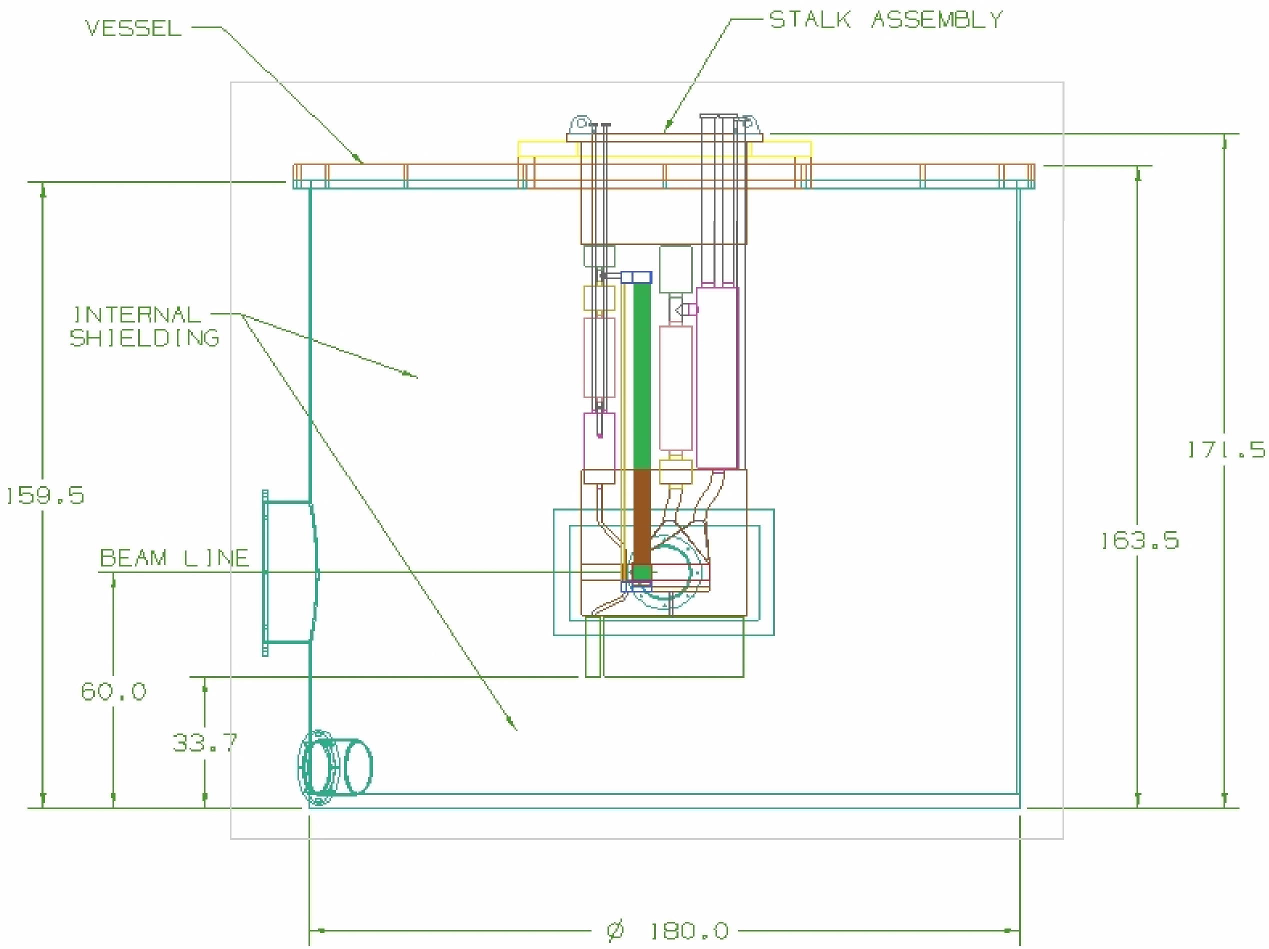
The MTS 13-foot-diameter vacuum vessel would fit within the existing shielding

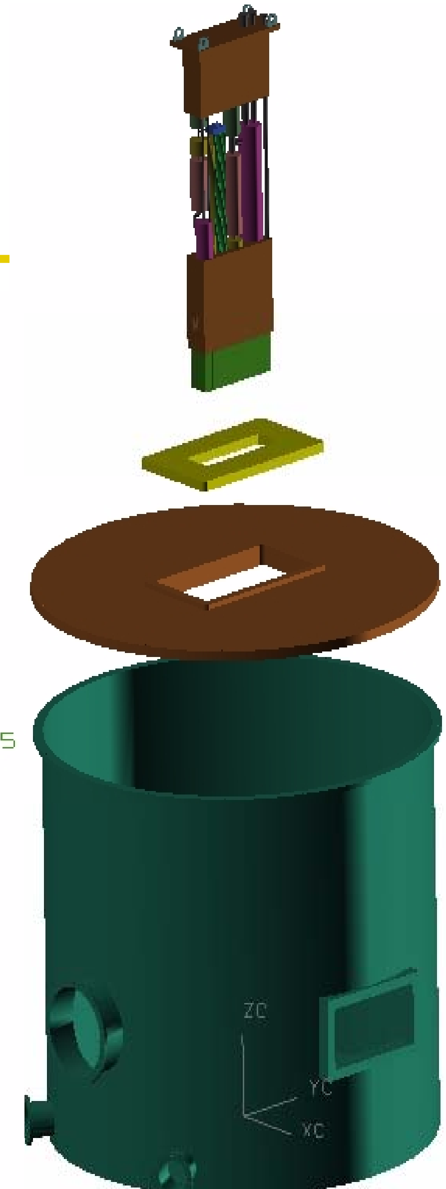


The MTS includes a neutron source, irradiation positions, shielding, and vacuum vessel



The target and irradiation zones will sit on a stalk that is inserted into the vacuum vessel from above





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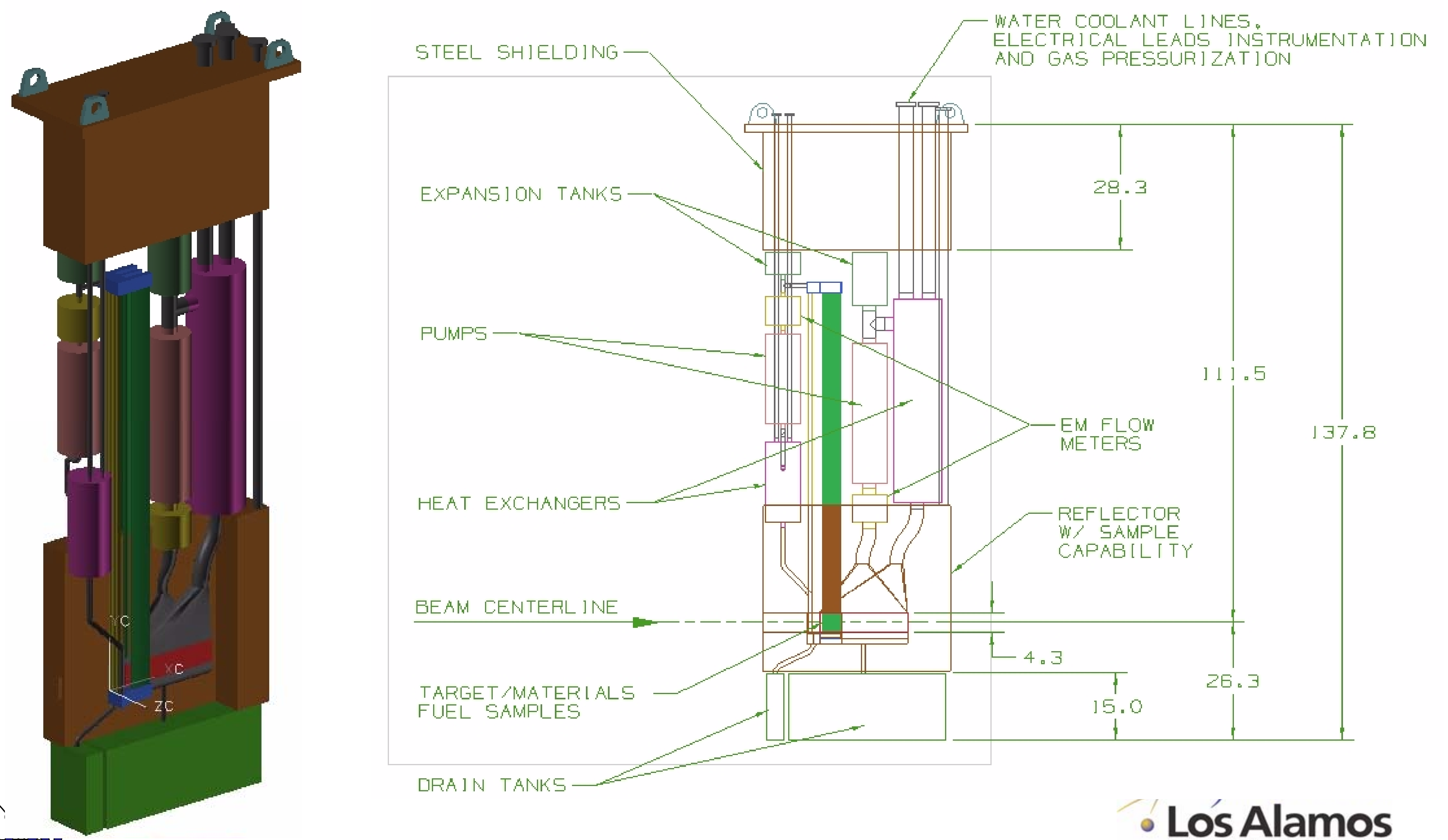
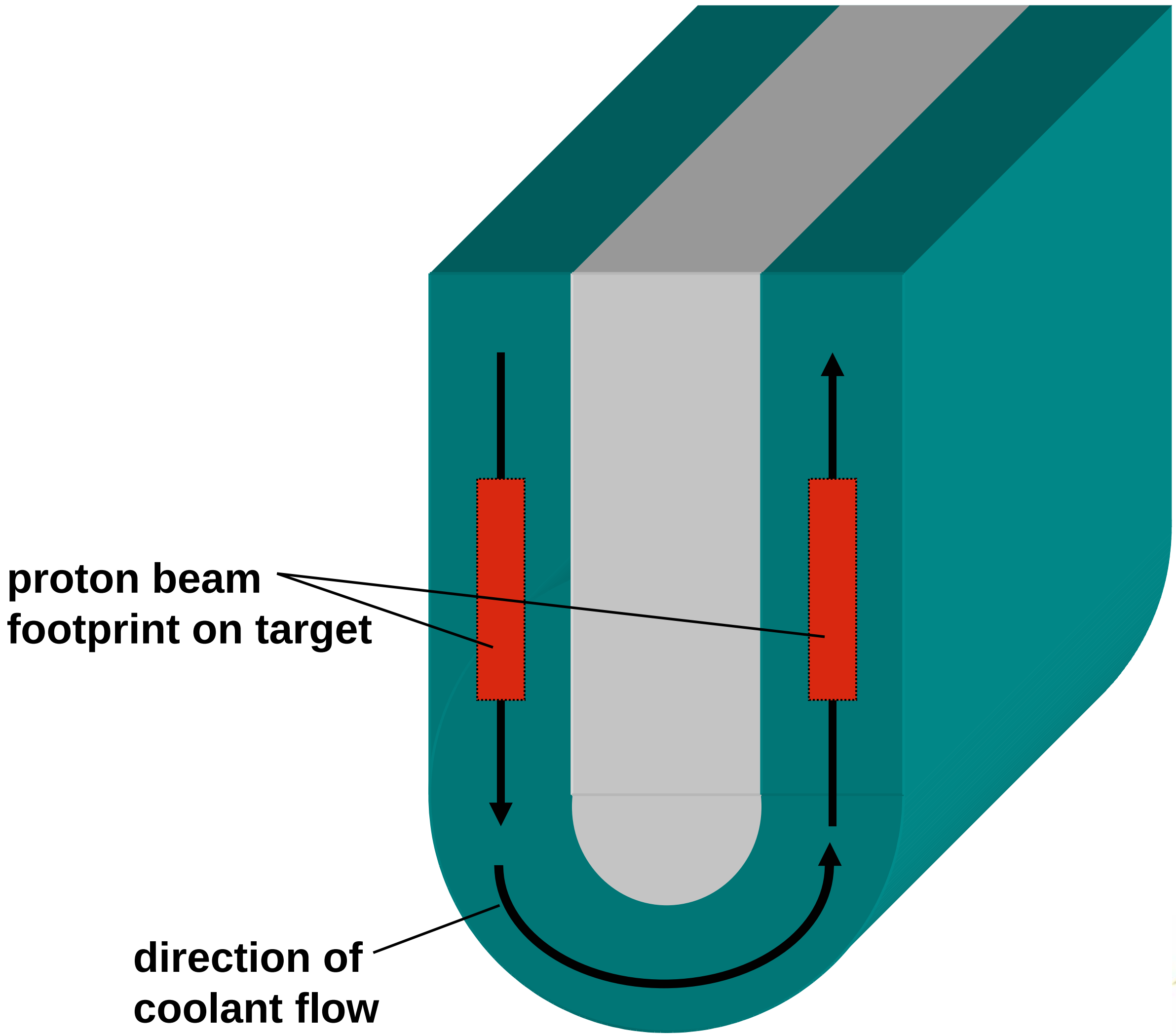
A conceptual design of a flowing Pb-Bi target has been developed



A phased approach in spallation targets is proposed for achieving ever-greater neutron fluxes

- Heavy-water cooled clad tungsten target
  - Extensive development within the Accelerator Production of Tritium program gives high confidence that this target will work reliably
- Flowing Pb-Bi target
  - Moderate risk whose design will draw from lessons learned in the MEGAPIE project
- Heavy-watered cooled uranium target
  - Testing of uranium alloys under proton irradiation is required to validate target lifetimes

The U-shaped target canister provides excellent target window cooling



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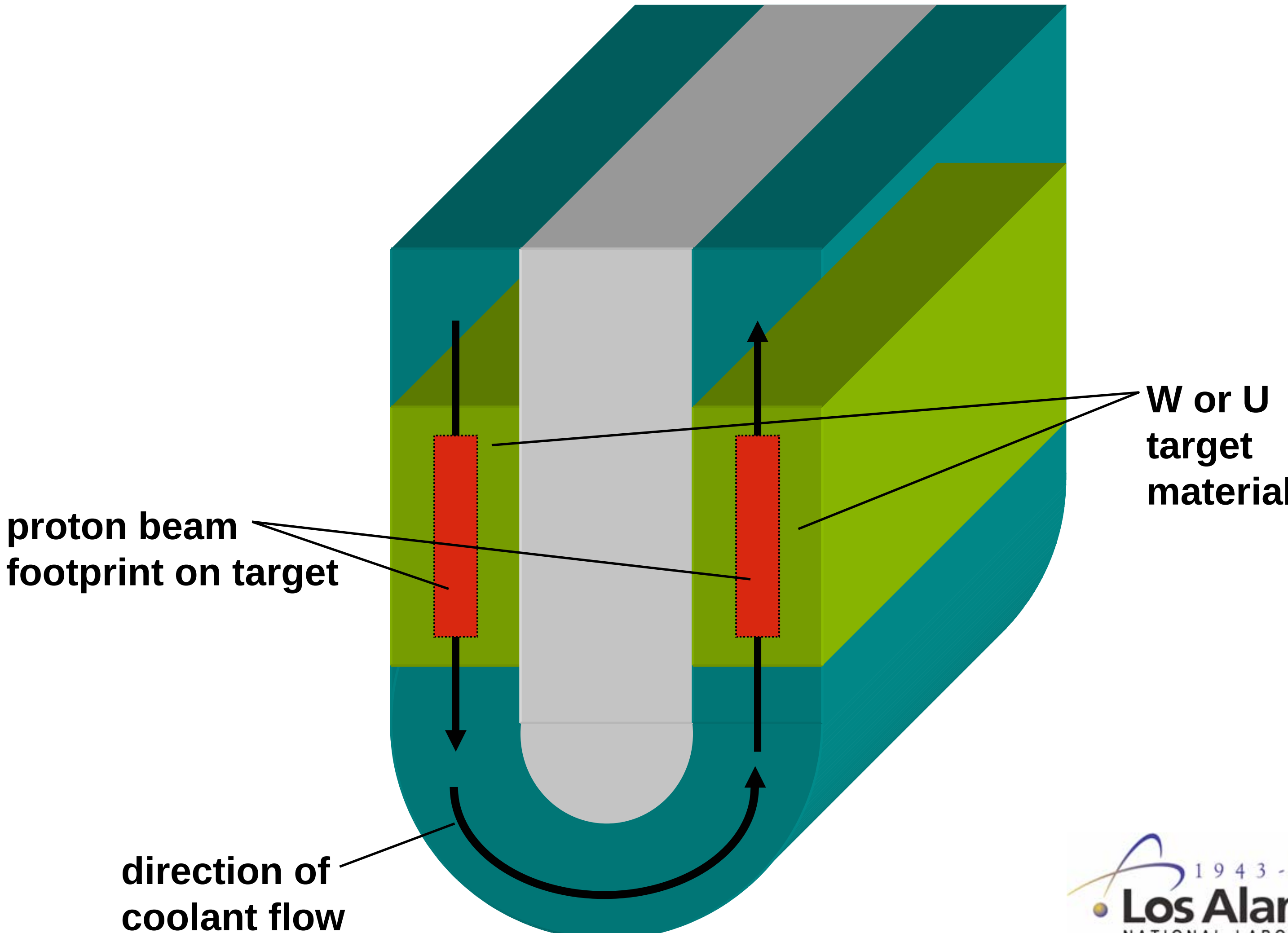
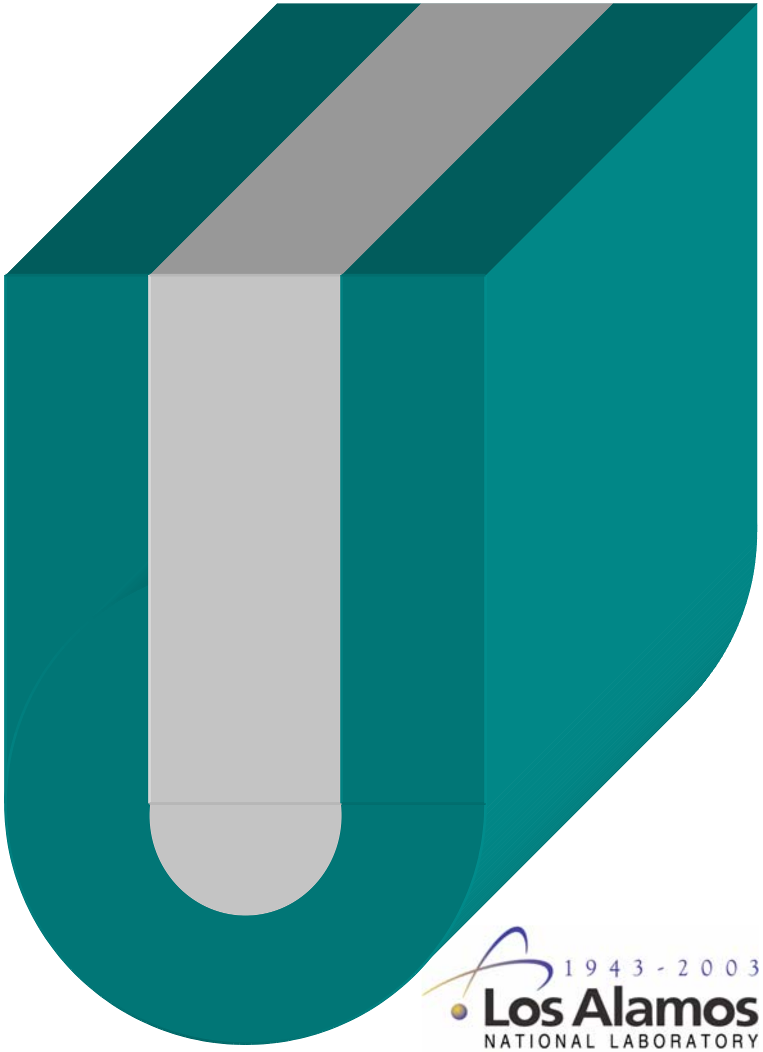


MTS takes advantage of the pulsed nature of the LANSCE beam to illuminate two spots on target

- **Beam frequency is 120 Hz, pulse duration is 1 ms**



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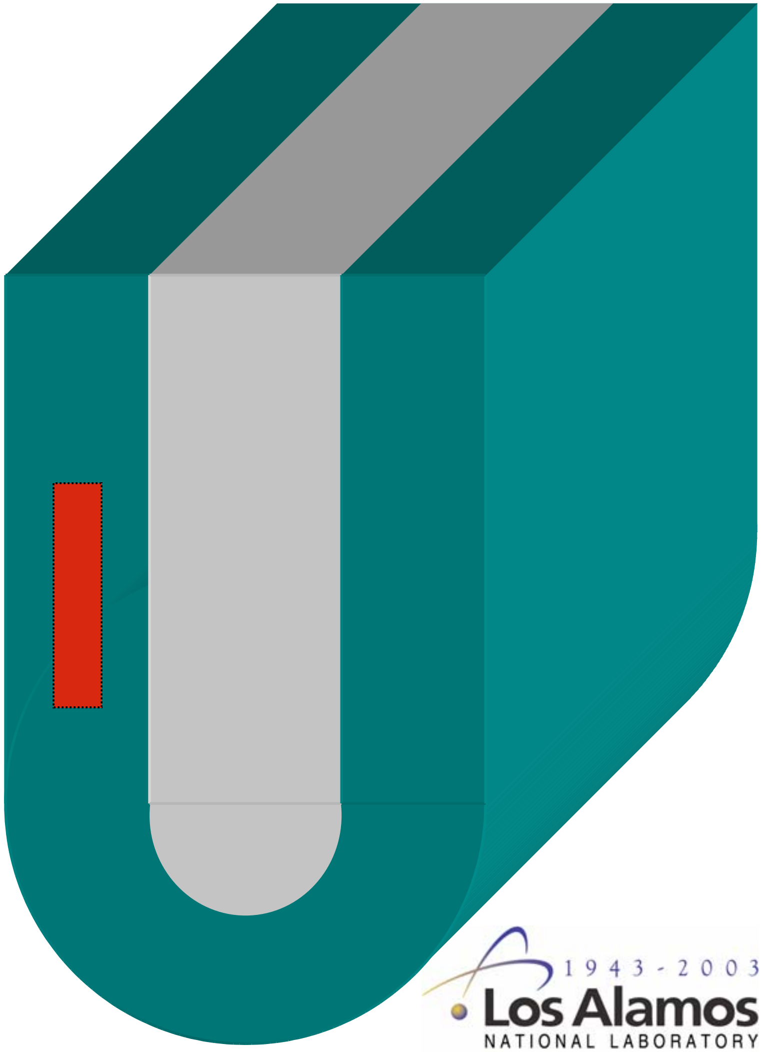

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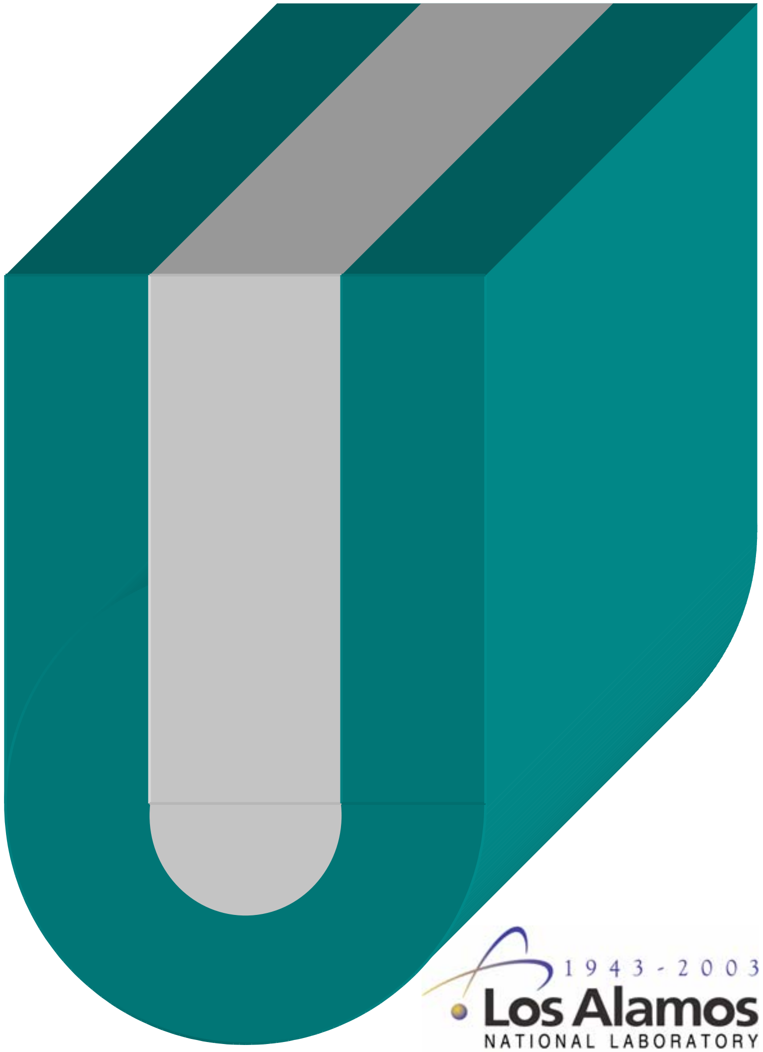

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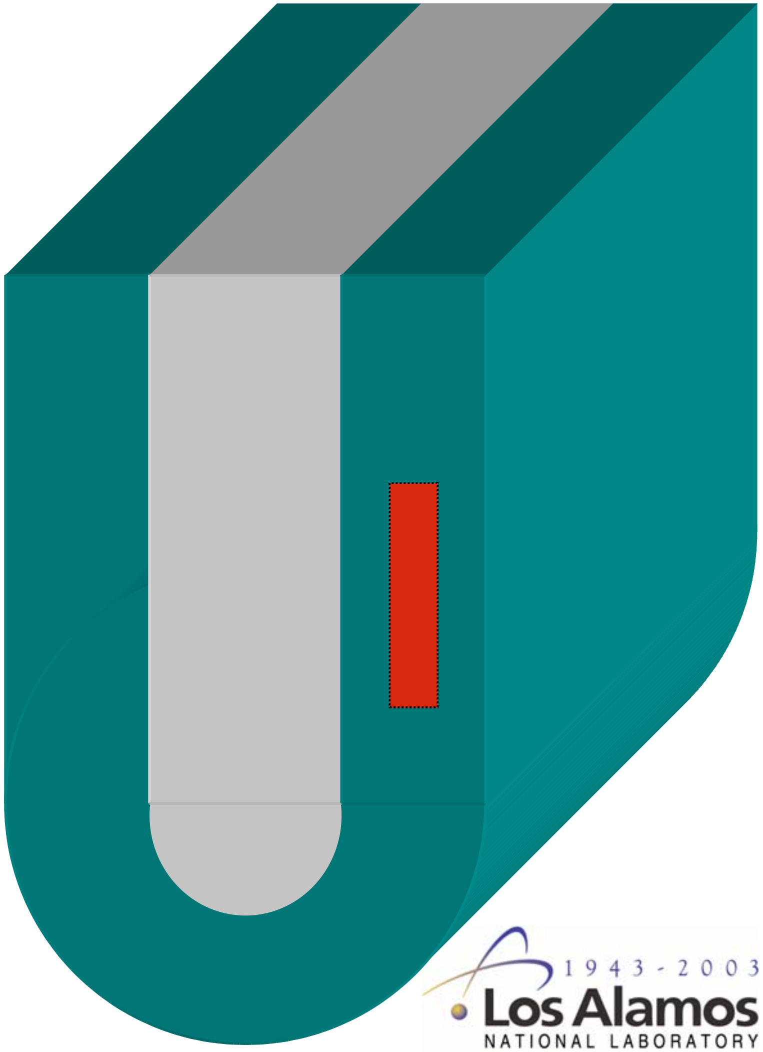

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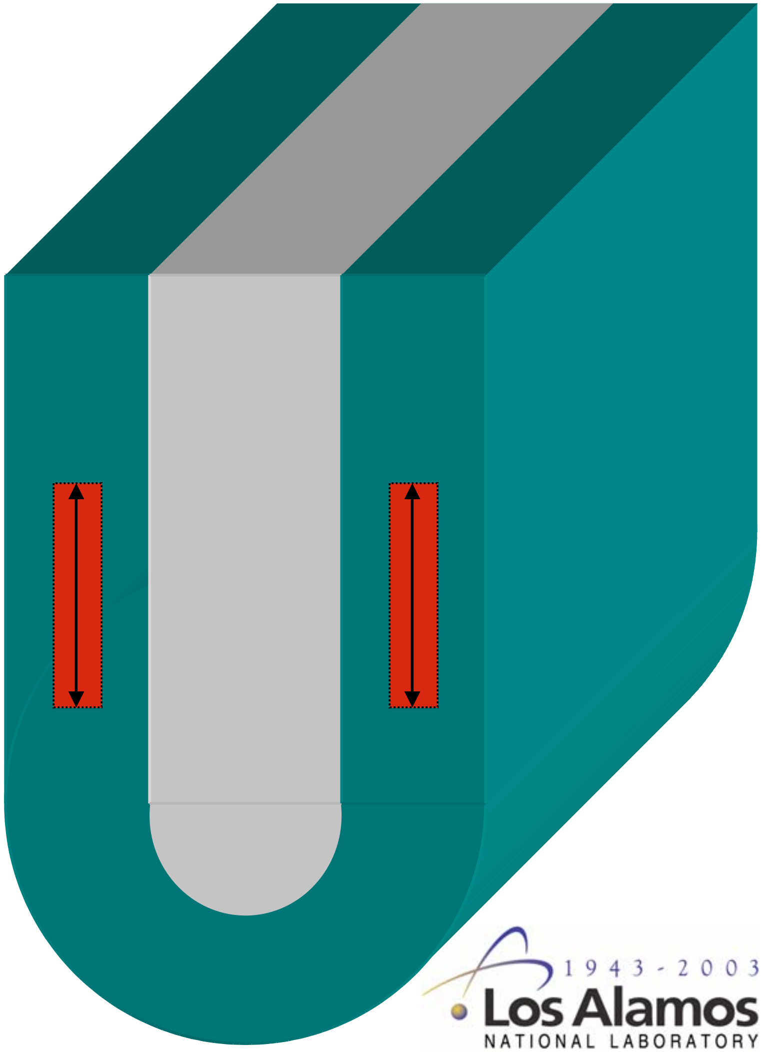
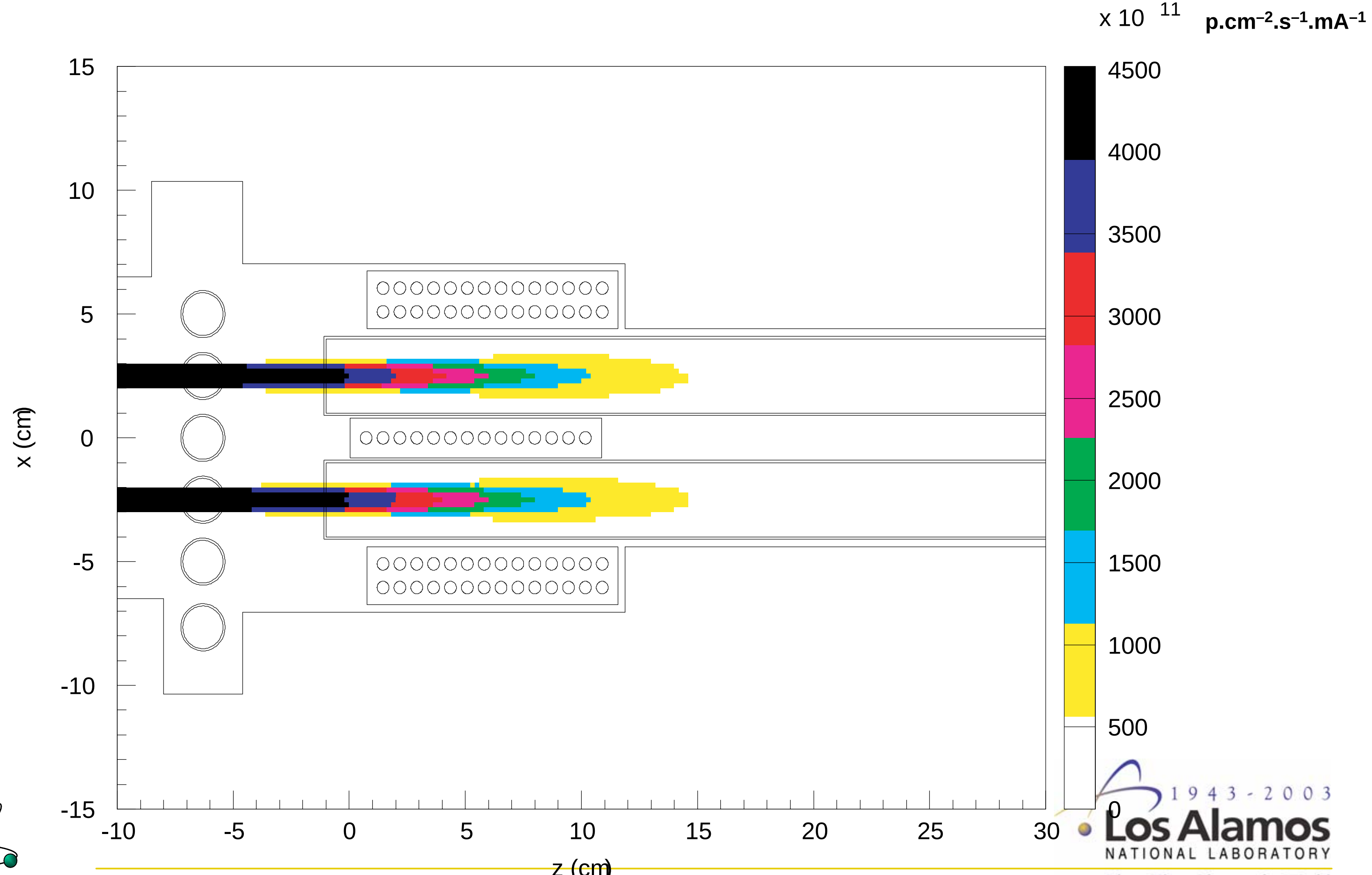
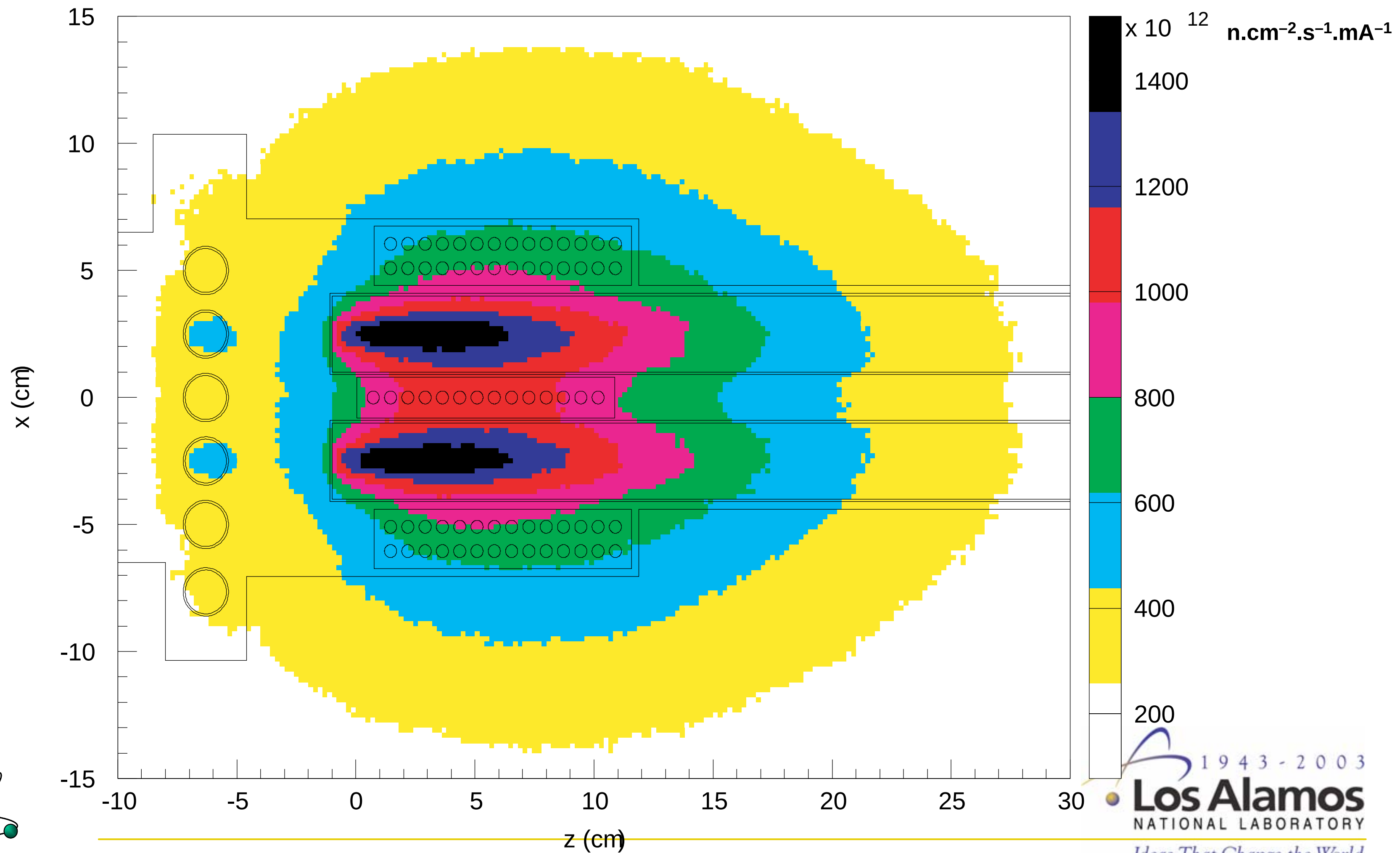
- **The beam is rastered vertically at a high frequency (~1 kHz)**



Spatial distribution of the proton flux for an LBE-cooled U-10Mo target



Spatial distribution of the neutron flux for an LBE-cooled U-10Mo target



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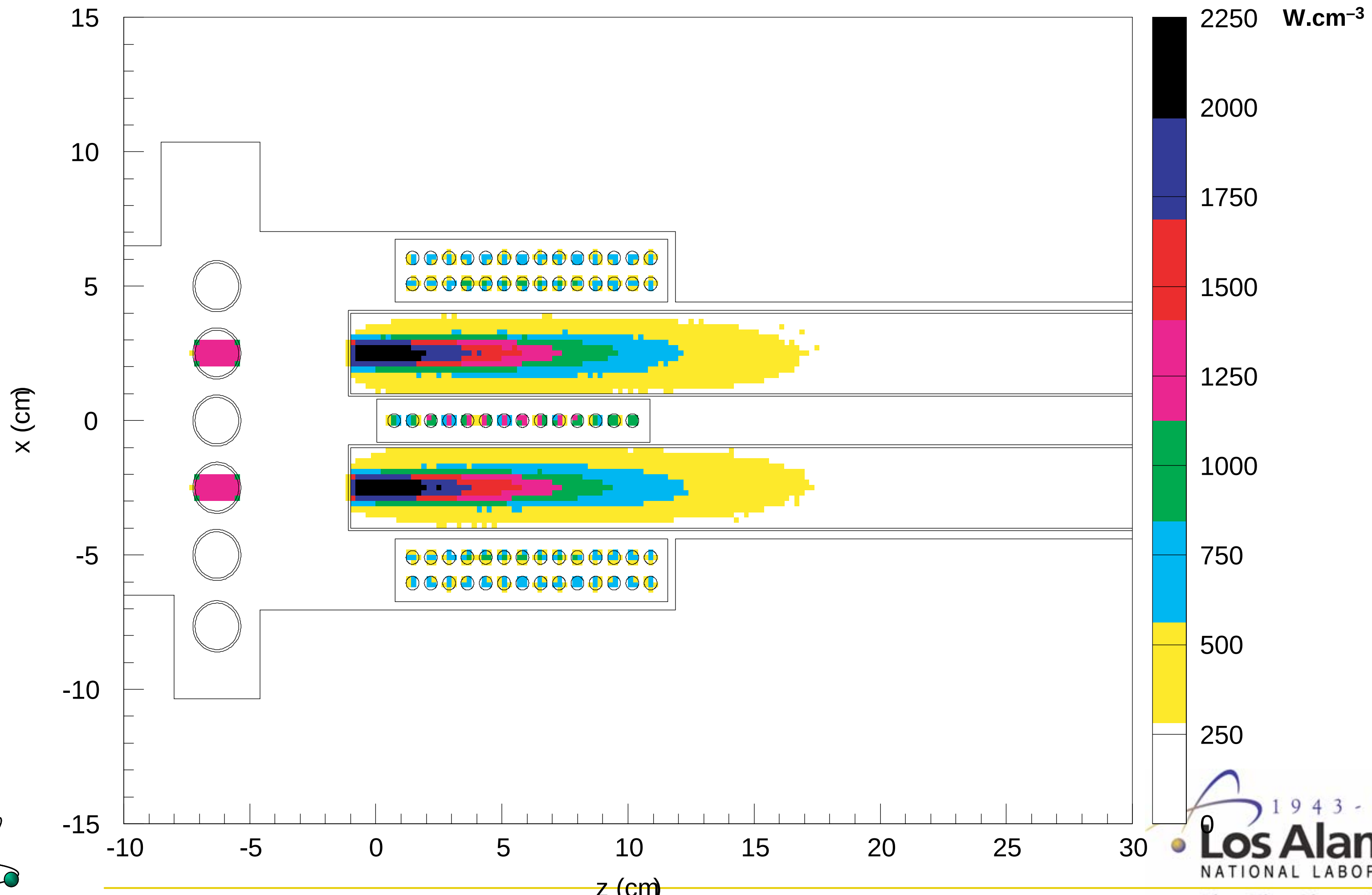
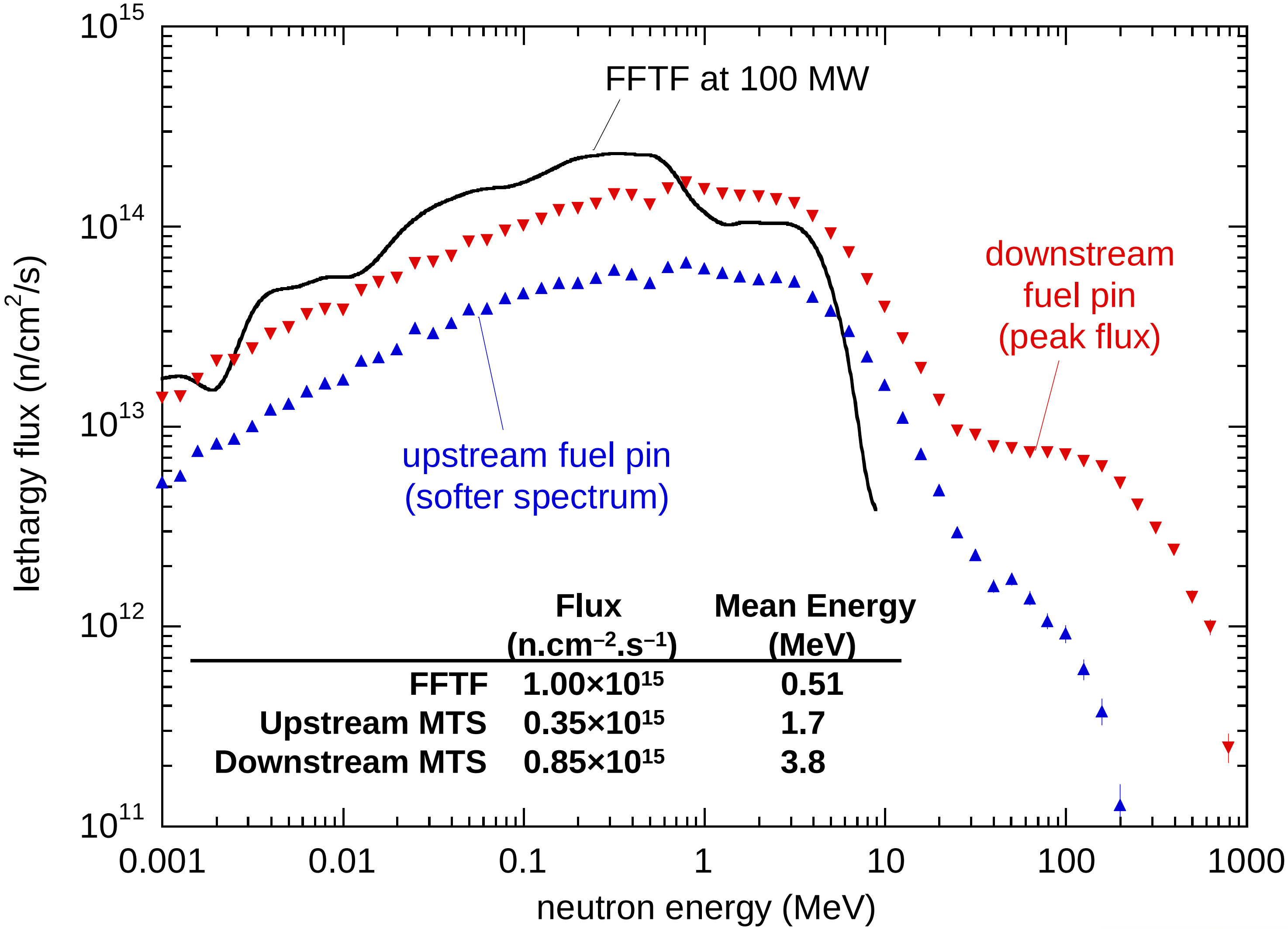
Spatial distribution of the power density for an LBE-cooled U-10Mo target



The flux spectrum the MTS with a D_2O-cooled U target compares favorably with the FFTF



The MTS can be completed in 3 years at a cost of $20M

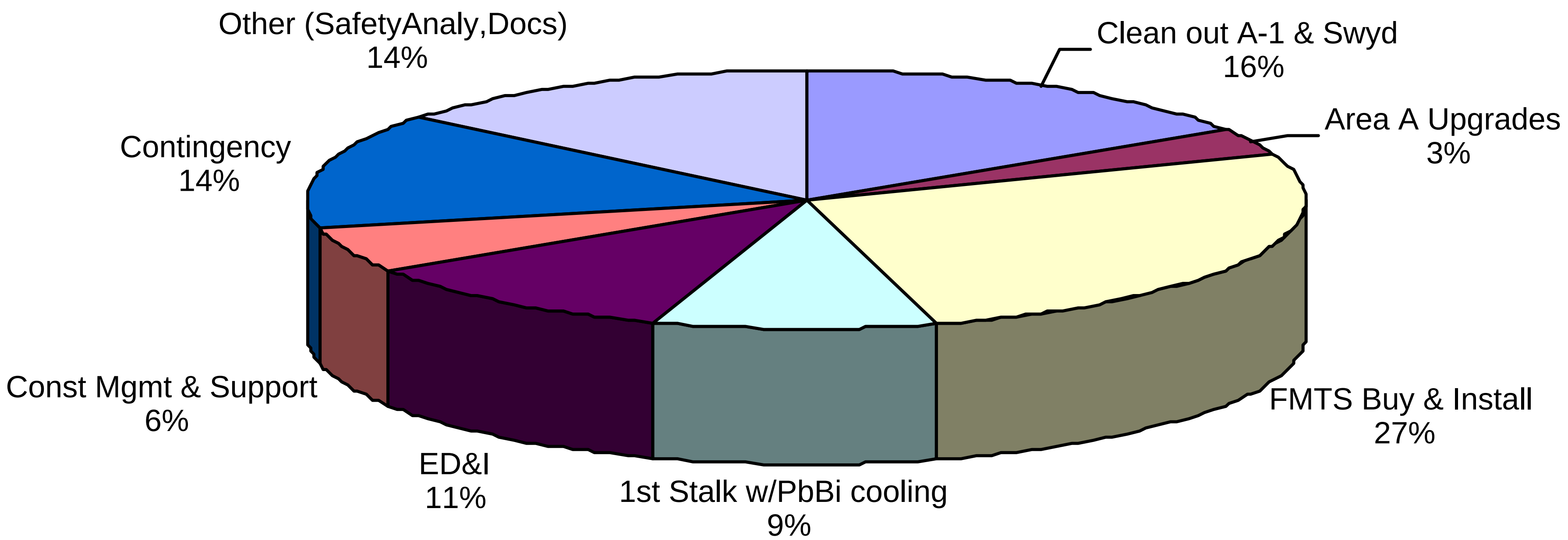
MTS Schedule and Cost

FY04	FY05	FY06	FY07	FY08
Installation/Commission				
			Operation/Testing	

Costs (Operating Funds)

FY04	FY05	FY06	FY07	FY08
$5M	$8M	$7M	$3M	$3M

Breakdown of $20M Cost Estimate



MTS Status

- Pre-conceptual design completed in FY02. No work performed in FY03.
- Safety authorization plan completed.
- MTS is within the existing Environmental Impact Statement.
- Total installation cost estimated at $20M, and can be completed in 3 years.
- Project will replace an experimental station that is no longer used. It will be installed with operating funds because we are replacing a test station within an existing experimental area.
- Seeking authorization from DOE-NE to start work in FY04.

Summary

- We need a domestic fast neutron source for materials and fuels irradiations. The alternative is expensive irradiations abroad.
- The MTS meets this need at a reasonable cost.