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Advanced Accelerator Applications
General Presentation
Technology Project Office

AAA Project Quarterly Review
February 6-7, 2001

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February 6-7, 2001

Document Number:
TPO-RGN-1002
AAA-PDO-GEN-01-0034
LA-UR-01-1524
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Abstract:

The AAA Quarterly Project Review (held February 6-7, 2001) addressed four major issues: Transmutation of Waste, the Accelerator-Driven Test Facility, Scenario Development and Analysis for the Project's Future, and Tritium Production Capabilities. This document records the presentations made at the quarterly meeting.

Approval:

ADTF Director	*Signature on File 6/6/01*
AAA/TPO	Michael W. Cappiello / Date

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Agenda

Los Alamos National Laboratory

AAA Project Quarterly Review

February 6 & 7, 2001

Location: TA53, Bldg. 31
Pinon Conference Room

February 6

Session Chair, Mike Cappiello

8:00 - 8:10	Welcome	Ed Arthur
8:10 - 8:25	DOE Remarks	John Herczeg
8:25 - 9:20	AAA Project Overview AAA Program Goals Congressional Report Status	Ed Arthur
9:20 - 9:30	1.18 Project Controls	George Coward
9:30 – 9:45	Quality Assurance	Bob Baumbach
9:45 - 10:00	Break	
APT Topics		
10:00 - 10:45	1.17 Systems Engineering APT Preliminary Design Status Report Plans IMS Database Status and Archiving Plans	Larry Parme
	Accelerator Activities	
10:45 - 11:15	1.06 Accelerator Design	Joe Tooker
11:15 - 12:00	1.01 LEDA	David Schneider
12:00 - 1:15	**Lunch Break**	
1:15 – 1:30	1.04 Superconducting RF	Dominic Chan
1:30 – 1:45	1.04 High Energy Linac ED&D	Rich Sheffield
	Target/Blanket Activities	
1:45 – 2:15	1.07 Target/Blanket Design	Alan Baxter
2:15 - 2:45	1.02 Target/Blanket ED&D	Laurie Waters

2:45 – 3:00	Break	
	Session Chair, Rich Marquez	
	Tritium Separation Activities	
3:00 – 3:15	1.09 Tritium Separation Facility Design	Don McEachern
	BOP, Systems Engineering, ES&H Activities	
3:15 - 3:45	1.05, 1.11 Site, Buildings, and Balance of Plant	Ray Chuebon
3:45 - 4:00	1.08 Integrated Control System Design	Greg Campbell
4:00 - 4:15	1.19 Safety	Larry Parme
4:15 - 4:30	1.19 Environment and Permitting	Jack Roberts
	Operations Activities	
4:30 - 4:45	1.14 Operations & Maintenance	Brent Boore

February 7, 2001
ATW and ADTF Topics

Session Chair, Greg VanTuyle

	Facility Activities	
8:30 – 10:00	1.20 ADT Facility	Mike Cappiello/ Steve McConnell
10:00 - 10:15	Break	
10:15 – 10:45	1.19 ES&H - AAA	Jack Edwards
	Transmutation Activities	
10:45 – 11:15	FY01 Major Activities Overview	Greg VanTuyle
11:15 – 12:00	1.22 AAA Sys. Def. & Assess.	Deborah Bennett
12:00 - 1:15	**Lunch Break**	
1:15 – 1:45	1.26 Transmutation Proof of Performance	Deborah Bennett
1:45 – 2:15	1.24 Separations Technology	Jim Laidler
2:15 - 2:30	Break	
2:30 – 3:00	1.25 Transmutation Technology	Kemal Pasamehmetoglu
3:00 - 3:15	1.21 Collaborations	Greg VanTuyle
3:15 - 3:30	1.27 Academic	Denis Beller
3:30 – 4:00	Q&A, Wrap Up	Ed Arthur

Advanced Accelerator Applications Program (AAA)

Edward D. Arthur
AAA
Los Alamos National Laboratory

February 6, 2001

AAA Program Background

- PROGRAM CONCEPT: Use APT design and technology base, coupled with ATW technology development, to
  - Jump start transmutation technology development
  - Complete accelerator-based tritium technologies demonstration
  - Help reinvigorate the national nuclear science infrastructure by creating a new class of nuclear engineering test facility

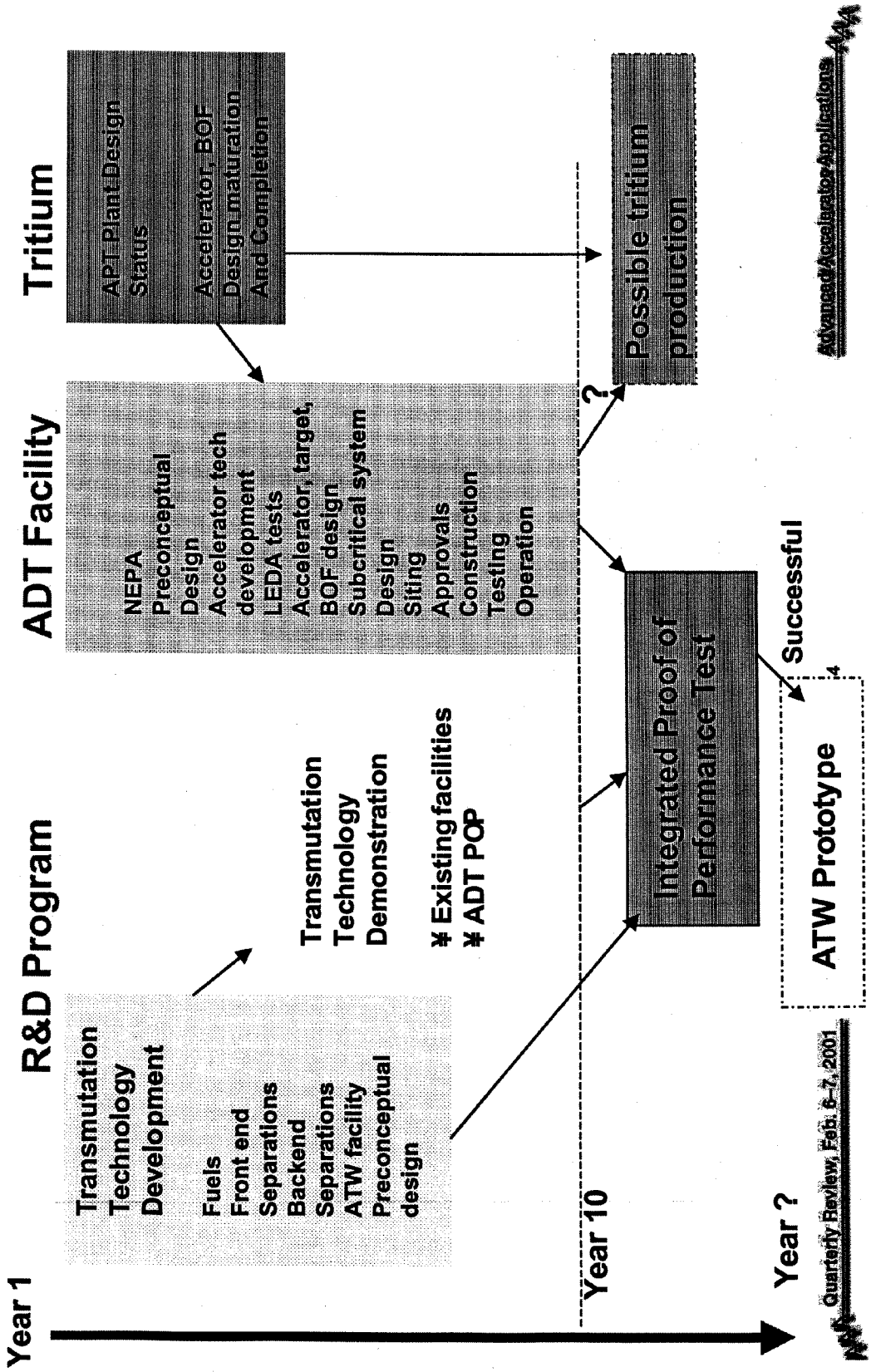
- FY01 funding - $68M
  FY02 - $70+ M (?)

- Participants
  - Los Alamos, Argonne, Savannah River
  - Burns and Roe, General Atomics
  - Universities (U Texas, UC Berkeley, Michigan) - more in FY01
  - Other DOE labs (LLNL, BNL, ORNL, Sandia)

The Five AAA Program Goals

- Develop technology base for transmutation
  - Fuels
  - Separations
  - High power accelerator and neutron target
- Demonstrate proof-performance (practicality) of transmutation as a meaningful approach to long-term nuclear materials management
  - Material balance
  - Coupling of an accelerator to a multiplying assembly (safe and reliable operation)
- Continue technology development for tritium backup capabilities
- Build the Accelerator Driven Test Facility
- Strengthen the domestic nuclear infrastructure (people and facilities)

AAA Major Program Focus and Top-Level Timeline



Addressing Major Issues

Transmutation	
• Environmental impact and perf	Demonstrate material balance (POP)
• Proliferation	Scenario analysis, tech demo
• Economics	Analysis
• Technology performance	Development, testing
The ADT Facility	
• Feasibility	Design and tech demo
• "Credibility"	Analysis of impacts, potential
Accelerator Benefit	
• Transmutation	Scenario development and
• Advanced Nuclear Systems	analysis
Tritium Production Capabilities	Design statusing, options development, wait for decisions

Key AAA Milestone Targets

AAA Effort Areas

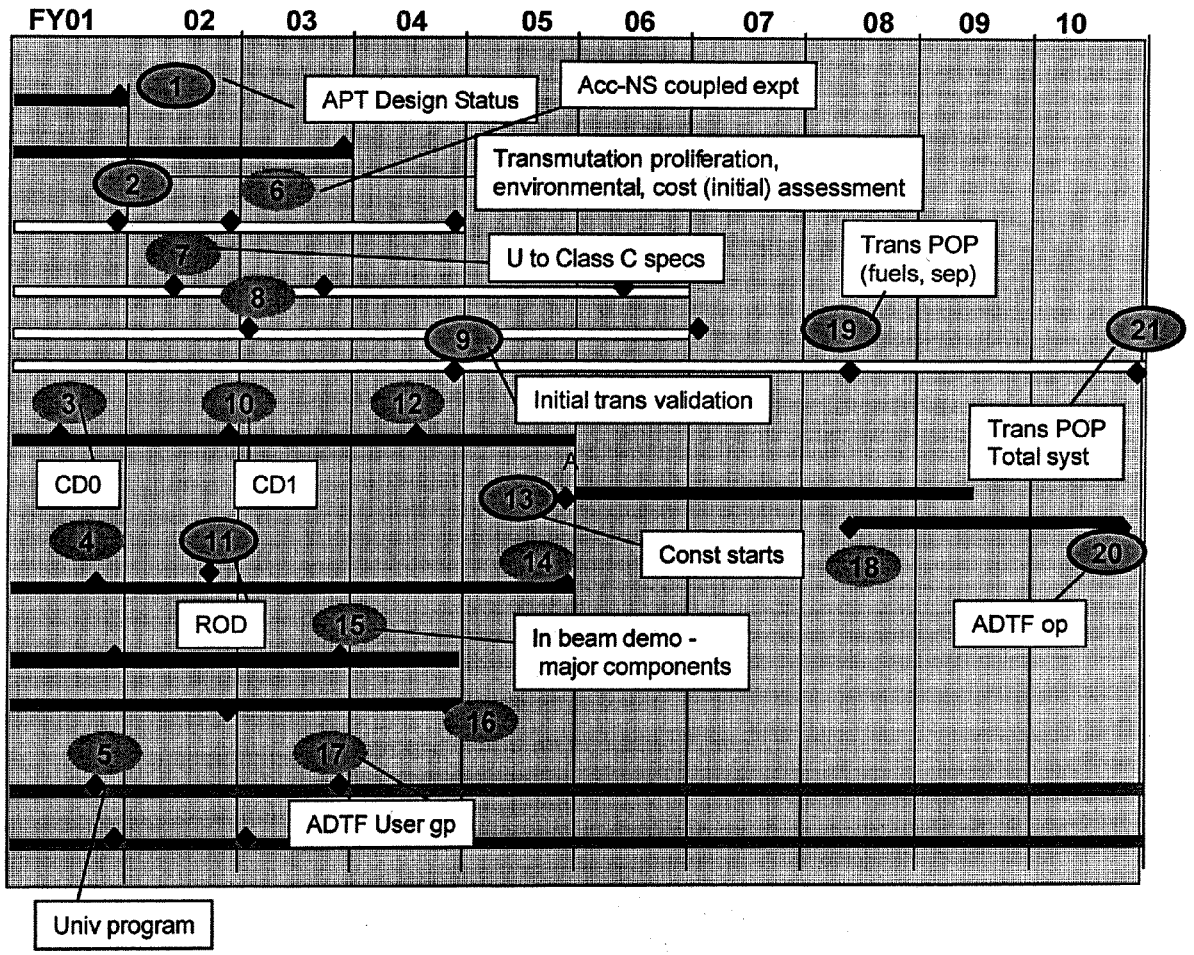
Tritium
- APT Design
- Accelerator Design *

AAA R&D
- Systems and design
- Separations
- Transmuter
- Proof Of Performance

ADT Facility
- Design
- Construction
- Operation
- ESH

- ED&D
  - Accelerator
  - Target/materials

Collaborations
- University
- Foreign



FY01 Top-Level Goals for AAA

- Successfully merge APT and ATW programs into a common AAA program

- Define a 10 year program
  - transmutation (supplant ATW roadmap)
  - ADT facility
  - tritium capability

- Aggressively execute the program

- Identify key priorities for 01 needed to
  - deliver March, 2001 plan to Congress
  - solidify support base for 02 and beyond
  - position for fast start on ADT Facility
  - focus transmutation technology development
  - meet tritium goals
  - maintain key capabilities

Major Deliverables for FY01

- **Report to Congress**
- **Status report of APT plant design and ED&D efforts with supporting database**
- **Effect BCP translating APT activities into AAA program in FY02**
- **Transmutation system performance requirements**
- **Transmutation system economics, environmental performance, proliferation risk assessment**
- **ADT Facility**
  - Establish master schedule
  - CD0
  - Initiate NEPA
- **LEDA beam halo test results**
- **Technologies**
  - fuel sample creation
  - separations flowsheet candidates defined

Report to Congress

- Requirements - Identify AAA missions, program, and annual cost estimates

- Schedule
  - 3rd draft complete
  - week of 2/5 review requirements and data needs
  - 2/12: final data inputs
  - 2/15: initiate management review and informal reviews
  - 2/22: report revised to reflect review input and comment
  - 3/1 report submitted to Congress

- Report outline
  - Introduction
  - Goals and objectives
  - Meeting technology challenges
  - Program plan
  - Cost targets
  - Program components

Advanced Accelerator Applications (AAA)
Quarterly Review
February 6-7, 2001

George Coward
Project Controls Manager
AAA Project Director's Office

Cost & Schedule Performance

- First quarter cost & schedule performance data not very meaningful
  - Continuing Resolution
  - Final budget guidance not received until mid November
    - » Work Packages not finalized until mid December
  - Delay in getting NE funds released & emergency Fin Plan allocations to institutions
  - All Work Packages were statused as level-of-effort for first two months of quarter
- Tracking 3 types of funding
  - DP Operating; DP Capital; NE Operating

Cost & Schedule Performance (cont'd)

- Budget allocation matrix includes $68M of new funds plus more than $10M of APT capital and operating carryover
  - DP Ops = $3000k; DP Cap = $7350k; ATW Ops = $100k
- Almost $2.5M in DOE taxes on new funds
  - NE taxes = 1,850k
  - DP taxes = 595k (includes 546k LANL security tax)
- Limited contingency
  - DP Ops = 883k
  - DP Cap = 1,000k
  - NE Ops = 1,150k
    - » Includes for 500k Russian Target & 150k MCNPX

Cost and Schedule Performance (cont'd)

- Cost & schedule indices not meaningful

- Total Project Cost Performance Index (CPI) = 1.03
  - DP Capital CPI = 1.04
  - DP Operating CPI = .79
  - NE Operating = 1.56

- Total Project Schedule Performance Index (SPI) = .89
  - DP Capital SPI = .91
  - DP Operating SPI = .89
  - NE Operating SPI = .85

AAA WBS Level 2 Cost Performance Report - December, 2000
Total ($000's)

Description	Current Month (ACWP)	Cumulative to Date Through 012/31/2000							Current Budget	Current EAC	FY01 Open Commit.	YTD Actual + Commit.
		Budgeted Costs BCWS	Budgeted Costs BCWP	Actual Cost (ACWP)	Schedule Variance	SPI	Cost Variance	CPI				
1.01: LEDA	$ 1,215	$ 4,485	$ 3,956	$ 3,789	$ (528)	0.88	$ 47	1.01	$ 15,933	$15,933	$ 120	$ 3,909
1.02:T/B (Target Blanket) & Mat'ls	$ 200	$ 532	$ 457	$ 628	$ (75)	0.86	$ (186)	0.71	$ 1,451	$ 1,451	$ 14	$ 643
1.03:Tritium Separation ED&D	$ 3	$ 13	$ 13	$ 7	$ (0)	1.00	$ 6	1.79	$ 50	$ 50	$ -	$ 7
1.04: High Energy Linac ED&D	$ 313	$ 705	$ 729	$ 981	$ 24	1.03	$ (445)	0.62	$ 3,050	$ 3,050	$ 193	$ 1,174
1.05: Plant Site & Buildings	$ 120	$ 447	$ 377	$ 333	$ (69)	0.84	$ 34	1.10	$ 1,553	$ 1,553	$ 10	$ 343
1.06: Linac Complex	$ 476	$ 1,615	$ 1,597	$ 1,239	$ (18)	0.99	$ 207	1.15	$ 5,622	$ 5,622	$ 151	$ 1,390
1.07:Target Blanket System	$ 340	$ 1,373	$ 1,103	$ 1,098	$ (270)	0.80	$ (58)	0.95	$ 3,839	$ 3,839	$ 62	$ 1,161
1.08: Integrated Control System	$ 13	$ 77	$ 77	$ 54	$ -	1.00	$ 19	1.34	$ 279	$ 279	$ 3	$ 57
1.09: Tritium Separation Facility	$ 53	$ 261	$ 229	$ 156	$ (32)	0.88	$ 61	1.36	$ 698	$ 698	$ 12	$ 168
1.11: Balance Of Plant Systems	$ 179	$ 680	$ 611	$ 614	$ (70)	0.90	$ (17)	0.97	$ 2,339	$ 2,339	$ 14	$ 627
1.14: Operations & Maintenance	$ 51	$ 236	$ 236	$ 217	$ -	1.00	$ 19	1.09	$ 800	$ 800	$ -	$ 217
1.17: Systems Engineering	$ 195	$ 674	$ 620	$ 565	$ (54)	0.92	$ 23	1.04	$ 2,294	$ 2,294	$ 33	$ 598
1.18: Project Management	$ 780	$ 2,348	$ 2,348	$ 2,157	$ -	1.00	$ (124)	0.95	$ 9,519	$ 9,519	$ 315	$ 2,472
1.19: Environment, Safety & Health	$ 90	$ 311	$ 385	$ 283	$ 74	1.24	$ 100	1.35	$ 1,980	$ 1,980	$ 3	$ 286
1.20: Accel. Demo. Test Facility	$ 215	$ 651	$ 485	$ 342	$ (166)	0.75	$ 143	1.42	$ 3,948	$ 3,948	$ -	$ 342
1.21: Collaboration	$ 5	$ 18	$ 18	$ 5	$ -	1.00	$ 14	3.87	$ 100	$ 100	$ -	$ 5
1.22: AAA Sys. Def. & Assessment	$ 194	$ 944	$ 635	$ 440	$ (309)	0.67	$ 33	1.05	$ 4,486	$ 4,486	$ 163	$ 603
1.24: Separations Technology	$ 134	$ 645	$ 119	$ 336	$ (526)	0.18	$ (218)	0.35	$ 2,800	$ 2,800	$ -	$ 336
1.25: Transmuter Technology	$ 347	$ 1,330	$ 1,411	$ 679	$ 81	1.06	$ 724	2.05	$ 6,734	$ 6,734	$ 8	$ 687
1.26: Transmuter Proof of Perf.	$ 10	$ 83	$ 120	$ 10	$ 37	1.45	$ 110	12.24	$ 400	$ 400	$ -	$ 10
1.27:UNLV	$ -	$ -	$ -	$ -	$ -	-	$ -	-	$ 3,000	$ 3,000	$ -	$ -
Subtotal	$ 4,934	$ 17,426	$ 15,524	$ 13,932	$ (1,902)	0.89	$ 491	1.03	$ 70,875	$70,875	$1,101	$ 15,034
DOE Funds									$ 2,513	$ 2,513		
Reserve for DOE Taxes									$ 2,445	$ 2,445		
Contingency									$ 3,033	$ 3,033		
Contingency/DOE Funds Subtotal									$ 7,991	$ 7,991		
Project Total									$ 78,866	$78,866		

BCWS = Budgeted Cost of Work Scheduled

BCWP = Budgeted Cost of Work Performed

SPI = Schedule Performance Index = BCWP/BCWS

CPI = Cost Performance Index = BCWP/(ACWP + Commitments)

ACWP = Actual Cost of Work Performed

Project had 10 Level 2 Milestones Due During First Quarter of FY01

- **WBS 1.01 - LEDA**
  - Four due, two completed
- **WBS 1.02 - Target/Blanket and Materials**
  - Four due, none completed
- **WBS 1.04 - Linac SCRF**
  - Two due, one completed
- **WBS Level 2 managers will discuss details**

Baseline Change Proposals and Contingency Actions

- No Baseline Change Proposals (BCPs) were processed in the first quarter
- No contingency was used during the first quarter

APT Re-baseline

- Baseline Change Proposal (BCP) will be submitted to DOE to change APT's current baseline (due March 1)
- BCP scope will include FY01 DP funded work (operating & capital) and FY02 NE capital funded design effort
- APT specific work will be completed in FY01 and the Preliminary Design Status Report will be issued in September
- FY02 design work will be adapting portions of the APT design that will support the Accelerator Driven Test Facility (ADTF)
- APT "Line Item" will be terminated at the end of FY02

Issues

- Very little contingency available for unexpected problems
- Fin Plan process needs to be improved
  - Some institutions still do not have their NE funds
- Tight schedule for the APT BCP submittal by March 1

Project Controls Summary

- Continuing Resolution and delay in NE funds caused the project to have a rough start in FY2001
- Cost and schedule indices not meaningful - will need a couple of months to settle down
- APT re-baseline BCP to be submitted by March 1
- Milestone performance needs to be improved

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

Robert Baumbach, Quality Assurance
February 6, 2001

Quality Assurance means all those actions that provide confidence that quality is achieved.

- *ACTIONS! Whose actions?*
  - *YOURS.*
  - *Quality is attained by all of us performing through plans, procedures and direction.*
  - *The performing functions are those of engineers, designers, scientists, planners, directors, controllers, schedulers, manager, supporters, and staff who attain quality by following plans and procedures on the job.*
- *So what are the QA folks paid for?*
  - *QA verifies quality through audits, inspections, reviews and similar activities.*

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

Closed audit of the APT Records Management and Document Control (RMDC) program.

Reviewed approximately 122 documents.

Prepared eleven (11) inspection plans.

Conducted six (6) receiving inspections.

Conducted seven (7) in-process and final inspections.

Twelve (12) nonconformance reports (NCR) were opened.

Fourteen (14) NCR were closed during the quarter.

Six (6) NCR remained open at the end of the quarter

QA Look Ahead

- *Ongoing review, comment, inspection, and reporting.*
- *Develop AAA Quality Assurance Program Plan*
- *Perform the APT (AAA) PPO Quality Assurance Audit Schedule 2001.*
  - *PPO-01-01 APT Project Work Packages Second Quarter*
  - *PPO-01-02 APT Preliminary Design Plan Second Quarter*
  - *PPO-01-03 APT Records Management Third Quarter*
  - *PPO-01-04 AAA Program Preparations Third Quarter*
  - *PPO-01-05 AAA Document Control Fourth Quarter*
- *Perform surveillances of ongoing work activities.*

Quality Assurance Observations, Concerns and Issues

Quality Assurance requires assignment of responsibilities and authorities, definition of policies and requirements, and provision for the performance and assessment of work.

It's the regulation, 10CFR830.120!

It's the order, DOE O 414.1A!

Advanced Accelerator Applications needs its own specific Policies, Plans and Procedures. We can't continue using those that worked for the APT.

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01

WBS 1.17
Systems Engineering

Laurence L Parme, Level 2 Manager

February 7, 2001

Major Activities Planned for FY01

- Update *Preliminary Design Plan*
  - Revise Plan to reflect FY-01 planning and backup Baseline Change Proposal
  - Planned for 26 January 2001
- Coordinate preparation of *Preliminary Design Status Report* - 28 September 2001
- Update *Facility Design Description* and subordinate Plant Requirements Documents to resolve outstanding comments and provide consistency in plant requirements
- Support preparation of (30) System Design Descriptions

Major Activities Planned for FY01 (continued)

- Operate APT Records Control Document Management System including
  - Information Management System
  - Archive APT documentation at end of year
- Cost estimating
  - Support ongoing Design Change Requests with cost estimating
  - Update Reference Design Cost Estimate to reflect status at end of year

Milestone Status for FY01

- Preliminary Design Plan - Level 2 Milestone
  - Originally scheduled for release Jan 26
  - Delayed to allow coordination with BCP guidance
  - Plan drafted in December - comments received and in final preparation
- Facility Design Description (FDD) & Plant Level Requirements revisions
  - In progress
  - Completion planned by 27 April - on schedule
- Preliminary Design Status Report
  - Rough draft completed based on existing materials
  - Provided to WBS leads for development or revision
  - Completion planned by 28 September - on schedule

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

- FY-01 work pakages and schedules were completed reviewed and approved
- Drafted and provided for review and comment
  - Preliminary Design Plan, &
  - Preliminary Design Status Reports
- Successfully archived first boxes of APT engineering documents
- Drafted revisions and submitted for review
  - Environmental requirements
  - Revised availability requirements
- Conducted SDD preparation workshops in Aiken & Oradell
- Completed documentation of updated Linac availability calculations

Planned Activities for Jan-Mar 2001
(Second Quarter FY01)

- Release Revision 2 of Preliminary Design Plan
- Submit FDD Revision C for review
- System Design Descriptions
  - Support preparation and release of ~10 documents
  - Maintain Interface Control
  - Conduct preparation workshop in La Jolla
- Configuration Management
  - Operate APT Records Control Document Management System
  - Maintain APT Information Management System (IMS)
- Support preparation of DCRs including cost changes due to design evolution

Issues

- Need to adopt APT plans & procedures to AAA
  - Vital for "real" project
  - Required for meaningful conceptual design
  - Essential if Preliminary / Final Design to proceed in timely manner
- Records Management and Document Control for AAA is needed
  - Plan for extending APT-like IMS system to AAA completed
  - Decision and resources to execute plan required
- Need to keep "critical mass" of staff together

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

Preliminary Design Status Report

Laurence L Parme, Systems Engineering Manager
February 7, 2001

Preliminary Design Status Report Provides an Overview and Roadmap of APT

- Overview of the APT, including history, mission and scope.
- Provide the technical basis for project restart including
  - plant and major system functions and performance requirements,
  - design bases and constraints,
  - documentation of the basis and rationale for selection of design alternatives, and
  - status of Project technical risks at completion of the backup design phase.
- Integrate design and ED&D giving
  - an overview of the design and ED&D status,
  - how the two relate to one another, and
  - advanced techniques that could be used for future accelerators or tritium separation applications

Purpose of Report (continued)

- Provide a road map for the larger compilation of documentation (the *Preliminary Design Package*) containing the details of the preliminary design and ED&D
- Summarize APT cost and schedule, including the activities, time periods and costs needed to complete design, construction and commissioning the facility.
- Capture other information not readily presented as engineering documentation, such as
  - lessons learned during the Project, and
  - any risks from incomplete test programs.

Outline Covers Purposes of Report

Executive Summary

1 Introduction

2 APT Project Overview

3 Document Management

4 Summary of Preliminary Design and Engineering Development

5 Plant Assessments

6 Cost Status Summary

7 Project Restart

Detailed annotated outline available in Appendix A of Preliminary Design Plan

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.17
Information Management System (IMS)

Laurence L Parme, Level 2 Manager
February 7, 2001

APT Records & Document Control Based on Information Management System (IMS)

- System to control all project documents and records
  - Inventories and tracks all documents & records
  - Automates many records management & document control tasks while providing error checking
  - Provides auditable trail of all document changes
  - Maintains old or superseded versions of documentation
  - Database attributes store additional document data
  - On-line backup without downtime
- Vehicle for information dissemination
  - Accessible to all project participants at multiple locations
  - Organized and searchable by "document tree structure"
  - Users can view or print PDF documents or download native files
  - Displays latest version of "approved" documents

APT Information Management System Offers Additional Desirable Features

- System features based on Configuration Management & Project Controls procedures
- Relatively flexible, economical, and robust
  - Built around commercial, off-the-shelf software (Documentum, SQL Server) customized to our business practices and project needs
  - Software needed by general users is free and has extensive history of successful use (Internet browser and PDF reader)
- System is capable of growth
  - Document routing
  - E-mail notification of document changes
  - Electronic authentication, etc.
  - Easily adaptable to other large projects

APT Information Management System Offers Additional Desirable Features

- Provides security & ensures records integrity
  - Usernames / passwords for security
  - Records Management / Document Control (RMDC) staff control contents
  - Users cannot change contents
  - Access control by user, group, document
- Provides Records Management & Document Control Center staff with additional "privileges"
  - Allows document or record entry
  - Can see ALL records and documents and access older (superseded) versions of documents
  - Perform complex searches if required
  - Generate reports

IMS Is Not The Legal Record - Only a part of Records Management & Document Control

- Information (IMS)
  - Electronic documents
  - No signatures
  - Cannot be used for procurement, etc.
  - Provide user with copy of current documentation
  - Paper documents scanned in as needed
  - Not all documents in the system

- Records system (RMDC)
  - Information (IMS)

    Plus...
  - Paper copies
  - Signatures
  - Used for procurement, etc.
  - Everything in the system

Keys to Our Success with Information Management System and Records Management / Document Control

- Defined goals
  - What the system is to accomplish
  - What to control
  - Who is the audience
- Comprehensive, written procedures controlling project processes
  - Provides structure for system
  - Controls system usage
- Clear definition of document types
  - What to control, what you need back (reports)
- Strong team leader
- Strong and unequivocal project support

Keys to Success (continued)

- User-friendly
  - System useful to staff in getting the job done
  - Users understand how to use the system
  - System is maintained current
  - Accessible at all project sites

- Use commercial off-the-shelf software
  - Wide user knowledge base
  - Stable maintenance support options
  - Rapid development
  - Easily expandable in scope and function

Advanced Accelerator Applications (AAA) Quarterly Review

Oct-Dec 2000

WBS 1.06
Linac

Joe Tooker

February 6, 2001

Major Activities Planned for FY01

- *Design Integration*
  - *Revise Reference Design cost estimate & schedule*
  - *Compile subsystem inputs into Preliminary Design Summary Report*
- *Injector*
  - *Assembly & General Arrangement drawings; ICDs; P&IDs*
- *RFQ*
  - *Movement method; revised ICDs; RCCS layout; updated cost estimate*
- *CCDTL & CCL (incorporates BCP-F003)*
  - *Determine minimum coupling requirements and designs to achieve the required coupling*
  - *Evaluate 8__ lattice--clearances, partitioning, & impacts to other systems*
  - *Evaluate slot field enhancements*
  - *Process Design Change Request*

Major Activities Planned for FY01

- *High Energy Linac*
  - *General Arrangement drawings; cryomodule assembly drawings*
  - *Thermal & structural analyses*
  - *High Order Mode coupler concept*
  - *Revise SDD*
- *Radio Frequency Power System*
  - *Gallery & tunnel layout drawings; maintenance issues; and P&IDs*
  - *Report on Low Level RF control algorithms*
  - *Revise SDD*
- *Cryogenics System*
  - *ICDs & P&IDs*
  - *Transfer line drawings and thermal-mechanical analyses*
- *Beam Diagnostics & Linac Maintenance Facility Equipment*
  - *SDDs: Section 1 and App B&C*

Milestone Status for FY01

- ***Status of level 3 milestones***

Activity	Description	Status
AC0F0065	Issue General Arrangement Dwg - Injector	Completed 15Dec00
AC0F0205	Issue General Arrangement Dwg - HE Linac	Completed 18Dec00
AC0F0370	Issue SDD Sect 1 & App B&C - Beam Diag	Completed 31Jan01
AC0F0385	Issue SDD Sect 1 & App B&C - Linac Maint	Due 31Jan01, project 7 days late
AC0F0450	Issue LLRF Report	Due 15May01, on schedule
AC0F0590	Issue DCR on CCDTL/CCL	Due 01Jun01, on schedule
AC0F0265	Issue SDD - RF Power System	Due 16Jul01, on schedule
AC0F0235	Issue SDD - High Energy Linac	Due 16Jul01, on schedule
AC0F0050	Issue input-prelim design status report	Due 27Jul01, on schedule

Major Accomplishments for Oct-Dec 2000

- *Level 4 Milestones completed*
  - *Injector Assembly Drawings*
  - *Injector P&IDs*
  - *RFQ ICDs*
  - *RFQ Cost Estimate*
- *Issued cost estimate on RFQ, CCDTL, & CCL vacuum systems*
- *PPO and TPO undertook a joint review of the CCDTL and CCL architecture; processing BCP-F003 to address issues*
- *Developing a revised cryomodule shield cooling circuit to improve cryogenic system requirements*
- *Issued Low Level RF functions and requirements document*
- *Working with OPO and BOP, revised gallery RF layout for maintenance & developed klystron replacement method*
- *DCR for Cryoplant was approved for revised heat loads*

Planned Activities for Jan-Mar 2001

- *SDDs: Beam Diagnostics & Linac Miscellaneous Systems*
- *ICDs: Injector & Cryogenics System*
- *RFQ, CCDTL, and CCL RCCS layout drawings*
- *RFQ movement drawings*
- *Report on field enhancement and rectangular coupling slot in CCL segment 243*
- *RF gallery maintenance report*
- *Revise klystron specification to improve maintainability and remove modulation anode*
- *RF water cooling P&IDs and klystron water cooling manifold layout*

Other Activities

- **ES&H Activities**
  - Designs to improve safe handling and replacement of RF klystrons and components in gallery
  - Investigating reduction of operating pressure in cryomodule shield cooling circuit from 18 atm to 4 atm
- **QA Activities**
  - Support cold model activities
  - Document reviews

Issues

- ***Retain key personnel to continue accelerator design***

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.01 Low-Energy Demonstration Accelerator

J. David Schneider & H. Vernon Smith
Project Leaders
February 7, 2001

Topics for LEDA Quarterly Summary

- Review of work scope
- Documentation status
- Accomplishments
- Planned work
- Milestone status
- Highlights of technical accomplishments
  - CCDTL
  - Halo measurements

Major LEDA Activities Planned for FY'01

- Confirm ADTF component designs; reduce surprises and delays
  - Benchmark design codes
  - Improve budget and schedule estimates
  - Conduct operator training and define commissioning procedures
  - Qualify major components performance before using at ADTF
- Qualify beam-halo codes
  - Add beam diagnostic gear to extended beamline
  - Introduce deliberate mismatch, observe halo growth and behavior
  - Characterize and understand RFQ output beam
  - Correlate pulsed-mode measurements with cw mode operation
  - Use observed effects to predict halo effects in ADTF

Additional LEDA Activities for FY 2001

- Determine suitability of normal-conducting structures
  - Assemble and tune CCDTL section 2
  - Perform hot-model test of CCDTL section 2
  - Construct CCDTL section 1
  - Conduct beam tests with sections 1 & 2 (FY'02)
  - Update cost estimates & and refine the detailed design
- Document and improve accelerator operational reliability
  - Determine and document the systems causing beam trips
  - Devise corrections and fixes to these most-troublesome systems
  - Implement reductions of beam-recovery times

Additional Accelerator Structure Testing on LEDA

- LEDA can be used to test additional accelerating structures prior to use on the ADTF.
  - These may be additional CCDTL structures.
  - Assuming studies, fabrication, and off-line testing continue to be promising; we can run beam tests with a prototype low-beta, spoke-cavity SCRF structure.
- Other expected hardware testing will verify components (such as RF sources and windows) planned for use on ADTF.

First-Quarter LEDA Milestone Status for FY01

Milestone	Due Date	Status
HVDC Power Supply Performance	10/31/00	Complete
700-MHz Klystron Performance	10/31/00	Complete
700-MHz Circulator Performance	1/31/01	Final signatures
700-MHz Ripple Response	1/31/01	In modification

Anticipated LEDA Milestone Completion Status for 2nd thru 4th Quarters of FY'01

Milestone	Due Date	Expected
RFQ constructability & performance	4/20/01	4/20/01
End of halo data acquisition	*6/8/01*	*6/15/01*
LBHM power stop band perf.	9/4/01	9/4/01
LBHM RCCS performance	9/4/01	9/4/01
Beam halo final report	9/28/01	9/28/01

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

- The installed diagnostics gear was shown to perform very well.
- The RFQ, and entire LEDA system performed beautifully with 20-μs, 1 or 2 pps beam operation.
- We verified that the RFQ output beam transported as predicted through the halo magnet lattice.
- We are nearing completion of pre-braze tuning of CCDTL section 2.

Planned Activities for Jan--Mar 2001
(Second Quarter FY01)

- Continue beam-halo measurements
- Further characterize the RFQ output beam
- Complete assembly of the CCDTL section 2
- Set up section 2 for hot-model RF testing
- Commence pre-braze stack tuning of CCDTL section 1
- Start preparing for installing the CCDTL (sections 1 & 2) on the beamline
- Identify steps to improve reliability

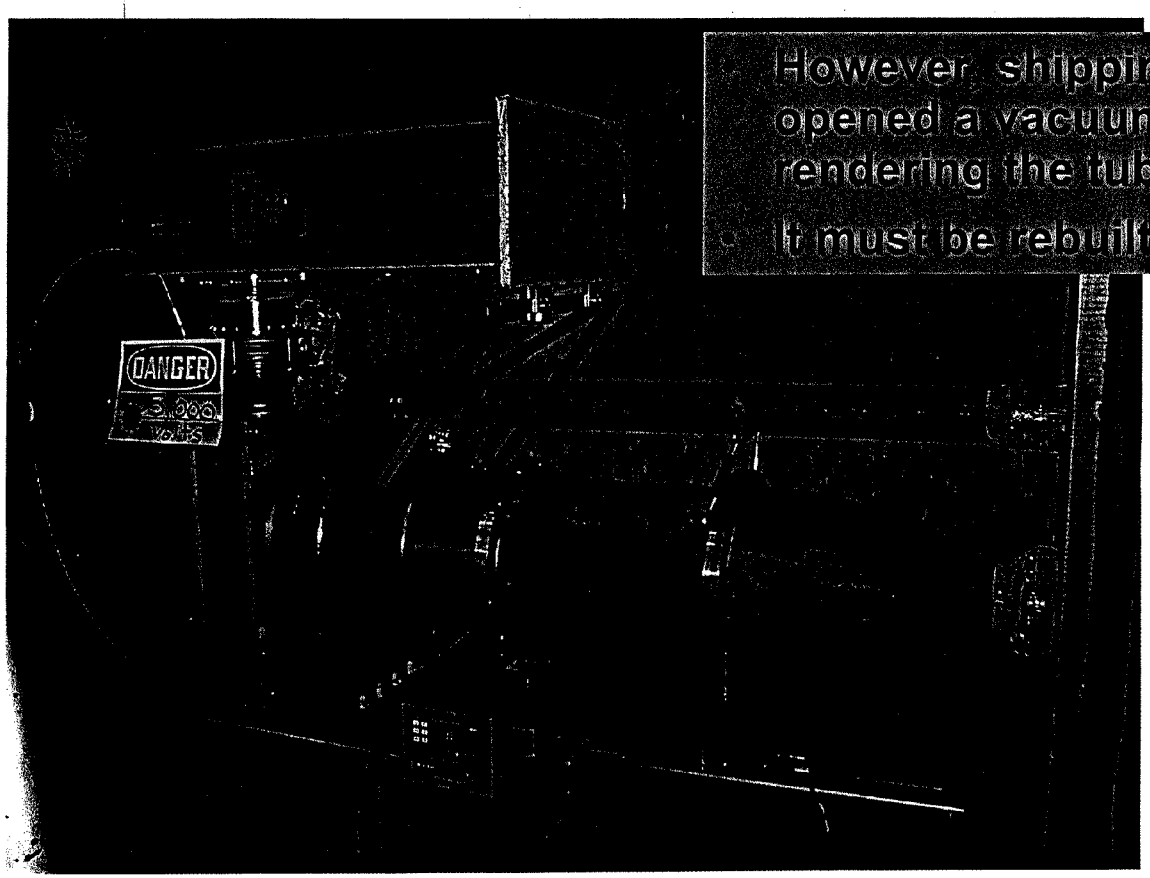
Safety, Compliance, and QA Highlights

- The modified plan for self assessment was submitted to LANL, reflecting the transition from APT to AAA.
- The safety team submitted the annual report for the LEDA (environmental) mitigation action plan.
- Prestart findings for the halo measurement were closed out on Oct 19.
- LEDA has approximately 150 official (safety-related) documents in the Q/A files.
- We continue regular meetings and updates on LIRs, facility tenants, RCT interfaces, organizational safety, & LEDA-specific safety training.

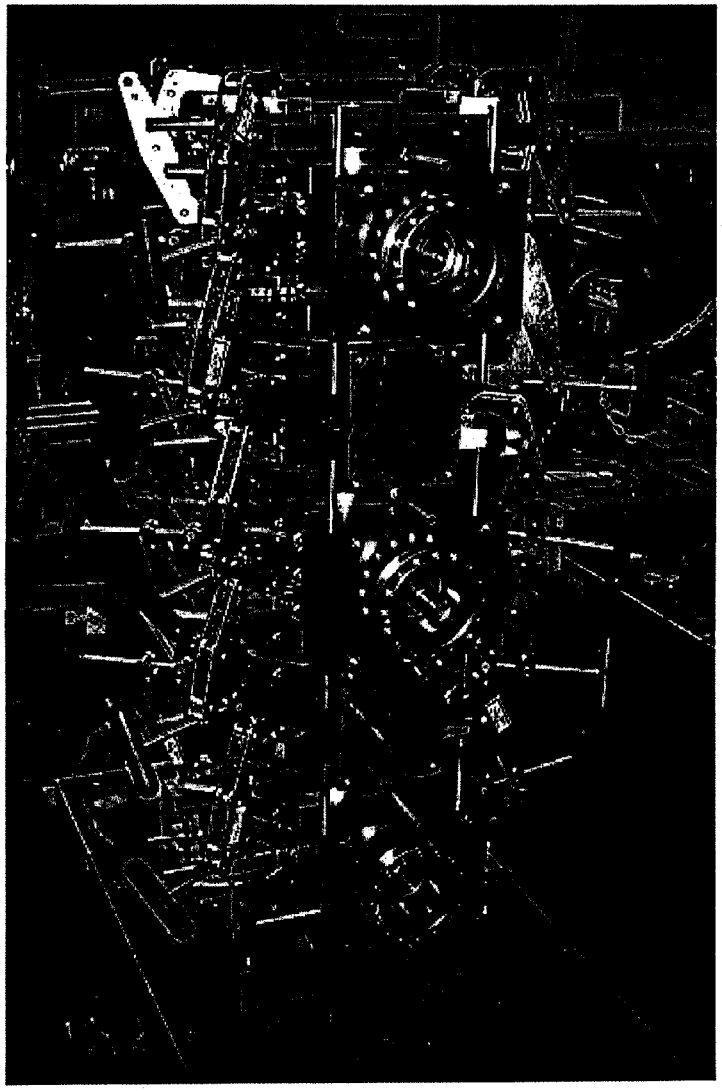
Major LEDA Issues

- Still no spare 350-MHz klystron
  - Replacement tube showed multipacting at pre-ship checkout
  - Our rebuilt tube was damaged in shipment and lost vacuum
- AC Power shortage and complications
  - LEDA demands nearly 10 MW of ac power (highly variable)
  - Shortages in California are increasing costs of power.
- Delays in completion of the CCDTL
  - Section 2 nearly assembled
- Resource shortage due in part to SNS demands

The repaired 350-MHz klystron with the redesigned beam collector finally arrived from EEV.



- However, shipping damage opened a vacuum leak, rendering the tube useless
- It must be rebuilt again

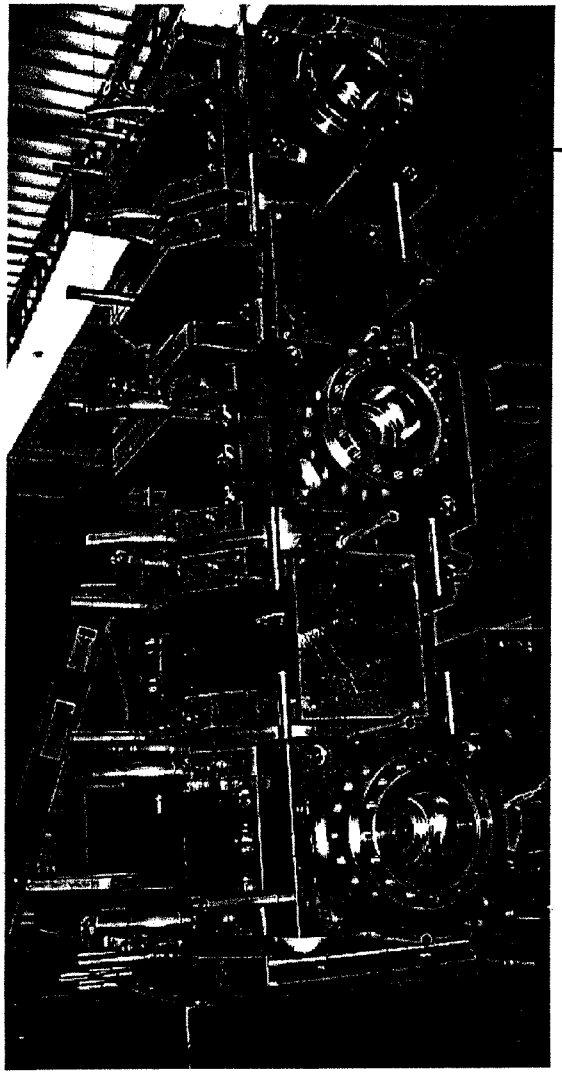


January, 01

LEDA

One step in the stack tuning of the CCDTL

- This shows one of the many 'stack and clamp' steps needed to effect proper tuning of the LEDA section 2 CCDTL structure.
- An iterative procedure is necessary to get the proper resonant frequency, correct field distribution, appropriate coupling, good surface contact, and proper cavity Q.



CCDTL Section 2 Stacked, and nearly tuned

- This vertical configuration will be used inside the hydrogen braze furnace to convert these 'parts' into a solid accelerating structure.
- Each individual part has been machined, brazed, leak-checked, inspected, and tuned.
- Before final stacking for furnace heat, each piece will again be cleaned meticulously, then carefully stacked with appropriate braze foils and wires.

Challenges seen with CCDTL stack tuning and preparation

- We were forced to rebuild one endwall because of a dimensional error during machining.
- It has been difficult to get consistent good contact on the stacked flanges.
  - This contributed to a poor {and decreasing} Q (quality factor) during measurements.
  - The use of sulphur-free, condutive oil provides a good electrical contact and aids tuning. Meticulous cleaning of this surface is essential for subsequent brazing.
- Measured resonant frequencies after multiple corrective cuts gave a resonant frequency acceptably close to predicted values.

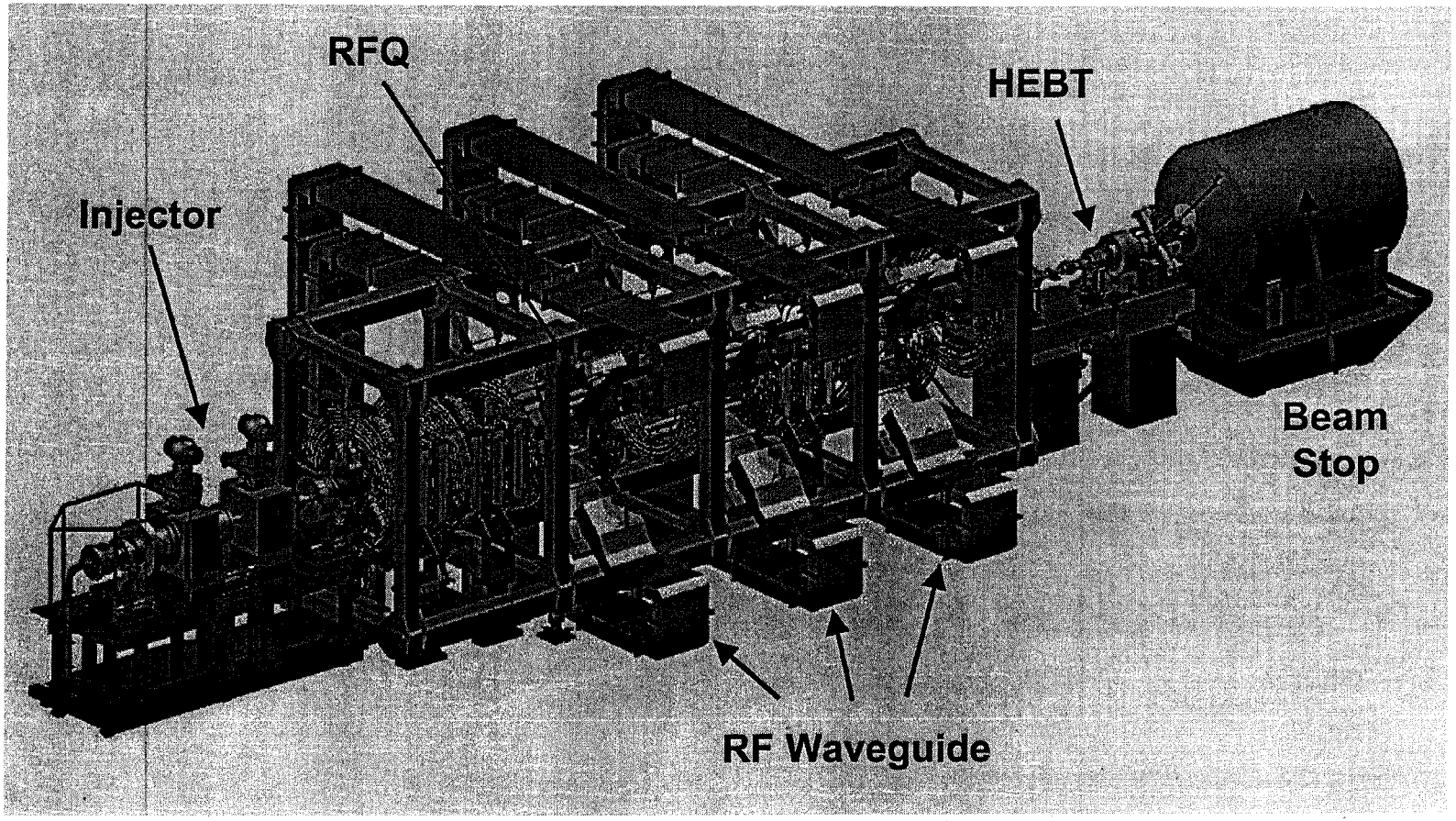
Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.01 Low-Energy Demonstration Accelerator Halo Measurements

Vernon Smith
David Schneider
February 6, 2001

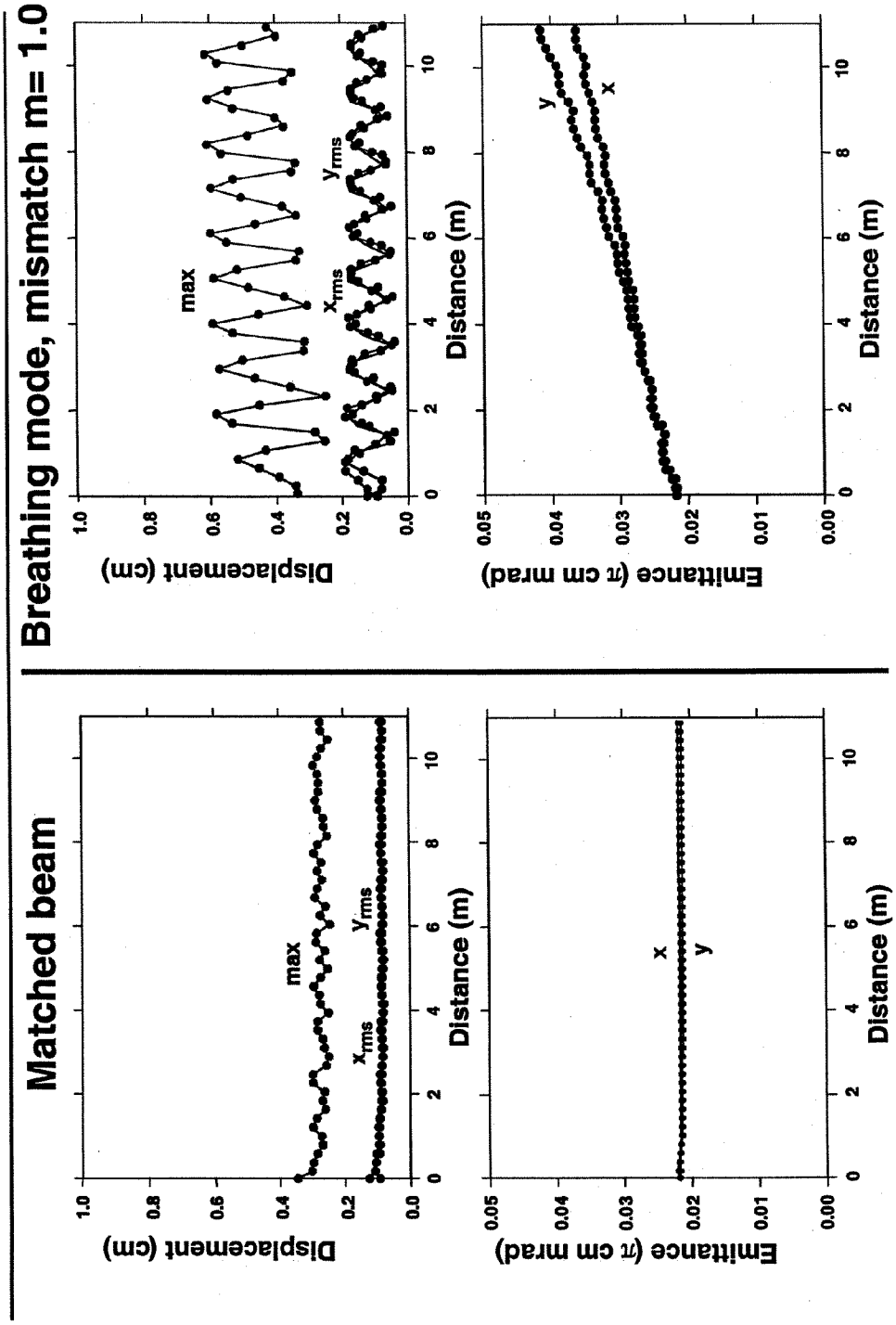
LEDA Consists of an Injector, 6.7-MeV RFQ, HEBT, and Beamstop.



Beam-Halo Measurement

- If particle losses in high-energy accelerators are not controlled, components can become activated
- Mechanisms such as beam-halo formation can lead to particle losses
- Because of the high risks associated with small amounts of beam loss, it is important to benchmark our beam-halo codes
- We are preparing to intentionally introduce halo in a 52-magnet channel, measure the resulting particle distributions, and compare the results with the simulation codes

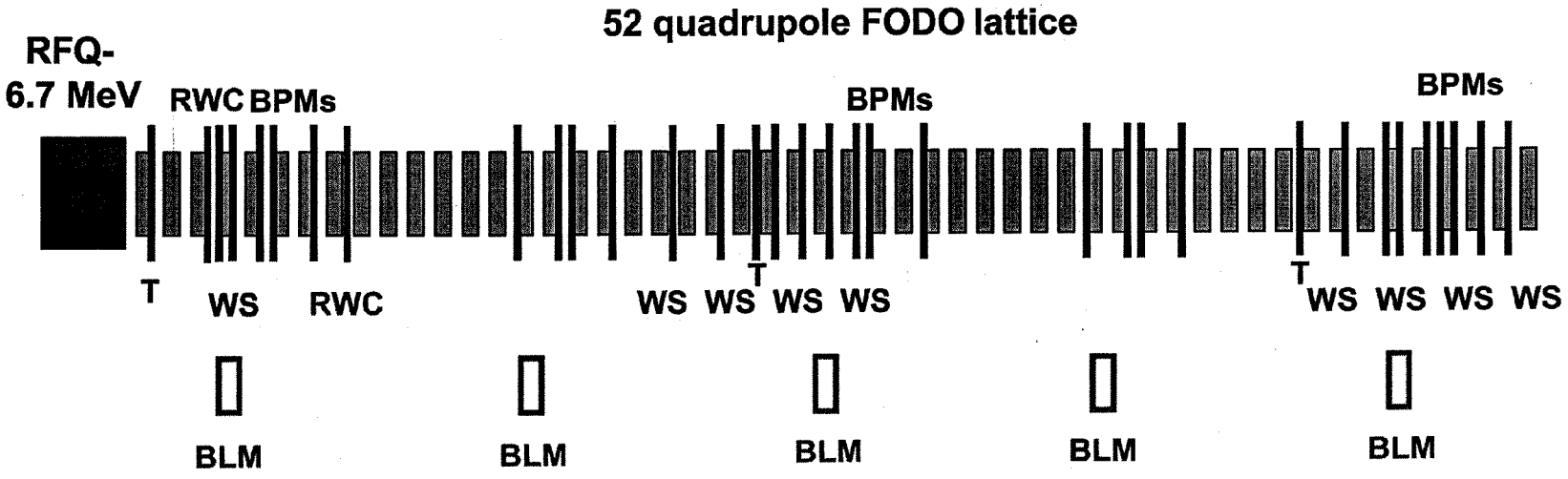
Simulated results of beam-halo measurements.



Measurements for each mismatch condition.

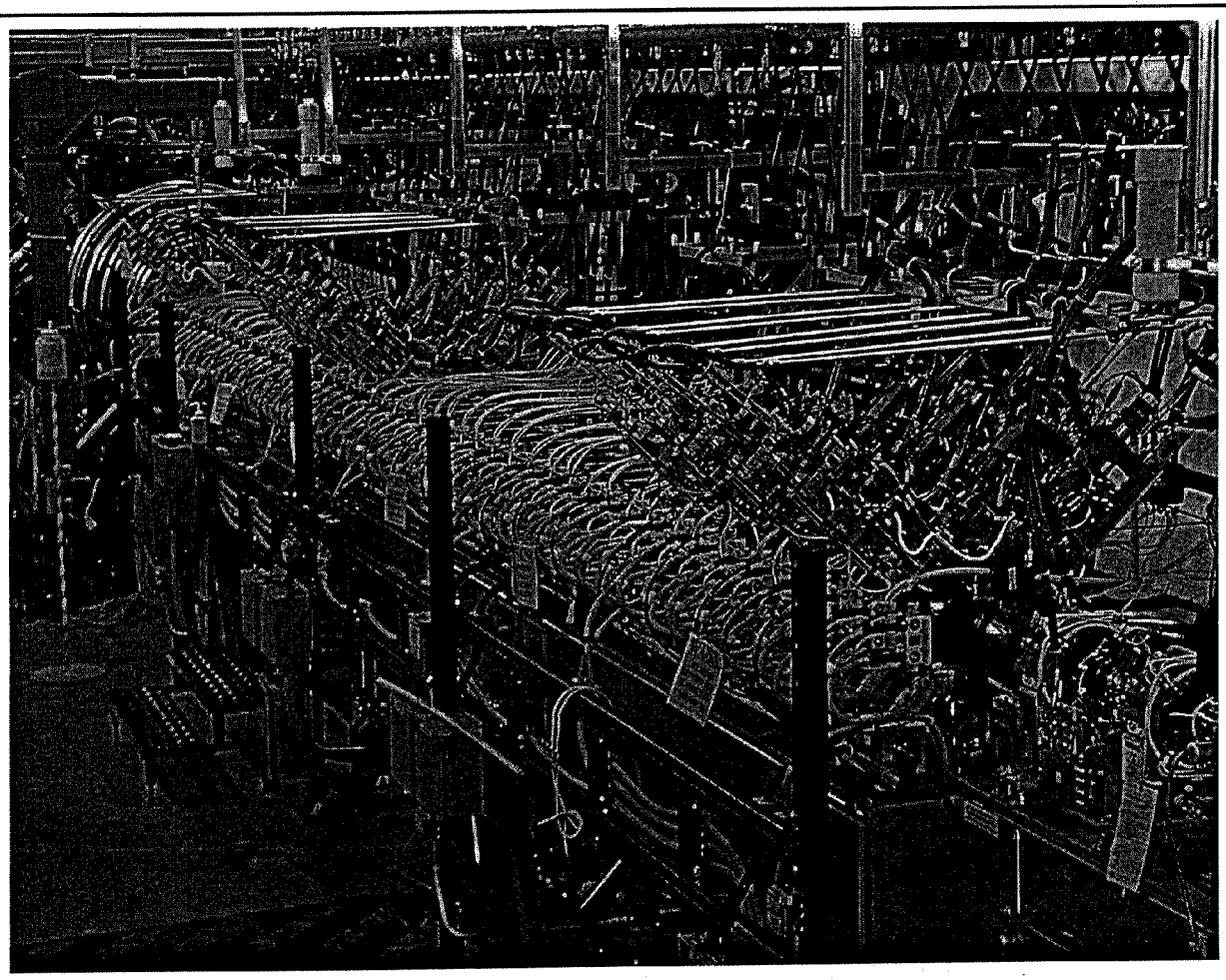
- Measure beam profile at each halo-scraper, wire-scanner location.
  - Extract rms sizes, 4th moments, and maximum detectable amplitudes from each scraper-scanner measurement.
  - Extract rms emittances at the halo channel mid-point and exit
  - Extract rms emittance at the RFQ exit, if possible.

Fully-instrumented LEDA beam-halo channel

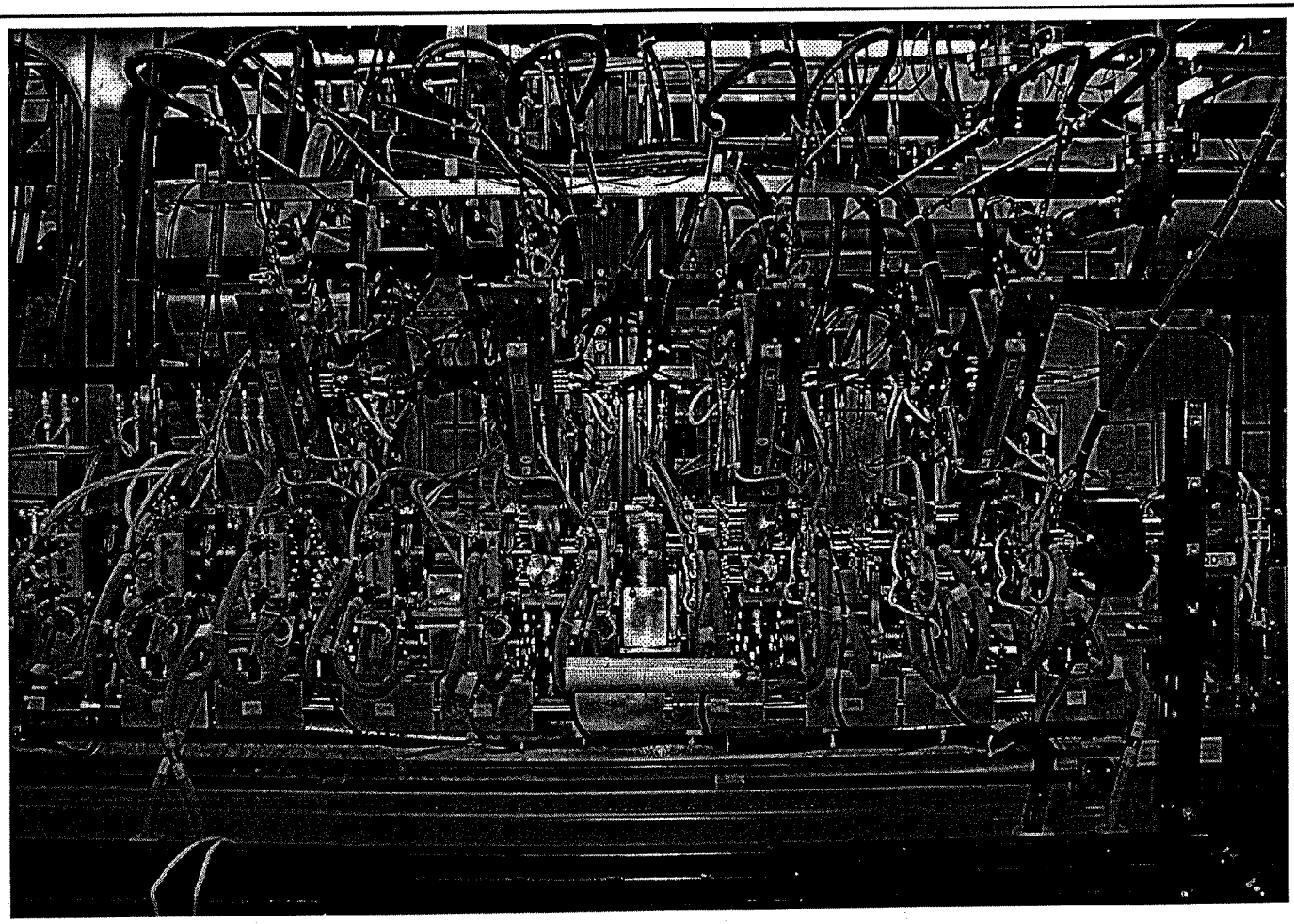


52 Quadrupole Magnets
10 Steering Magnets
9 Halo-Scraper, Wire-Scanner Assemblies
3 Toroids
10 Beam-Position Monitors
5 Beam-Loss Monitors
2 Resistive Wall-Current Monitors

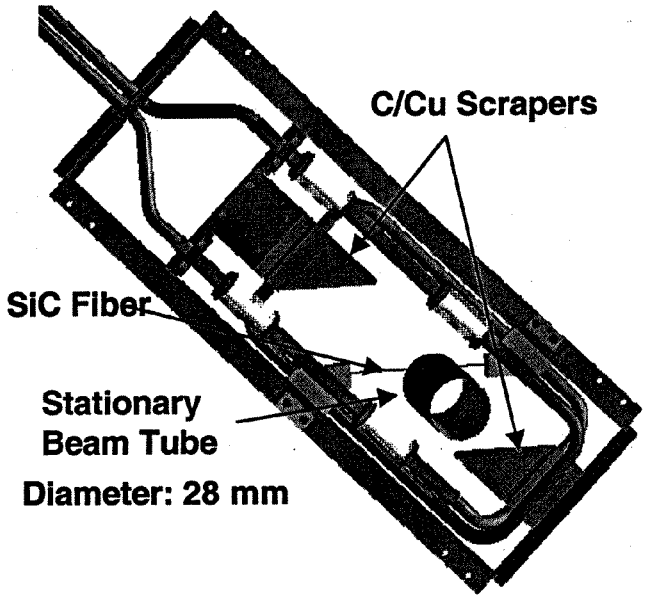
The halo equipment is completely installed on the beamline.

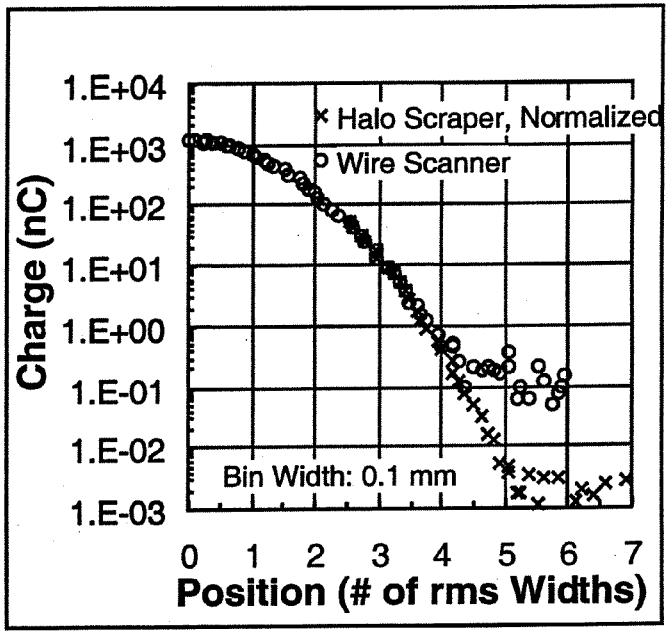


The four halo-scraper, wire-scanner assemblies at the end of the halo channel.



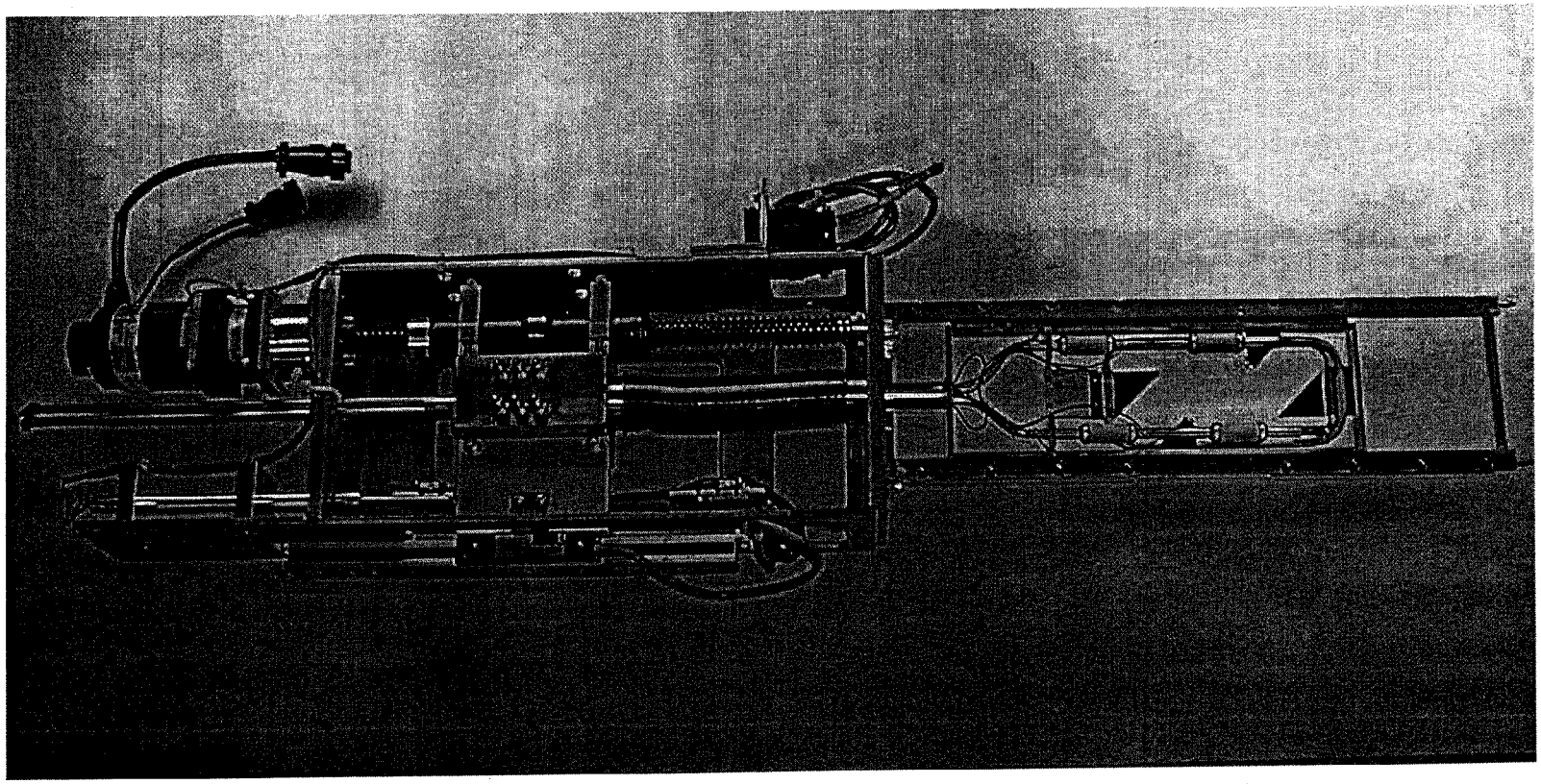
The halo-scraper, wire-scanner diagnostic is designed to measure the beam profile to five rms widths.



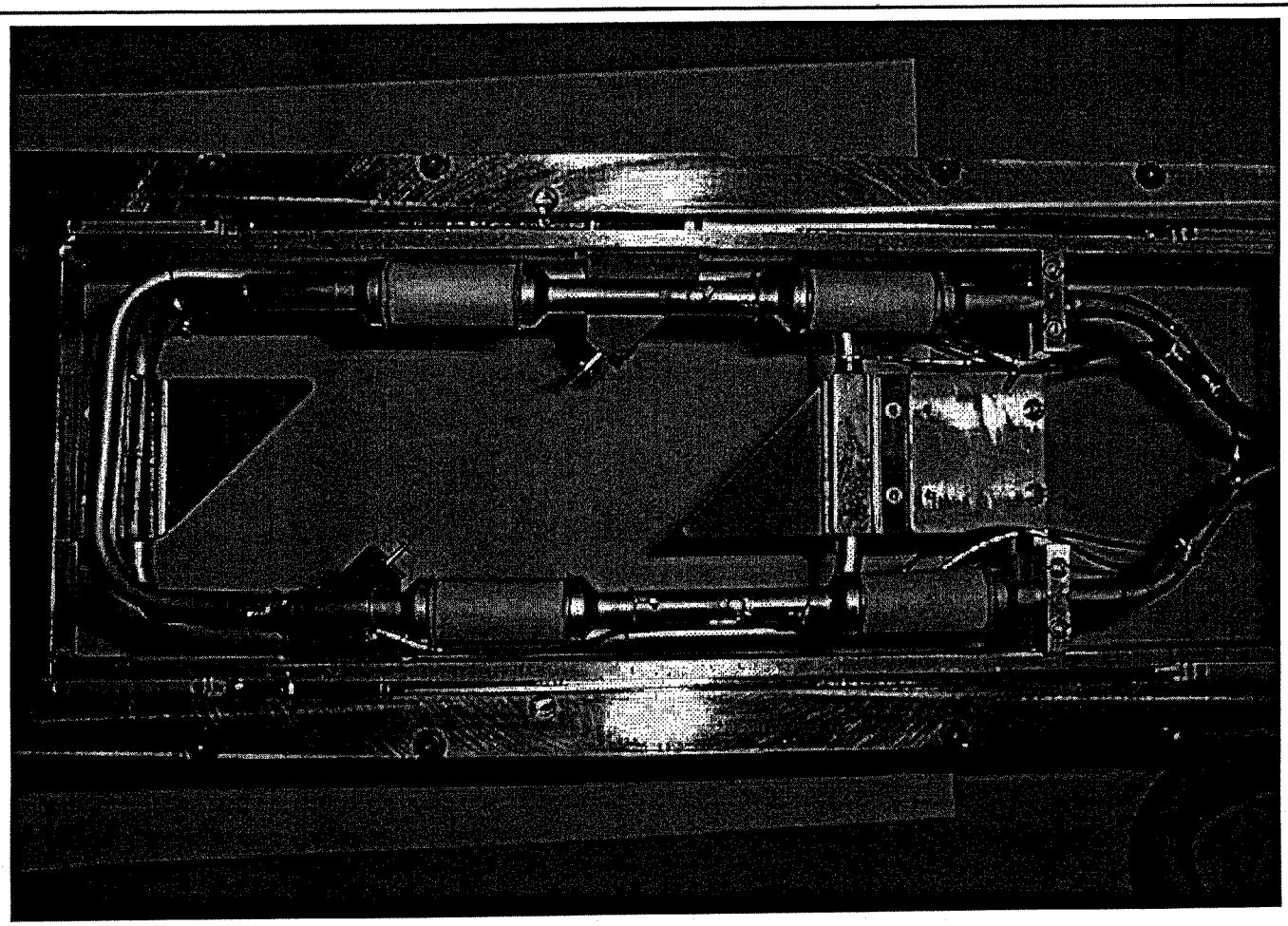


- Wire scanner fiber: 33-μm C fiber, detect secondary electrons
- Scraper: Graphite brazed on Cu: range out protons in 1.5-mm thick graphite
- Simulated distributions show wire scanner can detect to 4 rms widths
- Simulated halo scraper measurement acquires beam distribution data to 5 rms widths

The halo-scraper, wire-scanner assembly.



A close-up of the halo-scraper, wire-scanner assembly showing the 33-μm SiC wire.



Beam-Halo Channel Commissioning Status

- Initial pulsed beam transported through the halo channel on November 7, 2000
- Full complement of beam-transport and diagnostic devices is mechanically installed on the halo channel
- All halo channel beam-transport devices are commissioned and fully operational
- Most halo channel beam-diagnostic devices are commissioned and fully operational
- The halo-scraper, wire-scanner devices and the resistive wall current devices are being commissioned
- 75 mA of 1-Hz, 50-μsec, reliable, steady pulsed beam has been transported through the halo channel to the beamstop
- We expect to have all of the halo channel diagnostic devices commissioned and fully operational by mid-March

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.04
SCRF ED&D

Dominic Chan, Project Leader
February 7, 2001

Major Activities Planned for FY01

- *Power coupler and β=0.64 cavity development work for APT SCRF High-energy linacs will be documented*
  - *All tests will be completed*
  - *Documentations of cavity and coupler development will be delivered in March*
- *A SC structure for low energy between the RFQ and elliptical cavities will be studied*
  - *Complete concept design study in March for an April Review*
  - *Additional work will be contingent to outcome of review*
- *APT elliptical cavities and ANL spoke cavity will be tested in the LANL SC Laboratory*
  - *Complete tests of spoke cavity on loan from ANL*
  - *Develop general-purpose diagnostic equipment for cavity tests*
  - *Tests of APT elliptical cavities for better performance*

Milestone Status for FY01

	Due Date	Status
APT β=0.64 Cavity	1/22/01	• Completed tests this month • Completed first draft of final report
APT Power Coupler	11/22/00	• Completed tests • Completed first draft of final report

Major Accomplishments for Oct-Dec 2000

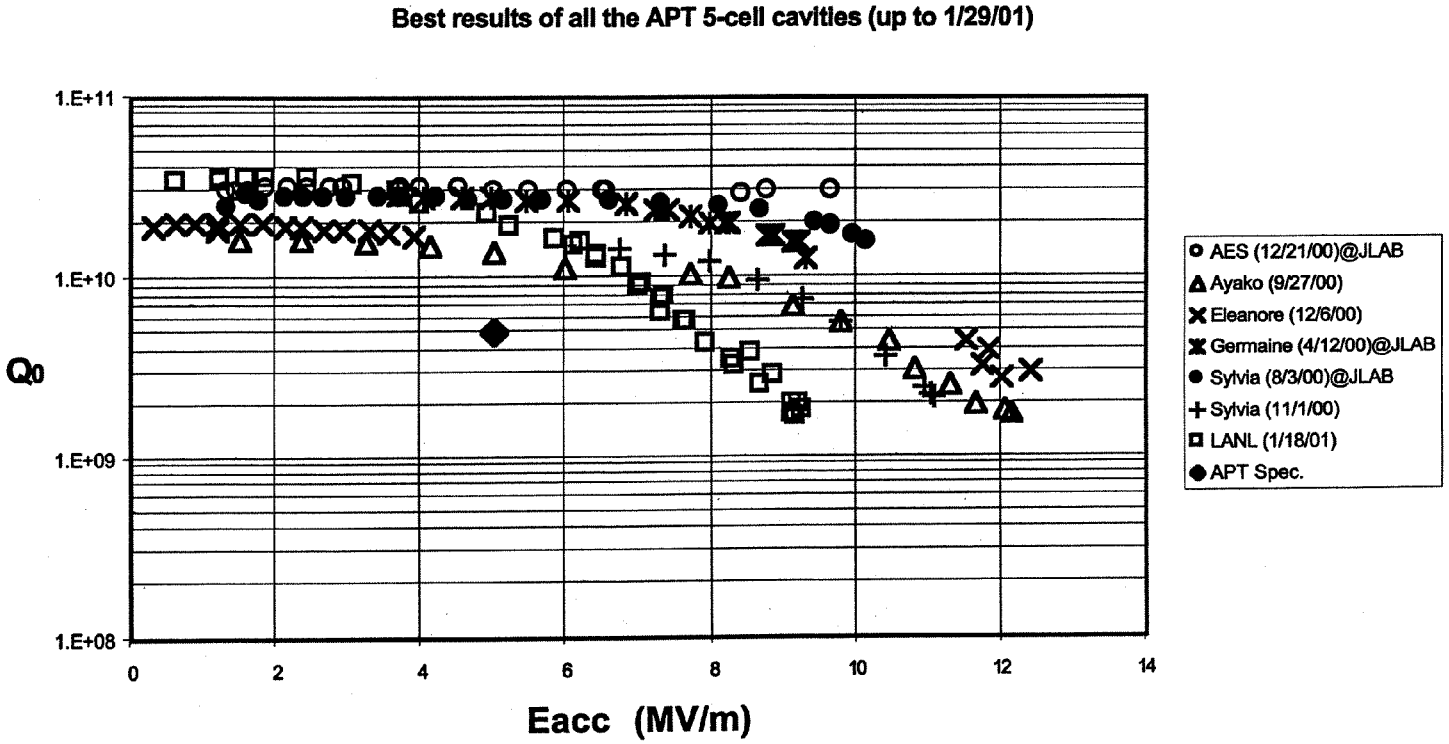
- *All APT β=0.64 5-cell cavities exceeded required performance of a Q-value of 5 x 10^9 and 5 MV/m*
  - *Typical low-field Q-value of 2 x 10^{10} and maximum accelerating gradient of 12 MV/m*
  - *Ambient magnetic field contributes to 35% of the difference of Q-values observed at LANL and JLAB*
- *APT power-coupler tests completed*
  - *Power coupler requirement raised from 210 kW to 420 kW after successful longer term (96 hours) tests at 420 kW*
- *Fabrication of APT prototype cryomodule and 4K-to-2K cold box completed*
- *First draft of final reports of APT cavity and coupler completed*
- *Fabrication of new rotary table for high-pressure rinse completed*
- *Ultrasonic cleaning station installed*

Major Accomplishments for Oct-Dec 2000 (cont.)

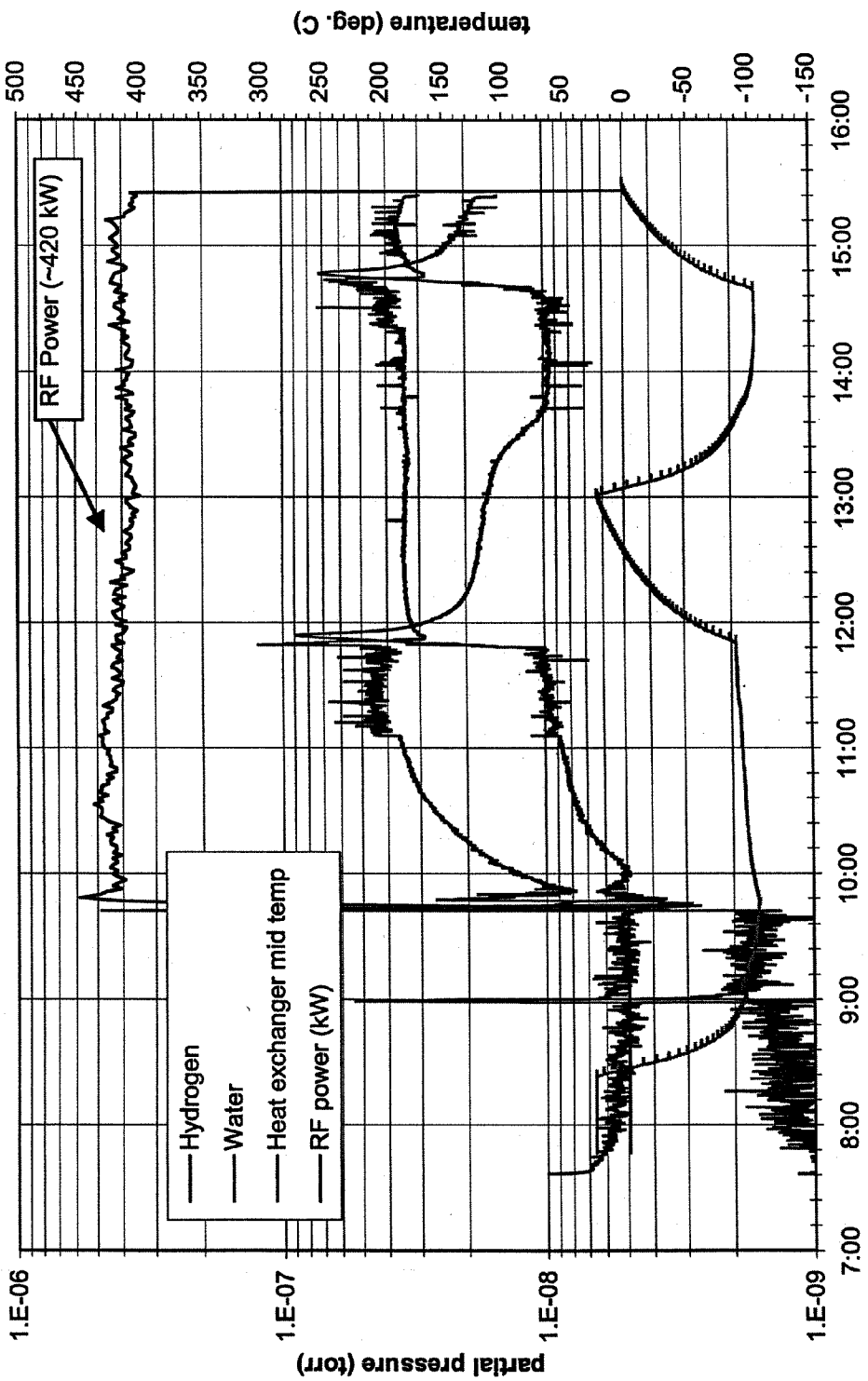
Concept Design Study of spoke cavity in progress for an April review

- ***Cavity geometry being optimized with respect to peak surface magnetic and electric fields***
- ***Structure analysis performed to predict stability under different load conditions and tuning sensitivities***
- ***Spoke cavity on loan from ANL being prepared for RF tests***
  - ***Tuning sensitivity and RF parameters were measured at room temperature***
  - ***Cavity-test equipment in SC Laboratory is being modified for spoke-cavity tests***

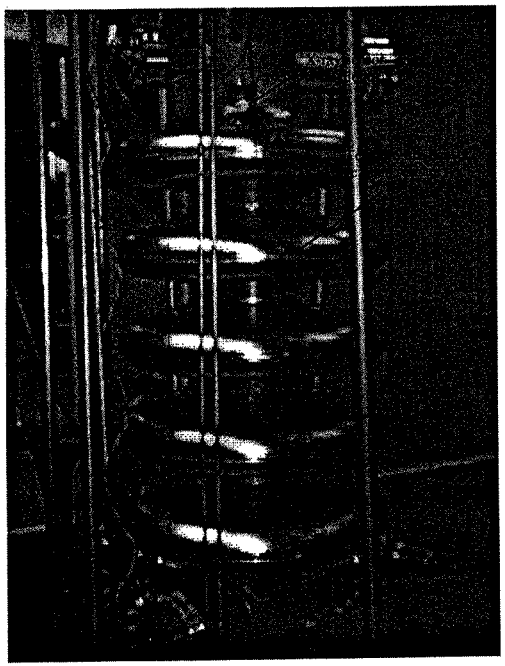
Summary of Cavity-Test Results (APT 5-Cell β=0.64 Cavities)

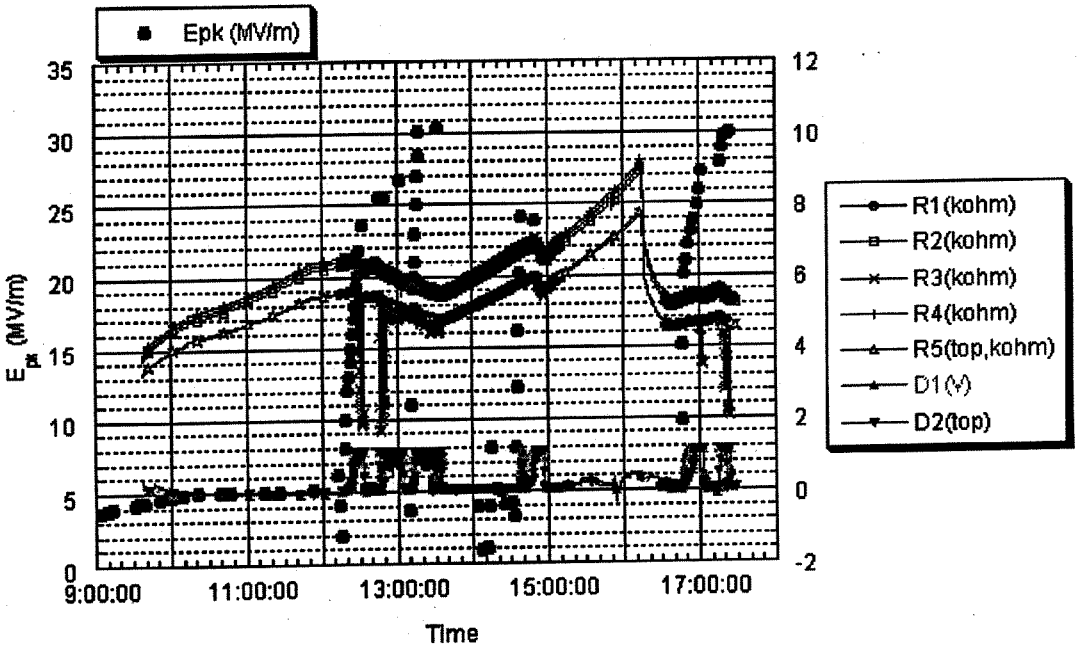


APT Couplers were tested at 420 kW over 96 Hours



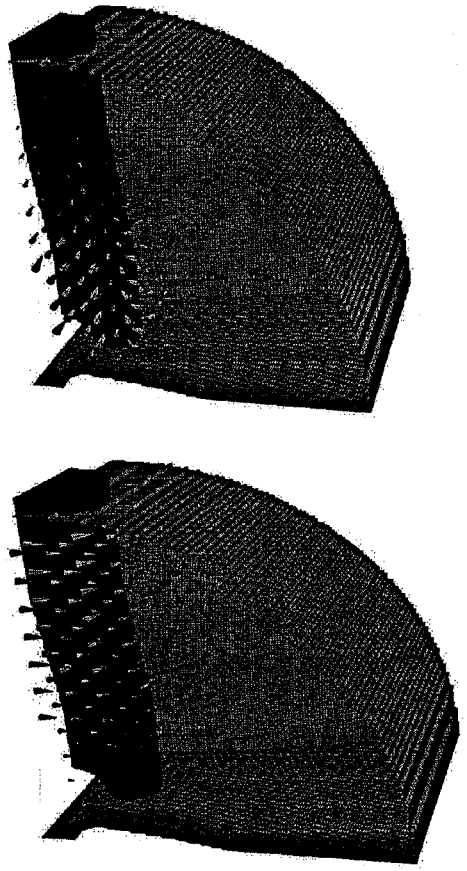
Temperature Diagnostic Helps to Locate Cavity Defects





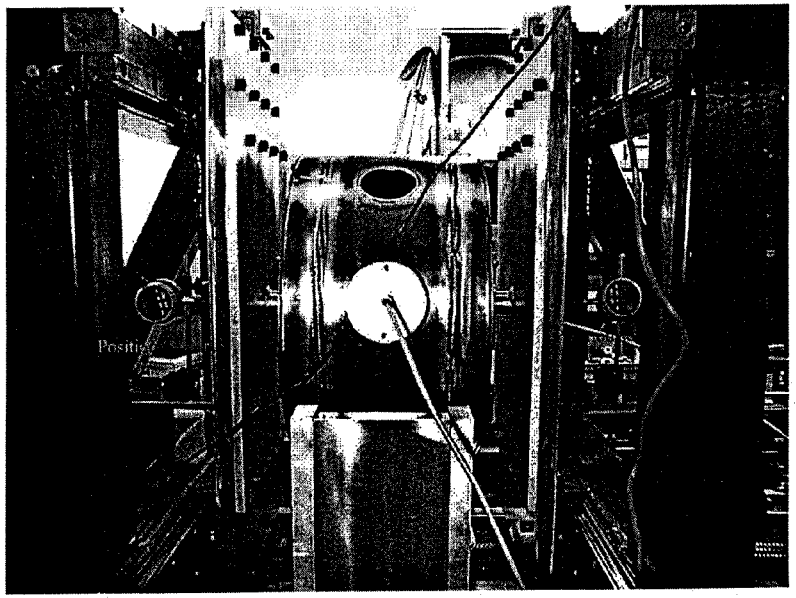
Model of Spoke Cavity

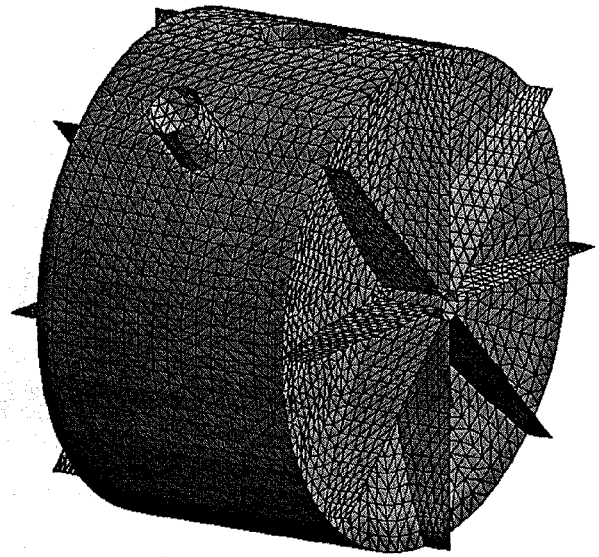
Study of Spoke-Cavity Shapes
Optimization of Peak Surface Fields



Frequency	349.47 Mhz
Q_0 (RT)	5628
Q_0 (4.5 K)	8.36E+08
Q_0 (2 K)	5.42E+09
T (β_g)	0.7955
$T_{max}(\beta)$	0.8111
$\beta(T_{max})$	0.2000
E_{pk}/E_0T	< 2.84
H_{pk}/E_0T	< 69.0 G/MV/m
Pcav (4.5 K)	3.15 W
Pcav (2 K)	0.49 W

Calculated ANL Cavity Tuning Sensitivity Agrees Well with Measurements





	Measured	MICAV COSMOS/M	Error
Resonant Frequency (MHz)	339.699401	338.821495	0.26%
Tuning Sensitivity (MHz/in)	9.356	11.32	21.03%
Structural Stiffeness (lb/mil)	34.36	44.4	29.22%
(KHz/lb)	0.272	0.255	6.35%

Planned Activities for Jan-Mar 2001

- *Complete final reports for cavity and power-coupler DDNs*
- *Complete concept design study of spoke cavities*
- *Complete preparation for testing spoke cavity on loan from ANL*

Other Activities

- *Management and ES&H walkarounds were performed regularly at least once a month*
- *Short proposal was written for UNLV University Participation Program*
  - *White paper is being prepared*
- *We participated in a Workshop on SC Proton Linacs in Saclay*
  - *Test results of APT power couplers and cavities attracted a lot of interest*
- *We completed a Hazard Control Plan for the ultrasonic cleaning station installed at the SC Laboratory*

Advanced Accelerator Applications (AAA) Quarterly Review

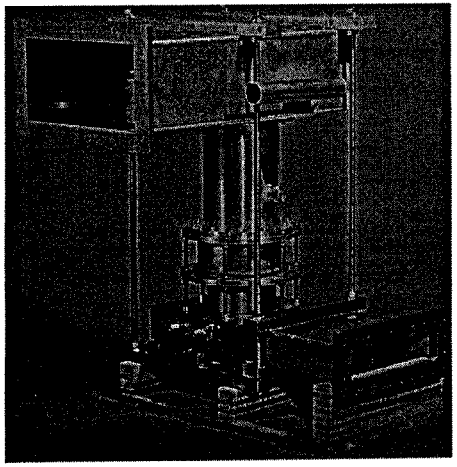
First Quarter FY01
Oct-Dec 2000

WBS 1.04
Non-SCRF ED&D

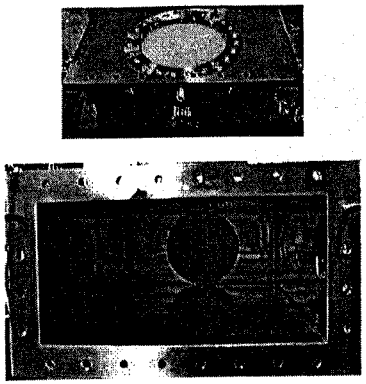
Richard Sheffield
February 6-7, 2001

Major Activities Planned for FY01

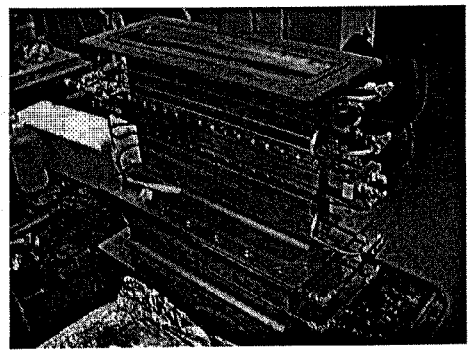
- ***RF Window Testing***
  - ***Design, fabricate, and test Planar (non-coaxial) RF windows***
  - ***FY01 demonstration of power capability***
  - ***$ 90K***
  - ***Non-coaxial windows offer advantage in reduction in size, cost, and maintenance. Also, these windows more readily allow implementation of waveguide valves for window replacement***



Coax Window



LANL/LBNL Planar Window



GA Planar Window

Milestone Status for FY01

- ***Non-SCRF ED&D to be completed 4/14/01***
- ***RF window lifetime data will not be available for input to APT Preliminary Design Status Report***

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

Results of Tests on LANL/LBNL 700 MHz Window

- RF Power = 800 kW into a matched load
- Ultra low loss - Insertion and Return Loss < 1% over bandwidth (VSWR = 1.22 with a 1% return loss)
- Frequency = 700 MHz
- Bandwidth = 12 MHz
- Vacuum = 1 x 10^{-7} Torr
- He Leak Rate = No leak detected at the level of 1 x 10^{-9} Torr Liter/Sec
- 100,000 life at nominal power (420 kW) – To be done

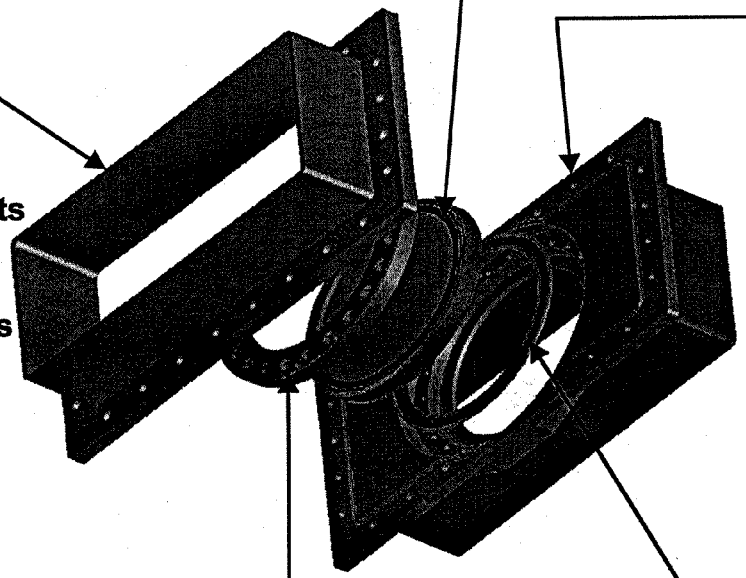
Major Accomplishments for Oct-Dec 2000

LANL/LBNL 700 MHz RF window

Alumina Ceramic Assembly

Air Side Waveguide

Vacuum Side Waveguide



- The moly keeper ring puts a compressive stress on the ceramic. This compressive stress allows the window to withstand larger temperature gradients
- A high purity alumina ceramic is used (AL995 alumina)

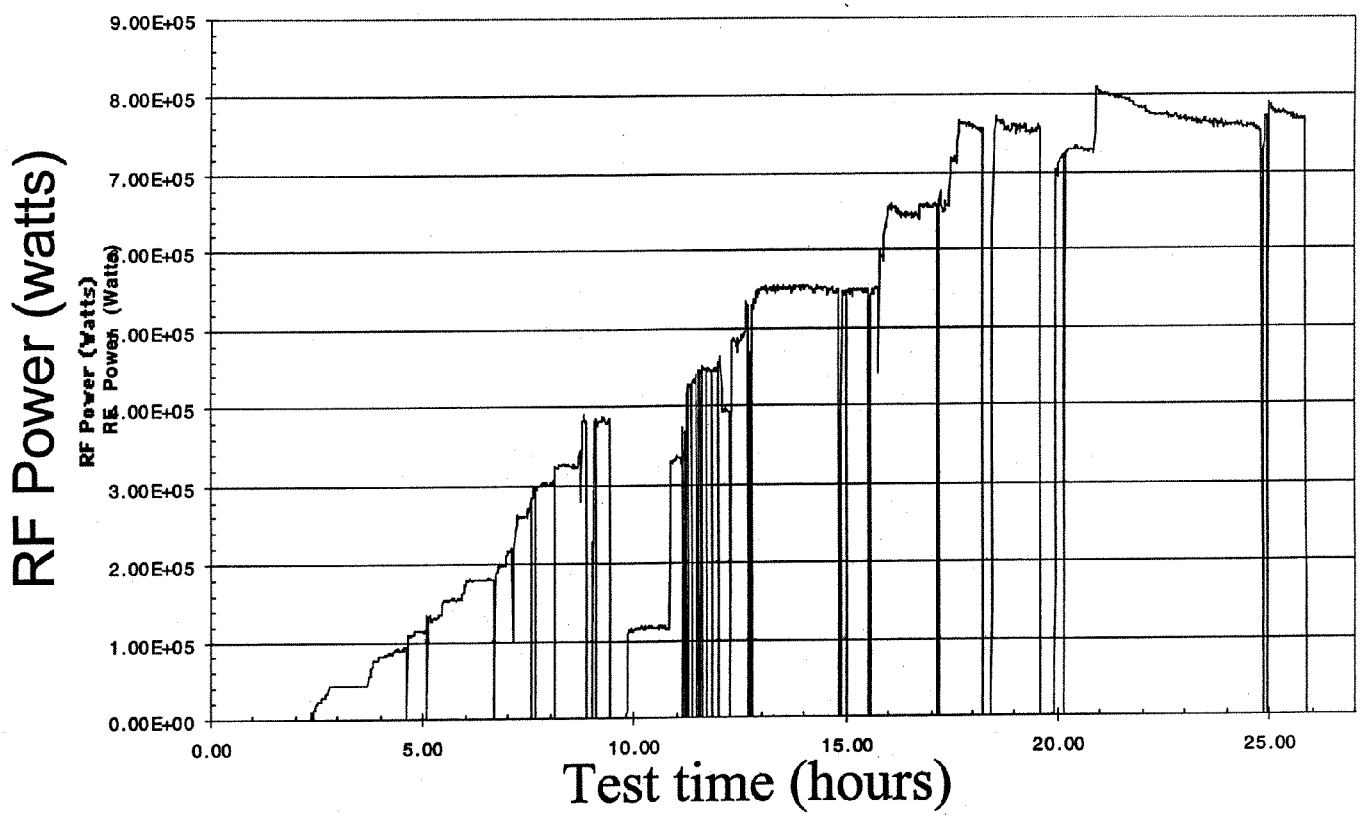
Window #	S11 at 700 MHz	S22 at 700 MHz
1	-35.0 dB	-34.0 dB
2	-30.6 dB	-29.8 dB
3	-31.1 dB	-30.2 dB
4	-30.3 dB	-30.1 dB
Average	-31.8 dB	-31.0 dB
Requirement	-20.0 dB	-20.0 dB

Clamping Ring

Copper gasket

Major Accomplishments for Oct-Dec 2000

LANL/LBNL 700 MHz RF Window



Planned Activities for Jan-Mar 2001
(Second Quarter FY01)

Install two LANL/LBNL planar windows on the lifetime test stand with 6 of the coax windows and operate at 1 MW RF power

Test GA planar window in window test stand

Other Activities

- ES&H Activities and QA Activities fall under the LEDA umbrella
- One of the two planar window designs was in collaboration with LBNL and based on the windows design for the B-factory

Issues

Window lifetime is still an issue for either APT, AAA, or ATW. We needed lifetime data for accelerator availability in APT (the main driver in downtime for APT) and now it is required for accelerator availability and reliability for ADTF.

The window lifetime test stand is now fully functional and able to run up to 1 MW CW 700 MHz RF power through 8 or more windows. The main expense for the lifetime test stand is the electric bill.

April Accelerator Review

CHARTER: Review will cover the accelerator designs, radiofrequency architectures, and issues associated with each of the designs. It will assess and make recommendations as to accelerator technology and strategies most appropriate for use in an ADT Facility.

- **Determine the effect of the different design requirements on the accelerator design by minimizing design changes from the APT baseline (i.e. - the "degraded" APT accelerator).**
- **Determine an ADTF design by modifying the present APT baseline to optimize performance for ADTF while maintaining the capability of APT performance levels.**
- **Determine if other design solutions, such as low-energy superconducting structures (spoke resonators*), might provide lower cost or better ADTF accelerator performance consistent with APT requirements with suitable system modifications.**

*** For the spoke resonator assessment we will prepare a concept design of the resonator including power couplers and tuners, and a low-power test of the existing spoke resonator on loan from Argonne National Laboratory.**

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.07
Target/Blanket Systems

Alan Baxter, Project Leader

February 6, 2001

Major Activities Planned for FY01

- 1.07.00 Target/Blanket (T/B) Systems Integration
  - Description: Integration of T/B technical work activities and coordination of programmatic activities, including design status reviews, and SDD preparation.
  - Major deliverables/dates
    - » T/B SDD Update.....4/30
    - » Complete T/B Preliminary Design Status report input.....7/31
    - » Complete T/B design status reviews.....7/31
  - Estimated cost.....$226K
  - Benefit/Impact: Assures diverse T/B design activities and disciplines are coordinated to produce an integrated T/B design

Major Activities Planned for FY01 (cont..)

- **1.07.01 Target/Blanket Module Design**
  - Description: Preparation of the preliminary designs of target, blanket, window and shield modules. Perform required prototyping. Design status review.
  - Major deliverables/dates
    - » Target thermal cycling report.....1/31
    - » Helium gas tube weld development report.....2/11
    - » Status report on module prototyping.....6/02
    - » Blanket fabrication development report.....6/21
    - » Complete all input to Design Status report.....7/01
    - » Status report on target ladder fabrication development ...9/21
  - Estimated cost.....$1556K
  - Benefit/Impact: Design documentation of preliminary design status, and major development activities, for the target, blanket, window, and shield modules. Status of prototyping development. Design status review. Incorporate ED&D data.

Major Activities Planned for FY01 (cont.)

- **1.07.02 T/B Cavity Vessel System**
  - **Description: Preparation of the preliminary design of the T/B cavity vessel. Issue drawings, and input to the Preliminary Design Status report. Conduct Design status review.**
  - **Major deliverables/dates**
    - » **Update of SDD 7/30**
  - **Estimated cost.....$309K**
  - **Benefit/Impact: Update of the cavity vessel preliminary design, and documentation of the design status. Design status review.**

Major Activities Planned for FY01 (cont.)

- **1.07.03 Target/Blanket External Shielding System**
  - **Description: Preparation of the preliminary design of the Target/Blanket (T/B) external shielding system. Conduct design status review.**
  - **Major deliverables/dates**
    - » **Update of SDD 7/01**
    - » **Preliminary Design Status Report input.....7/01**
  - **Estimated cost.....$245K**
  - **Benefit/Impact: Documentation of the T/B external shielding preliminary design status, update of the General Arrangement drawing. Design status review.**

Major Activities Planned for FY01 (cont.)

- **1.07.04 T/B Heat Removal Systems (HRS)**
  - **Description: Preparation of the preliminary design of the T/B heat removal systems, and update the T24 SDD to include this work. Conduct design status review of window cooling system.**
  - **Major deliverables/dates**
    - » **Issue Rev B of the SDD.....5/31**
    - » **HRS input to Preliminary Design Status report 7/31**
  - **Estimated cost.....$368K**
  - **Benefit/Impact: Design update and documentation of the T/B HRS preliminary design status. Design status review.**

Major Activities Planned for FY01 (cont.)

- **1.07.05 T/B Primary Coolant Purification System**
  - **Description:** Continue preliminary design of the T/B primary coolant purification system. Issue design code based on ED&D program results. Design status review.
  - **Major deliverables/dates**
    - » Update of SDD 7/23
    - » Preliminary Design Status report input.....7/20
  - **Estimated cost**.....$276K
  - **Benefit/Impact:** Documentation of the T/B primary coolant purification systems preliminary design status, incorporation of ED&D results. Design status review.

Major Activities Planned for FY01 (cont.)

- **1.07.08 Target/Blanket Systems Level Analysis**
  - **Description: Preparation of the preliminary physics, shielding, Thermal/Hydraulic (T/H) and structural design analyses of the Target/Blanket system**
  - **Major deliverables/dates**
    - » **Target/Blanket T/H Analysis report.....2/15**
    - » **Systems analysis input to Preliminary Design status report.....6/15**
  - **Estimated cost.....$459K**
  - **Benefit/Impact: Design documentation of the Target/Blanket system level preliminary design analyses status.**

Major Activities Planned for FY01 (cont.)

- **1.07.09 Target/Blanket Remote Handling System**
  - **Description: Preparation of the preliminary design of the T/B remote handling system. Issue preliminary design drawings and calculation files. Conduct design status review.**
  - **Major deliverables/dates**
    - **» Update of SDD 7/01**
    - **» Input to Preliminary Design Status report input....6/01**
  - **Estimated cost.....$400K**
  - **Benefit/Impact: Documentation of the T/B remote handling system preliminary design status, update system SDD, conduct design status review.**

Milestone Status for FY01

- **Status of level 0-3 milestones**
  - No Target/Blanket level 0-3 milestones due during 1st quarter of FY01.

- **Status/schedule for providing input to APT Preliminary Design Status Report**
  - T/B systems input to design status report scheduled for completion in 3rd quarter of FY01.
  - Preparation of initial inputs in some areas (Target/Blanket modules, T/H analysis) is in process.

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

- FY-01 work plan packages and schedules were completed, reviewed, and signed-off.
- Thermal cycling tests to prototypic plant conditions of target samples clad with Alloy 718, Alloy 600, or 316L stainless steel were completed. Ultrasound examinations showed no disbond between the cladding and tungsten.
- The following calculation files were issued:
  - Sizing of Retargeting Heat Removal Components.
  - Design Basis for Sizing 125 Ton T/B Building Crane and Lifting Devices
- The following papers were presented at ANS Accelerator Applications Conference:
  - Decontamination of a Spallation Target Water Cooling System
  - Process Development for Cladding APT Tungsten Targets

Cont:→

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

- The following Remote Handling System, and Cavity Vessel drawing packages were released:
  - General Assembly, Electro-Mechanical Manipulator, EMM-Effectors, and Electrical Conduit Routing.
  - Weldment, EMM Tool Rack.
  - Equipment Requirement Drawing, Electric Torque Wrench.
  - 8-inch Flexible Pipe Joint, Gimball and Hinged.
- The External Shield General Arrangement Drawing was issued
- The Target and Blanket P&ID drawings for the Heat Removal Systems and Cavity Flood were issued
- The interface control document for the Cavity Vessel and Jumpers was released.
- Tooling for drawing rung branches for Ladder 1 was ordered

Planned Activities for Jan-Mar 2001
(Second Quarter FY01)

- Issue update to T/B system (T11) SDD.
- Complete preparation for, and initiate T/B design status review meetings.
- Fabricate 5 ring clad tungsten sets.
- Issue Thermal Cycling Test Report.
- Release gas tube weld development report.
- Complete design of the window cooling system (T24).
- Prepare RANTAD code documentation for the Primary Coolant Purification System.
- Update coolant purification system SDD.
- Issue Target/Blanket T/H analysis documentation.

Issues

- **The Target/Blanket APT design effort is scheduled for completion this year:**
  - **A major issue is to maintain key staff to complete this effort and provide for the level of support needed for the work on the AAA program.**

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.02 Target/Blanket & Materials ED&D

Laurie Waters, Project Leader
February 6, 2001

1.02 Budget for FY01

• Core Team	$310 k
– Waters, Paciotti, Gac, Rutherford	
• Space Tax, Procurements, Travel	$202 k
• Coolant Tests (GA)	$ 30 k
• Area A Cleanup (LANSCE-7)	$150 k
• Activation Analysis (C-INC)	$ 10 k
• Hot Cell Support (NMT-11)	$300 k
• Corrosion Support (MST-6)	$ 20 k
• Corrosion Calculations (LANSCE-12)	$ 20 k
• Radiation Transport Codes (CCS-4)	$114 k
• Data Library Processing (X-5)	$ 25 k
• Programming Support (IM-7)	$205 k
• Programming Support (Ed Snow)	$ 55 k
• Programming Support (ORNL)	$ 10 k

Milestone Progress in 1st Quarter

Simulations still needed, tests complete (personnel shortage)

- Neutron leakage & flux & spectrum (#5) due 10/31/00
- Attenuation length in shielding due 10/31/00
- N/p and T/p demonstration (#24) due 11/9/00
- Groundwater & air activation (#7) due 11/20/00

Work Complete, DDN Closeout Drafted

- Tritium Implantation (#80) due 1/2/01
- He/H/Hg production, transport, release(#33) due 1/2/01
- MCNPX version 2.2.0 (#C1) due 1/2/01
- Fluence-to-dose conversion factors (#8) due 1/2/01

TPO Work on DDN Complete and Signed off

- Target Cladding Performance(#4) due 1/2/01
- Heavy Water Corrosion (#29) due 1/2/01
- 4 Major Materials DDNs (25,26,27,28) due 9/30/01

Remaining Milestones

- Light Water Corrosion — due 12/22/00
  - Completion next week
  - Final measurements at CMR underway
- Radionuclide Release to Primary Coolant — due 12/7/00
  - Anticipate completion end of March
  - Component counting and simulations in progress
- Simulation Tool QA & Validation — due 9/28/01
  - On schedule
- Air Corrosion — due 9/28/01
  - Will not be done

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

Materials Program (1.02.02)

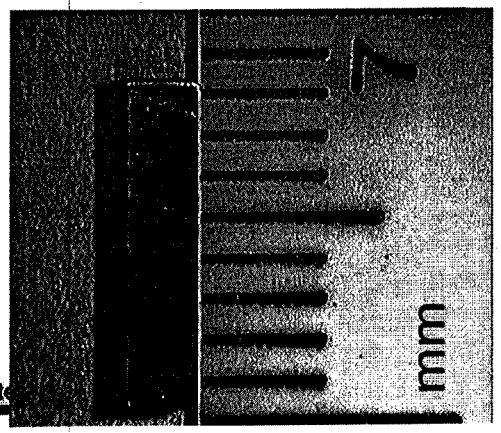
- Materials Handbook, Structural Design Criteria
- DDNs 25, 26, 27, 28 completed
- Fatigue Crack Growth - University of Illinois
- Aluminum shear punch results
- Copper Beryllium Bellows failure analysis
- Cladding studies
- Cleanup Activities in Area A

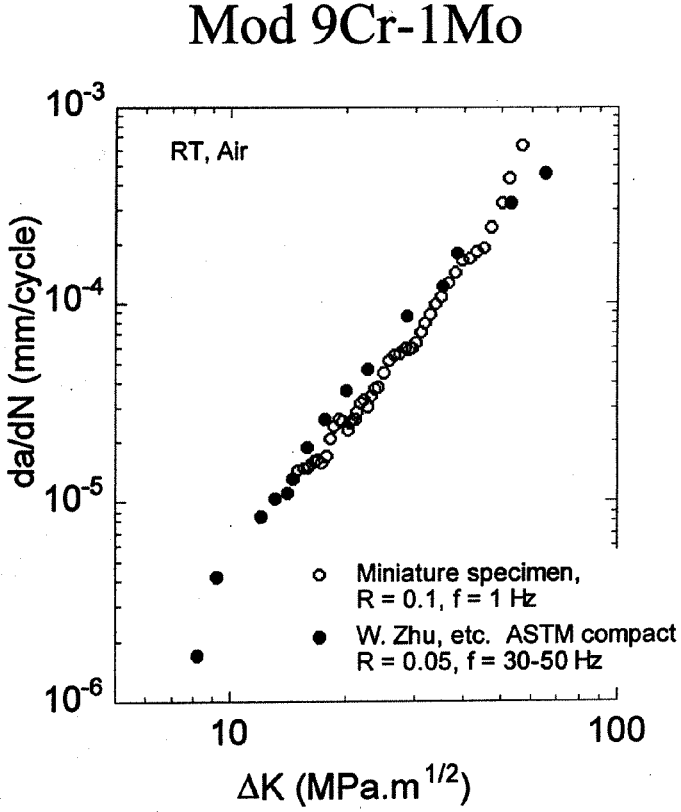
Related Activites (funded by SLAC)

- Analysis of W-Rh positron production target

Qualified Fatigue Crack Growth Testing for Small Bend Specimens (2x8x0.75 mm³)

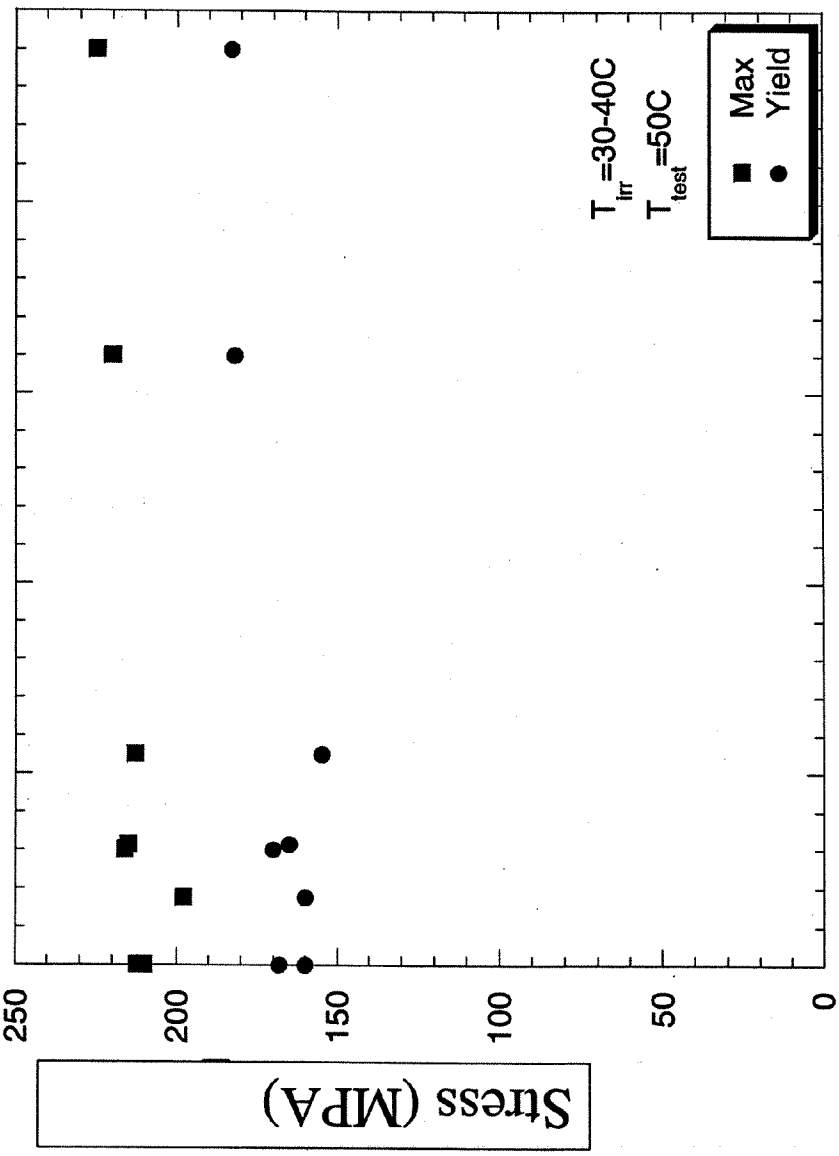
- Substantially smaller fatigue crack growth specimens were tested and compared to results for standard sized specimens.
- Results from small scale specimens compare very well with those from standard sized specimens.
- Materials tested were 304L SS, Alloy 718 and Mod 9Cr-1Mo Steel.
- These small scale specimens are available for testing and have been irradiated to up to 12 dpa.





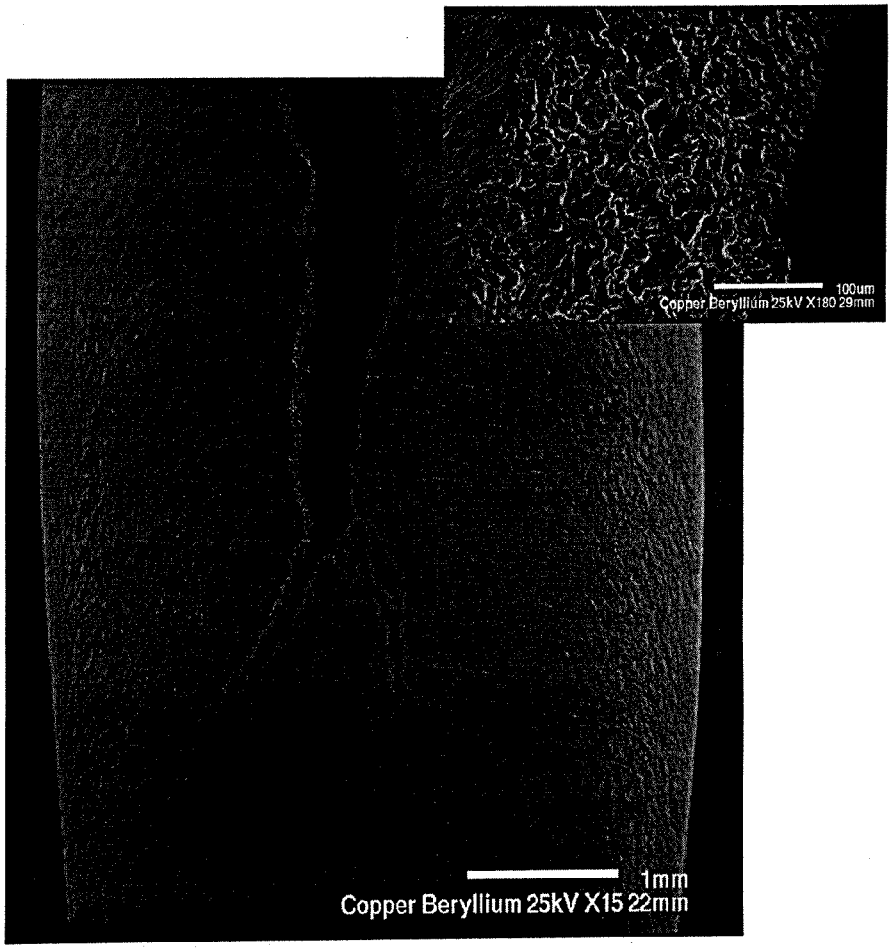
We will not be testing our irradiated specimens due to funding constraints

Observed Gradual Increase in Shear Punch Strength vs. Dose for Al6061-T6 (Correlates with tensile yield & ultimate strength)

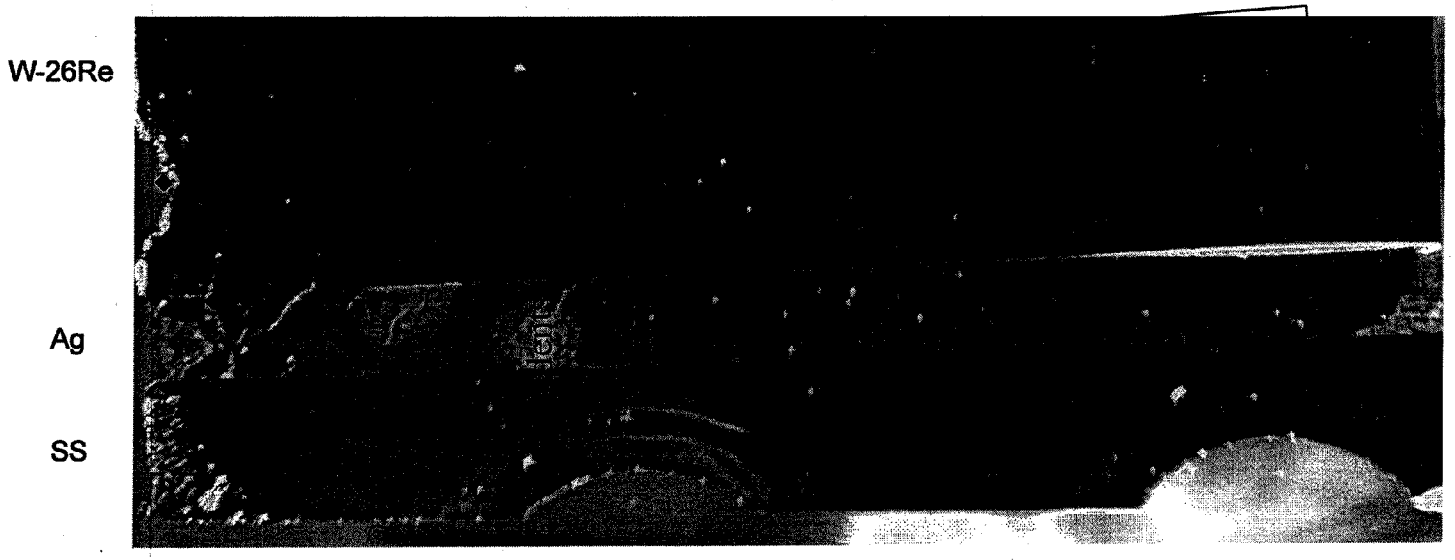


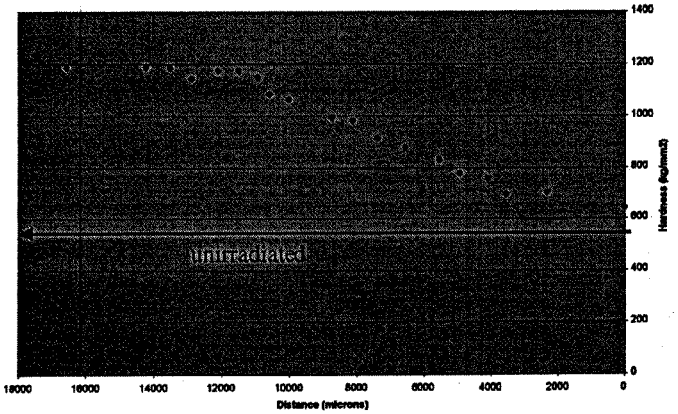
Failure Investigation in Copper Beryllium Bellows used in the Accelerator Power Coupler for SC Cavity

- Examined inner conductor tip bellows
- Bellows Failed During Testing after being exposed to 3-5 times the original design power (>700°F)
- Microhardness Testing of Failed Bellows Suggested that Overaging of the Alloy Occurred During Operation
- Failure Was Observed Along Grain Boundaries

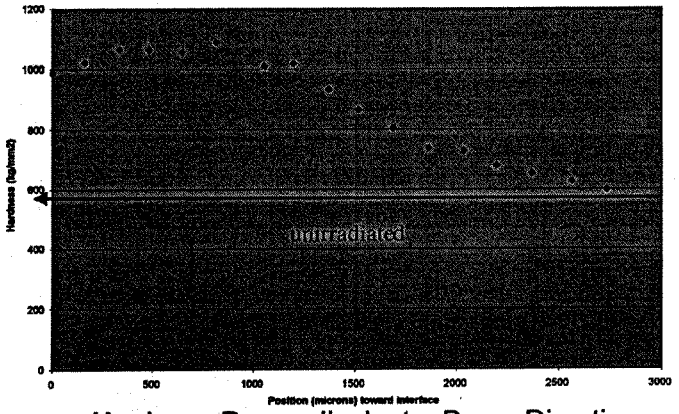


SLAC Work: Hardness Increased by a Factor of 2 on W-26Re after Irradiation in a 30 GeV Electron Beam





Hardness along Beam Direction



Hardness Perpendicular to Beam Direction

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

Corrosion Program (DDNs 29, 30)

- Heavy Water DDN #30 completed
- Analysis of 17B at CMR Hot Cells is nearly complete
- Analysis of beam structure effects underway

Tritium Implantation (DDN 80)

- All analysis complete, DDN signoff drafted

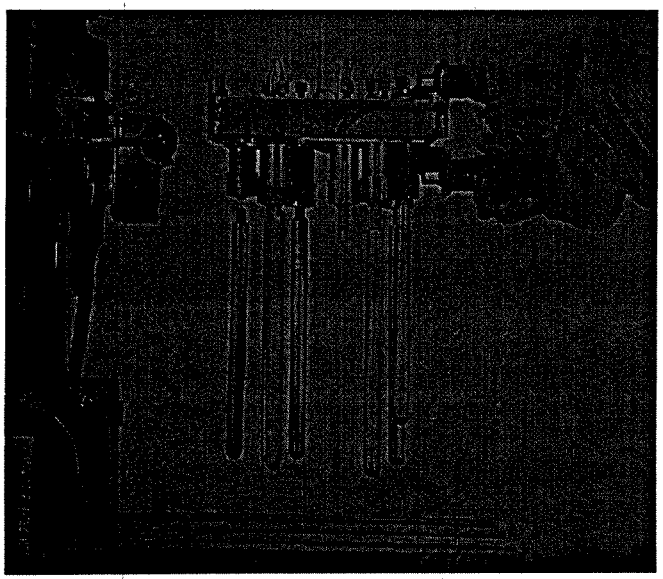
Target Cladding (DDN 4)

- Major work complete, DDN completed. Student thesis in progress.
- Thermal cycling work taken over by 1.07

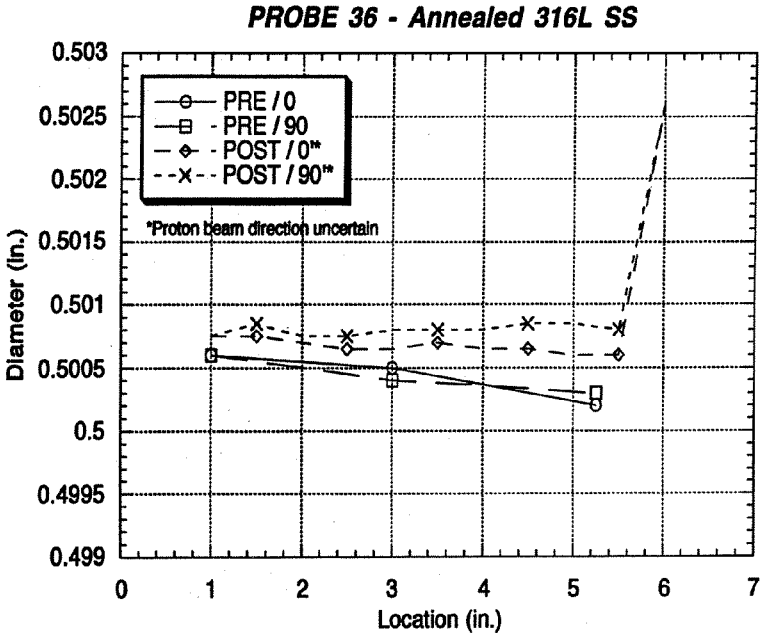
Codes and Data (DDN C1, 8)

- MCNPX version 2.2.0 released (DDN C1)
- Fluence-to-dose conversion coefficients complete (DDN 8)

Electrochemical and Dimensional Corrosion Measurements

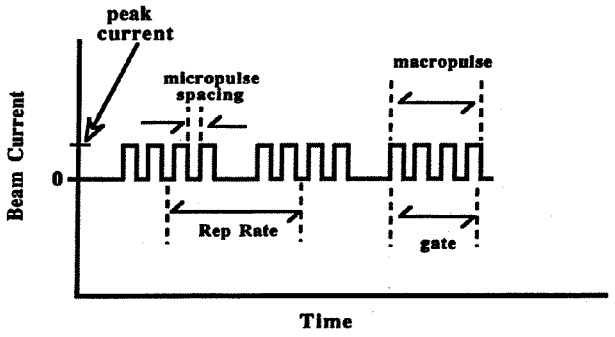


Upper manifold of '98/99 Corrosion
Insert with some probes still in place.



- EIS data from the LANSCE A6 target station (0.34 mA) yield an average corrosion rate of ~5 μm/y (~ 0.0002 in/y) for probe 36.
- Dimensional measurements show no discernible change.
- These results correlate and predict minimal corrosion.

Effect of the Beam Time Structure on the Corrosion Rate of 316L SS



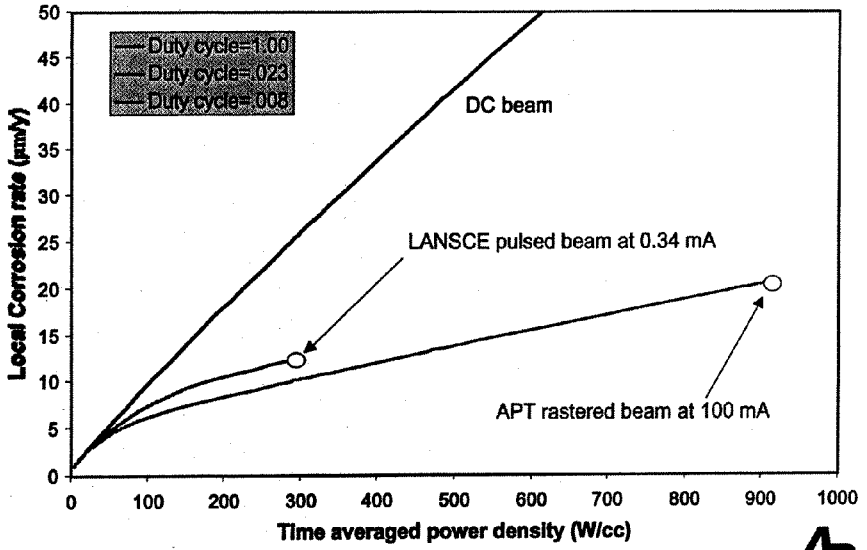
$$\text{CorrosionRate} = 0.73\ \mu\text{/y} + (0.114\ \mu\text{/y per W/cc})(Pd^{0.95})\ \varepsilon(Pd_i)$$

where

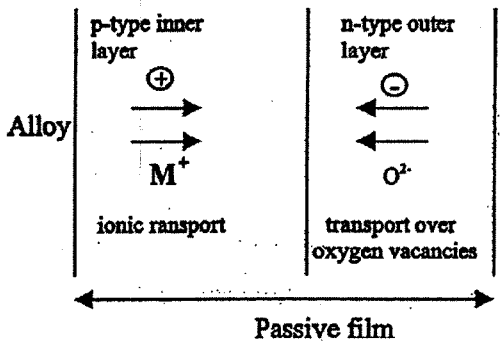
Pd is the local time-averaged power density in W/cc,

ε is the corrosion efficiency as a function of instantaneous power density,

Pd_i is the instantaneous power density in W/cc.



Extrapolation of Data to Other Systems



corrosion rate=a(1/N_D)

Summary of donor concentration (N_D, cation vacancies) from Mott-Schottky data for tungsten

	N_D, cm^{-3}
no irradiation	9.8×10^{20}
passivated during irradiation; data collected post irradiation	3.1×10^{19}
passivated during irradiation; data collected during irrad.	2.7×10^{19}

Influence of irradiation on transport will likely be independent of environment (water, gas, liquid metal); **i.e.corrosion mechanism will apply to APT, LEDA, AAA**

MCNPX Version 2.2.0 Released Dec 22nd (due date Jan 1st)

- Proton and Photonuclear Libraries
- High energy elastic and reaction cross section data
- Secondary particle biasing variance reduction
- Think target cross section generation mode
- Ability to turn off interactions for attenuation mode
- Spherical mesh tallies
- Cylindrical radiography tally grid
- New nuclear photon decay data (PHTLIB)
- Autoconfiguration for compilation
- Phase I Dynamic Linking
- Various bug fixes
- Improved GRIDCONV (more graphics options)

International team of 575 beta testers at 131 institutions

Additional funds from G&A received for new IBM AIX computer

Planned Activities for Jan-Mar 2001
(Second Quarter FY01)

Materials

- Perform compression tests on irradiated tungsten
- Analyze failure in Alloy 718 window
- Measure thickness and perform hardness testing on annealed Alloy 718 irradiated in 1998
- Perform pushout tests on HFIR-irradiated clad tungsten specimens (depends on shipping schedule)
- Perform hardness testing on cross-weld specimens irradiated in '96-97

Complete last Coolant DDN

Complete corrosion DDN (closeout talk next week)

Public release of MCNPX after beta test phase

- Include requested physics modules
- Complete code-benchmarking related DDNs
- Continue validation activities

Other Activities

- **ES&H**
  - Continue Management Walkarounds
- **QA Activities**
  - IMS: ~18,000 pages now entered for 1.02 activities
- **Collaborations**
  - Work transitioning into 1.25 (Transmuter Technology)
    - » Particularly high temperature testing at PNNL, ORNL
    - » Working with UNLV on possible materials-related research
    - » Team members providing expertise for proposed Blue Room fuel assembly test
- **Conferences**
  - IWSMT(International Workshop on Spallation Materials Technology)-4, Schruns, Austria, Oct. 8-13, 2000 (3 papers, organizing committee)
  - AccApp '00, Washington DC, Nov. 12-17, 2000 (21 papers, program chair)
  - ASTM Small Specimen Conference, Reno, NV Jan. 23-25, 2001 (2 papers)
  - Thermec 2000, Las Vegas, NV, Dec. 4-8 (1 paper)

Issues

Issues, Concerns, Problems

- Established systems are working well, particularly documentation (test plans, specs, procedures, etc.) It is hoped that this rigor will carry over into future experimental activities.
- The APT-TPO test activities were very successful.
  - We still need to get our products out into the community to gain acceptance for regulatory purposes.
  - 1.02 Team plans to become involved in CTP for ADTF.
- Lack of trained computational scientists is having an impact on completion of DDNs 5, 6, 7, 24.
- People are transitioning into other activities.
- Delays in funding to PNNL and ORNL will have an effect on cleanup activities there. We will have to budget for this in FY'02.
- Status of the AAA University program is unclear. We need stronger participation by the researchers in formulating these activities.

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.09
Tritium Separation Facility

Don McEachern, Project Leader

February 6, 2001

Major Activities Planned for FY01

- **1.09.00 Tritium Separation Facility Systems Integration**
  - **Description: Integration of TSF technical work activities and coordination of programmatic activities**
  - **Major deliverables/dates**
    - » **Glovebox Stripper System Design Description Update (S15 SDD) 2/16**
    - » **Isotope Recovery System Design Description Update (S11 SDD)..... 4/27**
    - » **Isotope Separation System Design Description Update (S12 SDD).....5/31**
    - » **Helium Supply System Design Description Update (S21 SDD).....6/28**
    - » **Complete TSF Input to Cost Estimate.....6/29**
    - » **Complete TSF Input to Preliminary Design Status Report (Revised by BCP F002)..... 4/6**

Major Activities Planned for FY01 (continued)

- **1.09.00 TSF Systems Integration (continued)**
  - **Estimated cost.....$698k**
  - **Benefit/Impact: Assures diverse TSF design activities and disciplines are coordinated to produce an integrated TSF design**

Milestone Status for FY01

- **Status of level 0-3 milestones**
  - **No TSF level 0-3 milestones due during 1st quarter FY01**
- **Status/schedule for providing input to APT Preliminary Design Status Report**
  - **TSF systems input to design status report scheduled for completion in 3rd quarter of FY01**

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

- **FY-01 work plan packages and schedules were completed, reviewed, and signed-off.**

- **SDD revision initiated for four systems selected for their critical importance to TSF design.**

Planned Activities for Jan-Mar 2001
(Second Quarter FY01)

- Issue update to Glovebox Stripper System (S15) Design Description
- Continue updates to three other System Design Descriptions
  - Isotope Recovery System, S11
  - Isotope Separation System, S12
  - Helium Supply System, S21
- Begin preparation of information needed for cost estimate

Other Activities

- **No other activities anticipated**

Issues

- **The design of the Tritium Separation Facility is being suspended early but the AAA program is introducing two new ways of producing tritium.**

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01

WBS 1.22
Site, Structures and Balance of Facility Systems

Ray Chuebon

February 7, 2001

Major Activities Planned for FY01

- **Civil/Structural**
  - **SDD Revisions (Milestone Level 3: ML-3)**
    - Initial Issue of Section 2 for Tunnel, Klystron Gallery, and Maintenance Building
    - Revise Section 2 for T/B Building, Site and Cryo Building
    - Prepare Section 1 for Mechanical & Electrical Support Buildings
  - **Drawings**
    - Revise tunnel widths for LE & HE portions of the accelerator tunnel to reflect O&M required clearances
    - Add emergency egresses to far side of tunnel now allowed because of cryo supply line relocation
    - Revise Klystron Gallery service and waveguide bay widths to accommodate movement of Klystrons and O&M service requirements
    - Revise Injector Building to reflect current status of RFQ Design
  - **Other**
    - Complete 3D analysis of tunnel seismic wave passage
    - Finalize Geotechnical report for SRS Site

Major Activities Planned for FY01 (cont'd)

- **Mechanical**
  - **Issue**
    - » **General Arrangement Drawings**
      - Accelerator Tunnel
      - Klystron Gallery including Mezzanine
      - Injector Building
      - Mechanical Service Buildings
    - » **SDDs**
      - Updated BOP Heat Removal SDD (ML-3)
      - Updated Production Building HVAC SDD(ML-3)
    - » **Revise PFD's and P&ID's**
      - Production Building HVAC
      - BOP Heat Removal system
    - » **Preliminary piping layouts for supply to:**
      - Accelerator, Klystron, RF, Waveguide and Magnet Cooling systems.

Major Activities Planned for FY01 (cont'd)

- **Electrical**
  - » **Update and Issue**
    - Electrical Design Criteria
    - Main AC Power SDD (ML - 3)
    - Non-Safety DC and UPS SDD - (ML - 3)
    - Safety Class DC and UPS SDD - (ML - 3)
    - Construction Power System SDD - (ML - 3)
- **Instrumentation & Controls**
  - » **Issue**
    - Issue Target Blanket Beam Shutdown System (TBBS) Block Diagrams
    - Section 2/Appendix C of the Radiation Exposure Protection System (REPS) (ML - 3)
    - Radiation Exposure Protection System (REPS) Block Diagrams
    - Section 1/Appendix B of the Health Protection Monitoring System (ML - 3)
  - » **Support the development of I&C on the Preliminary P&IDs**

Major Activities Planned for FY01 (cont'd)

- Nuclear
  - Document ALARA Implementation into the APT Design
  - SDDs
    - Issue Section 2 of the Material Handling (B52) (ML-3)
  - Issue revisions to:
    - Gaseous Radioactive Waste System (B41) (ML-3)
    - Liquid Radioactive Waste System (B43) (ML-3)
    - Target/Blanket Storage Pool (B45) (ML-3)
    - Hot Cell (B46) (ML-3)
  - Issue revised Gaseous Radwaste System PFD
    - Allow of He_3 recovery/collection

Milestone Status for FY01

Civil Structural

System	Level	Milestone	Date	Comments
B92 - Site	3	Issue SDD Sect. 1&2	2/28/01	On Schedule
B81 - Accelerator Tunnel	3	Issue SDD Sect. 1&2	1/31/01	On Schedule
B93 - Mechanical Building	3	Issue SDD Sect. 1	3/30/01	On Schedule
B96 - Accelerator Maintenance Building	3	Issue SDD Sect. 1&2	3/15/01	On Schedule
B94 – Electrical Building	3	Issue SDD Sect. 1	6/15/01	On Schedule
B95 – Cryogenic Building	3	Issue SDD Sect.1 &2	7/16/01	On Schedule
B84 - Target Blanket Building	3	Issue SDD Sect. 1&2	5/30/01	On Schedule
B82 – Klystron Gallery	3	Issue SDD Sect. 1&2	5/18/01	On Schedule

Milestone Status for FY01 (cont'd)

Mechancial, Electrical, I&C and Nuclear

System	Level	Milestone	Date	Comments
B11 - Main Power Supply	3	Issue SDD Sect. 2	6/29/01	On Schedule
B14 –Safety Class DC and UPS	3	Issue SDD Sect. 2	4/20/01	On Schedule
B13 - Non Safety DC	3	Issue SDD Sect. 2	4/27/01	On Schedule
B17 – Construction Power	3	Issue SDD Sect. 2	3/16/01	On Schedule
B31 – Heat Removal	3	Issue SDD Sect. 2	6/29/01	On Schedule
B23 – Health Protection Monitoring	3	Issue SDD Sect. 1	5/30/01	On Schedule
B27 – Radiation Exposure Protection	3	Issue SDD Sect. 2	4/30/01	On Schedule

Milestone Status for FY01 (cont'd)

Mechancial, Electrical, I&C and Nuclear (Cont.)

System	Level	Milestone	Date	Comments
B52 – Material Handing	3	Issue SDD Sect. 2	4/30/01	On Schedule
B41 – Gaseous Radioactive Waste	3	Issue SDD Sect. 2	6/01/01	On Schedule
B43 – Liquid Radioactive Waste	3	Issue SDD Sect. 2	5/15/01	On Schedule
B45 – T/B Storage Pool	3	Issue SDD Sect. 1&2	3/29/01	On Schedule
B46 – T/B Hot Cell	3	Issue SDD Sect. 2	6/29/01	On Schedule
B51 – Production Building HVAC	3	Issue SDD Sect. 2	7/16/01	On Schedule

Major Accomplishments for Oct-Dec 2000

- **Civil/Stuctural**
  - **Refined Tunnel Seismic analysis**
    - **Combine effects of simultaneous 3D wave propagation**
    - **Results showed no significant impact on the tunnel structure**
- **Electrical**
  - **Completed**
    - **Plant electrical single line diagrams depicting electrical distribution system**
    - **Short circuit analysis for the construction power system and confirmed that the selected distribution equipment ratings are satisfactory**
    - **Issued for peer review the cable interface block diagrams identifying electrical interfaces between Klystron Gallery and Accelerator Tunnel mounted equipment**

Major Accomplishments for Oct-Dec 2000 (cont'd)

- **Mechanical**
  - Prepared and released Fire Protection P&IDs for review and comment (Tanks, Pump House and Yard piping)
  - Revised Accelerator Chilled Water System Sizing Calculation and Issued to IMS
  - Issued Chilled Water System PFD
- **Instrumentation & Controls**
  - Issued the Target Blanket Beam Shutdown System (TBBS) Block Diagrams
  - Issued Section 1/Appendix B of the Radiation Exposure Protection System (REPS)
- **Nuclear**
  - Completed the ALARA Implementation Guidance Document

Planned Activities for Jan-Mar 2001

- Civil/Structural
  - Issue the following SDDs:
    - Site SDD Section 2
    - Mechanical Building SDD Section 1/Appendix B
    - Maintenance Building SDD Section 2
  - Complete Section 2 for review comments for the T/B Building and Klystron Gallery.
- Electrical
  - Update and Issue Electrical Design Criteria
  - Update and Issue the following systems for peer review
    - » Construction Power System SDD (B17)
    - » Safety Class DC and UPS SDD (B14) (for review)

Planned Activities for Jan-Mar 2001 (cont'd)

- **Mechanical**
  - **Issue Accelerator Tunnel general arrangements in March**
    - **Hold a drawing review and comment meeting on February 13th and 14th.**
  - **Complete**
    - **Preliminary piping for heat removal from cooling towers to the tunnel**
    - **Preliminary HVAC calculations for the tunnel and Klystron Gallery**
    - **DCN for addition of Window Cooling (Accelerator, Klystron and Injector)**
- **Instrumentation & Controls**
  - **Issue for review and comment:**
    - **Section 2/Appendix C of the Radiation Exposure Protection System (REPS)**
    - **Radiation Exposure Protection System (REPS) Block Diagrams**

Planned Activities for Jan-Mar 2001 (cont'd)

- Nuclear
  - Complete ALARA Design Review of the Target/Blanket Building
  - Revise the Gaseous Radioactive Waste System PFD
  - Complete design development for Klystron handling within the gallery
    - Will require a widening of maintenance asile
    - Have identified customized pallet truck
- DCR Resolution on:
  - DCR 034 - Accelerator Tunnel dimensions and stairwells
  - DCR 035 - High Activity Radwaste Storage railroad spur
  - DCR 036 - Klystron Gallery aisle dimensions
- Preliminary Design Status Report
  - Prepare schedule for providing Balance of Plant input

Issues

- **No Issues -**
  - **We are ready to continue onto the ADTF Design**

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.08
Integrated Control System

Greg Campbell, Project Leader
February 6, 2001

Major Activities Planned for FY01

- ***Release Revision C of Integrated Control System (ICS) System Design Description***
  - ***Add Section 2 content, update Section 1 and Interfaces***
  - ***Start review mid April, Release to IMS 31MAY***
  - ***Estimated cost $134K***
  - ***Captures ICS design status for APT***

- ***Develop Input to APT Preliminary Design Status Report***
  - ***Update costs, summary design description, lessons learned, references, etc.***
  - ***Draft 31MAR, Final 30JUN***
  - ***Estimated cost $120K***
  - ***Required APT preliminary design deliverable***

Major Activities Planned for FY01 (cont'd)

- ***Operator Interfaces Technical Report***
  - ***Released to IMS 9DEC00***
  - ***Estimated cost $25K***
  - ***Provides detail and basis for Operator Interface design solutions in SDD***

Milestone Status for FY01

- ***Level 3 milestone, System Design Description Revision C, is due 31MAY. Activity is on schedule***
- ***On schedule for providing input to APT Preliminary Design Status Report (PDSR) by 31MAR***

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

- ***Released Operator Interface Technical Report PPO-B21-J-TRT-X-00222 documenting:***
  - ***Operator interfaces context within ICS***
  - ***Connections to other ICS functions; particularly database, data storage, alarm manager and sequencer***
  - ***Data flow and functional block diagram of operator interface function***
  - ***Functional hierarchy (Function Flow Block Diagrams) for***
    - » ***Receive Operator Direction***
    - » ***Report To Operator***
    - » ***Control Access***

Planned Activities for Jan-Mar 2001
(Second Quarter FY01)

- ***Complete next draft Integrated Control System input to PDSR***
- ***Continue System Design Description revisions and additions***
- ***Participate in ADTF planning***

Other Activities

- **Reviews**
  - **Facility Design Description Section 7 (Plant Segment Summaries)**
  - **ADTF Requirements**
  - **Interface Control Documents (Injector, Cavity-Vessel)**
  - **Linac block diagrams**
  - **Retargeting Heat Removal Piping & Instrumentation Diagrams**

Issues

- ***Our primary connections to LEDA have been lost due to funding and personnel reductions***
- ***LEDA controls cooperation should be maintained to facilitate continuing development of accelerator control expertise at PPO***

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.19
APT Safety

Laurence L Parme, Level 2 Manager
February 7, 2001

Major Activities Planned for FY01

- **Complete Documentation of Safety Status**
  - **Complete documentation of PSAR safety analysis**
  - **Update safety requirements**
- **Ensure design compliance with safety requirements through document and design reviews**

Milestone Status for FY01

- **Update Safety Requirements Document**
  - **Reconcile document with outstanding comments and state of design**
  - **Scheduled for 27 April - task on schedule**

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

- Accident analyses calculations drafted and reviewed
- Draft *Preliminary Safety Analysis Report*
  - Outstanding editorial comments from DOE review incorporated into document draft
  - Agreement on path to resolve other comments reached

Planned Activities for Jan-Mar 2001
(Second Quarter FY01)

- Release accident calculations
- Draft and submit for review updated Safety Requirements Document
- Conduct ongoing safety reviews

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01

WBS 19.01
Environmental & Waste Management Support

Jack Roberts, Environmental Lead

February 6, 2001

WBS 1.19.01 Cost Performance 1Q01
Defense Programs

- **Total Budget** **$160K**
- **Work Package Plan (BCWS)** **$66K**
- **Actual Expenditures** **$57K**
- **Expectation - Complete scope within budget**

APT Environmental & Waste Management Program Status

- Environmental Program Plan (project organization and approach to ensuring environmental compliance).
- NEPA compliance: EIS complete; assure design within EIS bounds.
- Permit & Compliance Plan: early permit construction permit applications essentially complete.
- NESHAPs Alternate Source Term Calculation: approved by SCDHEC. Updated application partially complete.
- RCRA Regulatory Position documentation: provides basis why RCRA permit not required.
- Pollution Prevention Design Assessment (waste stream characteristics & management): issued; requires update.
- Baseline Environmental Monitoring Plan: majority of monitoring is complete and report issued.

Major Accomplishments for October - December 2000

- Met objectives for Environmental & Waste Management support of design organization including input and review & comment for design documents.
- Environmental Program Plan issued.
- Section 3.2.8 Environment, Safety, and Health Scope and Products submitted (input to Preliminary Design Plan).
- Section 5.3 Environment & Waste Management submitted (input to Preliminary Design Status Report).
- Radionuclide Release Pathways technical report issued for review.
- Environmental Safety & Health Design Guidance Document issued.
- APT Environmental Design Requirements document update initiated.

Major Activities Planned for FY01

- Finalize Environmental & Waste Management input to APT Preliminary Design Status Report. (9/01)
- Provide Environmental & Waste Management support to APT design and design documents. (9/01)
- Issue Radionuclide Release Pathways technical report. (4/01)
- Issue Rev. 1 of Environmental Design Requirements Document. (6/01)
- Issue Rev. 1 of Environmental Safety & Health Design Guidance Document (correlates with EDRD). (7/01)

Challenges

- **Utilize existing APT environmental documents and information to support development of technical input to writing the AAA EIS**
  - **radiological release to environment**
  - **waste generation**
  - **Balance of Plant information and impacts**

Advanced Accelerator Applications (AAA)

Quarterly Review

First Quarter FY01

WBS 1.14
O&M Support

Brent Boore, O&M Lead

February 6, 2001

WBS 1.14 Cost Performance 1Q01

- **Total Work Package Budget** **$800K**
- **Work Package Plan (BCWS)** **$236K**
- **Actual Expenditures** **$217K**
- **Extraordinary charges**
  - **$10K** **Late billing of moving expense from 8/00**
  - **$5K** **Personnel Re-assignment**
  - **Most of O&M Lead cost to 1.18 AAA Planning**
- **Anticipate no problems meeting scope within budget**

Other O&M AAA Cost Performance - 1Q01

WBS 1.18 Project Management - AAA

- **Work Package Budget** **$100K**
- **Actual Expenditures** **-**

WBS 1.20.05 ADT Facility

- **Work Package Budget** **$100K**
- **Actual Expenditures** **-**

Initial funding received 1/29/01

Major Activities Planned for FY01

APT

- *Review and comment upon APT design documentation*
  - *Requirements defined in the Design Authority and O&M Authority documents (matrices)*
- *Participate in design reviews and interface meetings*
- *Support BCP preparation*
- *Provide O&M Input to the Preliminary Design Status Report*
  - *5.2.2 O&M Requirements & 5.2.3 Design Considerations*
  - *5.2.4 Operability Assurance & 5.2.8 O&M Lessons Learned*
  - *5.2.9 O&M Restart Map (if still appropriate)*

AAA

- *Support development of the CD-0 Package*
- *Provide O&M Input to development of the Conceptual Design for the ADTF*

Major Accomplishments for Oct-Dec 2000

- **Supported PPO in timely completion of key deliverables**
  - **Drawings**
    - » **Target Blanket Beam Shutdown Block Diagrams**
    - » **Injector Assembly and General Arrangements**
    - » **SCRF General Arrangements**
    - » **Single Line Diagrams for Construction Power**
    - » **Relay & Metering Diagram for Construction Power**
  - **System Design Descriptions**
    - » **B96 Accelerator & Facility Maintenance Building,**
    - » **B27 Radiation Exposure Protection System**
    - » **A26 Linac Maintenance Facility Equipment**
  - **Plant Requirement Documents**
    - » **PRD-009 Design Envelope Requirements**

Major Accomplishments for Oct-Dec 2000 (Continued)

- **Design Team Interface**
  - Tunnel equipment layout and backside maintenance
  - Layout and piping for klystrons and waveguide
  - Material handling for klystron transport
  - Injector changeout

- **AAA**
  - Input to ADTF requirements
  - Participation in technology selection
  - Planning & strategy

Planned Activities for Jan-Mar 2001

- **Support PPO design documentation reviews**
  - **36 scheduled deliverables**
- **Complete O&M Requirements Update**
- **Support BCP Preparation**
- **Support O&M input to CD-0 package for the ADTF**
  - **Includes some NEPA support**
- **Ensure timely progress on WBS 1.24 work at SRTC**
  - ***Funding received on 1/29/01***
  - ***Work is 30 days behind scheduled start***

Issues

- APT has ~90 design deliverables before 6/29/01 in addition to the major ADTF Conceptual Design needs
- Interface meetings are extremely important and beneficial
  - should work to establish increased formality in AAA interfaces
  - O&M needs to become an integral part of the AAA program, especially the ADTF team
- A well published and visible integrated schedule is a necessity
  - should be evident and recognized by all
  - focus on a three month period

Advanced Accelerator Applications (AAA) Quarterly Review

Oct-Dec 2000

WBS 1.20
Accelerator Driven Test Facility

Steve McConnell, Project Leader, Integration

February 7, 2001

ADTF Site Rendering

Milestone Status for FY01

Milestone	Date	Status
Present Implementation Strategy to DOE (L3)	11/16/00	Complete
Submit CD-0 Package (L3)	3/02/01	First draft (outline) issued on 12/18/00 On schedule to issue 2nd draft for review on 2/2/01
FY03 PE&D Budget Request (L2)	3/20/01	On schedule - CPDS data will be provided in preconceptual cost report
CD-0 Approval (L0)	4/16/01	Will slip; ESAAB requested on 4/18/01 with memorandum on 5/02/01
FY03 PE&D Budget Validation (L0)	6/15/01	On schedule

Conceptual Design (post CD-0) Activities Planned for FY01

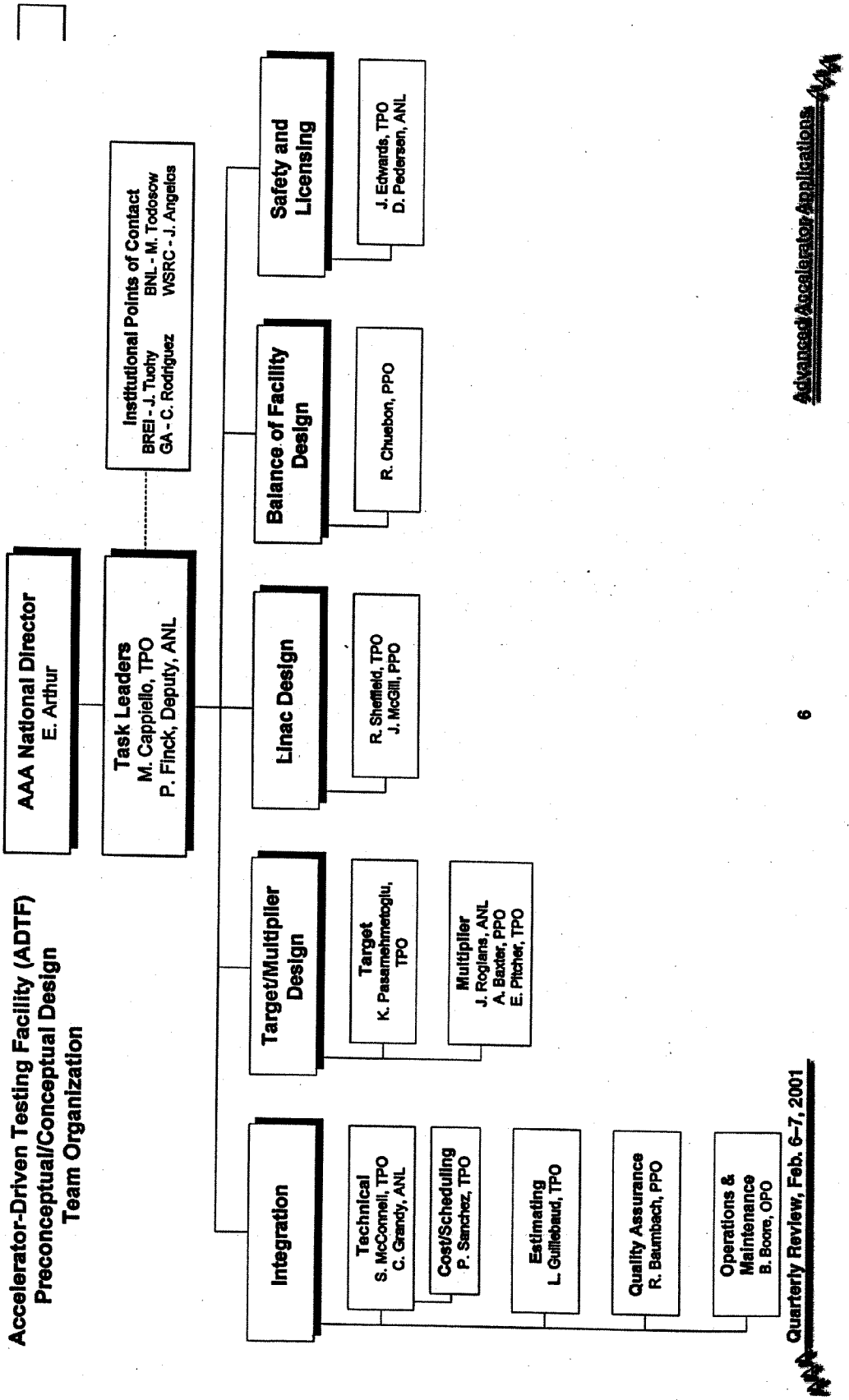
ADTF Conceptual Design

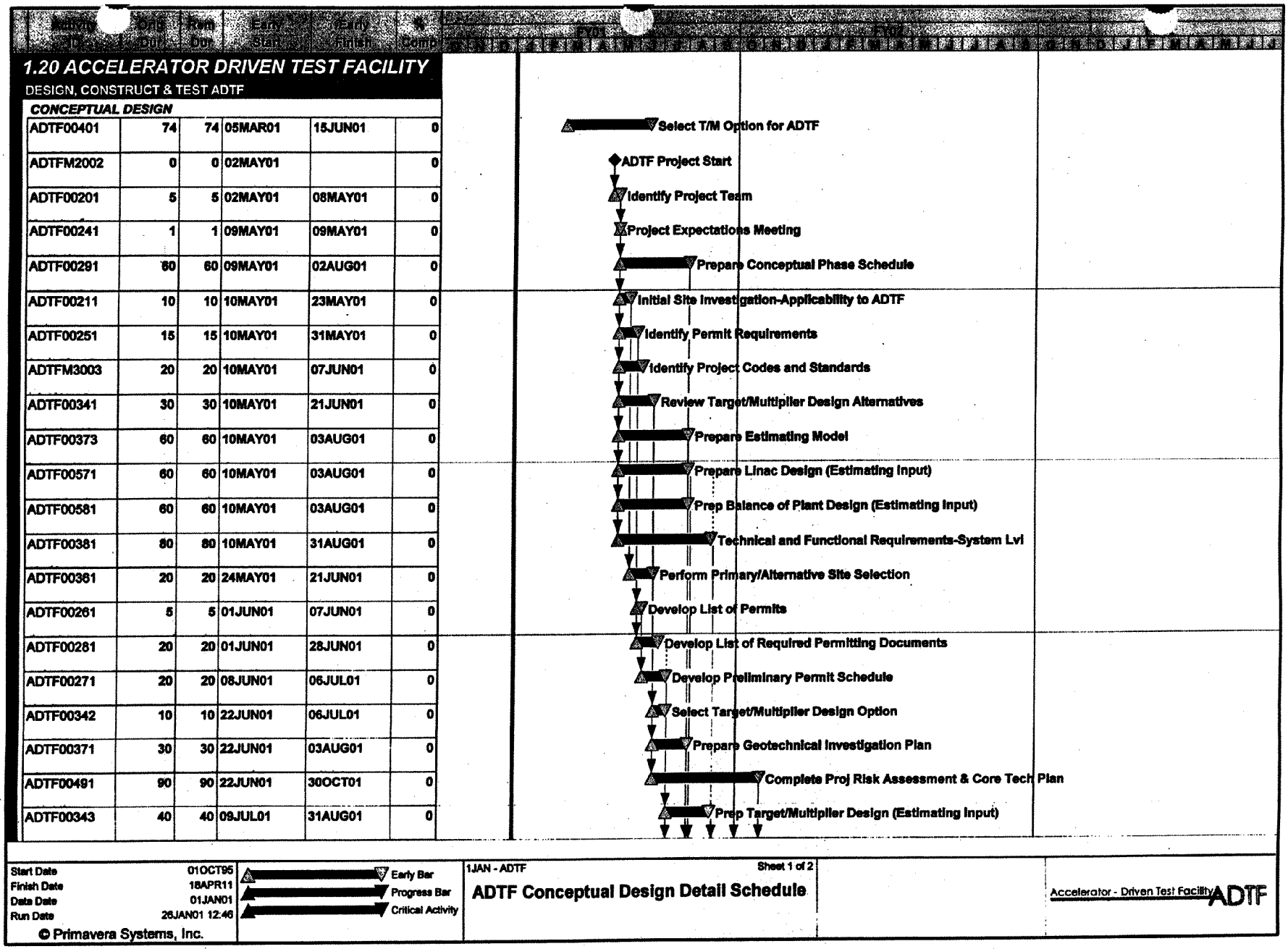
- *Start Conceptual Design (contingent on CD-0 approval) – 4/16/01*
  - » *Major FY01 activities include*
    - *FDD – 6/01*
    - *Select T/M Design Option – 7/01*
    - *Permitting Requirements – 7/01*
    - *Geotechnical Investigation Plan – 8/01*
    - *Refine Estimating Model – 8/01*
    - *Core Technology Plan – 10/01*
- *Conduct External Review @ ~50% conceptual design complete – 9/01*
  - » *Assess readiness to meet FY02 milestones*
    - *Draft CDR - 12/01*
    - *Final CDR - 4/02*
    - *CD-1 – 8/02*

Major Accomplishments for Oct-Dec 2000

- ***Prepared and began execution of a detailed work plan to obtain authorization of a new start line item for ADTF***
  - ***Team organized; roles and responsibilities defined***
  - ***Detailed conceptual design schedule for FY01 and FY02; summary project schedule through FY11***
  - ***Established budgets and milestones for each institution; work packages approved***
  - ***Effective interface and planning meetings held at Argonne and Los Alamos; weekly videoconferences to track progress and issues***
  - ***Participant in DOE CD-0 team in preparation for ESAAB review***

Team Organization




1.20 ACCELERATOR DRIVEN TEST FACILITY
DESIGN, CONSTRUCT & TEST ADTF
CONCEPTUAL DESIGN
Activity ID | Orig Dur | Rem Dur | Early Start | Early Finish | % Comp
ADTF00401 74 74 05MAR01 15JUN01 0
ADTFM2002 0 0 02MAY01 0
ADTF00201 5 5 02MAY01 08MAY01 0
ADTF00241 1 1 09MAY01 09MAY01 0
ADTF00291 60 60 09MAY01 02AUG01 0
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ADTFM3003 20 20 10MAY01 07JUN01 0
ADTF00341 30 30 10MAY01 21JUN01 0
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ADTF00571 60 60 10MAY01 03AUG01 0
ADTF00581 60 60 10MAY01 03AUG01 0
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ADTF00361 20 20 24MAY01 21JUN01 0
ADTF00261 5 5 01JUN01 07JUN01 0
ADTF00281 20 20 01JUN01 28JUN01 0
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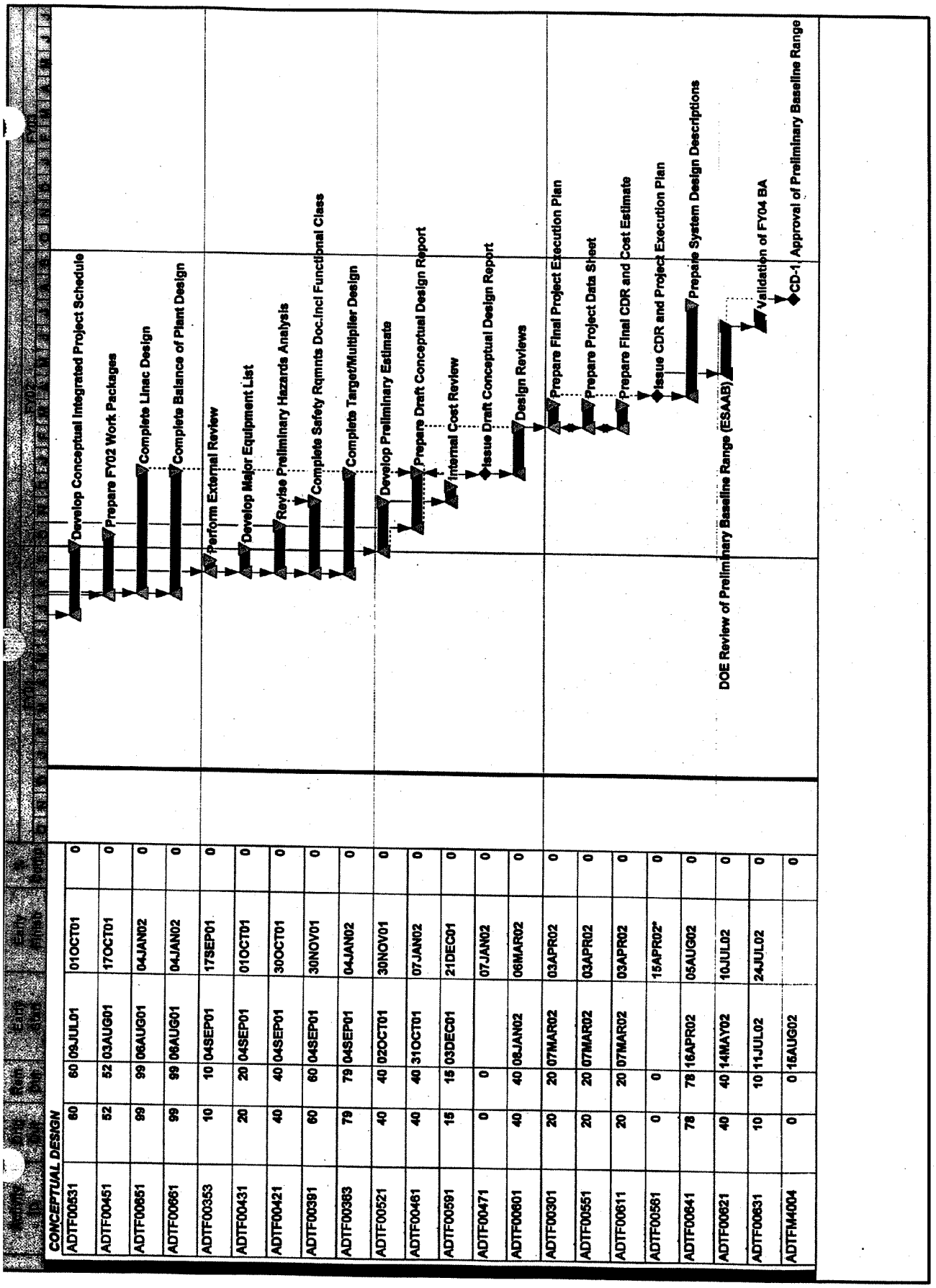
ADTF00342 10 10 22JUN01 06JUL01 0
ADTF00371 30 30 22JUN01 03AUG01 0
ADTF00491 90 90 22JUN01 30OCT01 0
ADTF00343 40 40 09JUL01 31AUG01 0
FY01
FY02
Select T/M Option for ADTF
ADTF Project Start
Identify Project Team
Project Expectations Meeting
Prepare Conceptual Phase Schedule
Initial Site Investigation-Applicability to ADTF
Identify Permit Requirements
Identify Project Codes and Standards
Review Target/Multiplier Design Alternatives
Prepare Estimating Model
Prepare Linac Design (Estimating Input)
Prep Balance of Plant Design (Estimating Input)
Technical and Functional Requirements-System Lvl
Perform Primary/Alternative Site Selection
Develop List of Permits
Develop List of Required Permitting Documents
Develop Preliminary Permit Schedule
Select Target/Multiplier Design Option
Prepare Geotechnical Investigation Plan
Complete Proj Risk Assessment & Core Tech Plan
Prep Target/Multiplier Design (Estimating Input)
Start Date 01OCT95
Finish Date 18APR11
Data Date 01JAN01
Run Date 26JAN01 12:46
© Primavera Systems, Inc.
Early Bar
Progress Bar
Critical Activity
1JAN - ADTF
Sheet 1 of 2
ADTF Conceptual Design Detail Schedule
Accelerator - Driven Test Facility
ADTF


CONCEPTUAL DESIGN
ADTF00531 60 60 09JUL01 01OCT01 0
ADTF00451 52 52 03AUG01 17OCT01 0
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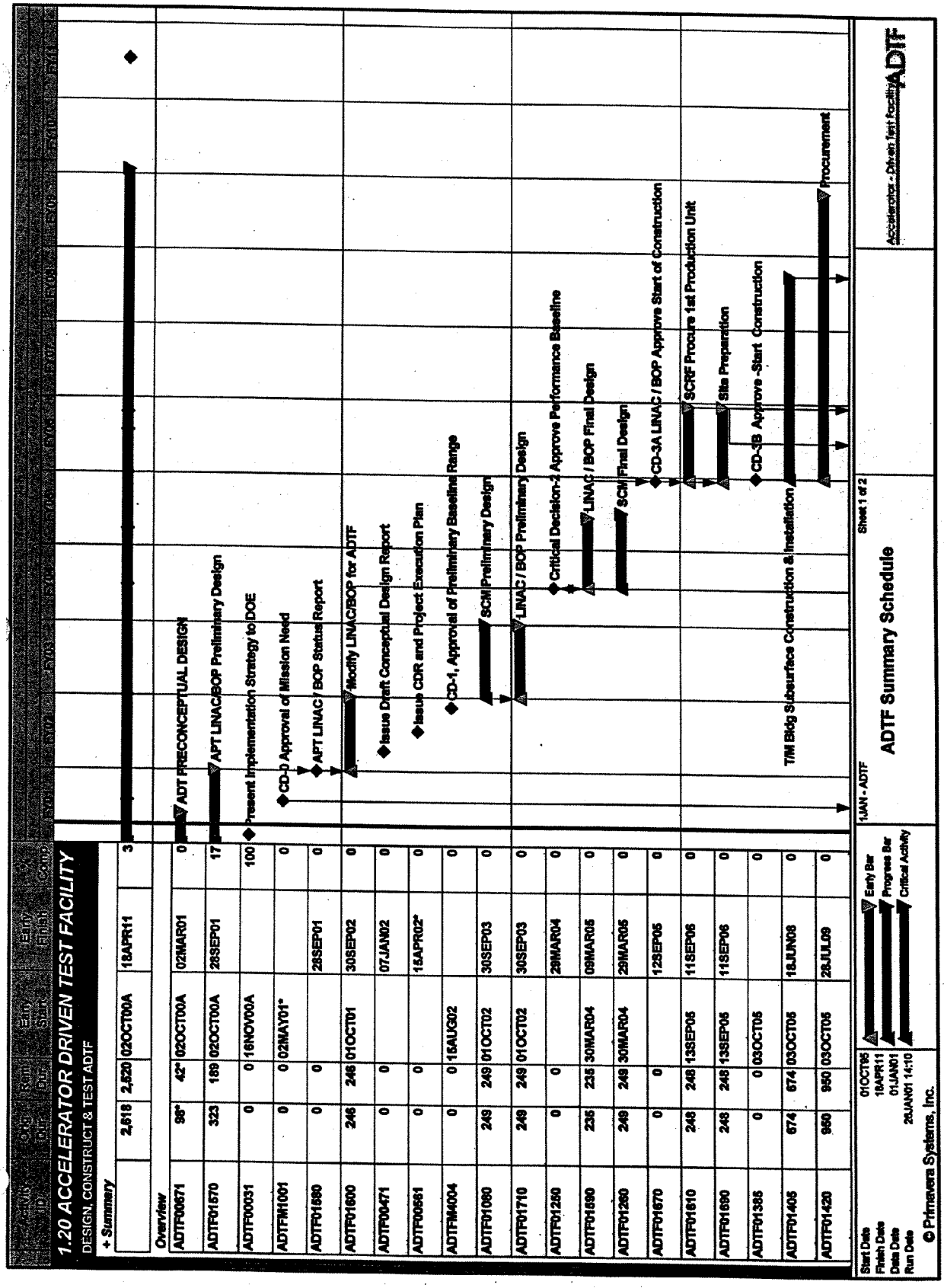
ADTFM4004 0 0 16AUG02 0
Develop Conceptual Integrated Project Schedule
Prepare FY02 Work Packages
Complete Linac Design
Complete Balance of Plant Design
Perform External Review
Develop Major Equipment List
Revise Preliminary Hazards Analysis
Complete Safety Rqmnts Doc.Incl Functional Class
Complete Target/Multiplier Design
Develop Preliminary Estimate
Prepare Draft Conceptual Design Report
Internal Cost Review
Issue Draft Conceptual Design Report
Design Reviews
Prepare Final Project Execution Plan
Prepare Project Data Sheet
Prepare Final CDR and Cost Estimate
Issue CDR and Project Execution Plan
Prepare System Design Descriptions
DOE Review of Preliminary Baseline Range (ESAAB)
Validation of FY04 BA
CD-1 Approval of Preliminary Baseline Range

Sheet 2 of 2


1.20 ACCELERATOR DRIVEN TEST FACILITY
DESIGN, CONSTRUCT & TEST ADTF
ADTF Summary Schedule
Sheet 1 of 2
Accelerator - Driven Test Facility ADTF
ADT PRECONCEPTUAL DESIGN
APT LINAC/BOP Preliminary Design
Present Implementation Strategy to DOE
CD-0 Approval of Mission Need
APT LINAC / BOP Status Report
Modify LINAC/BOP for ADTF
Issue Draft Conceptual Design Report
Issue CDR and Project Execution Plan
CD-1, Approval of Preliminary Baseline Range
SCM Preliminary Design
LINAC / BOP Preliminary Design
Critical Decision-2 Approve Performance Baseline
LINAC / BOP Final Design
SCM Final Design
CD-3A LINAC / BOP Approve Start of Construction
SCRF Procure 1st Production Unit
Site Preparation
CD-3B Approve -Start Construction
T/M Bldg Subsurface Construction & Installation
Procurement
Early Bar
Progress Bar
Critical Activity
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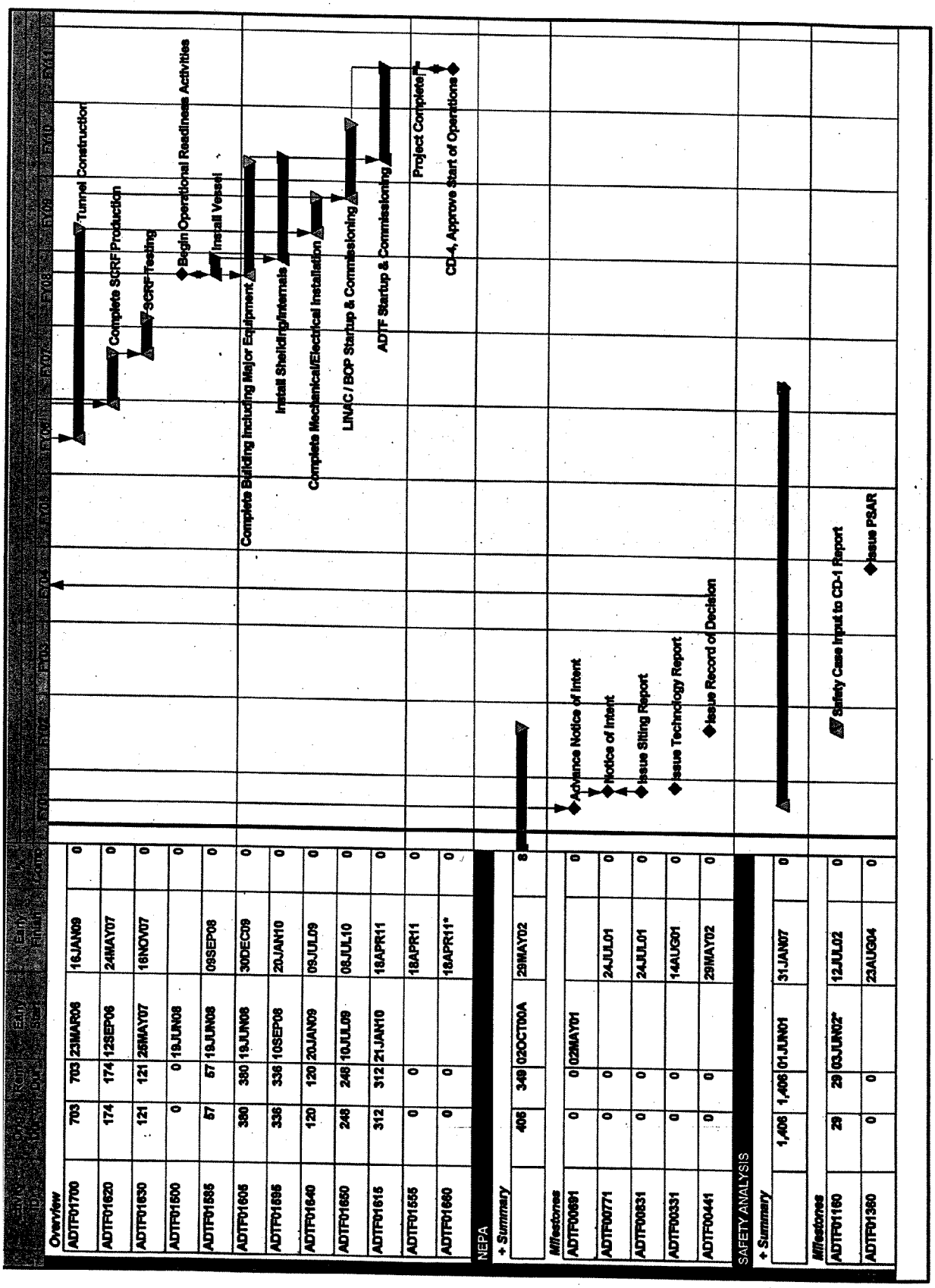
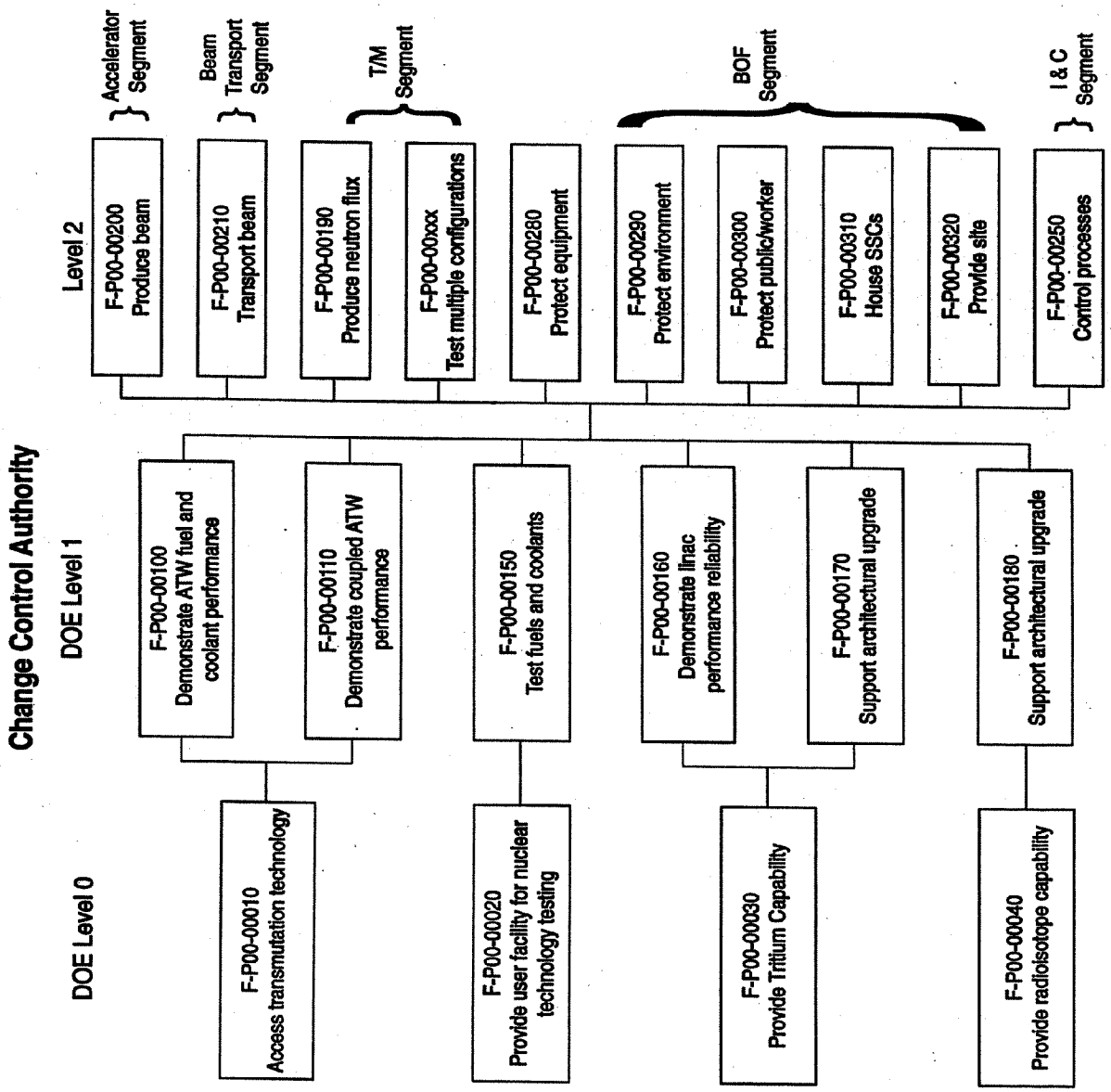

Tunnel Construction
Complete SCRF Production
SCRF Testing
Begin Operational Readiness Activities
Install Vessel
Complete Building Including Major Equipment
Install Shielding/Internals
Complete Mechanical/Electrical Installation
LINAC / BOP Startup & Commissioning
ADTF Startup & Commissioning
Project Complete
CD-4, Approve Start of Operations
Advance Notice of Intent
Notice of Intent
Issue Siting Report
Issue Technology Report
Issue Record of Decision
Safety Case Input to CD-1 Report
Issue PSAR

Sheet 2 of 2

Major Accomplishments for Oct-Dec 2000

- *Completed the Trade Study of the four candidate T/M options*
  - *Using SE methodology, prioritized and ranked options using weighted decision criteria*
  - *Presented to independent review panel on December 12*
  - *Will proceed with Sodium-cooled Fast Spectra concept (ANL lead) and Modular concept (LANL lead)*
- *Prepared draft of the ADTF Missions, Functions and Performance Requirements*
  - *Comprehensive reviews by all project participants and independent review panel*
  - *Performed Mission Needs Analysis to develop Functional Flow Block Diagram*
    - » *derives high level facility requirements from program missions*
    - » *Establishes logical basis for change control authority*


Change Control Authority
DOE Level 0
DOE Level 1
Level 2
F-P00-00010 Access transmutation technology
F-P00-00100 Demonstrate ATW fuel and coolant performance
F-P00-00110 Demonstrate coupled ATW performance
F-P00-00020 Provide user facility for nuclear technology testing
F-P00-00150 Test fuels and coolants
F-P00-00030 Provide Tritium Capability
F-P00-00160 Demonstrate linac performance reliability
F-P00-00170 Support architectural upgrade
F-P00-00040 Provide radioisotope capability
F-P00-00180 Support architectural upgrade
F-P00-00200 Produce beam
F-P00-00210 Transport beam
F-P00-00190 Produce neutron flux
F-P00-00xxx Test multiple configurations
F-P00-00280 Protect equipment
F-P00-00290 Protect environment
F-P00-00300 Protect public/worker
F-P00-00310 House SSCs
F-P00-00320 Provide site
F-P00-00250 Control processes
Accelerator Segment
Beam Transport Segment
T/M Segment
BOF Segment
I & C Segment

Major Accomplishments for Oct-Dec 2000

- *Prepared first draft of CD-0 package document – 12/18/00*
  - *Address all elements needed to support Approval of Mission Need*
    - » *Project Technical Description*
      - *ADTF Missions, Functions, and Requirements*
      - *Preconceptual Design Report*
    - » *Conceptual Design Plan and detailed schedule to execute work*
    - » *ROM Total Project Cost Estimate*
    - » *Schedule Range for Design, Construct, and Startup*
    - » *Project Management approach – Project Execution, Risk Management, NEPA Strategy, Safety Strategy, Acquisition Strategy*

Preconceptual Cost Estimate Summary

Issues

What is working well

- *Despite geography, integrated team is working well; commitments are being met and communications are effective and continuous*

Issues needing attention

- *Maintain focus during month of February to ensure quality of CD-0 package review by all participants; plan to conduct focused review meetings during the week of 2/19*
- *Resolve scope relative to tritium production capability*
  - *Major pathways - Separate target station or integral to subcritical multiplier assembly; to be addressed in NEPA action*
- *Out-year strategy for phased critical decisions re: start final design (CD-2) and start construction (CD-3)*

Modular ADTF Conceptual Design

AAA Quarterly Review

Los Alamos, New Mexico

February 7, 2001

M. Cappiello

Los Alamos National Laboratory

Multiple Missions: Operational Flexibility

Transmutation technologies proof of performance and proof of practicality

User facility for advanced nuclear technologies, materials and physics research.

Isotopes for medical and industrial applications

Multiple Missions means Flexibility in providing:

- Flux and spectra
- Fuels, coolants and their combinations
- Geometry
- Access for materials and isotopes

Accelerator - Driven Test Facility ADTF

Modular Option Provides Operational Flexibility

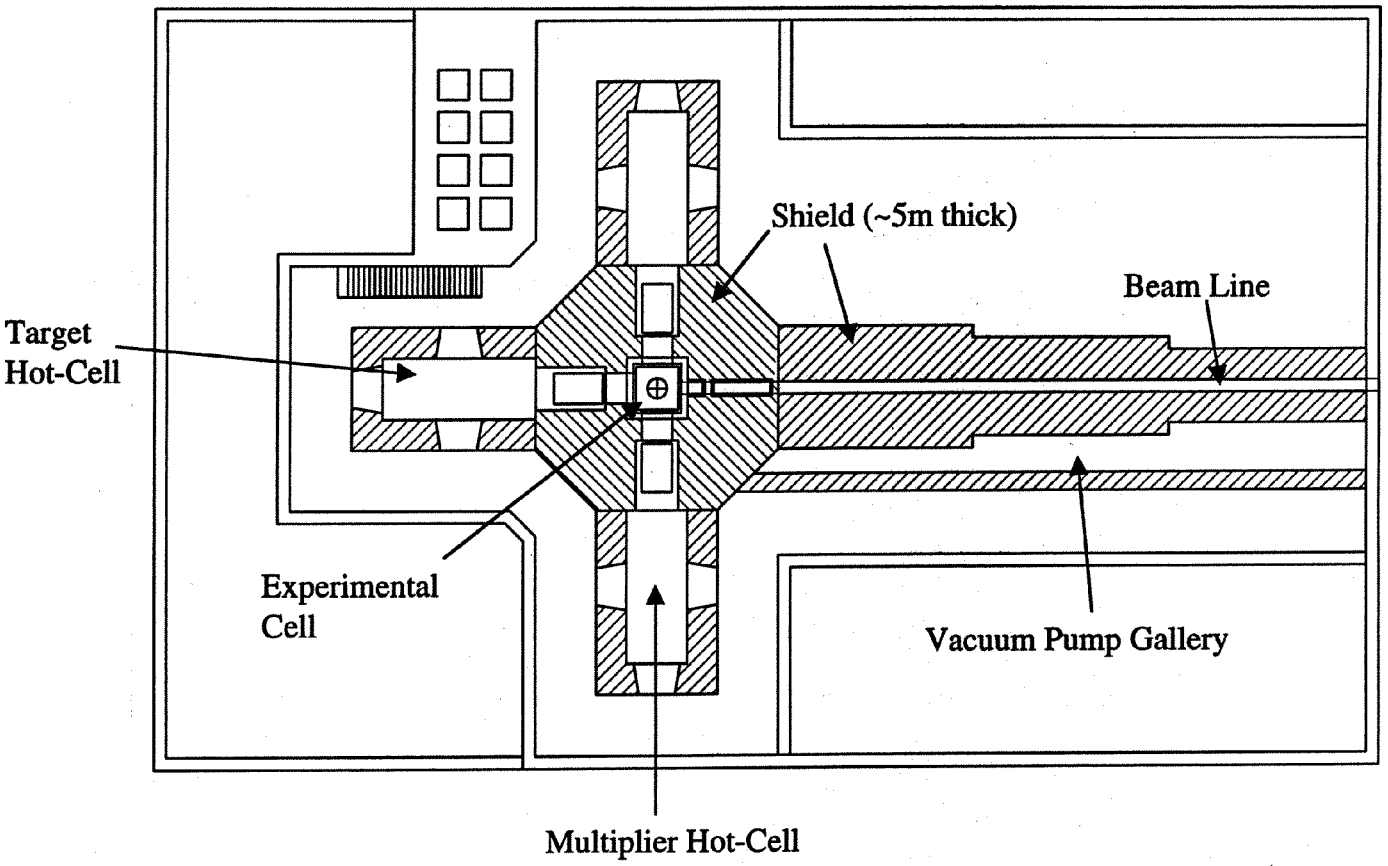
System Characteristics:

- Horizontal beam insertion into Target/Multiplier
- Horizontal target insertion and replacement
- Horizontal multiplier component insertion
- Hot cells adjacent to the target/multiplier outside 5m thick shield

Operational Flexibility:

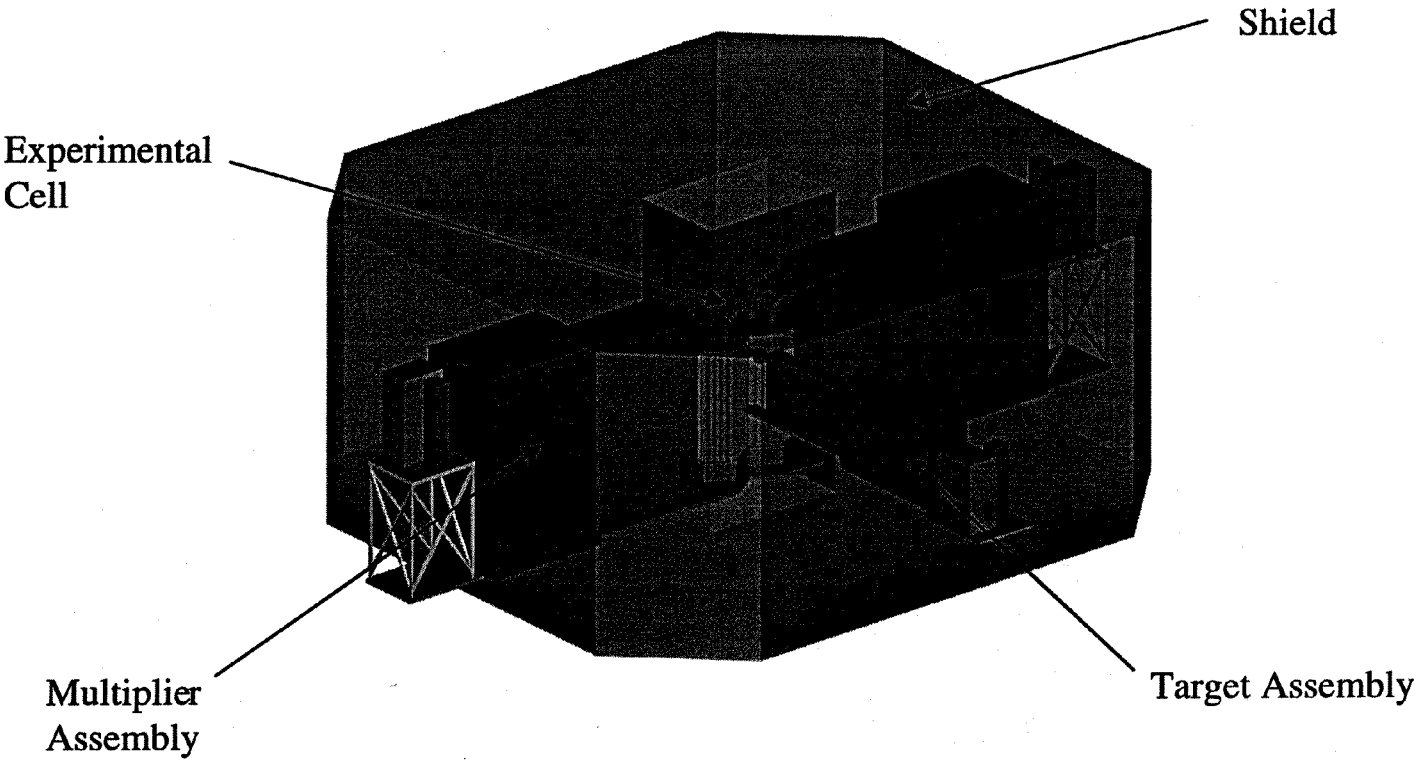
- Allows for testing of multiple target options
- Allows for quick replacement of target
- Allows for either testing of either fast or thermal multiplier systems
- Allows for testing of different multiplier coolants
- Allows for isotope production and closed loops
- Allows for safe maintenance of primary heat removal systems
- Separate target cooling isolates spallation products from multiplier coolant

Modular Concept: Plan View



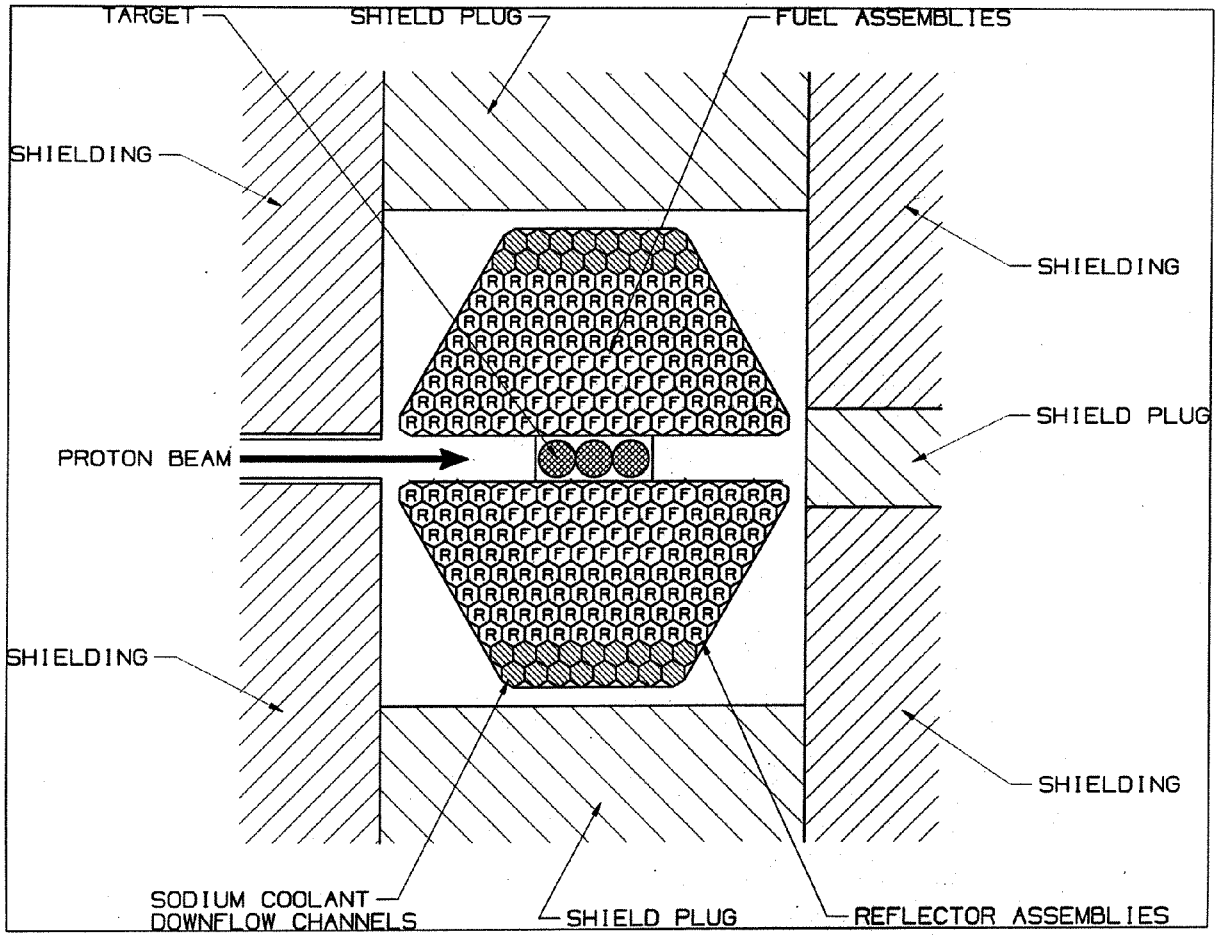
Accelerator - Driven Test Facility ADTF

Target and Multiplier Modules Inserted Horizontally Through the Shield



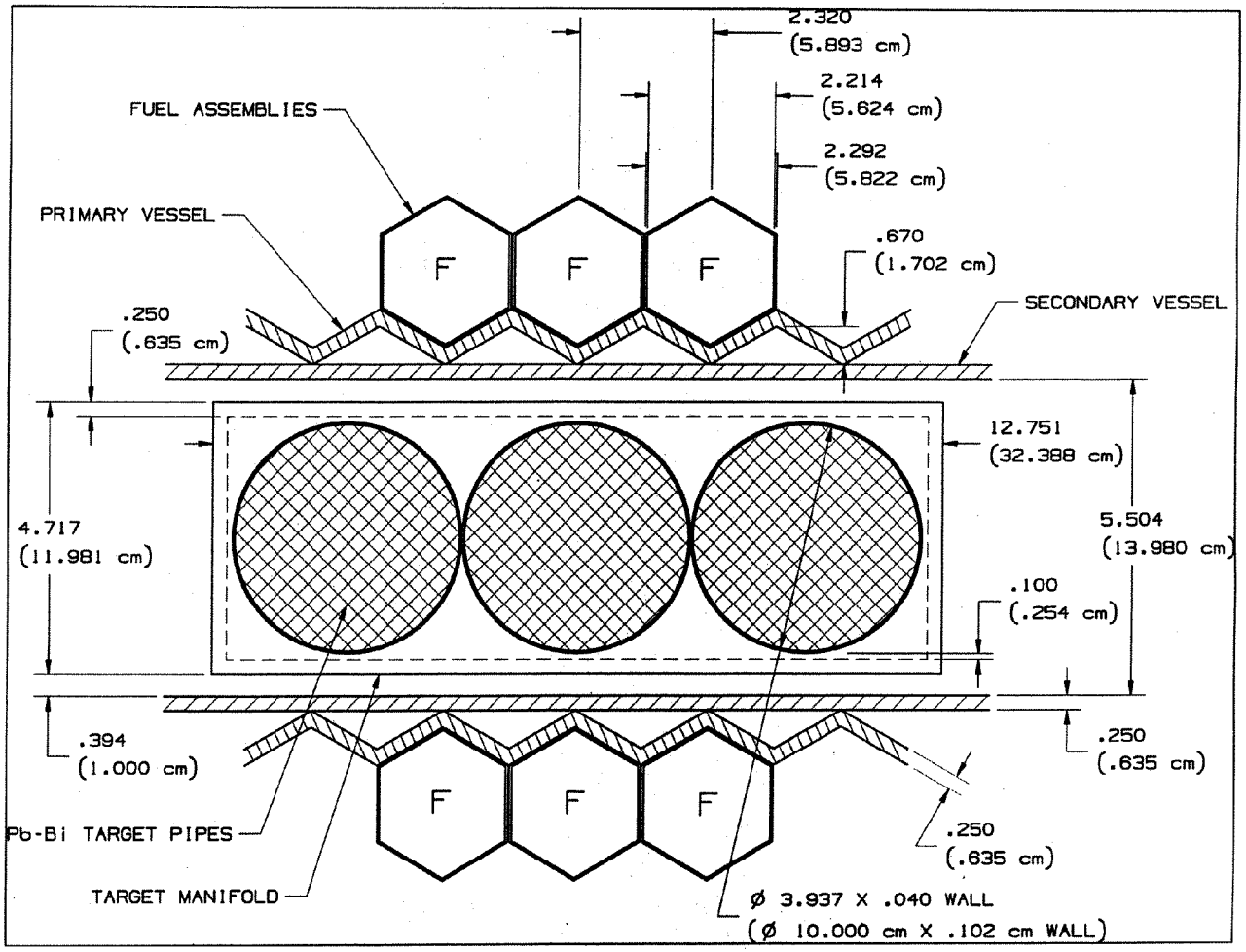
Accelerator - Driven Test Facility ADTF

Experimental Cell Detail with Fast Spectrum Multiplier



Accelerator - Driven Test Facility ADTF

Target System Detail: Plan View



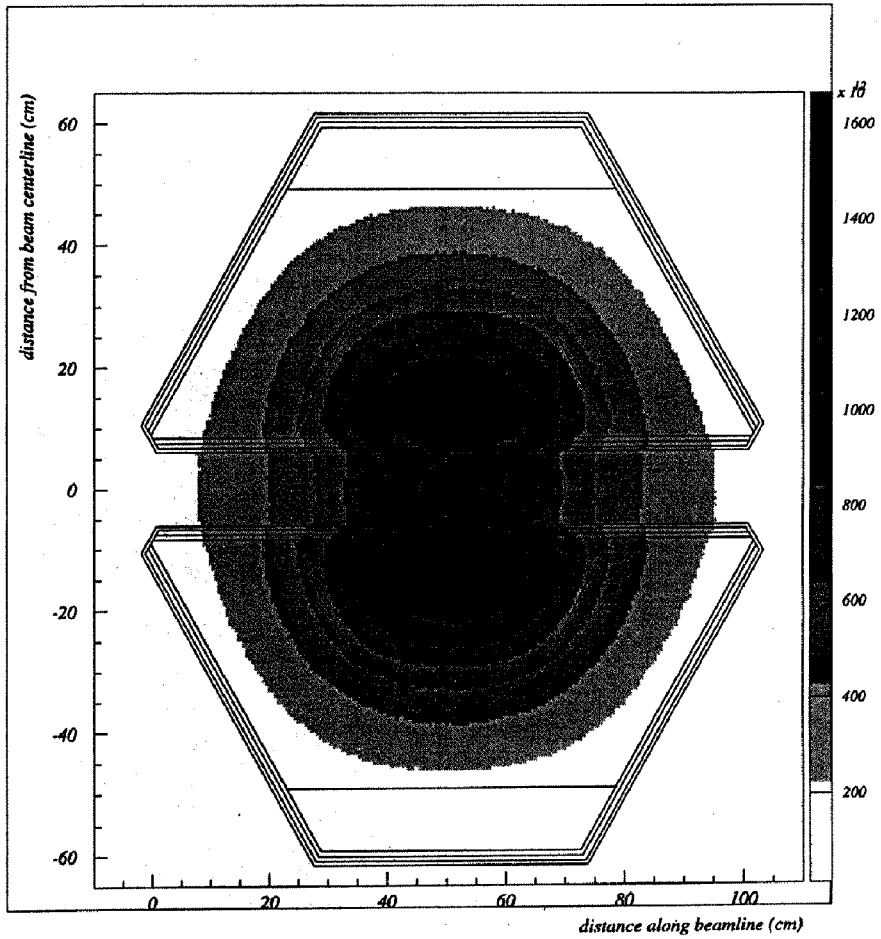
Proton Beam →

Accelerator - Driven Test Facility ADTF

Fast Spectrum Example: Neutronics Results

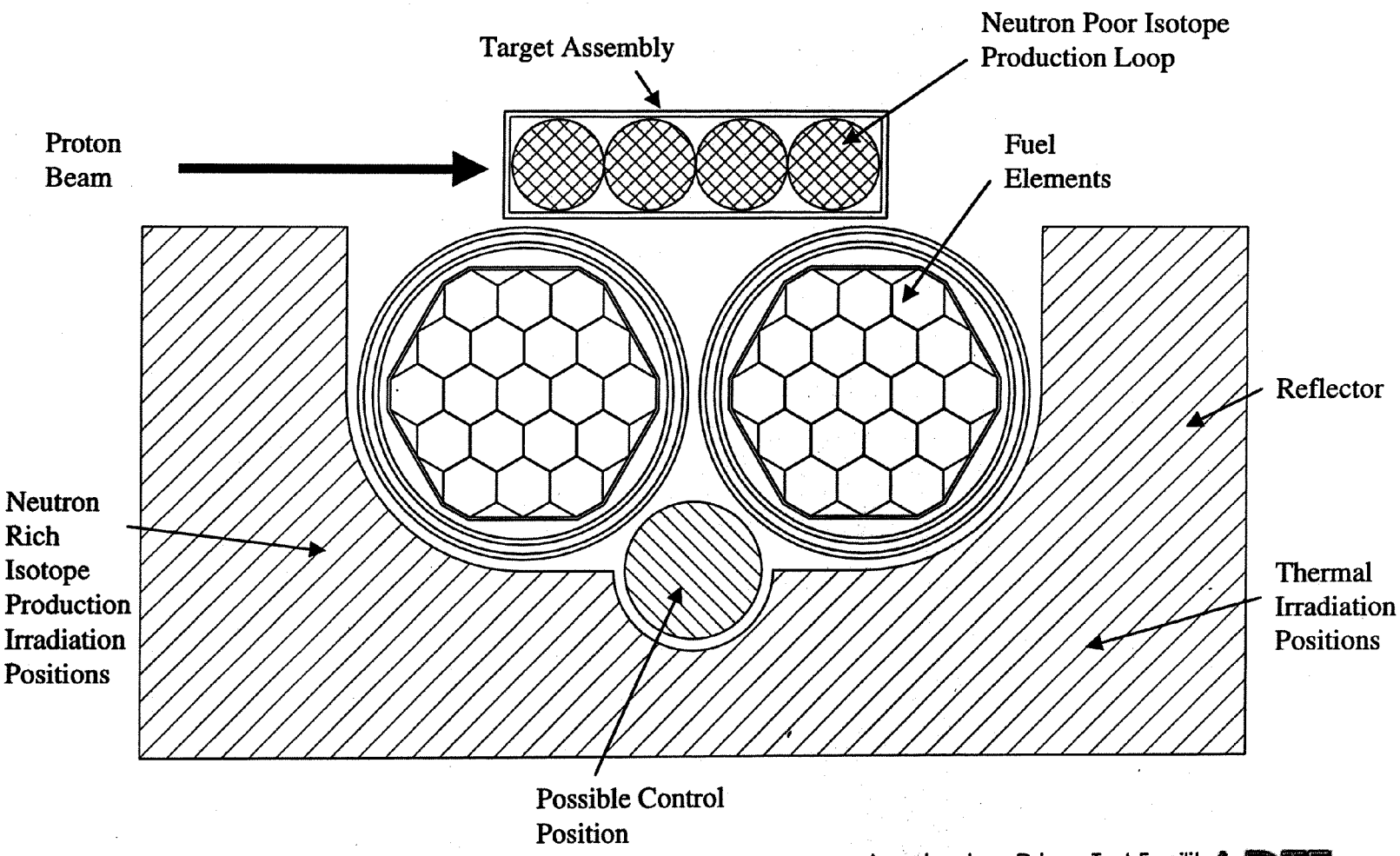
HM inventory = 339 kg
# of fuel assemblies = 60
fuel collumn height = 34 cm
fuel =U-10Zr, 67% enriched (EBR-II)
target = lead/bismuth
reflector = Inconel
coolant = sodium

k_{eff} = 0.85
blanket power = 20 MW
target power = 2.3 MW
average flux over fuel volume = 1 x 10^{15} n/cm^2/s
peak flux in fuel = 2 x 10^{15} n/cm^2/s



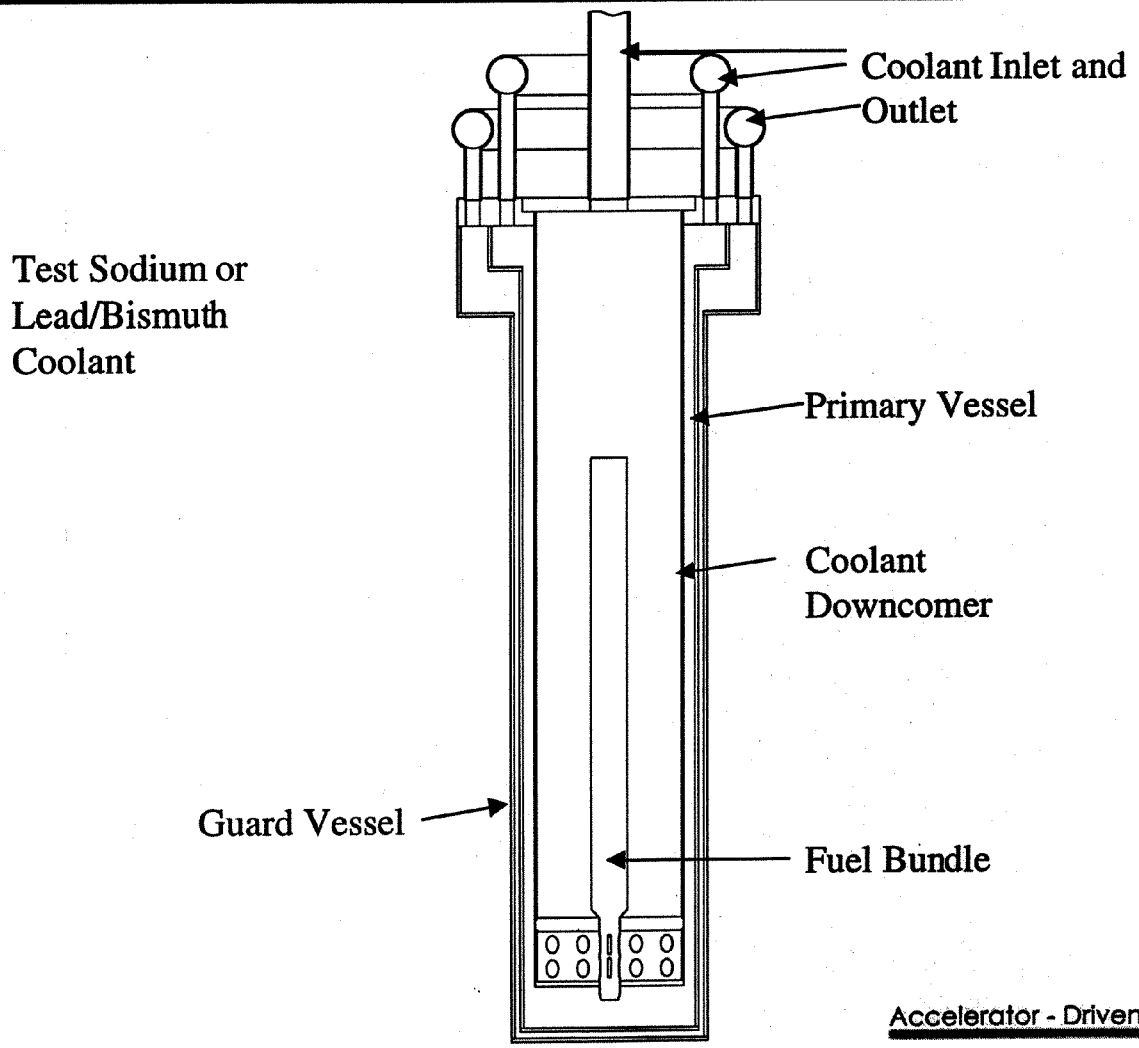
Accelerator - Driven Test Facility ADTF

Multiplier Option: Separate Vessels



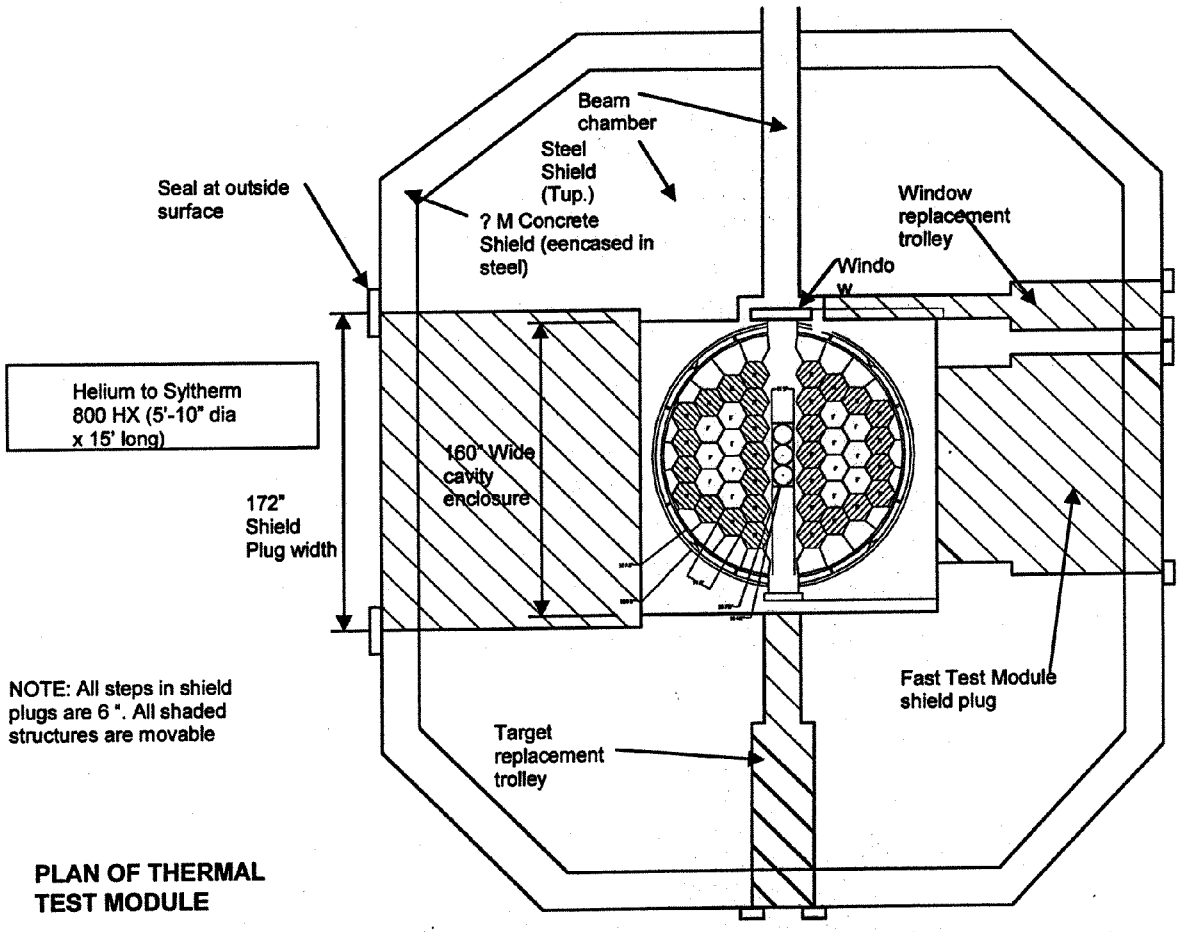
Accelerator - Driven Test Facility ADTF

Vessel Option for Fast Spectrum Test



Accelerator - Driven Test Facility ADTF

Modular Design Allows Testing of Thermal Systems



PLAN OF THERMAL TEST MODULE

Accelerator - Driven Test Facility ADTF

Safety Features

- Beam Shutdown:
  - safety class active systems tie trip signals to the injector
    - fail safe
    - diverse and redundant
  - passive beam shutdown
    - leaks or breaks in the experimental cell will cause loss of vacuum
    - passive beam shutdown will occur in the event active systems fail
- Power:
  - physical constraint at injector prevents overpower
- Decay Heat Removal
  - natural circulation in the event pump fails
  - separate guard vessel cooling circuit in the event of primary system failure
  - conduction to backup heat sink also a possibility
- Containment/confinement:
  - experimental cell and massive shield
- Sodium Fires:
  - heat removal equipment in inert atmosphere (hot-cell environment)
  - helium secondary coolant

Summary

- Modular Design offers flexible system that can provide test and irradiation environments necessary to demonstrate both transmutation and advanced nuclear systems.
  - different materials and coolants are possible
  - fast or thermal neutron environment
- Both neutron-poor and neutron-rich isotope production is possible.
- Horizontal beam and target insertion is a well developed, mature technology.
- Beam shutdown and decay heat removal can be done passively.

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

Concept for an Accelerator-Driven Test Facility (ADTF) Using a Pool-Type Metal-Fuel Sodium-Cooled Subcritical Multiplier

Joseph E. Herceg, Arlen R. Brunsvold, and Phillip J. Finck
Reactor Analysis and Engineering Division
February 7, 2001

Rationale: machine should be adapted to multiple missions:

Mission 1:

Demonstrate the safe and efficient operations of a coupled system

- No other facility available within reference timeframe
- Significant new challenges in design and engineering, safety, physics, controls, operations ADTF experience will be critical to ATW

This led to a design representative of the current reference ATW design

- Physics (k) and control
- Materials and fuels
- Geometry
- High flexibility for testing

Mission 2:
Test ATW fuels and materials

- Existing facilities are only partially adequate
- Need representative spectra, high flux level, and large irradiation volume

This led to designing a high power density 100MW system, starting up at 20MW, with design representative of reference ATW

Mission 3:
Testbed for advanced nuclear technology

- Potential lack of fast irradiation facilities; need to investigate new coolants and fuel forms
- Many thermal test reactors currently available

This led to incorporating three test loops in the design

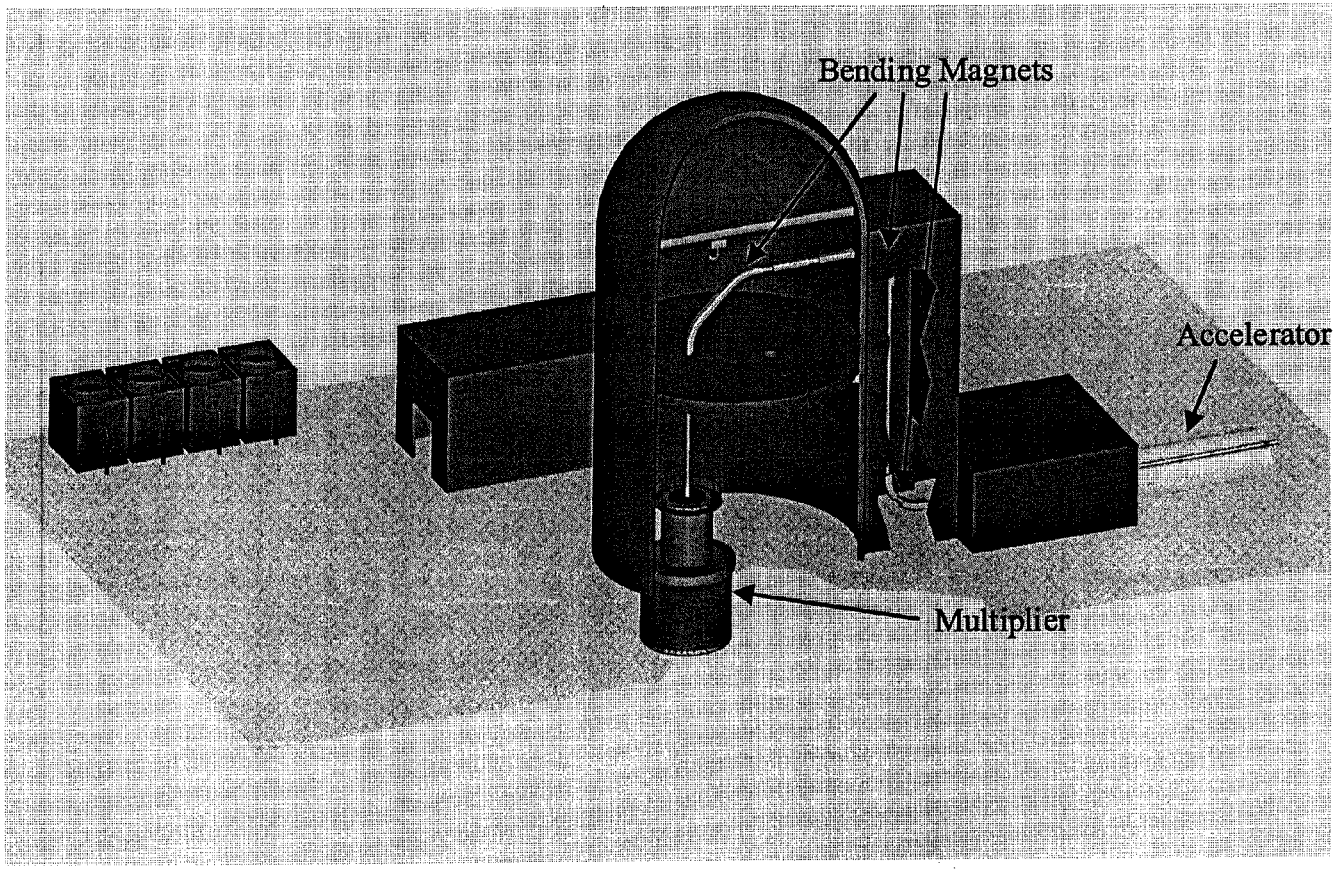
Rationale: Schedule and Technology Constraints

- Representativity of current ATW design
- Reliance on proven technologies and designs

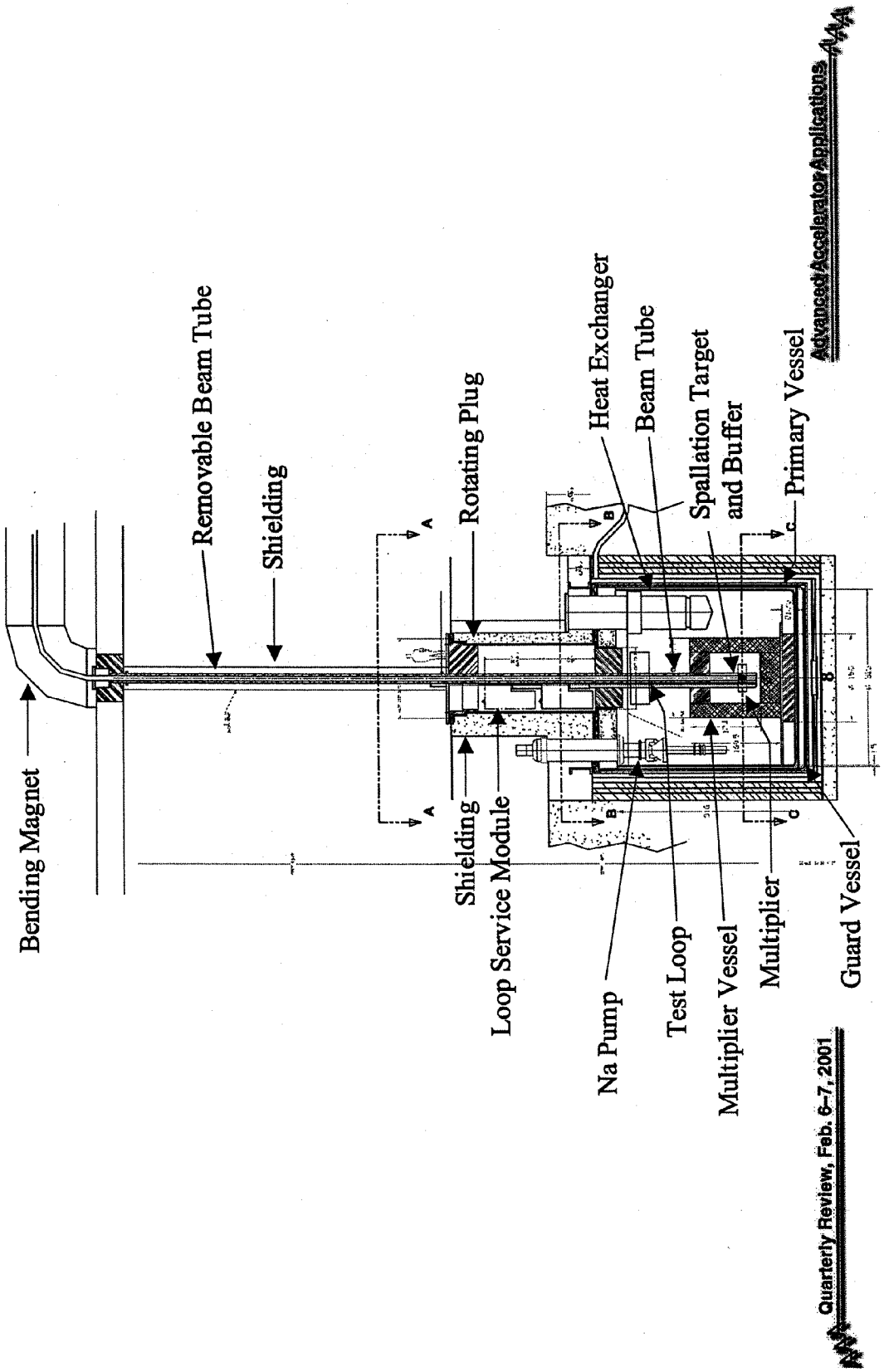
Characteristics of Sodium-Cooled ADTF Concept

- Pool-type multiplier system using standard U-10%Zr metal fuel, with gradual changeover to prototypic ATW fuel.
- Two primary Na pumps with intermediate heat exchanger to secondary Na system.
- Proven fuel handling using a rotating plug and a rotating offset gripper with transfer to in-vessel storage basket.
- Multiplier 48-in.-dia (including reflectors) with space for accelerator spallation target/buffer.
- Control rods at periphery or in interior of multiplier fuel region.
- Three semi-permanently installed loops for developmental testing of ATW fuels under prototypic thermalhydraulic and neutronic conditions with Na, He, and Pb-Bi coolants.
- Irradiation assemblies may be placed anywhere in and around the multiplier region and handled same as fuel assemblies, and instrumented assemblies may be included as well, if provisions are initially made for them (i.e., access holes through rotating plug and multiplier vessel cover.)

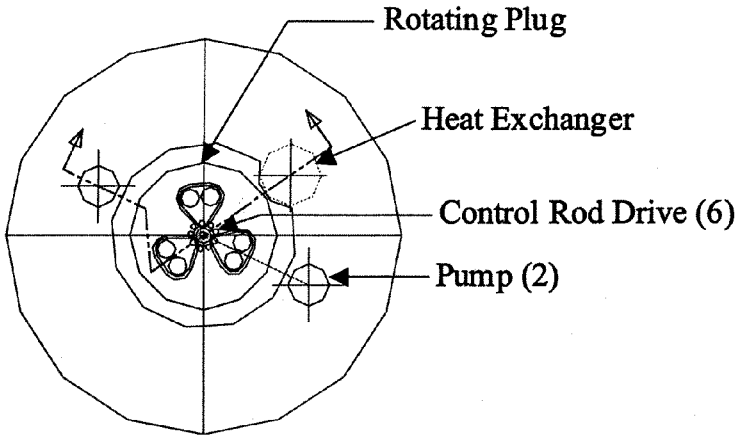
ADTF Concept with Vertical Entry of Accelerator/Target Tube



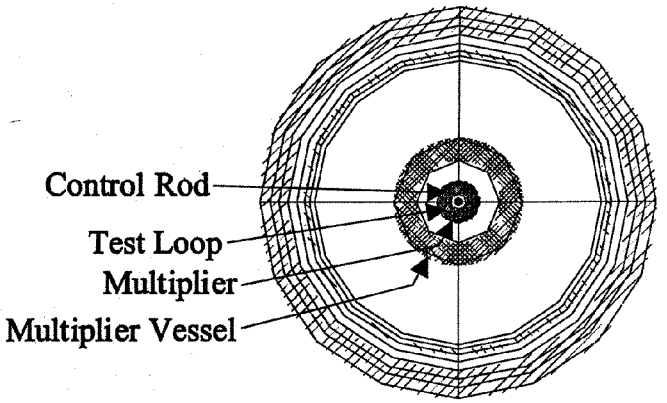
Vertical Sections of Vertical-Entry Pool-Type ADTF



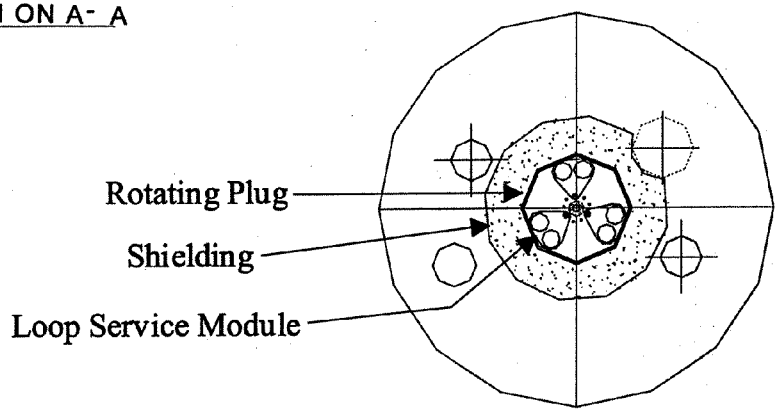
Horizontal Sections of Vertical-Entry Pool-Type ADTF



SECTION A-A

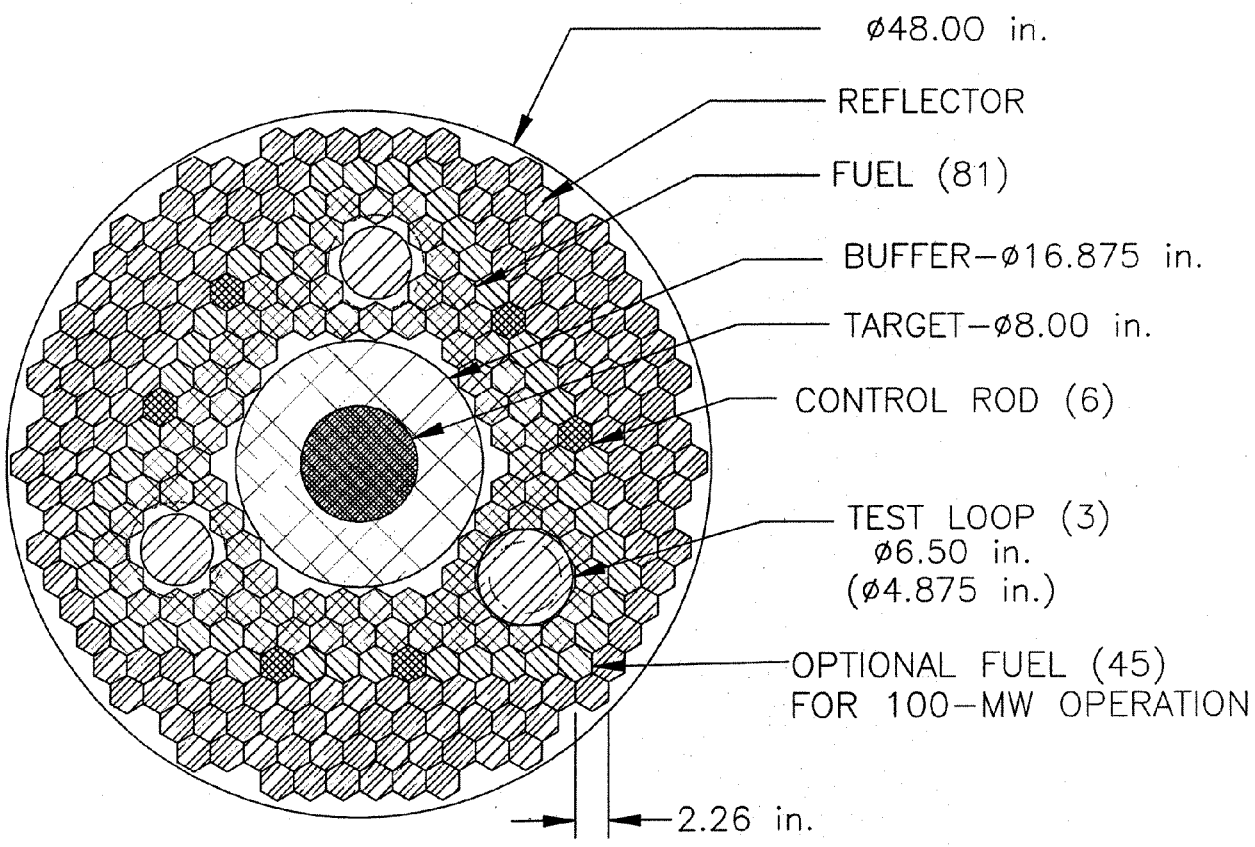


SECTION C-C

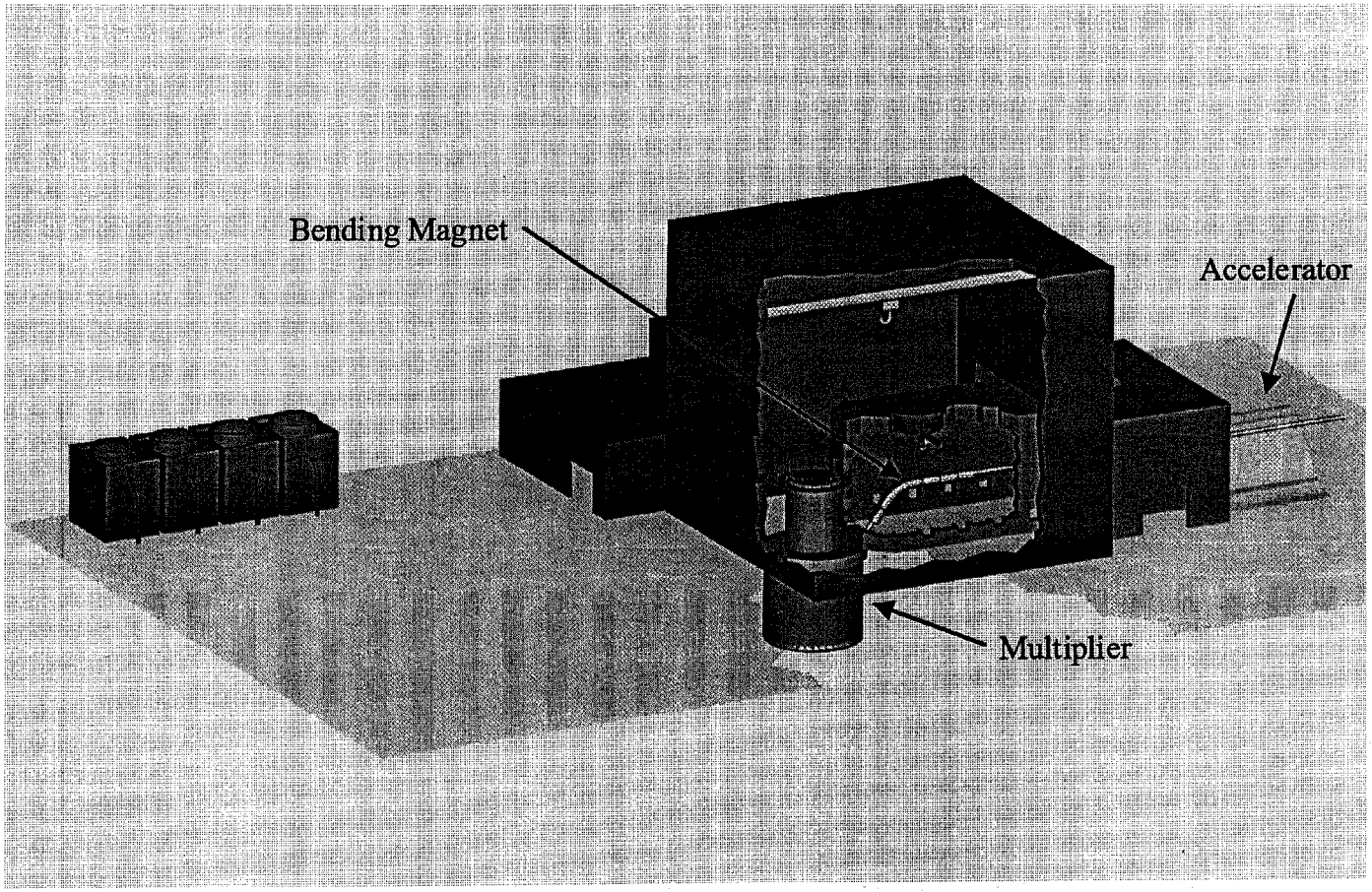


SECTION B-B

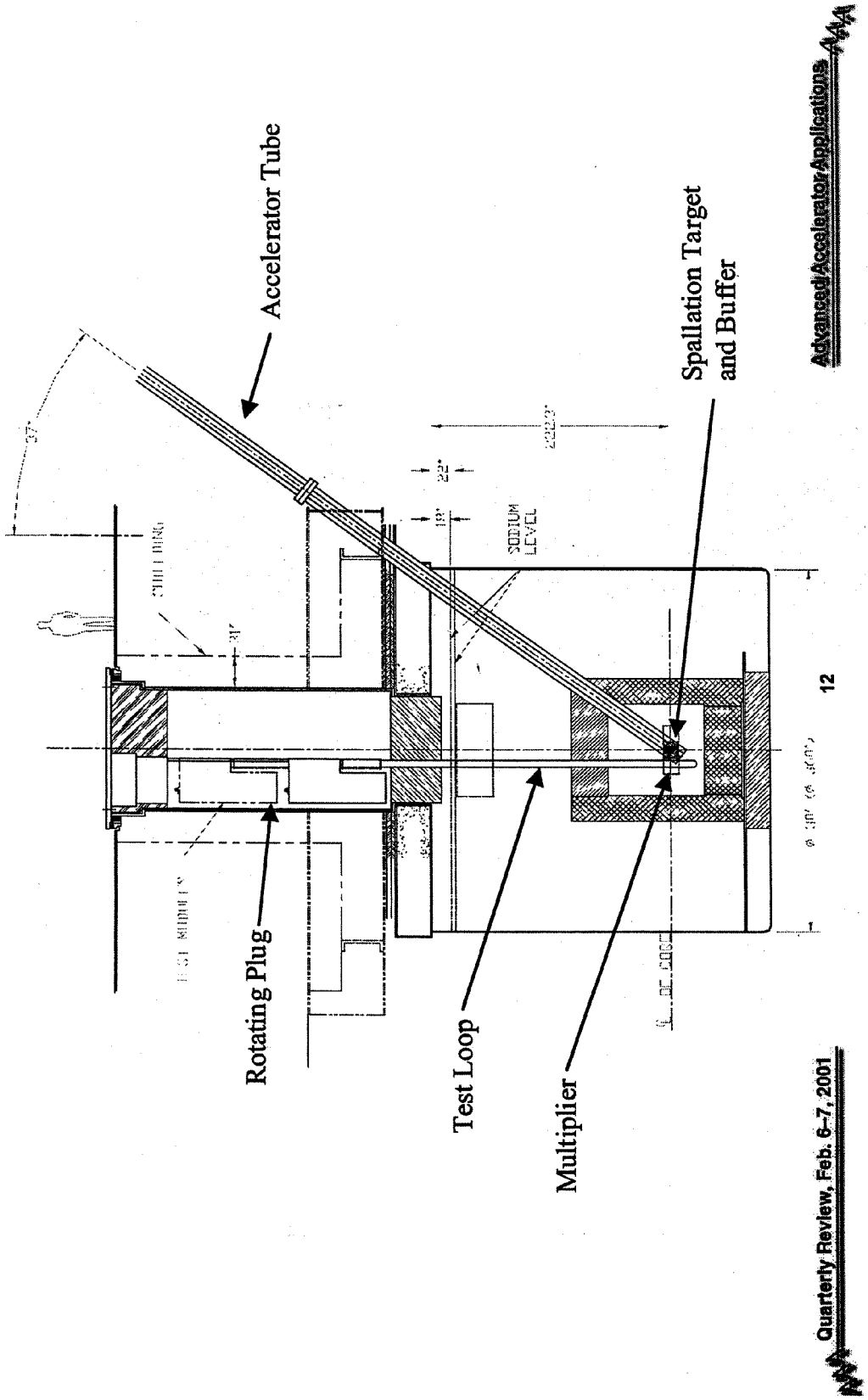
Target/Multiplier for Vertical-Entry Pool-Type ADTF



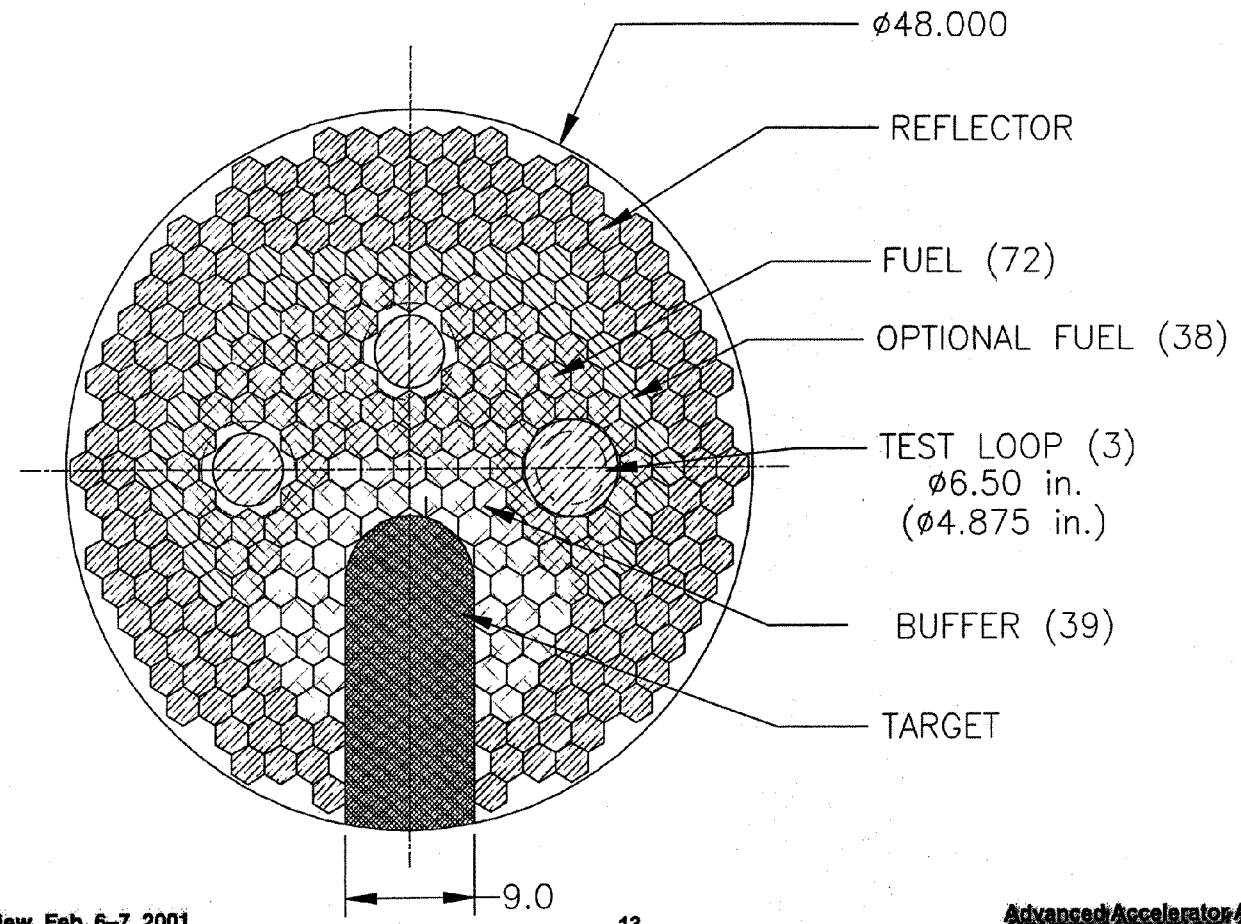
ADTF Concept with Inclined Entry of Accelerator/Target Tube



Vertical Section of Inclined-Entry Pool-Type ADTF

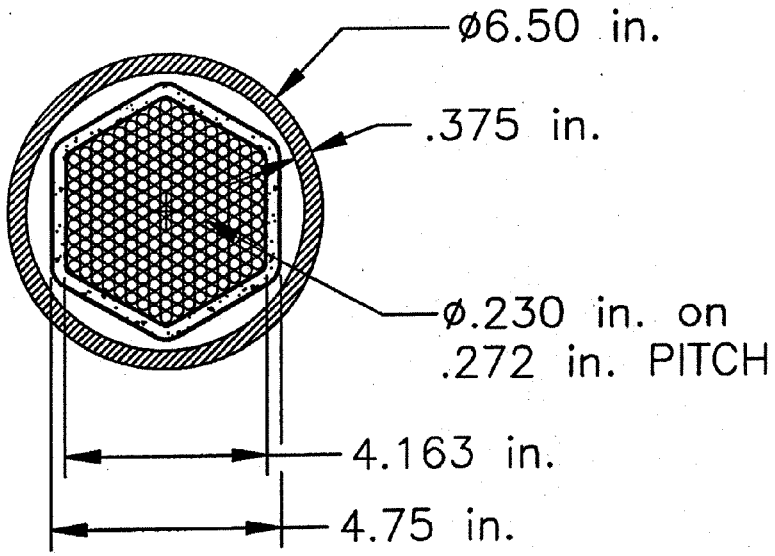


Target/Multiplier for Inclined-Entry Pool-Type ADTF



Sodium-Cooled ADTF Concept: Test Loop Cross-Section with Multiplier-Type Fuel

217-ELEMENT TEST SECTION BUNDLE (~16KG-HM)



Sodium-Cooled ADTF Performance Versus Requirements

Target/Multiplier Requirement	Goal	Concept Capability
Produce neutrons with prototypical spectrum using high energy proton beam and subcritical multiplier	20 MW_t thermal power initially, eventually 100 MW; k_{eff} 0.8 to 0.97	20 MW_t derated, 100 MW_t at rated power with additional assemblies; k_{eff} 0.8 to 0.97
Provide peak neutron flux with representative ATW spectrum and level	~ 3-5 $\times 10^{15}$ n/s-m^2 > 0.1 MeV ~ 1-2 $\times 10^{13}$ n/s-m^2 Thermal (<0.1 ev)	At 20 MW_t: ~ 0.8 $\times 10^{15}$ n/s-m^2 > 0.1 MeV ~ 0.2 $\times 10^{14}$ n/s-m^2 Thermal
Irradiate fresh/irradiated/recycled ATW fuel samples in representative conditions	Up to 40 kg, up to 3 $\times 10^{15}$ n/s-m^2, prototypical thermal and hydraulic conditions	~ 16 kg typical LMR-type fuel in Na coolant non-fuel-failure; less in fuel-failure tests
Provide coolant loops for testing ATW representative assemblies in all coolant environments	At least 2 closed loops to test representative fuel assemblies and coolants	3 loops: Na, He, Pb-Bi, each with independent thermal and hydraulic control
Provide ATW prototype materials irradiation environment	Window: 30-100 uA/cm^2 protons, Multiplier: Near target ~ 44 dpa/yr, 80 appm/yr H, 10 appm/yr He; Far from target: ~ 40 dpa/yr	Materials may be irradiated in any inner row fuel assembly position(s) close to buffer, any other position(s) far from target
Capability to test prototype spallation targets	Protoypical ATW liquid Pb-Bi and He-cooled W Targets	Targets are independent of multiplier system
Demonstrate integrated ATW system behavior	Control reactivity, power and power distribution under all operating conditions	Multiplier system includes 6 control rods and grid spaces for optional fuel assemblies
Allow for controlled transient testing	Conditions to allow validation of safety codes and analyses	Thermalhydraulics and control system will allow transient tests
Maximum reliance on passive safety strategies	Depend on passive safety systems	Na-cooled critical systems shown to be passively safe under many conditions. Coupled target/ subcritical multiplier needs investigation

Status of Technology for a Sodium-Cooled ADTF

+ Sodium technology very mature, used in many reactors world-wide.
+ Fuel and assembly design and performance well characterized and fully qualified.
+ Fuel handling techniques well characterized and fully qualified.
+ Designs of major pieces of equipment can be duplicated or adapted from proven LMR designs for use in ADTF.
+ Considerable equipment on hand from EBR-II that can be used in ADTF (e.g., IHX).
? Compactness of Na-cooled fast multiplier makes placement of requisite test, operations, and fuel handling components difficult.
? Targets will be extensively tested in the near term, but engineering of accelerator beam tube for insertion, sealing, and removal and for beam diagnostics will be challenging.
? Shielding of components to allow for routine operations and recovery from off-normal operations will require complex design and extensive detailed planning, especially for vertical entry concept.

Summary and Conclusions

- An ADTF with a 600-MeV LINAC and a Na-cooled, pool-type subcritical multiplier accomplishes the primary missions of the Project:
  - Demonstrate the operability, controllability and safety of coupled accelerator and subcritical multiplier systems
  - Provide an irradiation environment for development of fuel and materials for eventual application to ATW plants
  - Provide a testbed for application to more general advanced nuclear technology development
- Technologies for both component systems are well developed; only technical risk is with marrying the two technologies, and the main goal of the Project is precisely to investigate this area
- A Na-cooled pool-type subcritical multiplier is the primary candidate for the first generation ATW power plant, so implementation of a 100-Mwt version in the ADTF

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.19
AAA Environmental Safety & Health

Jack Edwards, Project Leader
February 7, 2001

Major Activities Planned

NEPA/Safety products to support Critical Decisions

- **CD-0 Approve Mission Need (start conceptual design) (Feb 01)**
  - **Preliminary Environmental Strategy**
  - **Preliminary Safety Plan**

- **CD-1 Approve Preliminary Baseline Range (start preliminary design) (Aug 02)**
  - **Final NEPA plan (NEPA and ROD will be completed 9/02)**
  - **Safety plan (Detailed)**
  - **Waste management plan**
  - **Preliminary hazards analysis**
    - » **Safety classification and requirements**

Major Activities Planned

Key Integrated NEPA/Safety Milestones

- **CD-2 Approve Performance Baseline (start of final design) (Oct 03)**
  - **Draft PSAR**
- **CD-3 Approve Start of Construction (Linac 12/04, T/M 3/05)**
  - **Approval of PSAR**

NEPA Activities Planned

NEPA Plan

- DOE hired Battelle Labs as NEPA Contractor
- Plan developed and schedule integrated with project
  - Plan input to CD-0 report, 1/29/01
    - » Includes site selection criteria and screening results
  - Advanced Notice of Intent, 4/16/01
  - Site screening report, 6/22/01(draft), 7/24/01 (final)
  - Technology Report, 7/13/01 (draft), 8/14/01 (final)
  - Notice of Intent 7/25/01
  - Public Scoping meetings September 01
  - Draft EIS available for comment 3/15/02
  - Final EIS released June 5, 2002
  - ROD in Federal Register September 19, 2002

NEPA Activities Planned

NEPA SCOPE INCLUDES

- ATW research
- Tritium production with APT of sub-critical multiplier
- Medical and Industrial Isotope Production
- Nuclear Science and Engineering research capability

NEPA SCOPE DOES NOT INCLUDE

- Requirement that site be capable of accommodating an ATW facility

Site selection process is part of NEPA plan

Siting Report

- **Three exclusion criteria developed**
  - **Must be existing DOE site**
  - **Site must be available during the mission need time -50 years and not interfere with existing or assigned missions**
  - **Large enough to accommodate AAA Missions 5000 ft x 2500 ft**
- **Eleven sites meet exclusion criteria and will be carried forward to EIS**
- **Additional evaluation criteria developed**
  - **Nine sites to be evaluated against criteria, hope to get down to 3 - 4 sites**
  - **Remainder of sites will be listed in a section as considered but not analyzed**

Site Selection Status

Nine Sites Meet Exclusion Criteria

- INEEL / Argonne National Laboratory West
- Brookhaven National Laboratory (BNL)
- Los Alamos National Laboratory
- Nevada Test Site (NTS)
- Oak Ridge National Laboratory (ORNL)
- Pantex
- Sandia National Laboratory
- Savannah River Site (SRS)
- Waste Isolation Pilot Plant

Technology Report will provide NEPA data

Technology Report

- Provide data to NEPA contractor on AAA/ADTF
- Plan to treat ADTF as three phases
  - Phase 1, ADTF uses proven driver fuel and tests ATW advanced fuels
  - Phase 2, ADTF uses significant amounts of advanced driver fuels (still tests others)
    - » All fuels fabrication and separations in existing facilities
  - Phase 3, ADTF requires large quantities of fuel from separated spent commercial fuels to demonstrate ATW
    - » New fuel fab or separations facilities required
    - » Decision made to develop national ATW program
    - » New NEPA action required
    - » Phase 3 will be discussed but not evaluated in AAA/ADTF EIS - The issue is not "ripe" for decision

Technology Report will provide NEPA data

- *Technology Report (con't)*
- A process flow sheet will be developed to identify ADTF:
  - Processes
  - Facilities to be constructed
  - Fuel fabrication or separations facilities
- NEPA status of existing facilities will be evaluated
- ADTF target/multiplier technology options will be treated in a bounding or encompassing fashion
  - This allows technology selection to be outside of EIS

Major Safety Activities Planned

Safety Plan

- Safety Plan input to CD-0 January 26, 2001
- Preliminary Hazards Analysis June - September 2001
- Safety Case input to CD-1 Report July 12, 2002
- Draft PSAR to DOE for review as part of CD-2, December 2003
- DOE review PSAR March 04
- PSAR revised, project review and submitted for approval July 2004
- DOE approve PSAR before construction August 2004

Milestone Status for FY01

- **Advance Notice of Intent for EIS**
  - **Scheduled March 5, 2001**
  - **Rescheduled to April 16, 2001**
    - » **Linked to DOE approval of CD-0**
    - » **Complete for CD-1**
- **Notice of Intent for EIS**
  - **Scheduled June 28, 2001**
  - **Rescheduled to July 25, 2001**
    - » **Linked to completion of Siting Report and DOE duration from ANOI**
    - » **Complete for CD-1**

Milestone Status for FY01

Milestone	Due Date	Status
Advance Notice of Intent for EIS	3/5/01	Revised date 4/18/01 to coincide with approval of CD-0, On schedule. Date supports completion for CD-1.
Notice of Intent for EIS	June 28, 2001	Revised date 7/25/01. Linked to completion of siting report, On schedule. Date supports completion for CD-1.

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

- NEPA Planning near completion
- Team developed
  - DOE, Battelle, TPO, PPO, OPO
- Input to CD-0 report completed
- Schedule and activities integrated with DOE
- Siting exclusion criteria developed, eleven sites screened
- Site ranking criteria near complete
- Technology report kick off meeting held,
  - Flow sheet developed
  - Data call spread sheet developed, assignments made
- Safety schedule developed

Planned Activities for Jan-Mar 2001
(Second Quarter FY01)

- **Milestones - None**
- **Activities**
  - **Prepare detailed outline for Technology Report 3/23/01**
  - **Continue preparation of Siting Report**
    - » **Draft 6/22/01**
    - » **Final 7/23/01**
  - **Continue preparation of technology report**
    - » **Draft 7/13/01**
    - » **Final 8/14/01**

Other Activities

- **Frequent NEPA team Tele - conferences**

Issues

NONE

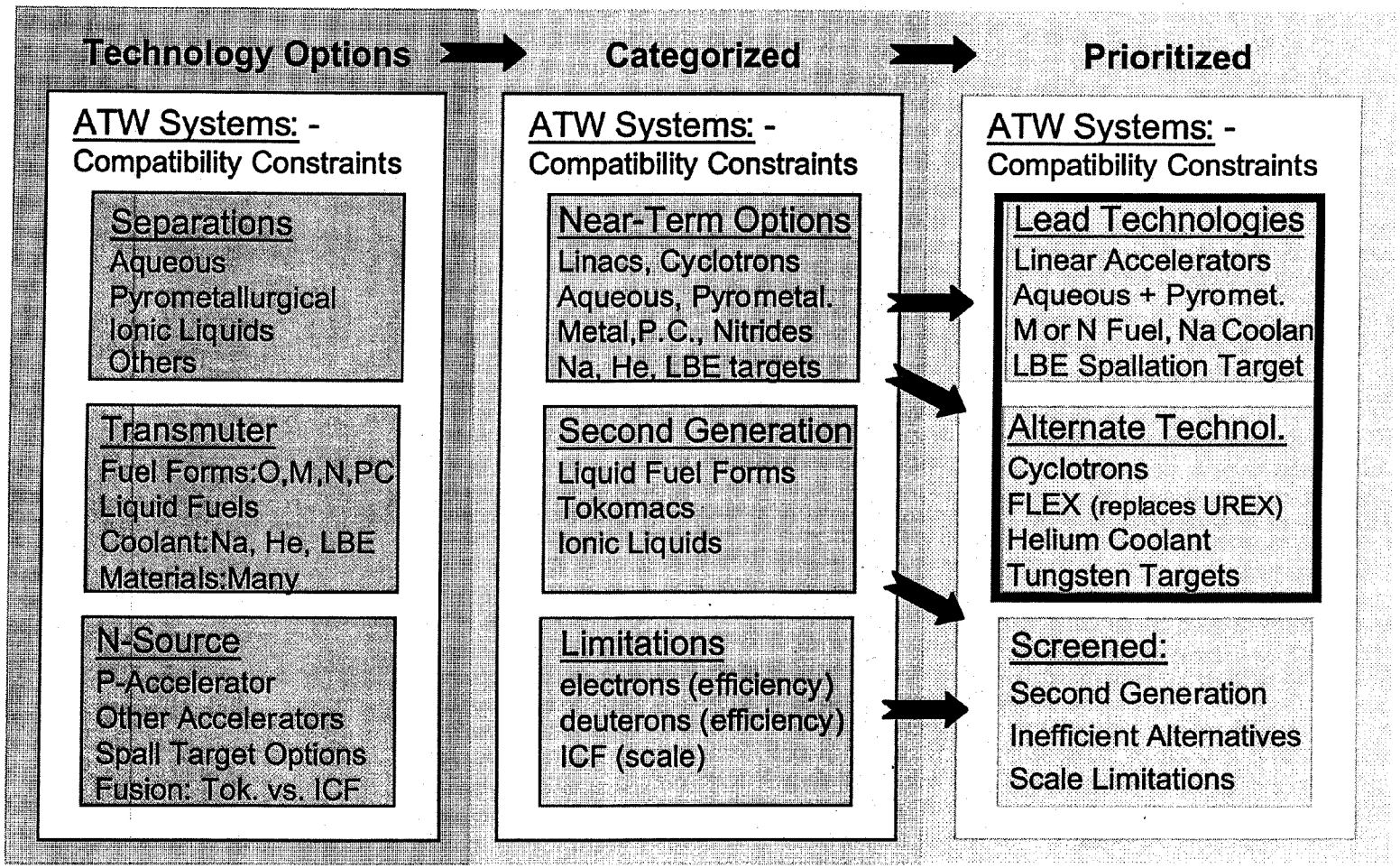
Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

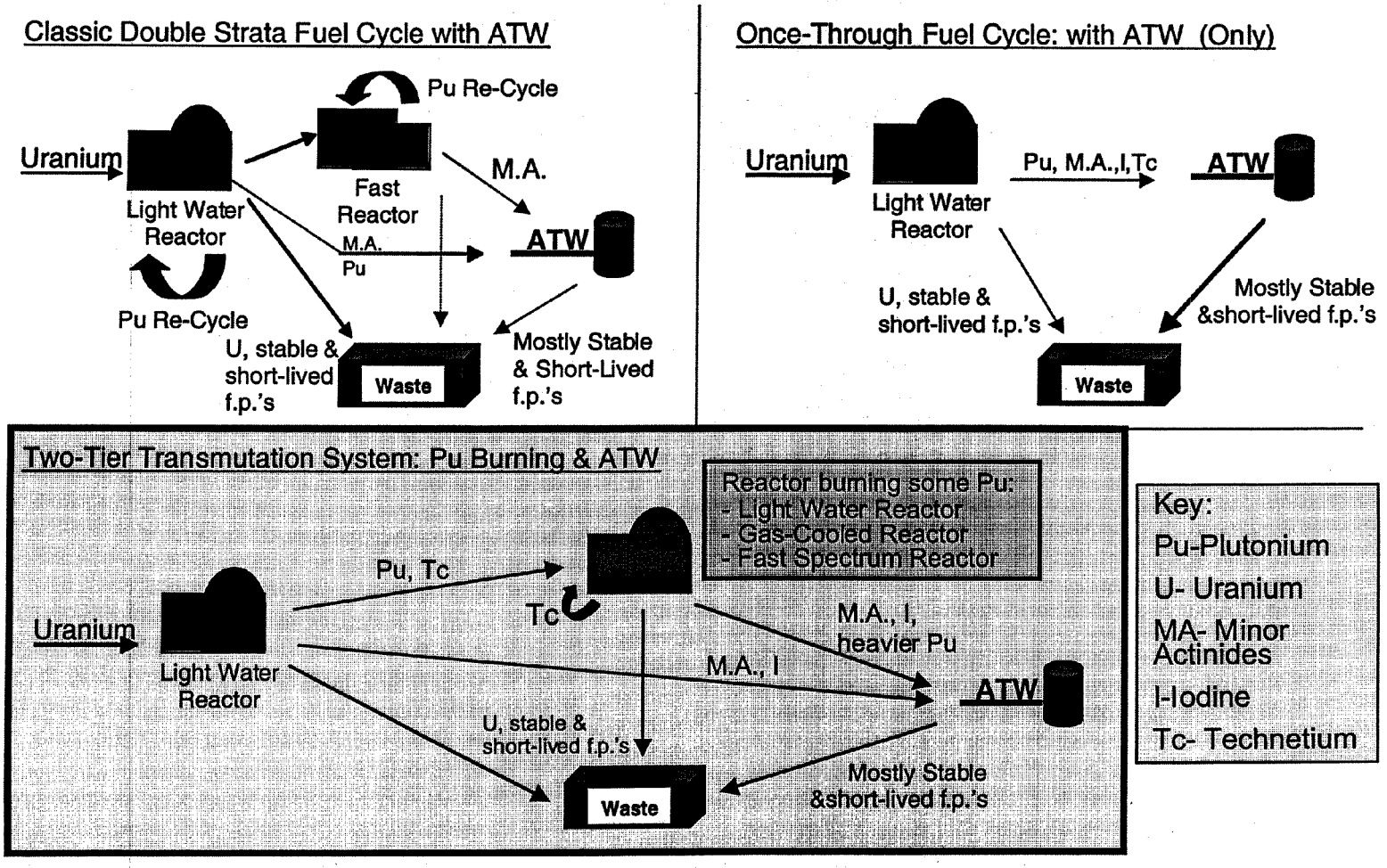
FY01 Transmutation Activities Overview

Greg Van Tuyle, RPO Project Director
February 7, 2001

Transmutation Effort Focusing on Leading Technologies + Alternates



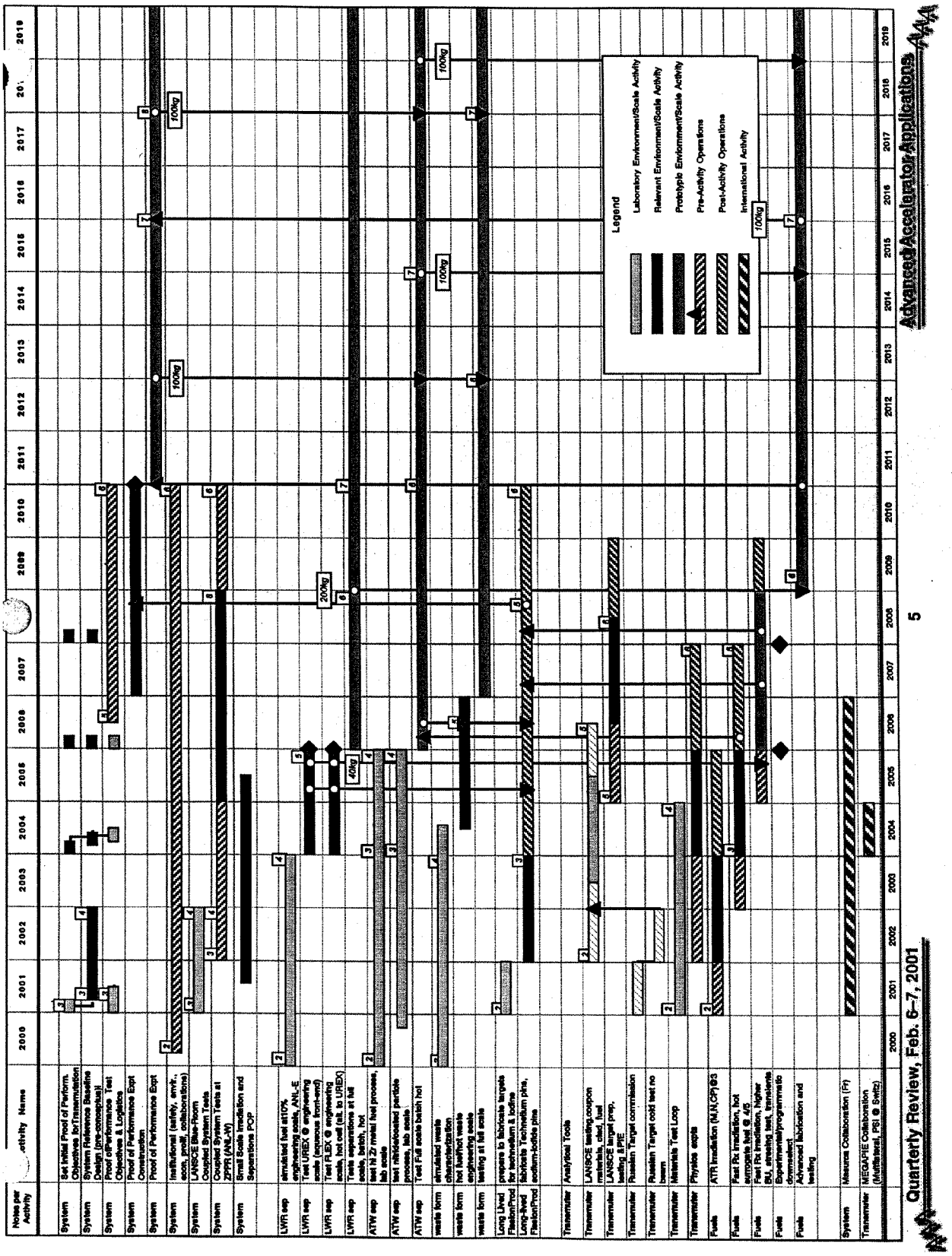
Two-Tier Transmutation System Reduces ATW Scope / Scale



Some Baseline Transmutation Technologies Must Be Advanced from Level 2 ~ 3 to 6 Prior to Integrated System Testing in ADTF

TABLE 1. TECHNOLOGY READINESS LEVEL DEFINITIONS

Level	Stage	Definition
1	Research	Basic principles observed and formulated
2	Research	Technology concepts and/or applications formulated
3	Proof of Phenomena/Principle	Analytical and experimental demonstration of critical function and/or proof of concept
4	Technology Down Selections	Component and/or breadboard validation in a laboratory environment
5	Development	Component and/or breadboard validation in a relevant environment
6	Proof of Concept	System/subsystem model or prototype demonstration in relevant environment
7	Proof of Performance	System prototype demonstration in prototypic environment ADTF
8	Prototype Demonstration	Actual system completed & qualified thru test & demonstration
9	Full Implementation	Actual system proven through successful mission operations


Notes per Activity
Activity Name
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Legend
Laboratory Environment/Scale Activity
Relevant Environment/Scale Activity
Prototypic Environment/Scale Activity
Pre-Activity Operations
Post-Activity Operations
International Activity
100kg
200kg
40kg
Quarterly Review, Feb. 6-7, 2001
5
Advanced Accelerator Applications

Transmutation **Systems-** Near-term Focus

Define Performance Requirements for Transmutation System

Develop Reference Design for Transmutation System(s) (Includes Two/Multi -Tier Systems)

Assess Institutional Issues & Plan Approaches (technical, strategic, etc)

Develop Proof-of-Performance Requirements for ADTF

Notes per Activity	Activity Name	2000	2001	2002	2003	2004
System	Set Initial Proof of Perform. Objectives forTransmutation		3			
System	System Reference Baseline Design (pre-conceptua)l		3	4		
System	Proof ofPerformance Test Objectives & Logistics		3			
System	Proof of Performance Expt Construction					
System	Proof of Performance Expt					
System	Institutional (safety, envir., econ, prolif, collaborations)	2				
System	LANSCE Blue-Room Coupled System Tests		3	4		
System	Coupled System Tests at ZPPR (ANL-W)			3 4		
System	Small Scale Irradiation and Separations POP					
		2000	2001	2002	2003	2004

Plan to test Dynamic Response of Driven Subcritical System: Form Team, Initiate Processes

Initial Planning for Two Additional Tests: ZPPR & Small-Scale POP

Transmutation **Separations-** Near-term Focus

Early Work on Separating Components of Spent Fuel at Small Scale, Focusing on Effectiveness, Waste Streams, etc. (UREX, FLEX, Possibly engineered solvents)

Notes per Activity	Activity Name	2000	2001	2002	2003	2004	2005
LWR sep	simulated fuel at10% engineering scale, ANL-E						5
LWR sep	Test UREX @ engineering scale (aqueous front-end)						
LWR sep	Test FLEX @ engineering scale, hot cell (alt. to UREX)						
LWR sep	Tests separations at full scale, batch, hot						40kg
ATW sep	test hi Zr metal fuel process, lab scale	2				3	4
ATW sep	test nitride/coated particle process, lab scale					3	4
ATW sep	Test Full scale batch hot						
waste form	simulated waste characterization						
waste form	hot fuel/hot waste engineering scale						
waste form	testing at full scale						
		2000	2001	2002	2003	2004	2005

Work on Waste Forms deferred due to insufficient funding

Work on Recycling ATW Fuel Initially Focused on the High-Zr Metal Fuel, Addressing Zr Issue

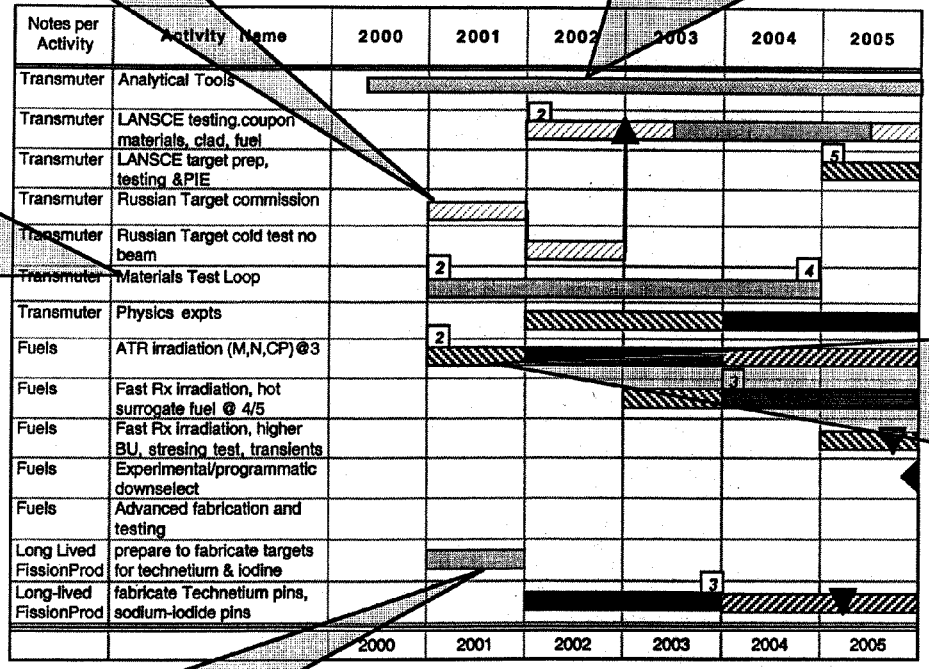
Small-Scale Testing of Variations on Standard Pyrometallurgical Processing for Nitride or Pyrolytic Carbon (Tier-I) Fuels

Transmuter - Near-term Focus

Export of ISTC 559 (Russian) Lead-Bismuth Target Delayed

Adaptation of Analytical Tools and their use in Evaluating Transmutation Performance is a continuing activity

Large LBE Test Loop w/ Oxygen Control Under Construction in MPF-18



Notes per Activity	Activity Name	2000	2001	2002	2003	2004	2005
Transmuter	Analytical Tools						
Transmuter	LANSCE testing.coupon materials, clad, fuel			2			
Transmuter	LANSCE target prep, testing &PIE						5
Transmuter	Russian Target commission						
Transmuter	Russian Target cold test no beam						
Transmuter	Materials Test Loop		2			4	
Transmuter	Physics expts						
Fuels	ATR irradiation (M,N,CP)@3		2				
Fuels	Fast Rx irradiation, hot surrogate fuel @ 4/5				3		
Fuels	Fast Rx irradiation, higher BU, stresing test, transients						
Fuels	Experimental/programmatic downselect						
Fuels	Advanced fabrication and testing						
Long Lived FissionProd	prepare to fabricate targets for technetium & iodine						
Long-lived FissionProd	fabricate Technetium pins, sodium-iodide pins				3		
		2000	2001	2002	2003	2004	2005

Major effort ramping up to fabricate Metal (ANL) and Nitride (LANL) Transmutation Fuels for Testing in Reactors

Equipment to Produce Tc and I Targets Being Installed

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.22
Integrated Transmutation Systems

Deborah Bennett, Project Leader
February 7, 2001

1.22 Integrated System Scope, FY01

Balance system definition, design and engineering activities with safety, environmental, economic, proliferation and institutional drivers.

- **Define reference system baseline**
- **Develop operational system performance requirements**
- **Perform system trade-off studies on multi-tier approaches to transmuting spent nuclear fuel**
- **Perform sensitivity analyses in spallation target and blanket characteristics**
- **Evaluate system objectives for safety, environment, economics, proliferation resistance and institutional issues**

System Integration Cost/Schedule Performance Summary, 1Q-FY01

- **Cost Performance:**
  - Actual staff costs being resolved between carryover and new year funding
- **Schedule Performance**
  - Activities for new fiscal year initiated and progressing in a timely manner
- **Cost/Schedule Summary:**
  - Even with delayed initiation and uncertain funding status, activities are fundamentally on schedule and within budget
  - Identification and commitment of dedicated resources always an issue...another symptom of eroding infrastructure?

Major 1.22 Activities Planned by Date
1Q-FY01

WBS	Milestone/Deliverable	Scheduled Date	Expected Date	Actual Date
1.22.3	Issue Draft repository metrics	11/30/00	2/15/01	
1.22.3	Complete the Quick ATW Costing code	12/1		11/1/00
1.22.3	Coordinate meeting with OCRWM on repository metrics	12/15/00	3/15/01	
1.22.3	Document QAC and the analyses in an LA-UR report.	1/1		
1.22.1	Provide access to knowledge Database, as allowed	1/15		
1.22.3	Coordinate environmental mtg with Separations	2/15		
1.22.3	Draft environmental impact screening framework	2/28/01		
1.22.3	Compare ATW with related sulti-strata studies	3/1		
1.22.2	Complete the initial design of Blue Rm experiments	3/15		
1.22.1	Issue Operational System Performance requirements	3/31		
1.22.3	Complete Preliminary Prolifeation Assessment Framework	4/27		
1.22.1	Issue Multiple strata definition report	4/30		
1.22.3	IssueSafety bases integration report	5/31		
1.22.3	Complete the Transmuter Systems Code (TSC)	6/1		
1.22.2	Complete Blue Room safety analysis and approval	6/15		
1.22.2	Complete the test plan and approval	6/15		
1.22.3	Assessment of system options for repository benefit	6/30/01		
1.22.1	Reissue knowledge database to allowed participants	7/15		
1.22.3	Document TSC economic model	9/1		
1.22.1	Multiple strata evaluation status report	9/15		
1.22.1	Issue Target sensitivity analysis report	9/15		
1.22.1	IssueBlanket sensitivity analysis report	9/15		
1.22.3	Issue Generic transmutation safety basis report	9/15		
1.22.3	Issue Licensability Status report	9/15		
1.22.3	Issue Non-proliferation Assessment of Relative proliferation risk	9/28		
1.22.2	Initiate Blue Room experiments	9/30		

Milestone Status
1Q-FY01

Funded Milestones anticipated in 1Q-FY01 achieved:

- **The QAC model (1.22.3) was completed and used for providing input to the NERAC sub-committee in November on electricity generation**

- **Milestones NOT funded, not achieved:**
  - **Draft repository metrics for assessing potential benefit to the repository were postulated and presented to the NERAC subcommittee in November, but were not provided as a deliverable**
  - **Interactions with OCRWM were not initiated to discuss the draft repository metrics**

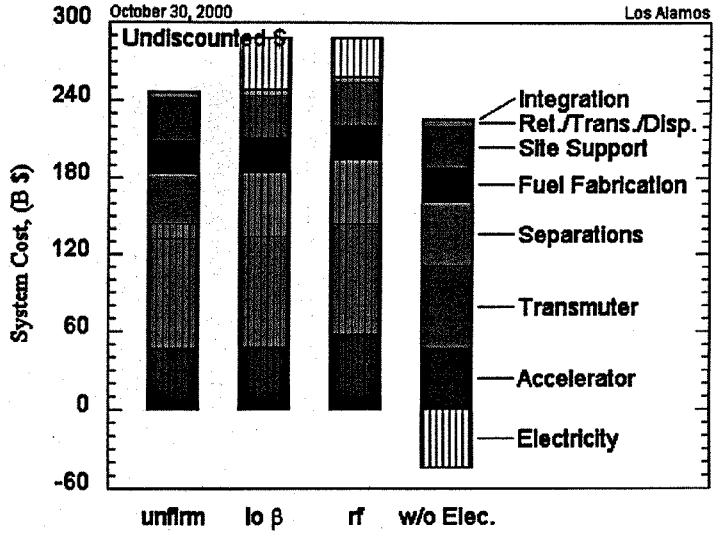
- ***Must assume time period to acquire funding will determine new milestone dates, but probably more timely***

System Objectives (1.22.3.4)
Economic Assessments Accomplishments

Accomplishment: The Quick ATW Costing (QAC) model was completed in Q1-FY01

- **The QAC model was used to assess the economics of producing electricity with accelerator-driven transmutation systems, in terms of "firm" and "non-firm" power generation**

- **Analyses compared the economics of improving accelerator reliability vs improved electricity generation**



Hashed lines show electricity generation, while columns show cost distribution by subsystem

Draft Repository Metrics

1Q-FY01 Milestone (1.22.3.3)

Major Accomplishment:

... assessing benefits of transmutation to the repository have been developed in terms of metrics specifying levels of isotopic reduction.

Component "What is the metric"	Rationale "Why"	Scale "What to measure"	Setpoint "How much is needed for repository benefit"	Breakpoint "Other limits to further benefit/What is that limit"	Goal "Suggested ATW goal"
Pu-239 Inventory Reduction	Proliferation/ Criticality	Log Inventory	90%	90% (HEU)	99%
Np-237 (Am-241) Reduction	Peak Dose	Linear EBS Release Rate	80%	95% (Tc)	99%
Total TRU Reduction	Proliferation/ Criticality	Log Inventory	90%	90% (HEU)	90% MA 99% TRU
Tc-99 Reduction	Dose Compliance	Linear EBS Release Rate	50%	80% (I)	90%
I-129 Reduction	Dose Compliance	Linear EBS Release Rate	50%	90% (C, DOE-SNF)	80%
Capacity	Cost, Second Repository	Quantity, Heat Load, Dose	N/A	N/A	N/A
WF, WP, Volume & Thermal	Design Flex.	Qualitative Judgement	N/A	N/A	Design evaluation

System Definition (1.22.1.1) Accomplishments 1Q-FY01

Accomplishment: Issued "Accelerator-Driven Transmutation of Waste (ATW): Generic Research and Development Needs" as LAUR-5336 ***(acquiring AAA program document number)***

- **Structured framework for identifying and prioritizing activities**
- **Leads to technically-justifiable Proof-of -Performance testing**

Accomplishment: Increased Knowledge Map database to contain over 12000 records, up from 3600 in summer FY00.

- **Stresses flexibility and versatility**

System R&D (1.22.1.2) Accomplishments 1Q-FY01

Accomplishment: Gained verbal "Concurrence" with DOE/HQ on definition of transmutation system baseline

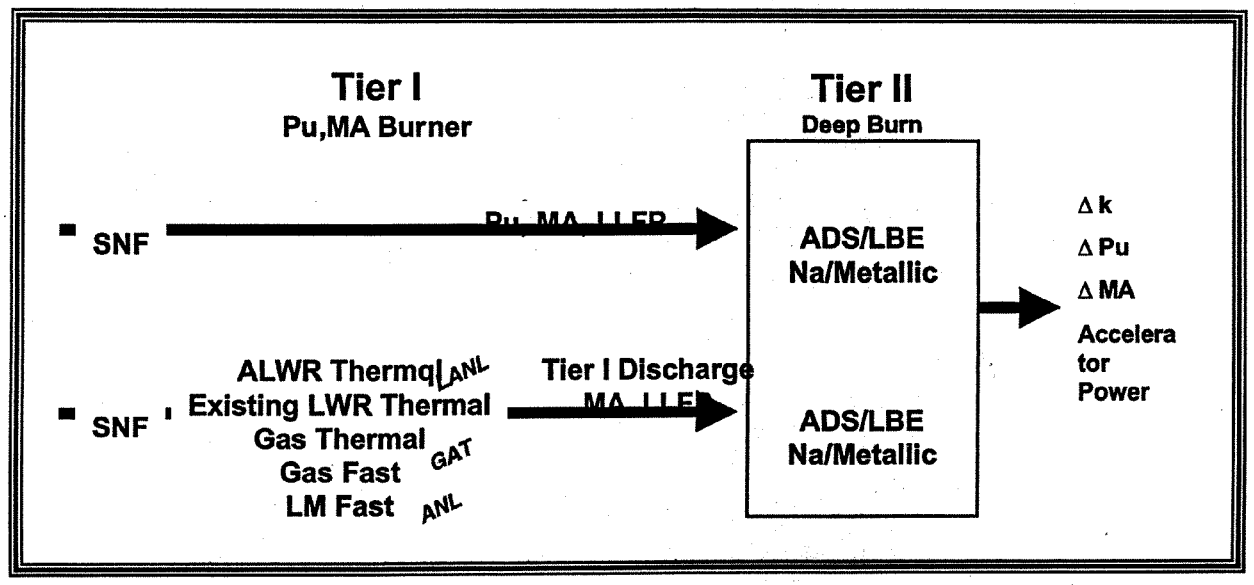
- ***Resolve system performance objectives*** *such as transmutation efficiency and separations efficiency, considering repository benefit, electricity production, and multiple strata implementation.*
- ***Utilize available APT accelerator design*** *and developments to the extent practical*
- ***Retain and aggressively develop current suite of separations process options*** *for LWR and ATW spent fuels until adequate information is available for process selection*
- ***Retain and aggressively develop current suite of metallic dispersion, nitride pellet and pyrolytic carbon fuel forms*** *until adequate fabrication and irradiated performance is available for fuel form selection.*
- *In support of the ADT Facility project, primary R&D assessments will focus on a* ***Lead Bismuth Eutectic and/or sodium-cooled tungsten target, and sodium-cooled blanket as the baseline for an accelerator-driven transmuter system.***
- *Parallel R&D assessments supporting waste transmutation will focus on* ***multi-tier (dual-tier) options,*** *including Tier I options for plutonium consumption in critical nuclear systems (LWR, HTGR with electricity generation), and subsequent Tier II accelerator-driven systems for minor actinide consumption, without electricity generation.*
- *Assertively* ***collaborate with international colleagues*** *on [alternative and advanced] transmutation schemes, [such as gas-cooled and molten fuel concepts], and leverage domestic programs in advanced nuclear systems to the extent practical.*

System R&D (1.22.1.2) Accomplishments
1Q-FY01 : Multi-Strata Evaluations

Accomplishments:

- **defined the scope of and framework for multi-strata evaluations**
- **established multi-institutional teams for evaluation, with designated leads**

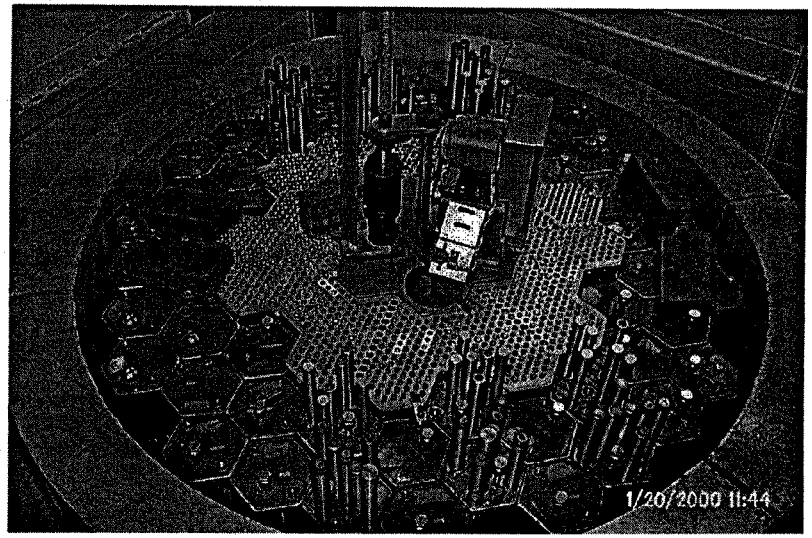
Fertile and non-fertile fuel forms will be evaluated in multi-strata assessments



System Demonstrations (1.22.2.1)
Blue Room Experiment Accomplishments
1Q-FY01

Scope:

- Use 800 MeV proton beam in the Target-2 experimental area (Blue room)
- Use Fast Breeder Blanket Assembly (Purdue) to provide a suitable blanket by replacing the steady-state Cf neutron source with a spallation neutron target to test reaction dynamics
- Other experiments
  - LBE outgas measurements
  - Oxygen evolution in LBE
  - Oxygen control on window surfaces



Accomplishments:

- Negotiations initiated for assembly transfer
- multi-institutional team established to define test scope

System Objectives (1.22.3.1)
Safety Accomplishments
1Q-FY01

- No reportable progress while acquiring resources

System Objectives (1.22.3.2)
Proliferation Resistance Accomplishments
1Q-FY01

Scope:

- Assess the relative proliferation risk between .
  - the current US once through LWR fuel cycle with direct geologic disposal of spent fuel and
  - that cycle modified to include transmutation of actinides and long-lived fission products prior to geologic disposal of waste?
- Assess the relative proliferation risk of a fuel cycle that recycles plutonium from SNF to MOX fuel as compared to a fuel cycle with separations for transmutation of actinides and LLFP, and geologic disposal

Accomplishments:

- Univ of Texas set up MAU model in EXEL/Crystal Ball 2000
- Compared once-thru PWR with once-through CANDU to test capabilities of model to discriminate between systems
- Conducted a literature review to establish the majority of input parameters for validation calculations
- Performed MCNP and ORIGEN calculations to obtain certain input parameters, such as radioactivity levels in spent fuel

System Objectives (1.22.3.3) Environment/Repository Accomplishments 1Q-FY01

Accomplishment:
Benefit to the repository ???
•Draft repository requirements developed

Component "What is the metric"	Rationale "Why"	Scale "What to measure"	Setpoint "How much is needed for repository benefit"	Breakpoint "Other limits to further benefit/What is that limit"	Goal "Suggested ATW goal"
Pu-239 Inventory Reduction	Proliferation/ Criticality	Log Inventory	90%	90% (HEU)	99%
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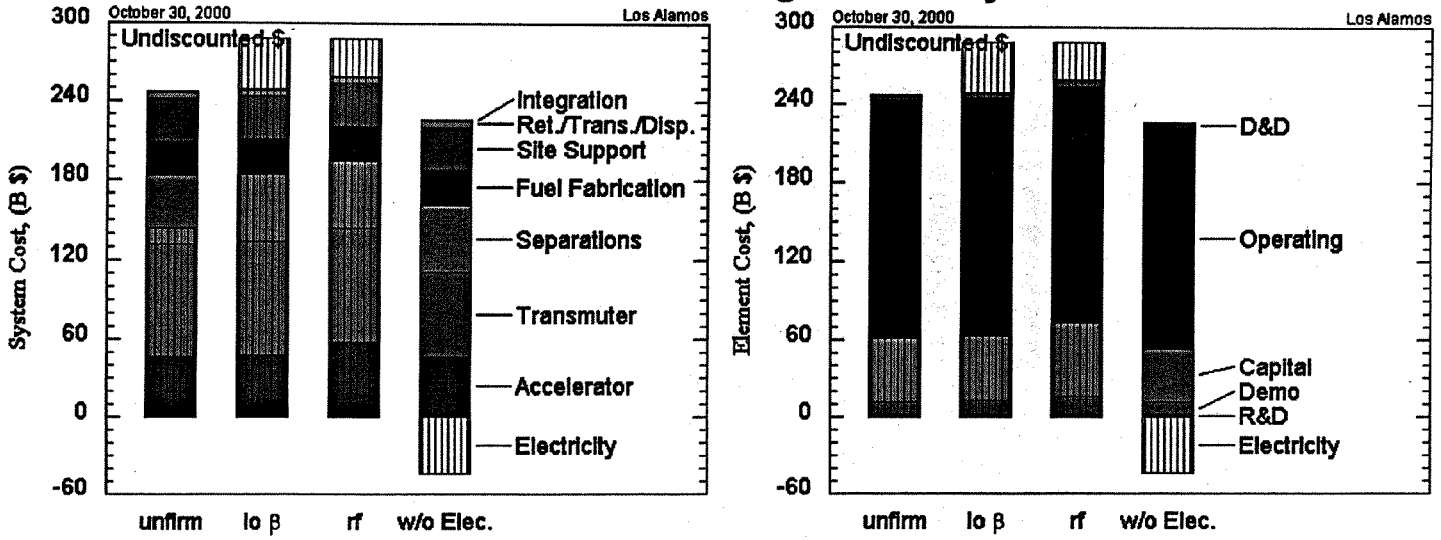
I-129 Reduction	Dose Compliance	Linear EBS Release Rate	50%	90% (C, DOE-SNF)	80%
Capacity	Cost, Second Repository	Quantity, Heat Load, Dose	N/A	N/A	N/A
WF, WP, Volume & Thermal Options	Design Flex. Lic. Confid.	Qualitative judgement	N/A	N/A	Design evaluation
DOE-SNF Transmutation	Proliferation/ Criticality	Log Inventory Reduction	90%	90% (W-Pu)	90%
DOE-SNF	Dose	Linear EBS	80%	90%	90-99%

System Objectives (1.22.3.4)
Economic Assessment Accomplishments
1Q-FY01

Accomplishment: Producing electricity is cost effective.



- E_B = 1800 MeV, k_{eff}^{EOEC} = 0.92, and k_{eff}^{BOEC} = 0.97.
- "non-firm" power is sold at 21.5 *vs* 43 mill/kWh for firm power.
- "lo β" achieves reliability by replacing normal conducting CCL and CCDTL with three superconducting spoke resonator sections at 12.5% increase in capital and triple the R&D cost.
- "rf" achieves reliability by de-rating rf system at triple the rf cost.

Planned Activities for Jan-Mar 2001
(Second Quarter FY01)

WBS	Milestone/Deliverable	Scheduled Date	Expected Date	Actual Date
1.22.3	Issue Draft repository metrics	11/30/00	2/15/01	
1.22.3	Complete the Quick ATW Costing code	12/1		11/1/00
1.22.3	Coordinate meeting with OCRWM on repository metrics	12/15/00	3/15/01	
1.22.3	Document QAC and the analyses in an LA-UR report.	1/1		
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1.22.3	Document TSC economic model	9/1		
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1.22.3	Issue Non-proliferation Assessment of Relative proliferation risk	9/28		
1.22.2	Initiate Blue Room experiments	9/30		

Other Activities

- ES&H Activities: None
- QA Activities: None
- Collaborations: All of system team is one big collaboration!!!
- Reviews: Richter, November 2, 2000
- Visits: None

Issues

- *Challenge to get multiple institutions to work and play well together, but we are!*
- *Wish Contracting mechanisms more flexible and rapid to implement*

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.26
Proof of Performance

Deborah Bennett, Project Leader
February 7, 2001

Proof of Performance Cost/Schedule Performance Summary for 10-12/2000

- Cost Performance:
  - Minimal Costs in 1Q-FY00
- Schedule Performance
  - Minimal activities in 1Q-FY00
- Cost/Schedule Summary:
  - Within cost and schedule constraints

Major Activities Planned for FY01 by Date

WBS	Milestone/Deliverable	Scheduled Date	Expected Date	Actual Date
1.26	Conduct Proof of Performance Requirements Workshop	1/15		
1.26	Issue Proof of Performance Requirements Report	3/31		

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

Initiated planning for Requirements Workshop in January

Planned Activities for Jan-Mar 2001
(Second Quarter FY01)

- *Hold ATW/POP Requirements Workshop in January*
- *Issue VG package of ATW/POP requirements in mid January*
- *Issue Draft ATW/POP Requirements document end of January*
- *Issue Rev. 0 ATW/POP requirements document end of March*

Issues. None

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.24
Separations Technology

James J. Laidler, Project Leader
February 7, 2001

Major Activities Planned for FY01

- **LWR Spent Fuel Treatment ($1,475K)**
  - UREX computer model operational 6/01
  - UREX flowsheet optimized 8/01
  - Parameters for UREX hot demonstration set 9/01
  - PYRO-A process optimized 9/01
  - FLEX process technical feasibility evaluated 9/01
  - Iodine and technetium recovery process feasibility evaluated 9/01

Major Activities Planned for FY01

- **ATW Transmuter Blanket Fuel Treatment ($1,325K)**
  - Design of distillation unit for molten salt chloride volatility process 8/01
  - Verification of plutonium electrowinning and electrochemical iodine extraction processes 9/01
  - Evaluate technetium extraction processes 9/01
  - Evaluation of reductive extraction option for TRU recovery 6/01
  - Develop process concepts for treatment of alternative transmuter fuels
    - » Nitride fuels 2/01
    - » Oxide fuels 6/01
    - » Graphite fuels 8/01

Milestone Status for FY01

- See following spreadsheets

Milestone Status 12/31/00
LWR Spent Fuel Treatment - SRS, LANL

Contractor	Milestone	Completion Date	Status
SRS	Transmit existing SRTC compilation of PUREX literature data to ANL	31-Jan-01	Delayed due to delay in funding allocation
	Technical report on thermal stability of AHA in nitric acid solutions	01-Mar-01	Delayed due to delay in funding allocation
	Interim report on Pu complexation and reduction kinetics	15-Mar-01	Delayed due to delay in funding allocation
	Interim report on Np complexation and reduction kinetics	01-May-01	Delayed due to delay in funding allocation
	Technical report on complexation and kinetics of reduction of actinides by AHA	01-Jul-01	Delayed due to delay in funding allocation
	Letter report summarizing assessment for hot demo	01-Sep-01	Delayed due to delay in funding allocation
LANL	Produce report on electroplating electropositive metals (Li, Na, K) from RTIL	31-Jan-01	Data collection is complete and report will be issued by the end of February
	Produce report on the viability of electroplating of thorium, plutonium from RTIL	31-Jan-01	Preliminary viability assessment will be published by the end of March
	Prepare Hazard Control Plan for iodine sparge experiments related to UREX process development	28-Feb-01	Review of existing hazard control plan is being done to see if planned experiments will be covered
	Prepare LWR fuel simulants for iodine and technetium experiments	28-Feb-01	Simulant based on LWR fuel has been formulated and chemicals for its preparation are being acquired
	Complete iodine sparging experiments	10-Sep-01	Different types of sparging equipment and apparatus are being considered for use
	Determine the behavior of Tc relative to U, Pu, and Np during the TBP extraction of LWR simulant using various reductants	10-Sep-01	Five reductants are being investigated for their effect on pertechnetate ion during this extraction
	Demonstrate the recovery of Tc from the TBP extraction of LWR simulant	10-Sep-01	Not started
	Issue letter report summarizing the Tc milestones	30-Sep-01	Not started

Milestone Status 12/31/00
LWR Spent Fuel Treatment - ANL

Contractor	Milestone	Completion Date	Status
ANL	Design and fabricate electrolytic cell for oxide reduction	15-Feb-01	Complete; testing/experiments are in progress
	Complete lab-scale feasibility studies of simultaneous reduction/salt recovery for Li-based process	15-Apr-01	On schedule; work is in progress
	Complete lab-scale feasibility studies of simultaneous reduction/salt recovery for Ca-based process	15-Jun-01	On schedule; preliminary literature studies underway
	Develop models for the UREX extraction behavior of U, Tc, Np and Pu	30-Jun-01	Code operational; model development started. Good opportunity for university participation program
	Evaluate kinetics of spent fuel dissolution for FLEX flowsheet development activities	15-Aug-01	On schedule; apparatus is fabricated and checkout is underway
	Initiate zirconium oxide solubility tests to support FLEX flowsheet development	30-Aug-01	Not started
	Issue letter report describing results of oxide reduction studies	30-Aug-01	Not started
	Optimize UREX process flowsheet	31-Aug-01	In progress; on schedule
	Demonstrate portions of the UREX flowsheet using pilot-plant centrifugal contactor	30-Sep-01	Centrifugal contactors being fabricated (64); on schedule
	Evaluate FLEX fuorination system design requirements	30-Sep-01	Not started
	Issue letter report describing FLEX process evaluations	30-Sep-01	Not started
	Issue letter report setting operating parameters for UREX hot demonstration	30-Sep-01	Not started
	Issue letter report summarizing the UREX milestone accomplishments	30-Sep-01	Not started
	Issue summary assessment report on FLEX process technological feasibility	30-Sep-01	Not started
	Issue summary assessment report on PYRO-A process technological feasibility	30-Sep-01	Not started

Milestone Status 12/31/00
ATW Transmuter Blanket Fuel Treatment - ANL

Contractor	Milestone	Completion Date	Status
ANL	Complete initial flowsheet development for nitride dispersion fuels	01-Feb-01	Two processes evaluated; will be reported in next quarterly report
	Complete initial flowsheet development for oxide dispersion fuels	01-Apr-01	Not started
	Evaluate alternative chlorination methods for the molten salt chloride volatility process	30-Apr-01	Alternative chlorinating agents identified and systems assessment is in progress
	Complete initial process development for non-brittle oxide fuels	01-Jun-01	In progress; on schedule
	Determine system design requirements for engineering-scale distillation unit	30-Jun-01	In progress; on schedule
	Evaluate reductive extraction option for TRU recovery and determine system design requirements	30-Jun-01	Not started
	Complete bench-scale verification of plutonium electrowinning	31-Jul-01	Not started
	Complete conceptual design of iodine recovery system based on electrochemical techniques	01-Aug-01	In progress; on schedule
	Complete initial flowsheet optimization for graphite-based fuels	01-Aug-01	Concept identified, analysis in progress
	Complete pre-conceptual design of engineering-scale distillation system	30-Aug-01	Not started
	Complete modification of pyrocontactor engineering design for use in reductive extraction process	31-Aug-01	Not started
	Complete conceptual design of laboratory-scale electrowinning cell for multicomponent studies	15-Sep-01	Not started
	Issue letter report documenting distillation process evaluation and design requirements	30-Sep-01	Not started
	Issue letter report documenting verification of the electrowinning process	30-Sep-01	Not started
	Issue letter report documenting results of reductive extraction process evaluation	30-Sep-01	Not started
	Issue letter report documenting feasibility of electrochemical iodine recovery process	30-Sep-01	Not started
	Issue summary assessment of PYRO-B process technological feasibility	30-Sep-01	In progress; on schedule
	Issue letter report describing alternative fuel treatment process development	30-Sep-01	Not started

Milestone Status 12/31/00
ATW Transmuter Blanket Fuel Treatment - LANL

Contractor	Milestone	Completion Date	Status
LANL	Set Up Schenk Line	28-Jan-01	Line is set up and is being leak checked
	Prepare hazard control plans for inert atmosphere Tc experiments	28-Feb-01	Review of existing hazard control plans is being done to see if planned experiments will be covered
	Prepare summary of literature review on TRISO fuel processing methods	10-Apr-01	Literature review on TRISO fuels has been done by General Atomics, and LANL are awaiting delivery of the references
	Obtain TRISO fuel simulant from General Atomics	10-Apr-01	GA is searching for depleted TRISO fuel to provide for the purposes of this program. Other sources are also being pursued
	Prepare TcCl4 for thermodynamic measurements	30-May-01	Three methods are being considered, two known and one using room temperature ionic liquids
	Demonstrate the behavior of Tc and I during processing of TRISO fuel simulant	15-Aug-01	Not started
	Investigate methods to separate Tc from either a noble metal matrix or from ZrCl4	15-Sep-01	Literature reviews on the chemistry of Tc and the noble metals are being done to develop several rational approaches
	Investigate methods to separate Iodine in the PYRO-B process	15-Sep-01	Not started

Major Accomplishments for Oct-Dec 2000 (First Quarter FY01)

- Electrowinning of U and Ce demonstrated
  - Decomposition potentials for U and Ce bracket those for TRU chlorides
  - Process will work for TRU recovery; to be demonstrated
- UREX flowsheet verified
  - Analytical results confirmed the plutonium decontamination of the uranium product and showed that Pu recovery exceeded target levels (>99.9%)
- Tc extraction in UREX process studied
  - Different reductants, commonly used for Pu(IV) to Pu(III) conversion, did not affect the distribution coefficient for technetium
  - Helps in the identification of means to extract Tc

Planned Activities for Jan-Mar 2001 (Second Quarter FY01)

- Evaluate Pu complexation and reduction kinetics in UREX process
- Prepare for UREX dissolver solution iodine sparging experiments
- Begin incorporating extraction models in the UREX computer code
- Demonstrate direct electrochemical reduction of oxide compounds in the PYRO-A process
- Develop process concept for treatment of nitride fuels

Issues

- Delay in allocation of funding to SRS has resulted in delays in technical progress; there is a risk that key people will be lost to other programs

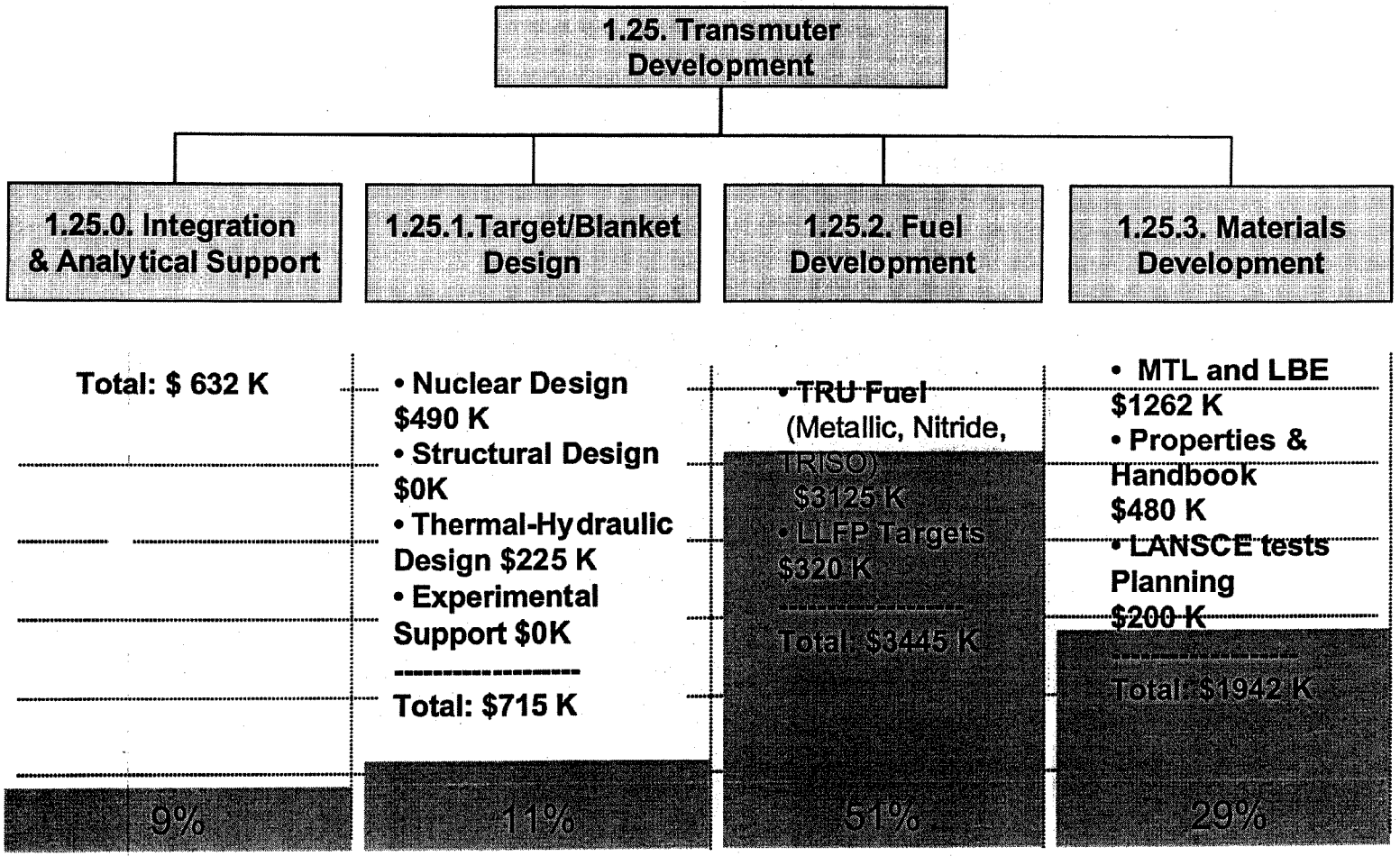
Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.25 Transmuter Development

Kemal O. Pasamehmetoglu, Project Leader
February 7, 2001

Transmuter Development Work Breakdown



Major Activities Planned for FY01

- Integration of activities (fuels, materials, design studies) into a common framework
  - Implementation of the long-term R&D plan
- Design sensitivity studies to guide the test program and to quantify the pros and cons of various design options.

1.25.0

- Cross-section evaluations
- Improved subactinide fission and fission fragment model for MCNPX.
- Benchmark results for deterministic codes
- Coupling of MCNPX and deterministic codes
- Time dependent source modeling in REBUS-3
- TRAC benchmarks and transport modeling

1.25.1

- Develop processes to fabricate metallic and nitride fuels (Pu) and characterize samples
- Conceptual design of the ATR tests
  - Start safety evaluation
- Fabrication processes for surrogates, UN, PuN
  - Initiate efforts to fabricate (Pu, Am, Np, Cm)N at TA-55
- Limited work on TRISO particles
  - Review of coating technology status
  - Assess the status of existing data in reference to transmutation applications
- Glovebox installation for LLFP targets

1.25.2

- Materials Test Loop construction and operations (testing).
- High temperature testing of irradiated materials
- Review of structural design criteria issues for transmutation applications
- Materials handbook revisions
- Planning and cost estimate for LANSCE irradiation campaign

1.25.3

Milestones and Status

Milestone (All Level 3)	Date	Status
Input to 10-yr R&D plan for transmutation	1/01	Done
Input to PoP requirements	1/01	Done
Detailed development plan for transmuter	6/01	In progress
Sensitivity Studies summary report	9/01	In progress
Subactinide fission and fission fragment model for MCNPX	4/01	In progress
Fission model in McGNASH	5/01	In progress
Lead-bismuth scattering cross-sections (ENDF)	9/01	In progress
239Pu ENDF evaluation	9/01	In progress
Nuclear data benchmarks/coupling of MCNPX with deterministic codes	9/01	In progress
TRAC benchmarks and transport modeling report	9/01	In progress
Fabricate Pu-Zr alloy and dispersion samples	2/01	In progress
Fabricate Pu-Zr and Pu-Zr/Nb dispersion samples in HUP	7/01	In progress
Fabricate PuN/ZR dispersion samples	9/01	In progress
Fabrication equipment installation in FMF complete	9/01	In progress
Conceptual design of ATR irradiation test	5/01	In progress
Select a fast spectrum reactor for fuel testing	6/01	??
Complete first safety review of ATR testing	9/01	In progress
LANL fabrication and characterization results for nitride samples	7/01	REVISION
Blue room irradiation results on nitride samples	9/01	REVISION
TRISO particle fuel assessment for fast spectrum applications	6/01	Not started
LLFP glovebox installation plan and procedure	3/01	In progress
Complete test plan for the MTL	2/01	In progress
Complete construction and readiness review for MTL	4/01	In progress
Complete operations testing and begin oxygen control and corrosion tests in MTL	7/01	In progress
Revision 3 of Materials Handbook	9/01	Rev. 2 finished
ORNL report on weld tensile tests, fracture toughness tests and fatigue growth	4/01	Funding ?
ORNL high temperature compact tension test results	9/01	Funding ?
PNNL high temperature tensile tests	9/01	In progress

Major Accomplishments in the First Quarter

- Developing details for the 10-yr transmuter development plan
- Developed an algebraic model to assess the sensitivity of the transmutation parameters to separations strategy and efficiency.
  - Fuel composition and burnup range needs will be quantified
- Evaluating the usefulness and accuracy of various multiplication factor definitions
  - We derived formulas for estimating the sensitivity functions of source-driven multiplication and source importance functions
  - Formulas are being used to perform sensitivity analyses of the European subcritical experiments (MUSE).

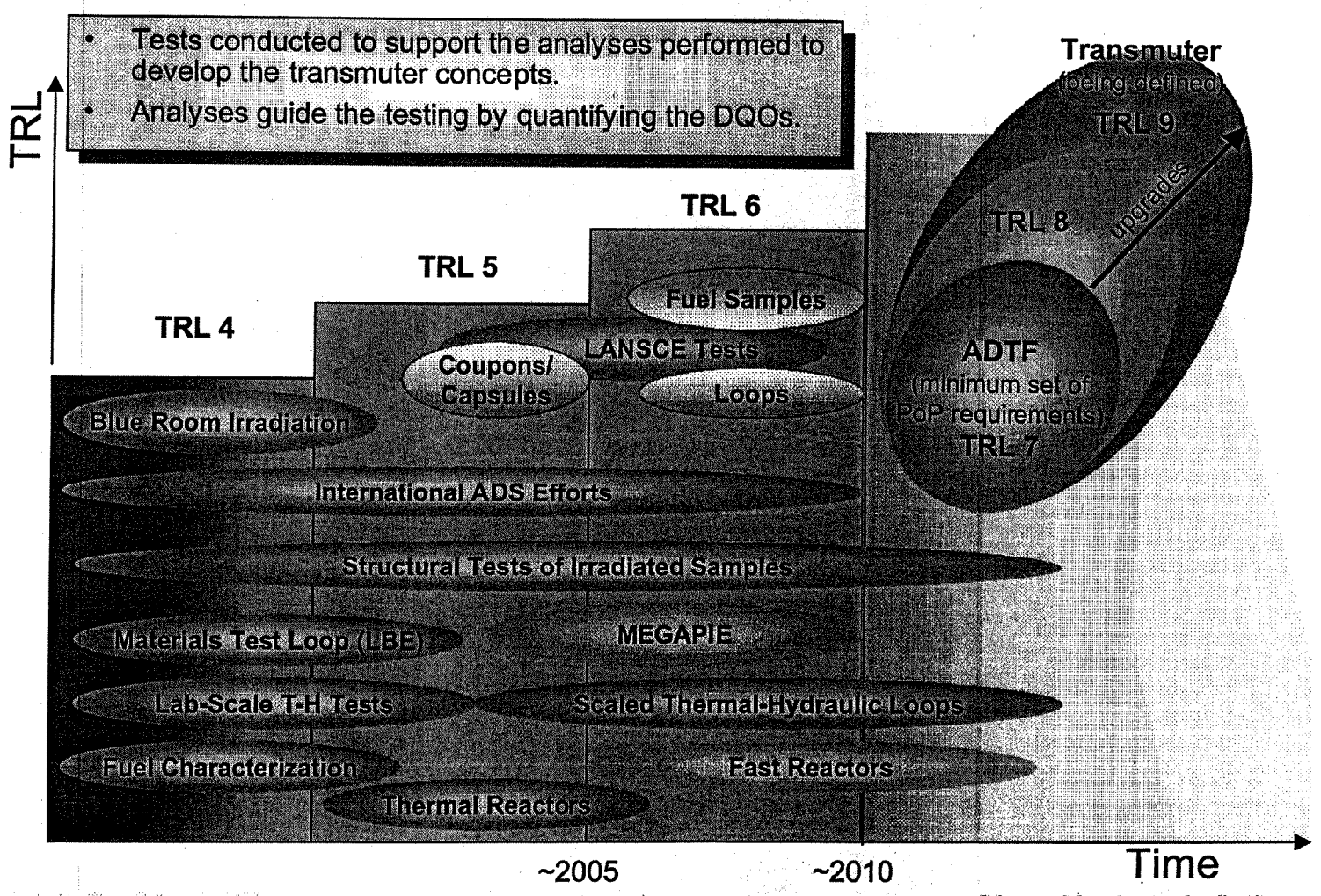
1.25.0

- Fission decay theory incorporated into McGNASH and is being tested.
- Started improving the spallation physics and high-energy fission model in the intranuclear cascade code (module in MCNPX).
- Assessment started to evaluate various deterministic codes
  - ETOE2-2 and MC2 packages are being modified to process ENDF-B/VI data
  - Comparisons are made to evaluate the individual isotope differences between MCNP, VIM and multi-group calculations.
- TRAC models compared favorably with Russian heat exchanger and recuperator data for a lead-bismuth system.
- ISTC target work is suspended as of December 2001
  - 3 engineers from LANL attended the testing of the ISTC target at IPPE, which achieved the major testing goals (level sensors being fixed)

1.25.1

SUMMARY OF THE TEST PROGRAM

Before the completion of the ADTF facility, various experiments will be conducted to advance the technology readiness level (TRL) for the accelerator driven transmuter development



Major Accomplishments in the First Quarter

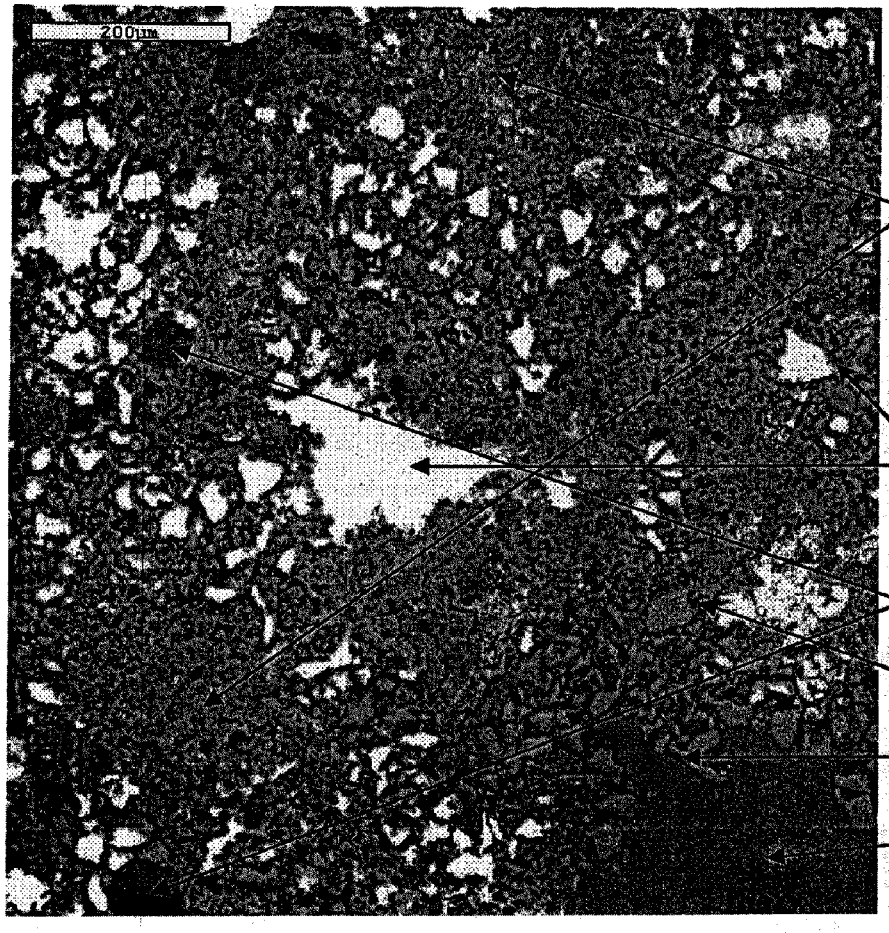
- Prepared 4-gr samples of Zr-Pu (25 wt% Pu) alloy to study the low temperature powder metallurgy techniques.
- Performed an initial evaluation of thermal conductivity of Pu-Zr alloys and dispersions.
- The efforts for the installation of the glovebox in two ANL-west facilities are initiated.
- An initial evaluation for the fuel testing options in ATR is conducted.
  - The least expensive and widely used option ("drop-in experiments") appear most attractive and meet the test objectives.
  - Other more elaborate options also are being evaluated.
- Efforts on nitride fuel development work at LANL were getting started: procedures, work authorization, etc…
- The old design for the LLFP glove-box installation is being reviewed.

1.25.2

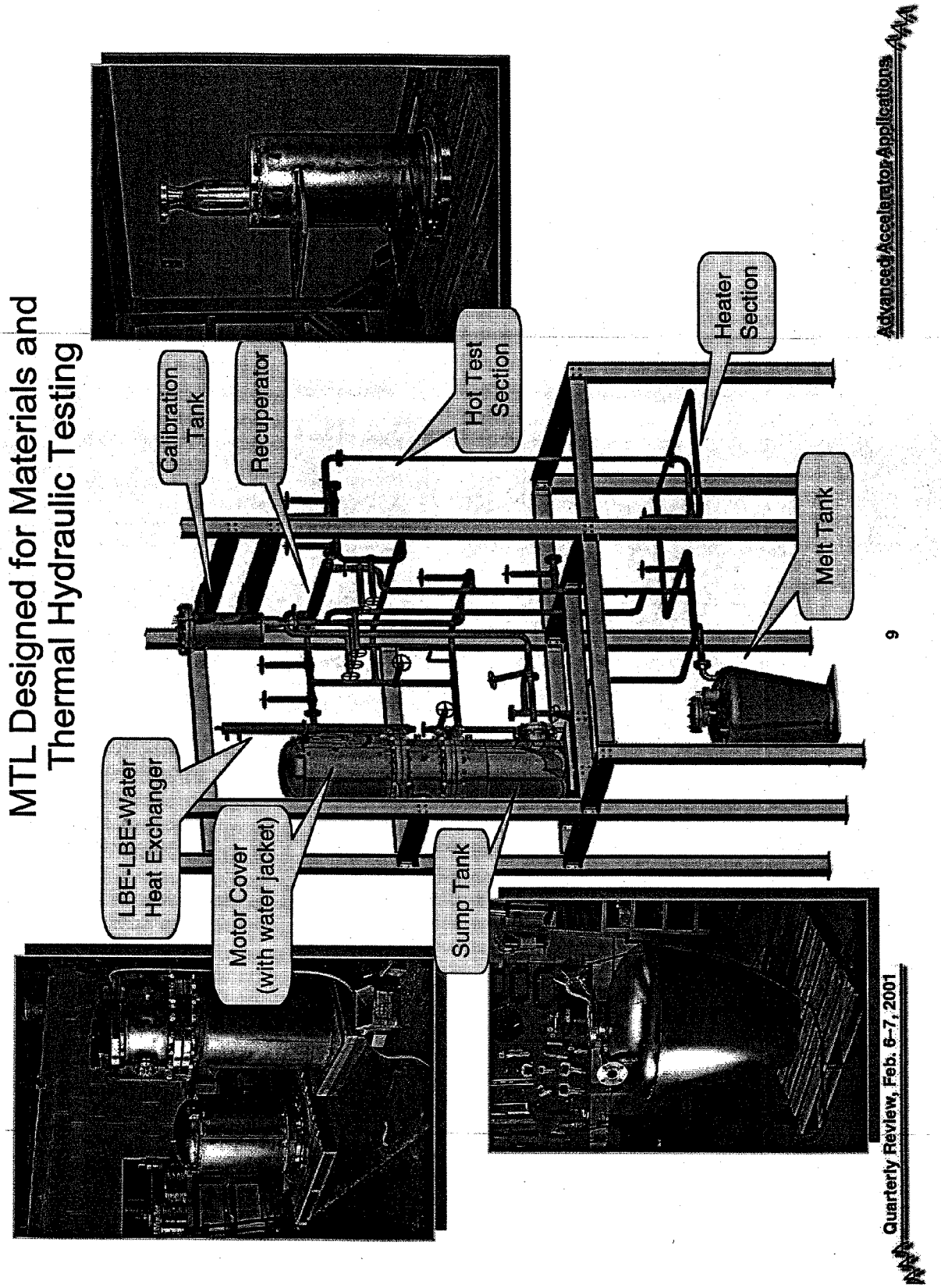
- Completed the MTL technical design review.
  - Initial draft of the welding specs completed.
  - Design of water and gas systems completed.
  - LBE-water heat exchanger completed and delivered.
  - Expansion tank design drawings sent out for fabrication.
  - Trace heating system design completed.
  - Ordered oxygen sensor elements, designed and fabricated 4 sensor wells and connectors.
  - Analyzed the IPPE corrosion test results and compared to a kinetic corrosion model.
- PNNL tested the tensile properties of Mod 9Cr-1Mo at temperature range from 250°C to 400°C using a specimen irradiated to 3 dpa (at 50°C).

1.25.3

The Pu-Zr samples did not achieve the desired degree of homogeneity but are useful for separations testing.



Multi-phase region of specimen edge region, showing that the microstructure is not homogeneous and that impurity phases are present near sample edge. A range of phases with varying Pu:Zr ratios are present. Y_2O_3 is from the mold wash used to coat graphite die, Fe is a result of filing to make Pu powder, and C may be an artifact originating from the graphite die.


MTL Designed for Materials and Thermal Hydraulic Testing
LBE-LBE-Water Heat Exchanger
Motor Cover (with water jacket)
Sump Tank
Calibration Tank
Recuperator
Hot Test Section
Heater Section
Melt Tank
Advanced Accelerator Applications
Quarterly Review, Feb. 6-7, 2001
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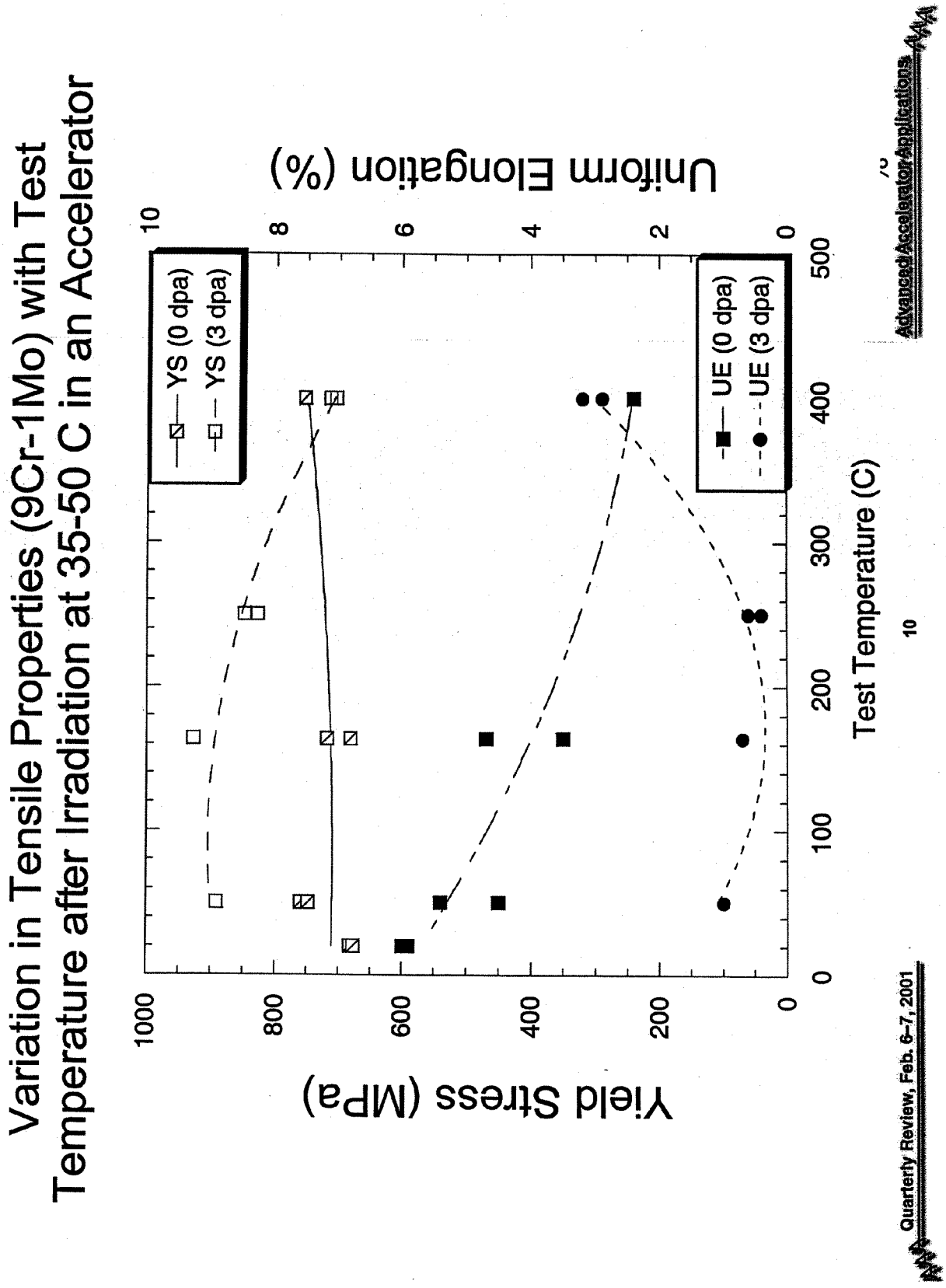
Variation in Tensile Properties (9Cr-1Mo) with Test Temperature after Irradiation at 35-50 C in an Accelerator
Yield Stress (MPa)
Uniform Elongation (%)
Test Temperature (C)
YS (0 dpa)
YS (3 dpa)
UE (0 dpa)
UE (3 dpa)
0
200
400
600
800
1000
0
2
4
6
8
10
0
100
200
300
400
500
Quarterly Review, Feb. 6-7, 2001
Advanced Accelerator Applications
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OTHER ACTIVITIES

- Members of the Materials Team had a strong showing in the ANS Winter meeting in D.C.
  - Chaired a session
  - Presented a number of papers
- Organized International Workshop on Spallation Materials Technology (IWSMT-4) (Schruns, Austria)
- The results of the LBE research are presented at
  - IAEA TCM on Emerging Nuclear Technologies (ANL)
  - JNC LBE International Meeting at O'arai (Japan)
- Participated in the NERAC subcommittee meeting (Nov.00)
- LANL hosted the International Liquid Metal Target Advisory Committee meeting (Oct. 00).
- Collaboration with PSI on 300-400°C irradiation tests
  - Mike James will be at PSI (March-June) as a visiting scientist

Planned Major Activities for the Second Quarter

- Continue
  - 10-yr detailed development plan
  - analytical work on multiplication factor definitions
- Implement the accelerated nitride fuel development plan (TA55)
- Develop and implement a plan to address the Na-LBE compatibility issue.

1.25.0

- Continue with Pu-Zr sample fabrication process by varying the process parameters.
- Start powder preparation experiments (Pu-Zr) using hydride/dehydride process.
- Continue design and installation of fabrication equipment in FMF.
- Complete the fabrication plan for nitride samples at TA-55, equipment allocation, scheduling and priority determination.
- Continue with the UN work for equipment shakedown and training.
- Initiate the surrogate work to look at the Am volatility issues (Dy,Zr)N
- Glovebox installation plan and procedure.

1.25.2

- Cross-section evaluations and deterministic code assessment work continues.
- TRAC modeling of the low cycle fatigue
  - Use ADTF design as the reference
- Start the LBE-Na compatibility assessment
  - Scoping tests
- Develop a test plan for continued testing of the ISTC target in Russia

1.25.1

- Materials Test Loop reviews
  - Test plan and procedures
  - Hazards review
- Materials test loop construction
- Continue with high temperature testing at PNNL
- Resume ORNL testing work.

1.25.3

GENERAL STATUS and ISSUES

- Despite a slow start in some areas because of funding uncertainties, the progress is on track for major activities.
  - As of January, ORNL has not received AAA funding
- Some programmatic re-directions are expected :
  - Decisions on the ISTC target export versus testing in Russia.
  - Modifications to the nitride fuel development work package to accelerate the FY01 fabrication efforts using TRU.
  - An experimental program to address the issue associated with lead-bismuth and sodium reactions.
- LANSCE irradiation test planning task is being addressed in ADTF ED&D plan
  - The funding will be allocated to other tasks.

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.21 Collaborations

Greg Van Tuyle, Project Leader
February 7, 2001

Major Activities Planned for FY01

- *Only One Work Package Under 1.21:*
  - *1.21.01 International Collaborations*
  - *Work Package Manager is Phillip Finck (ANL)*
- *Activity description: Two Major Components:*
  - *Arrange Workshop: Technical Leads from US and France*
  - *Recommend "Most Profitable" Areas for Collaboration*
- *Major deliverables/dates*
  - *Technical Workshop with CEA 4/1/01*
  - *Analysis of French Programs 6/1/01*
- *Estimated cost: $100K*
- *Benefit/Impact: Launch/Guide Collaborative Efforts with French CEA in Developing Technologies for Waste Transmutation*

Milestone Status for FY01

- *Status of level 0-3 milestones*
  - *Technical Workshop with CEA 4/1/01*
    - » *Scheduled for the week of March 12 through 16 in Paris or Saclay, with visit to CEA/Cadarache (~10 US)*
  - *Analysis of French Programs 6/1/01*
    - » *Informal "research" ongoing*

- *Status/schedule for providing input to APT Preliminary Design Status Report (if applicable)*
  - *Not Applicable*

Major Accomplishments for Oct-Dec 2000
(First Quarter FY01)

- *No "Major" Accomplishments*

...

- Initial attempts to meet with CEA Representatives were postponed due to reorganization efforts within the CEA Transmutation team

- Informal interactions continued through this period at various venues

Planned Activities for Jan-Mar 2001
(Second Quarter FY01)

- *Plan to Meet with CEA in France March 12 through 16*
  - *Paris or Saclay on Monday March 12*
    - » *Plan Technical Working Group Structure and Discuss Collaborations in Selected Areas*
  - *Visit to CEA/ Cadarache March 13, 14, ... (?)*

- *U.S. Delegation (Tentative):*
  - *DOE: John Herczeg, Frank Goldner*
  - *Los Alamos: Greg Van Tuyle, Ed Arthur, Mike Cappiello, Kemal Pasamehmetoglu*
  - *Argonne: Phillip Finck, Dave Hill, Jim Laidler, Doug Crawford, Hussein Khalil*

Issues

- *Issues/ Problems: None*
- *Suggestions for Improvements*
  - *WBS Category 1.21 : Collaborations does not appear to be self-consistent:*
    - » *Includes only international collaborations*
    - » *Includes only funding at one laboratory*
  - *Suggest more consistent treatment of category in future*

Advanced Accelerator Applications (AAA) Quarterly Review

First Quarter FY01
Oct-Dec 2000

WBS 1.27
University Collaborations

Denis Beller, Project Leader
February 7, 2001

Major Activities Planned for FY01

- Initiate AAA-UNLV UPP
- Initiate University Fellowship Program
  - $500 k for ~12 fellowships, Administered by ANRC
- Initiate Purdue FBBF Project
- Coordinate direct funding
  - U of Michigan, UT, UC Berkeley
- Develop plans/prepare for FY02
  - Competitive, peer-reviewed program

Milestone Status for FY01

- No milestones for first quarter
- Milestones for second quarter include
  - UNLV: sign contract, initiate program
  - Fellowship: distribution of announcements, collection and review of applications.
  - direct contracts with U.C. Berkeley, Univ. of Michigan, and Univ. of Texas at Austin.

Major Accomplishments for Oct-Dec 2000 (First Quarter FY01)

- Draft UNLV UPP proposal to DOE
- Draft plan for UFP to DOE
- I visited U. of Michigan and NCSU, gave colloquia, held research meetings, met with (recruited) students
- Initiated collaboration for using Purdue's FBBF at LANSCE
- Initiated contracting for direct university funding (SOWs and Sole Source justifications)

Planned Activities for Jan-Mar 2001 (Second Quarter FY01)

- **AAA-UNLV UPP**
  - AAA-UNLV mini-Workshop at UNLV
  - Review proposal, sign contract, begin
- **AAA Univ. Fellowship Program**
  - ANRC contract
  - Solicit and review proposals
- **Direct University Support**
  - sign contracts (U of Mich, UC Berkeley, UT)
- **Begin developing long-term plan (UGP)**

Other Activities (upcoming)

- collaborations
- review of fellowship applications (AAA technical leads) and selections (AAA and DOE management involvement)
- visits
  - U of Cincinnati
  - U of Wisconsin
  - UNLV
  - Purdue
  - others?

Issues

- Timing
  - AAA-UNLV UPP
    - » we may not have time to spend the large budget this FY or shortly into FY02
  - AAA UFP is late
    - » student selections may occur too late for synchronizing with summer hiring
    - » students may take other opportunities (the field is currently very competitive)