Tritium Processing

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VLT PAC
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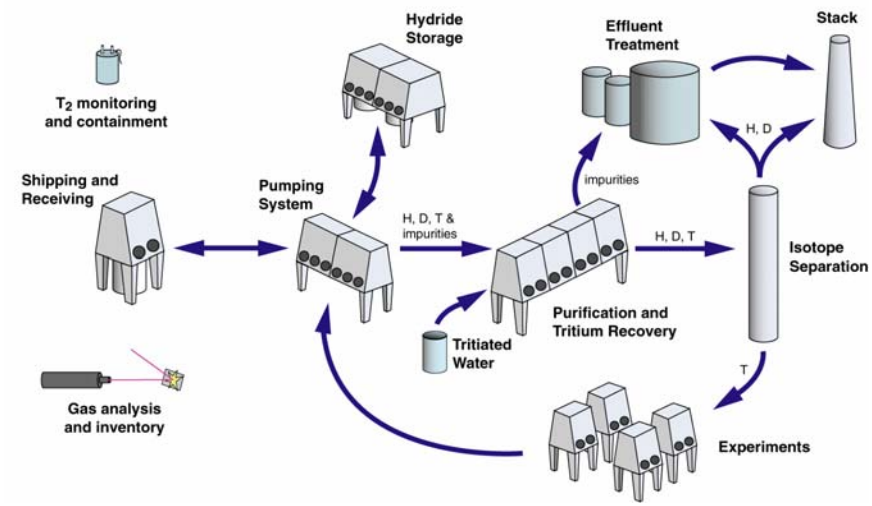
Mission and scope

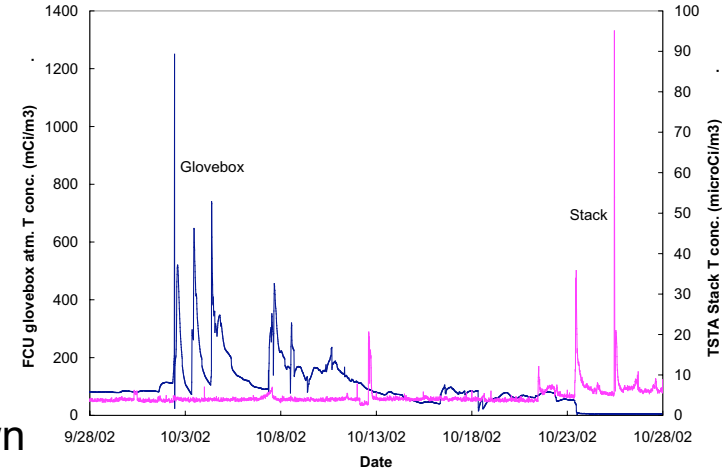
- Mission
  - To research, develop and design safe and effective tritium processing systems needed to accomplish the OFES mission



- Scope
  - **Separations**: Many unique separations are required for tritium impurities processing, isotope separation, purification, and gas and water detritiation
  - **Storage and delivery**: Isotopes must be safely stored and delivered to systems as needed
  - **Effluent cleanup**: High efficiency cleanup systems are needed to prevent worker & public exposure
  - **Analysis**: A variety of analyses are required for process monitoring, inventory control and contamination control
  - **Handling**: Tritium's unique properties lead to materials compatibility and containment issues
  - **Control**: Unique control issues arise from the challenge of producing on-spec product with this radioactive material while maintaining minimal inventory

Highlights

- The Tritium Systems Test Assembly (TSTA) stabilization project was completed. Approximately 140 gm of tritium returned to SRS or disposed of.
  - This was accomplished without any safety or compliance incidents
  - The facility was successfully transferred to EM for ultimate disposal
  - Valuable data was collected during the shutdown
    - Inventory reduction methods
    - Decontamination methods
    - Packaging and transportation
    - Residual inventory measurement
    - D&D-related operating experience
- The new Hydrogen Processing Laboratory was opened & fusion-related experiments performed
- Lead for Tritium processing remains at LANL
  - Support for ITER Tritium Processing issues was provided



Effectiveness of decontamination prior to glovebox breach

TSTA prior to shutdown

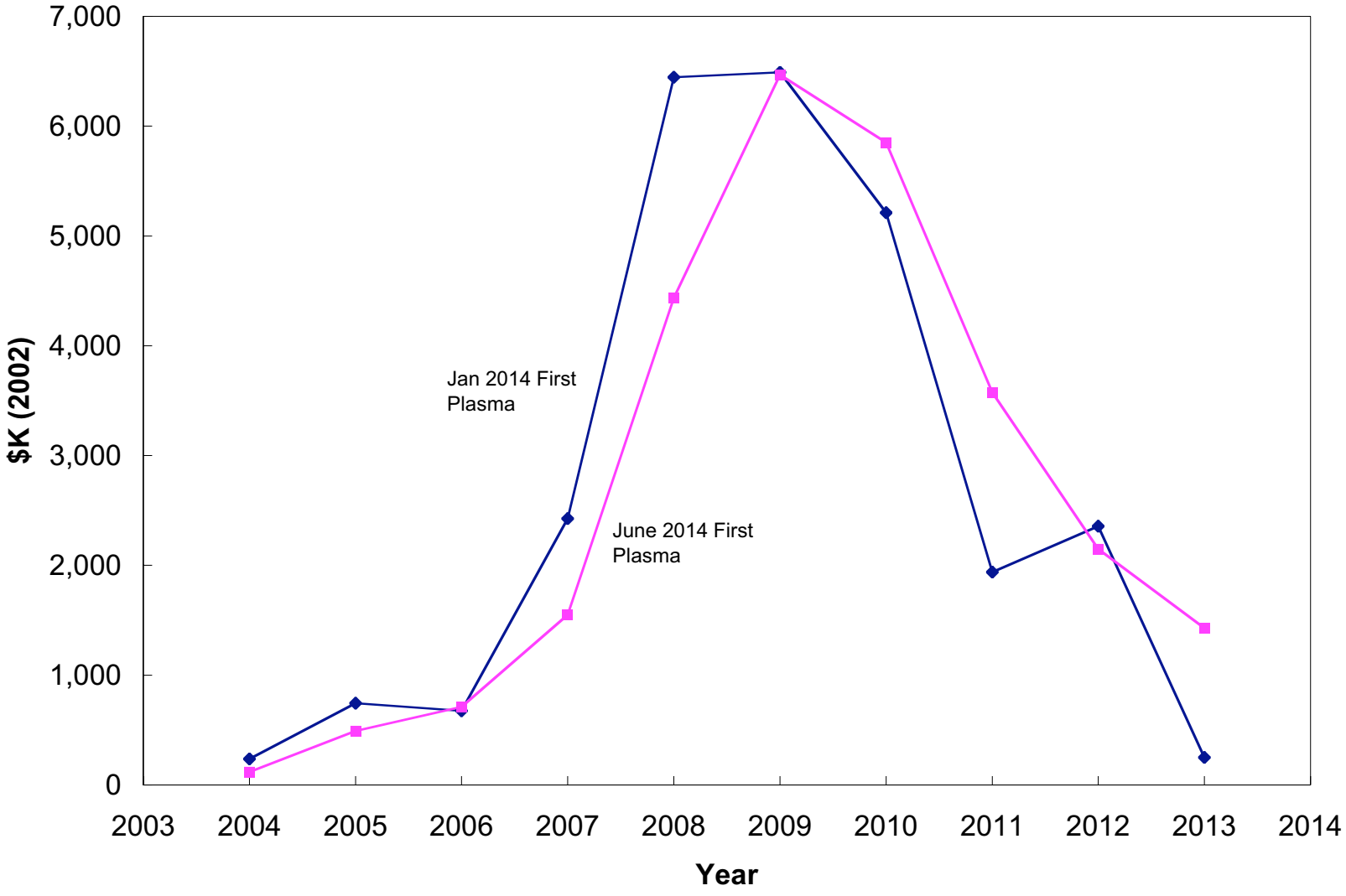
Concerns/Issues

- Planned fusion machine will substantially increase tritium processing demands. Compared to TSTA, ITER is 10x's flowrate, 10x's inventory and 1/10th the processing time.
- Integrated control, rather than tritium handling is the issue.
- TSTA shutdown limits tritium processing development capability
- A non-tritium control development facility would be ideal, but in a constrained budget dynamic modeling coupled with on-ITER testing will have to suffice
- Future component needs (low pressure permeator, disengager, cryopumps, etc.) can be adequately developed with H-D
- Tritium processing for blanket processing is not as developed as torus exhaust processing
- Water detritiation development is needed
- World-wide tritium processing expertise is dwindling

Future work outline

- Tritium processing for ITER Test Blanket Module program
  - Perform conceptual design of tritium processing system for each TBM concept
  - Perform low pressure permeator tests for ceramic breeder (tritium/He separation)
  - Perform vacuum disengager tests for low tritium solubility liquid blankets
- Continuously regenerable cryopump testing for ITER fueling system
- ITER Tritium Plant work
  - Torus Exhaust Processing procurement package
    - Design
    - Design integration
  - Dynamic modeling R&D/design

ITER TEP procurement package estimate



Budget summary

Category	FY04 Actual	FY05 Estimate	CBR '05	FY06 Estimate
VLT Tritium Processing	0	$125K	0	$250K
ITER Tritium Plant	0	$400K	$400K	$450K
Other Tritium Processing	See below	See below	See below	See below

Proposed FY05 Tasks

Task	Deliverable	CBR-VLT ($K)	Incr-VLT ($K)	CBR-ITER ($K)
TBM Tritium Processing Assessment	Literature review-12/04 Process flow diagram for each option-12/05 Ranking of TBM options from TP perspective-4/05 Identification of R&D needs-6/05	Proposed to include in Plasma Chamber	75	
TBM low pressure permeator testing for tritium recovery from helium	Permeator fabrication-11/05 Testing with H and D-9/05	Proposed to include in Plasma Chamber	75	
TBM vacuum disengager	Design vacuum disengager experiment-6/05	Proposed to include in Plasma Chamber	25	
Cryopump testing for ITER pellet injector	Install pump in vertical position-12/04 Test pump with H and D-6/05	Proposed to include in Fueling	125	
Tritium Plant dynamic modeling-ITER relevant	Obtain commercial modeling code-12/04 Begin module preparation for code-9/05	0	125	
ITER Tritium Plant integration	Organize and participate in Tritium Plant Design-9/05 Integration Team meetings-TBD			125
ITER TEP design	TEP design basis documentation-9/05 Update of TEP preliminary design-9/05			275

Proposed FY06 Tasks

Task	Deliverable	CBR-VLT ($K)	Incr-VLT ($K)	ITER ($K)
TBM Tritium Processing Assessment	Design of tritium processing system for US TBM option(s)	Proposed to include in Plasma Chamber	75	
TBM low pressure permeator testing for tritium recovery from helium	Testing with H and D	Proposed to include in Plasma Chamber	75	
TBM vacuum disengager	Test vacuum disengager with H	Proposed to include in Plasma Chamber	100	
Cryopump testing for ITER pellet injector	Test pump with H and D	Proposed to include in Fueling	50	
Tritium Plant dynamic modeling - ITER relevant	Obtain commercial modeling code Begin module preparation for code	0	250	
ITER Tritium Plant integration	Organize and participate in Tritium Plant Design Integration Team meetings			100
ITER TEP design	TEP design basis documentation Update of TEP preliminary design			300
TEP RFQ	Prepare TEP request for quotation			50