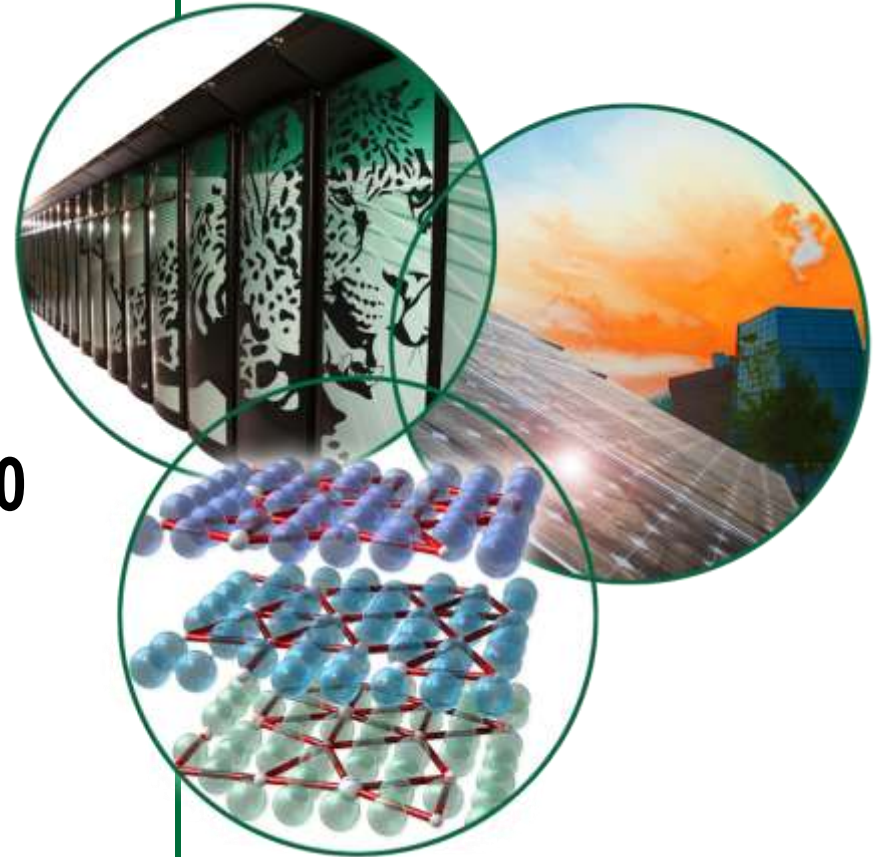


Accelerator Engineering Overview

Graeme Murdoch

NFDD Engineering Group Leader

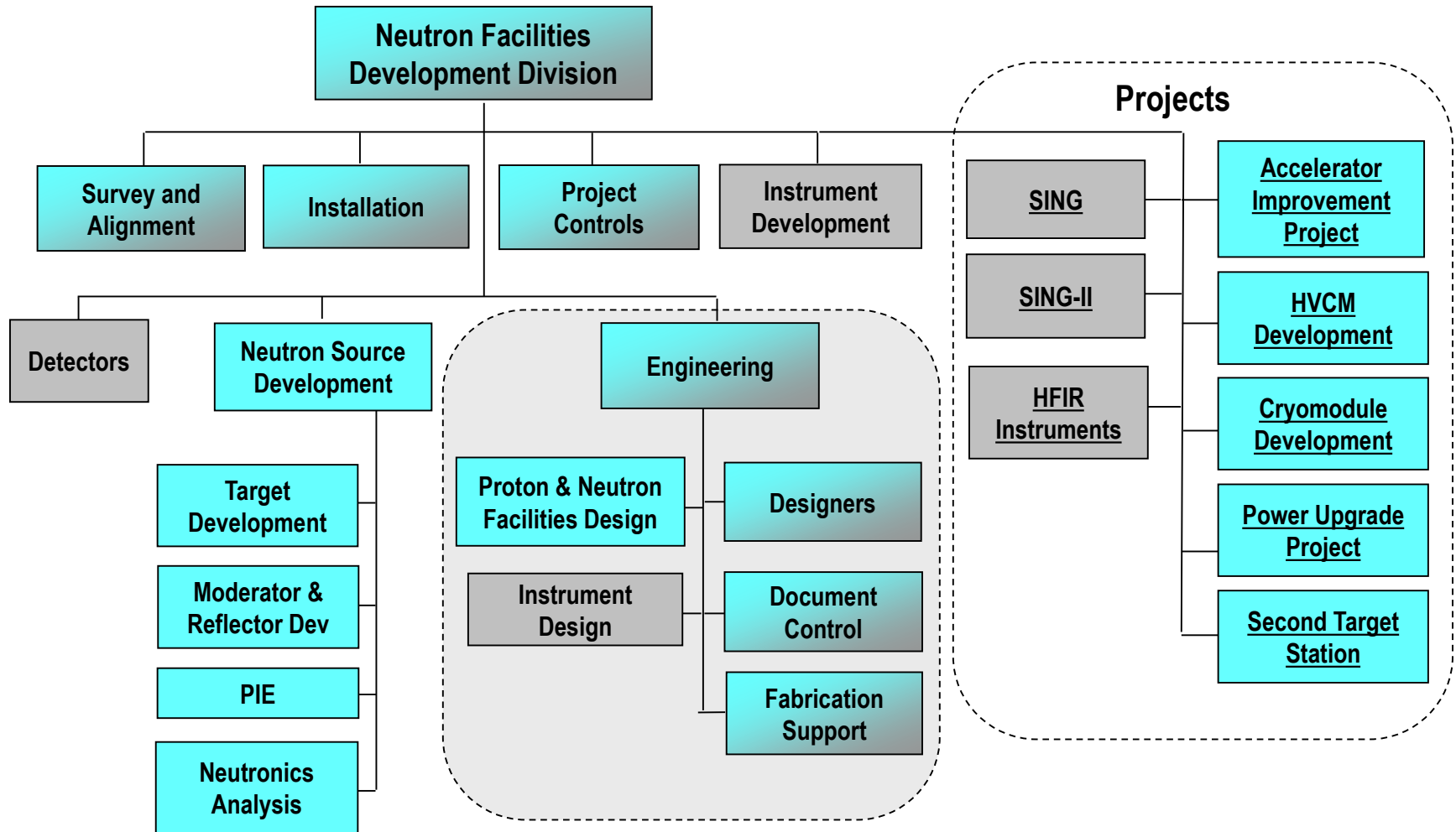
AAC Meeting February 2–4th, 2010



Outline

- **Organization**
- **Mechanical Engineering Accomplishments**
- **Current ME Activities**
 - Magnetic LEBT
 - Momentum Dump
 - Primary & Secondary Strippers
 - RID Aperture Increases
 - Ring Beam Dampers
 - HARP Assembly
- **Technical Component Utilities Accomplishments**
 - Accelerator cooling system upgrades
 - Momentum dump cooling loop
- **Summary**

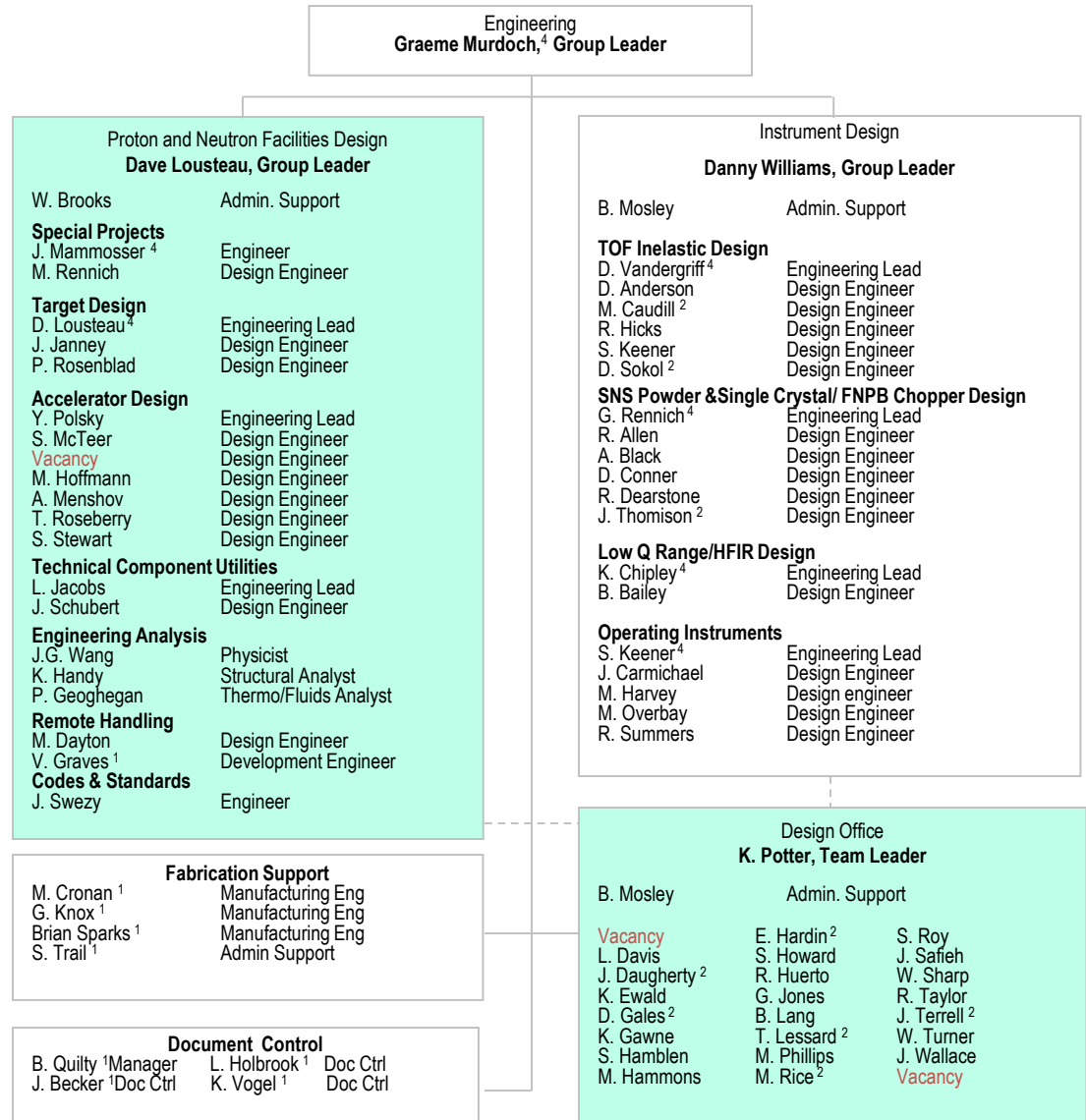
Neutron Facilities Development Division



Engineering Group Organization

- **Three Distinct Teams:**

- Proton and Neutron Facilities Design (PNFD) – Accelerator, Target, Technical Utilities, Analysis, Remote Handling & Codes & Standards
- Instrument Design – Support of new instruments at SNS & HFIR and support of all operating instruments
- Design Office – Support of both engineering design groups & other groups within SNS project
- DCC & Fabrication Support matrixed from ORNL



PNFD – Accelerator Team

- **Dedicated Accelerator Engineering Staff:**
 - 6 design engineers (+ 1 vacancy)
 - 1 cryogenics engineer
 - 2 utilities engineers
 - ~1.5 analysts
 - 1 remote handling engineer (shared)
 - 8 designers (including piping)
- **Installation support from RAD Mechanical Systems & Vacuum Groups**
- **Work is managed through:**
 - Accelerator Improvement Projects (AIP's) Process
 - Detailed Spreadsheet of work with priorities assigned by RAD
- **Design engineering follows SNS Design Development Process**
 - Design criteria document, formal design reviews etc

Accelerator Engineering Accomplishments

- **New magnetic LEBT designed, manufactured and under construction**
- **MEBT scraper designed, manufactured and installed**
- **MEBT Chopper designed, manufactured and installed**
- **Spare Croyomodule detailed design completed**
 - External design review Feb 2010
- **Laser wire station corrector magnet designed and ready for bid**
- **1 GeV HEBT Laser Emittance Scanner designed (vacuum system installed)**
- **New momentum dump designed and fabricated, installation in progress**
- **Re-designed primary foil stripper, components in manufacture**
- **Re-designed secondary foil stripper, assembly in progress**
- **Ring Injection Dump aperture increase designed and ready for bid**
- **Ring Beam Dampers designed, manufactured and installation in progress**
- **New HARP mechanism components designed, manufactured & assembled**
- **Remote tooling for HARP replacement designed and manufactured**

Current Activities – New Magnetic LEBT

- *A test stand is being built to evaluate the possibility of replacing the electro-static LEBT.*
 - The test stand uses a kinematic mounting system that will easily adapt for eventual installation in the accelerator.
 - Status - all components delivered and under assembly on test stand



ProE Model of Magnetic LEBT Test Stand



Solenoid under Test in Magnet Laboratory



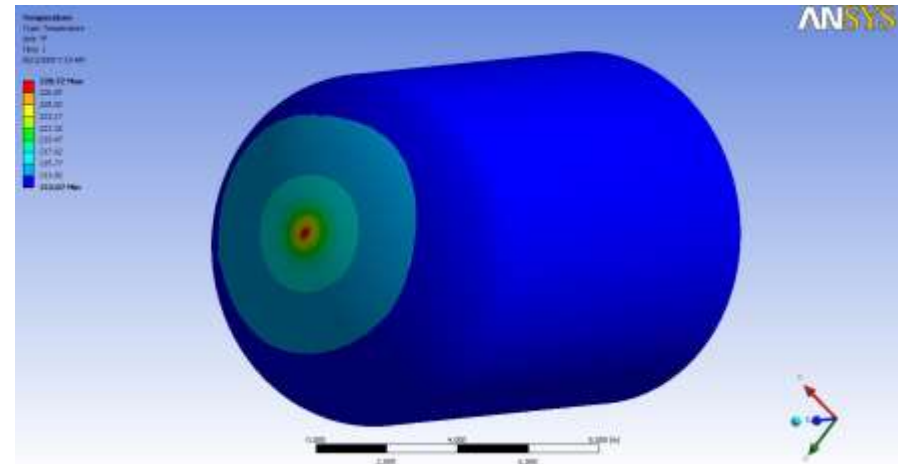
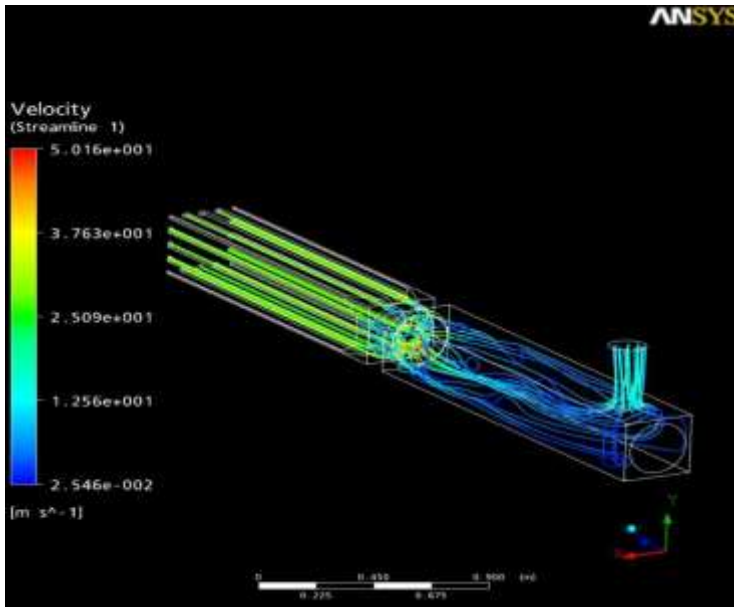
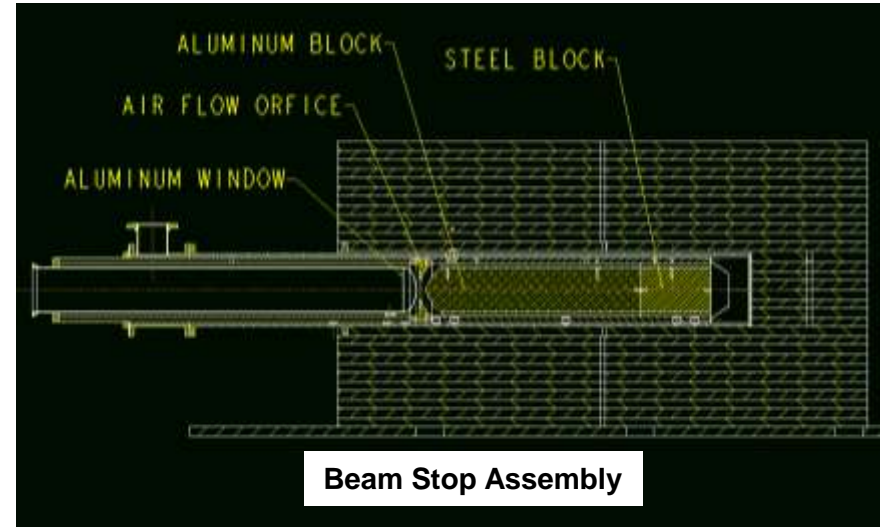
Magnetic LEBT under Assembly on Test Stand

Current Activities – New Momentum Dump

- ***A new momentum dump has been designed to replace the original dump that was decommissioned due to an off-normal event causing overheating of the dump and the subsequent build-up of radiolysis gases***
 - New design is air cooled instead of water cooled; eliminate radiolysis issues
 - Beam dump made of aluminum 6061 block with flow passages running axially along length
 - Fits into existing space envelope
 - The new dump is expected to significantly reduce beam loss
 - The upstream beamline will be upgraded with new instrumentation
 - Tooling was designed to remove the activated dump
 - Installation is underway

Current Activities – New Momentum Dump

- Design Requirements:
 - 1.3 GeV
 - 5 kW nominal (10 kW off normal)
 - 8mm x 5mm spot size
 - 50 C allowable air temp increase
- Dump Maximum Temp (10kW) ~250 C
- Max thermal Stress - ~10 Mpa



Temp profile on vacuum tube under natural convection
Peak temperature remains below 110 C

CFD Analysis of Dump: Forced airflow through dump

Current Activities – New Momentum Dump



Beam Stop Vessel



Beam Stop Enclosure



Beam Stop Vessel Installation



Aluminium Beam Stop



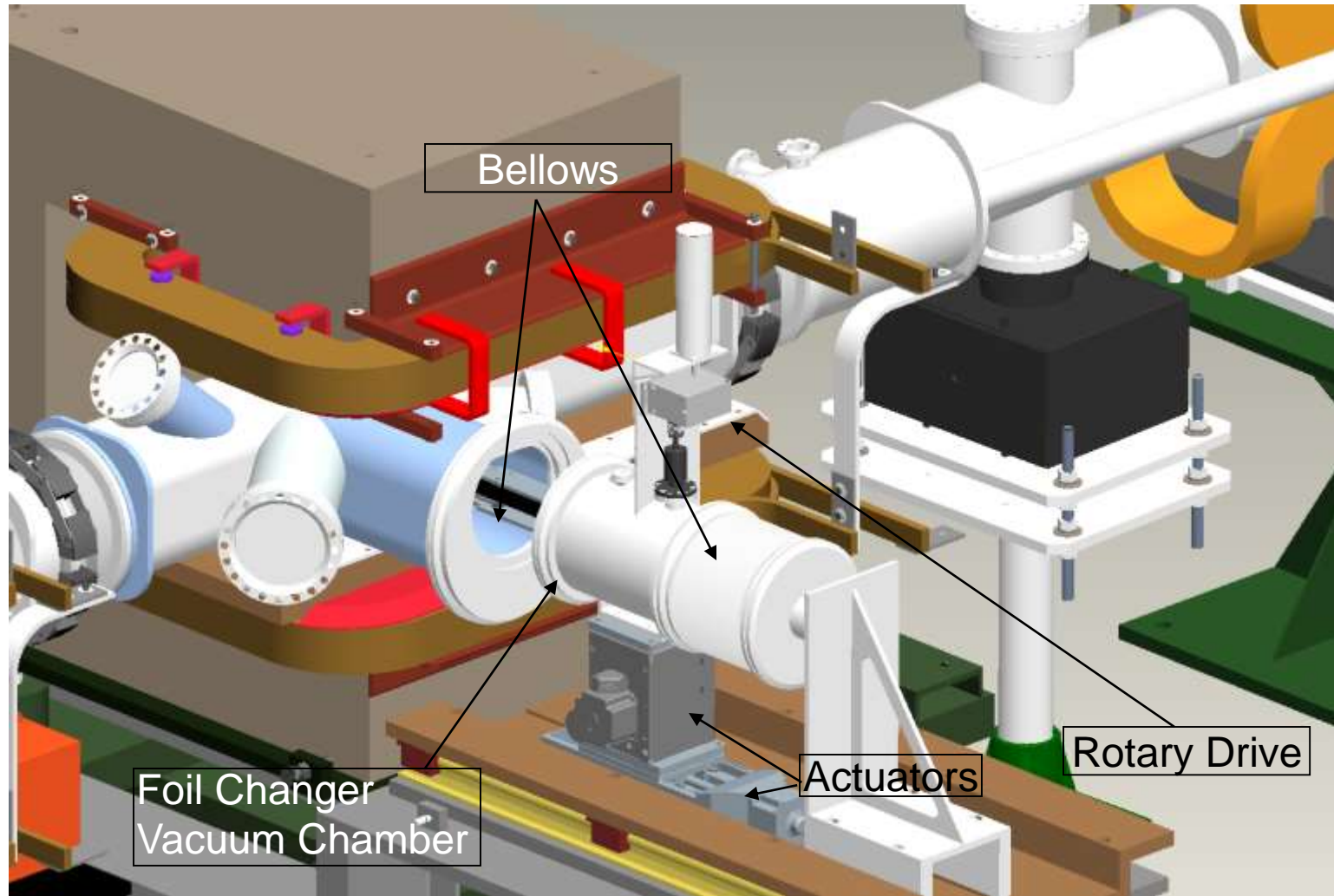
Current Activities – Primary Stripper Foil Up-grade

- ***New design addresses several problems that have developed during the first three years of operation***
 - Foil hanger drag on chain pins
 - Vertical alignment inaccuracy and drive slippage
 - Excessively large module size
 - Foil replacement access
- **Uses commercial foil changer with 30+ year application experience (some mods required)**
- **Foil changer can be manipulated with out-of-vacuum XY translation stage**
- **Bellows used to accommodate relative motion of vacuum chambers**
- **Up-graded primary stripper mechanism design is complete and under manufacture**



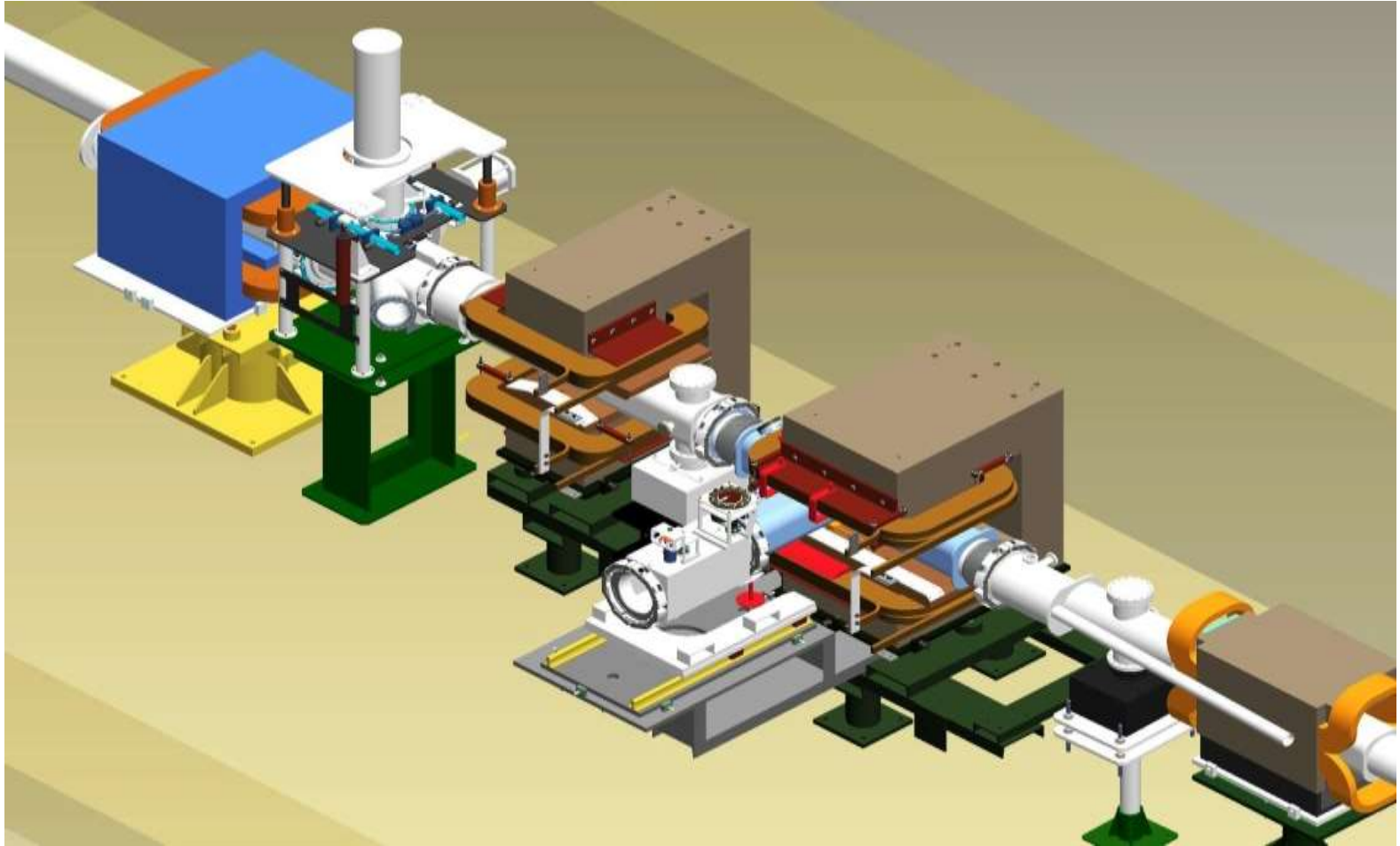
Current Primary Stripper Configuration

Current Activities - Primary Stripper Foil Upgrade



ProE Model of New Design

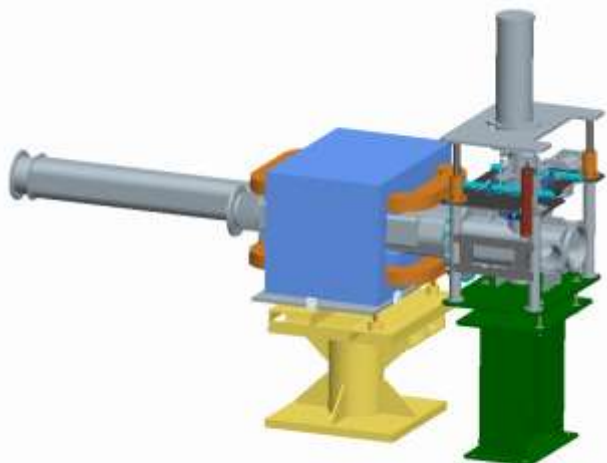
Current Activities – Injection Straight Configuration



Injection Straight showing Stripper Foils Positions

Current Activities – Secondary Stripper Foil Upgrade

- ***New design addresses maintenance & operational issues***
 - Separate Vacuum Vessel Design
 - Enlarged View-screen
 - Remote Vacuum Clamp
 - In Vacuum Actuator Design
 - Tooling Post Design for Foil Extraction
 - Quick Release Foil Mounting



Secondary Stripper Foil Assembly



**In-Vacuum Actuator
(needs proven)**

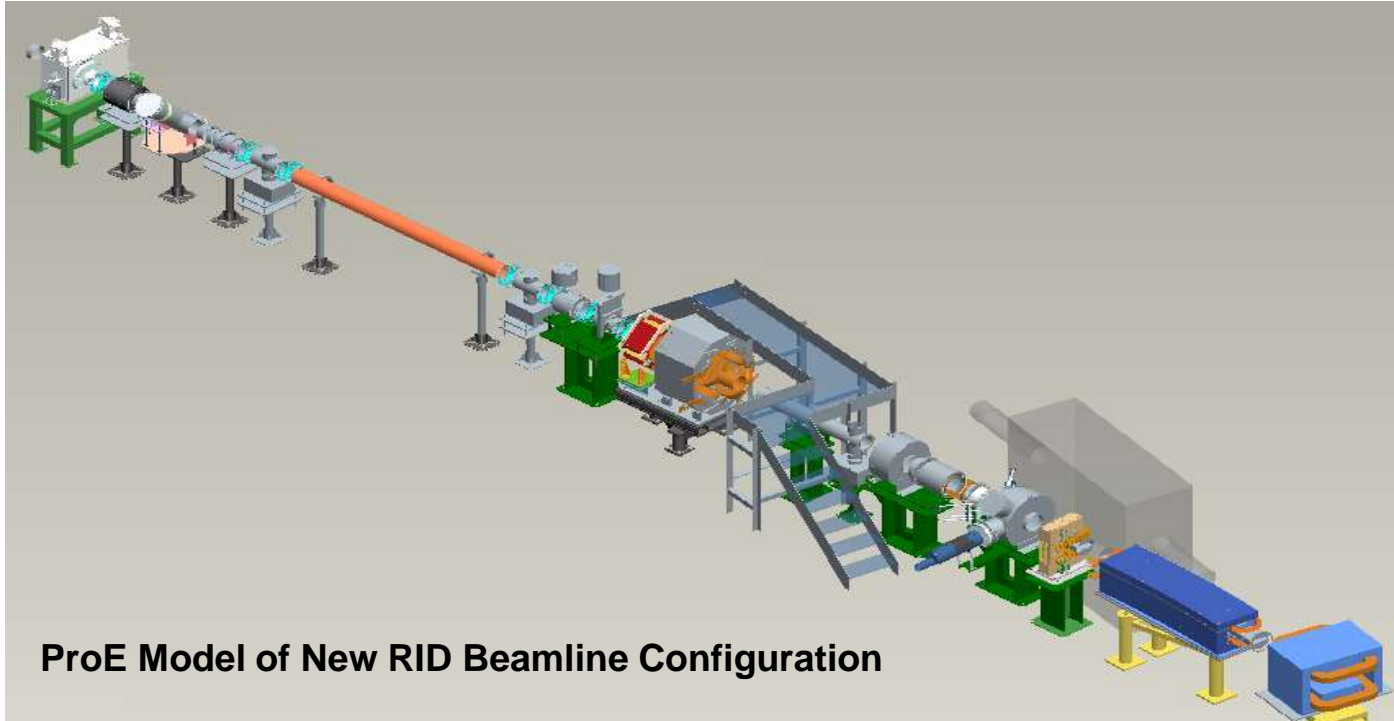
Foil Extraction Mechanism



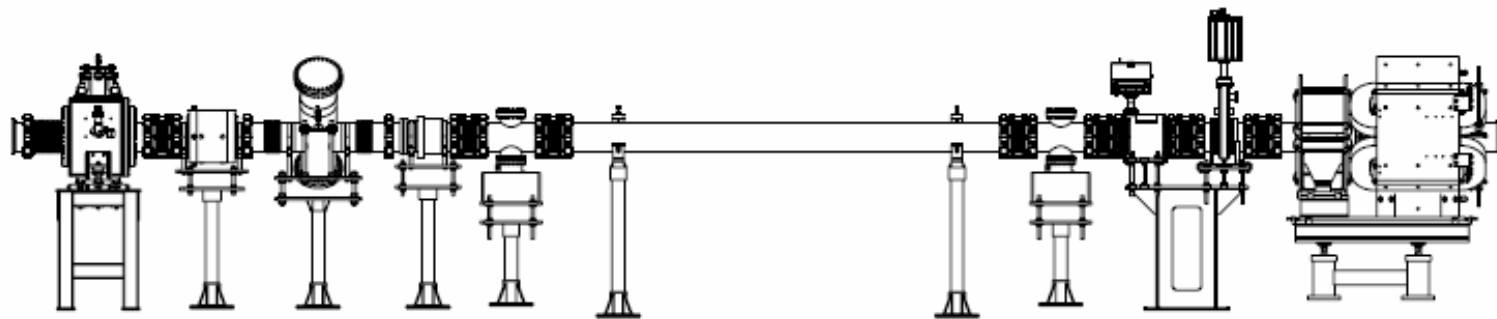
Current Activities – Ring Injection Dump (RID) Aperture Increase

- ***Increase aperture in the RID upstream beamline, improve diagnostics and improve mechanical engineering design from a handling and maintenance perspective***
 - Increase limiting aperture to 8 inch (20cm) minimum
 - 2 new BPM's & reconfiguration of existing BPM, BCM & WS
 - Modularize design
 - All beamline flanges EVAC style utilizing aluminium diamond seals
 - Utilize existing where possible
- **Engineering design is complete, BPM design in process**
 - Final design review held Nov 09
- **All long lead items are ordered**
- **Installation target date – Summer 2010 shutdown**

Current Activities – RID Aperture Increase



ProE Model of New RID Beamline Configuration



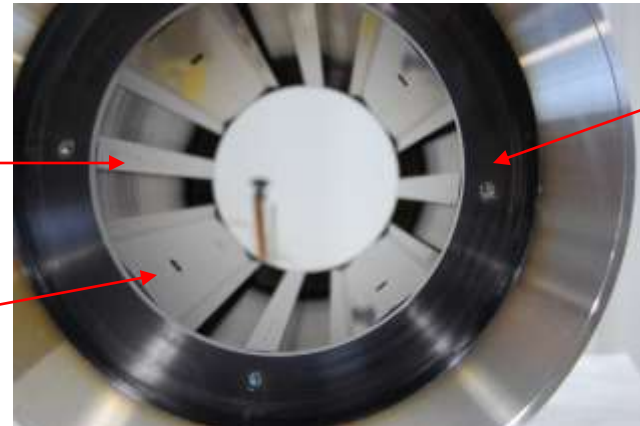
2-D Design Drawings of RID Beamline Configuration

Current Activities – Ring Beam Dampers

- *To control transverse beam instabilities at full power*
- **Engineering Design Requirements**
 - Electrodes to be electrically isolated
 - Shield bars in between electrodes to minimize electrical coupling from the other electrodes
 - End shields to minimize electrical signals from the other damper
 - Titanium Nitride Coated
- **Measured results in excellent agreement with simulation – manufacturing tolerances held**



Damper Vacuum Vessel



Shield bars

Electrode

End Shield

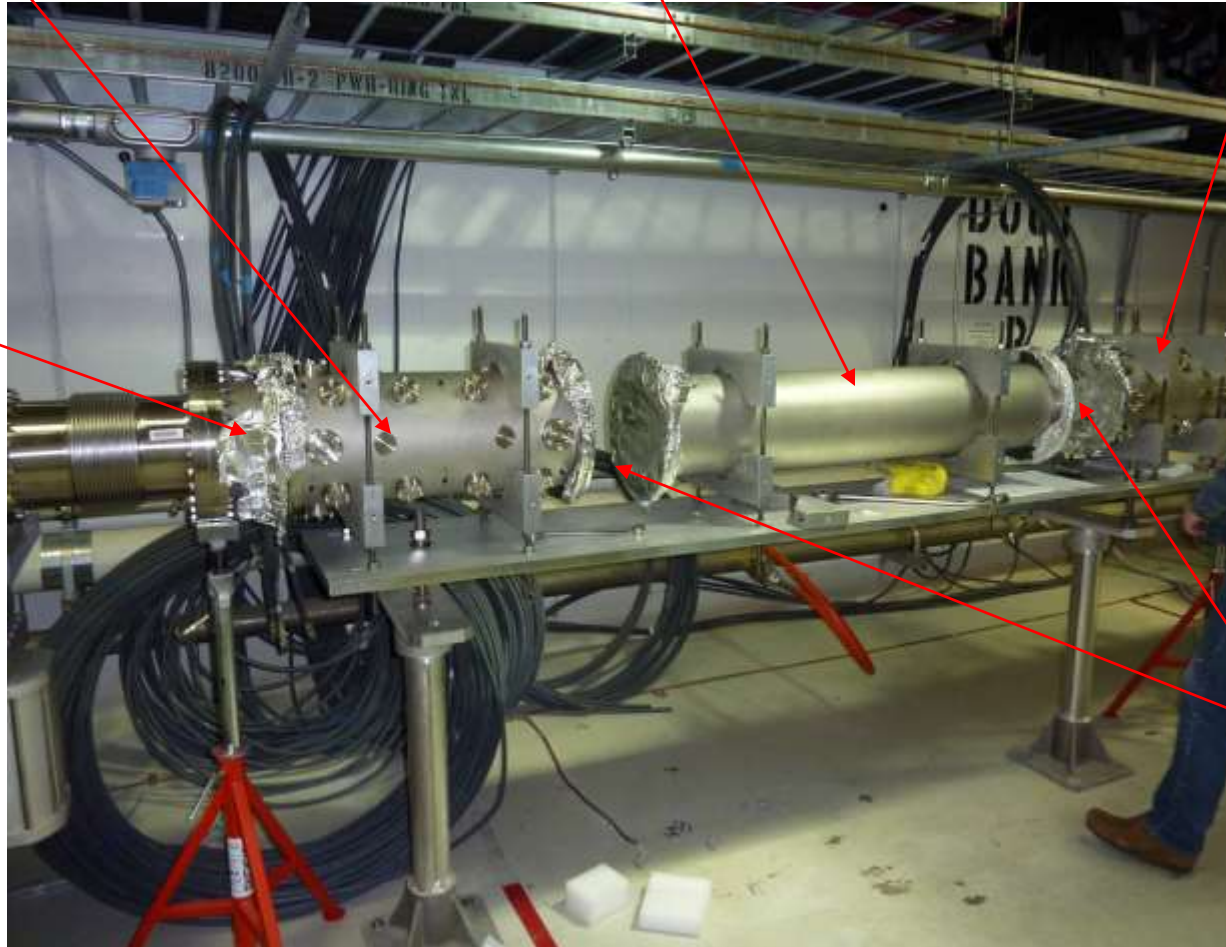
Current Activities – Ring Beam Dampers

Damper
(Kicker)

Spool

Damper
(Pick-up)

Conflat
to EVAC
adapter

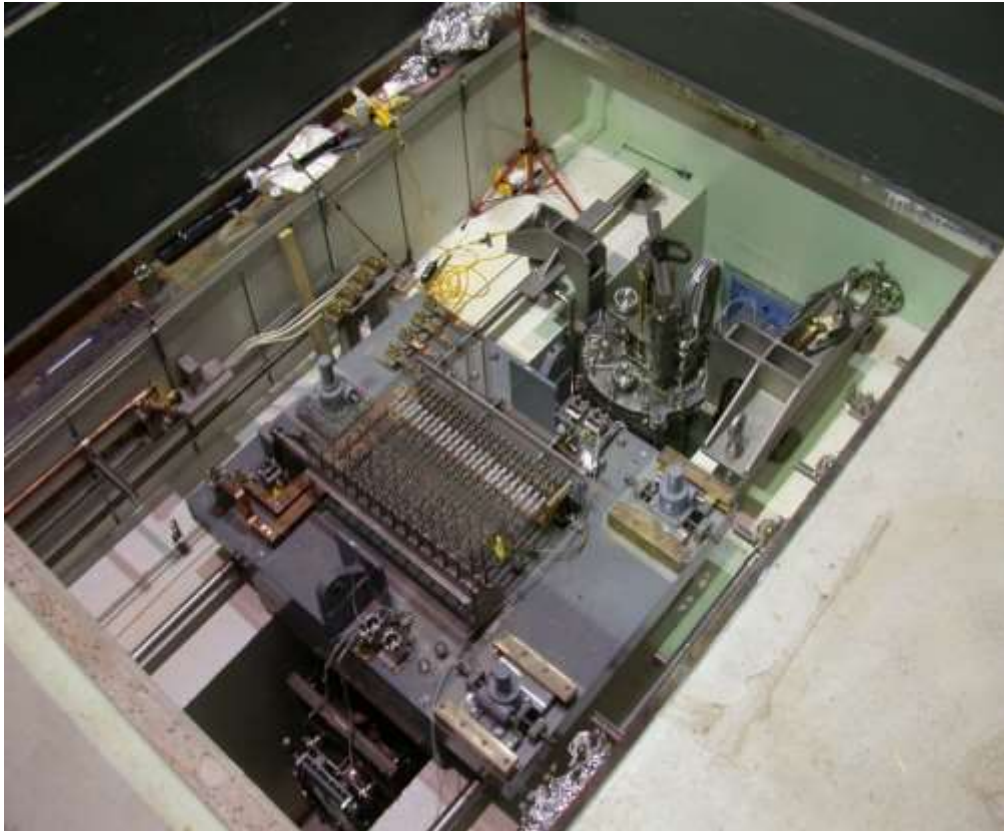


Bellows
(not
installed)

Damper Assembly during Assembly in Tunnel

Current Activities – HARP Mechanism Upgrade

- *New HARP mechanism design allows for HARP to be retracted from beam*
 - RAD hard pneumatic drive motor
 - Tooling post guide system

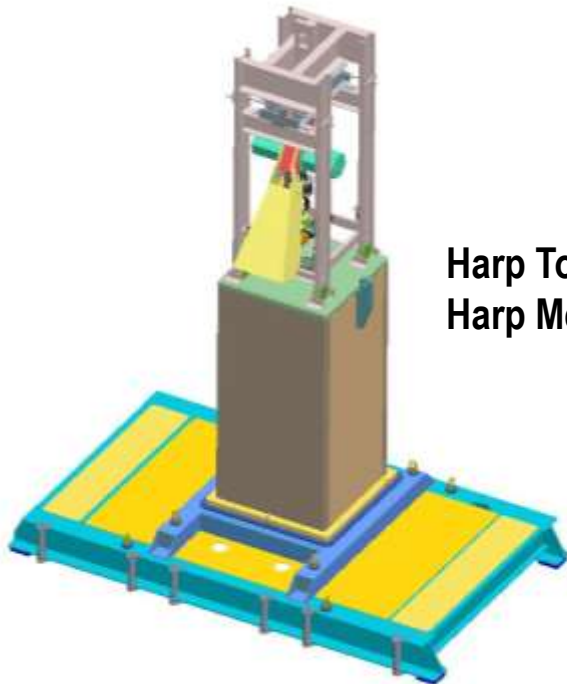


Q30 & HARP Mechanism Installed in RTBT

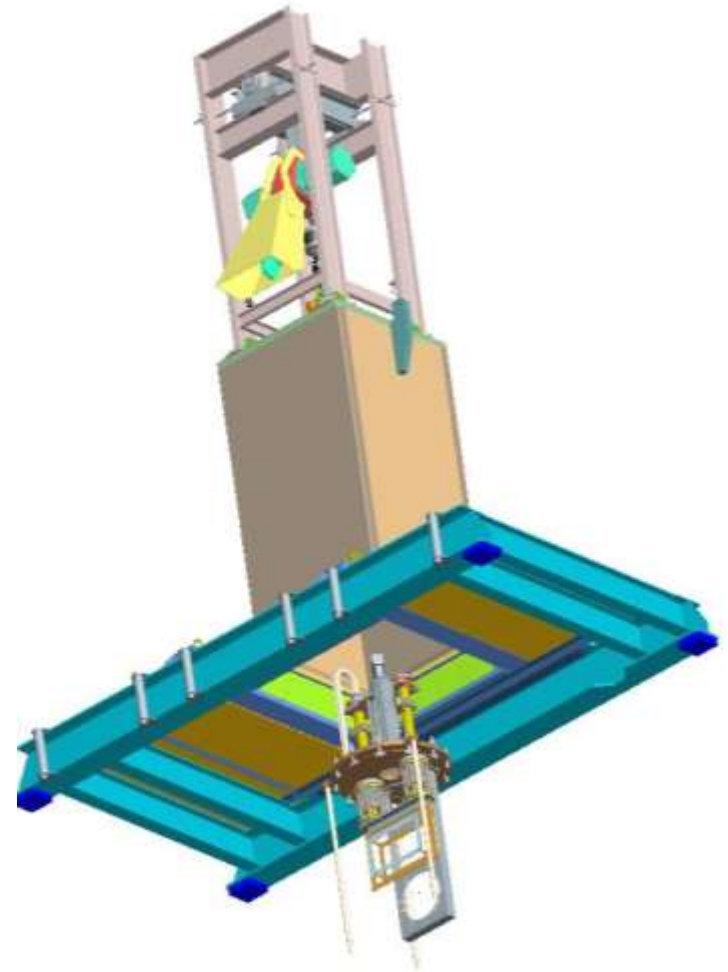
**HARP Mechanism Assembled
In Laboratory**

Current Activities – HARP Mechanism Tooling

- Harp Mechanism Replacement / Active Handling Status:
 - The remote handling tooling needed to replace the Harp mechanism has been designed & manufactured



Harp Tooling Configured for Harp Mechanism Removal



ProE Model showing Harp Mechanism Withdrawal into Shielded Cask

Technical Component Utilities - Accomplishments

- **Extended new DI Cooling Headers to the new MEBT Rf Power Supplies in the Front End Building**
- **Upgraded RFTF DI Cooling System**
- **Completed HVCM test stand modifications in the HEBT-SB**
- **Procured and installed a new vane chiller unit for the RFQ, based on system flow analysis**
- **Substantial review of water chemistry issues in accelerator**

Current Activities – Cooling System Upgrades

- **On-going Accelerator Cooling Systems Upgrades:**
 - Pump Room Instrumentation Upgrades
 - Resonance Control Cooling Skid Water Chemistry Test Panels & Studies
 - DI Loop Water Chemistry Test Panel & Studies
 - Work with Independent Consultant on systems cooling copper components to complete system evaluation report and implement recommendations (final report due Feb 2010)
 - Finalize operating and monitoring strategy
 - Initial recommendations include operating at resistivity > 12 Mohm-cm
 - Eliminate pH monitoring
 - Obtain baseline operating data using test panels noted above
 - Establish calibration program requirements to support operations

Current Activities – HEBT Momentum Dump

- **HEBT Momentum Dump Air Cooling Loop – Installation Status**
 - Main piping support installation nearing completion
 - Blowers delivered
 - Compressed air supply/purge to loop nearing completion
 - Electrical/Instrumentation installation ~40% complete
 - Main air loop piping nearing completion
 - Ring Magnet water loop supply to air/water heat exchangers tie ins nearing completion

Current Activities – Cooling Loop Installation



Cooling Loop Installation looking at Dump



Cooling Loop showing Heat Exchanger Mounted

Summary

- **Mechanical engineering organization continues to mature and improve**
- **Accelerator team lead has established himself over the last year**
- **High workload managed through AIP process and prioritized work spreadsheet; difficult to satisfy everyone**
- **Removal of existing equipment is becoming more challenging due to residual activation**
- **Emphasis on ease of handling and maintenance for new design work – quick release clamps, modular design etc**
- **Nice mix of new design and upgrade work**