Cryomodule Production

Harry Carter

Outline

- Technical Status
- Available Resources----Workforce
- FY09 Priorities, Accomplishments and Milestones
- FY10 Planning Goals and Milestones
- Issues
- Summary

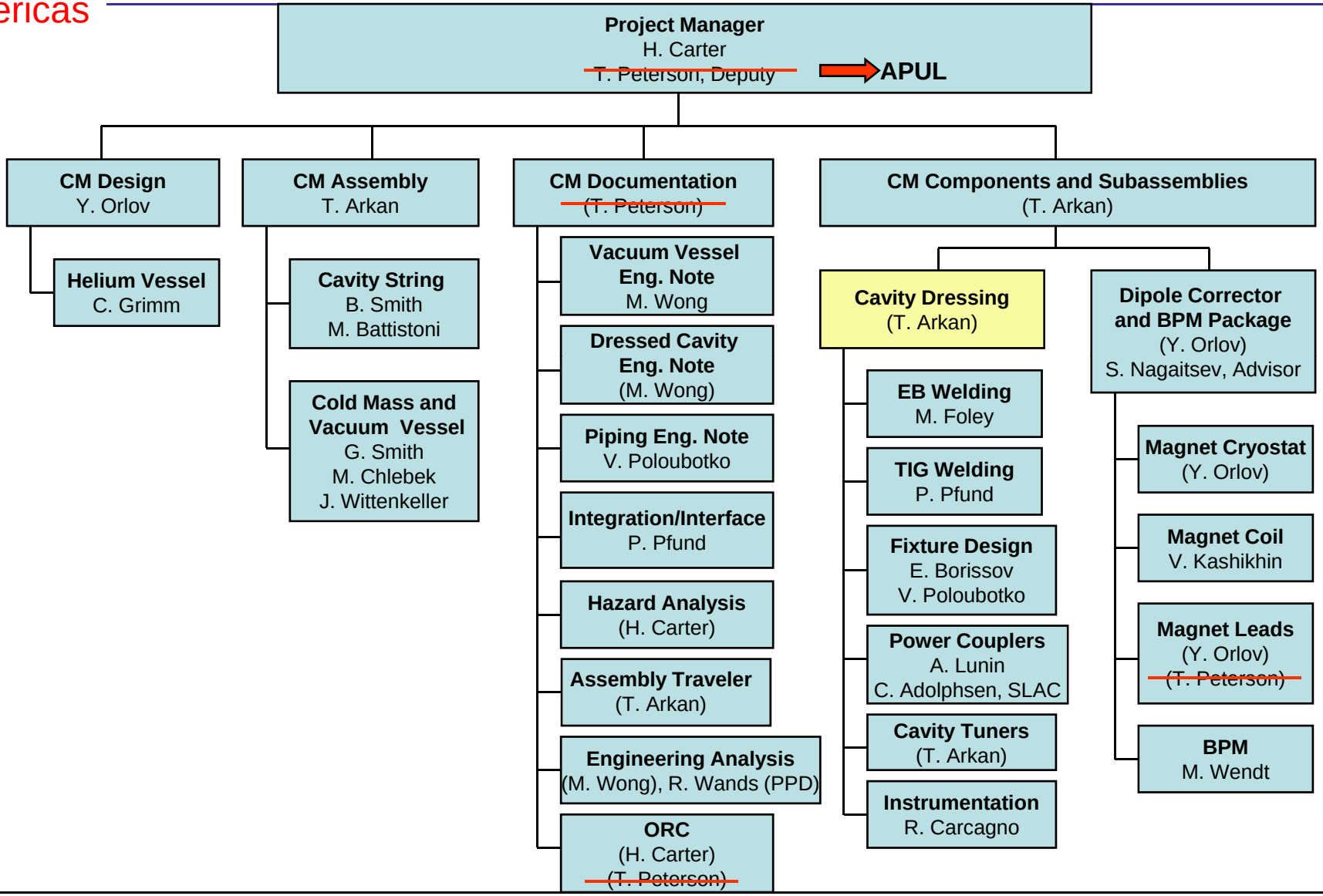
Americas

Technical Status: Snapshot

- 3.9GHz Cryomodule completed and shipped to DESY on April 24. Resources can now concentrate on 1.3GHz CM work
- Resumption of ILC cryomodule design (T4CM)
  - Solid model design at 95% complete stage; only dipole corrector package design work remains
  - 2-D drawing packages to be created from solid model and checked both by FNAL and our Indian colleagues prior to ordering parts
- Cavity dressing infrastructure complete and 1st article (AES1) assembly in progress
- Work towards GDE SRF S1 goal for cryomodules
  - Our first viable candidate will be CM2; assembly in early FY10
- Development of U.S. suppliers for cryomodule components
  - U.S. cavity suppliers development well underway
  - Cryomodule component supplier development will commence in earnest with CM3 procurements; planned for late FY09

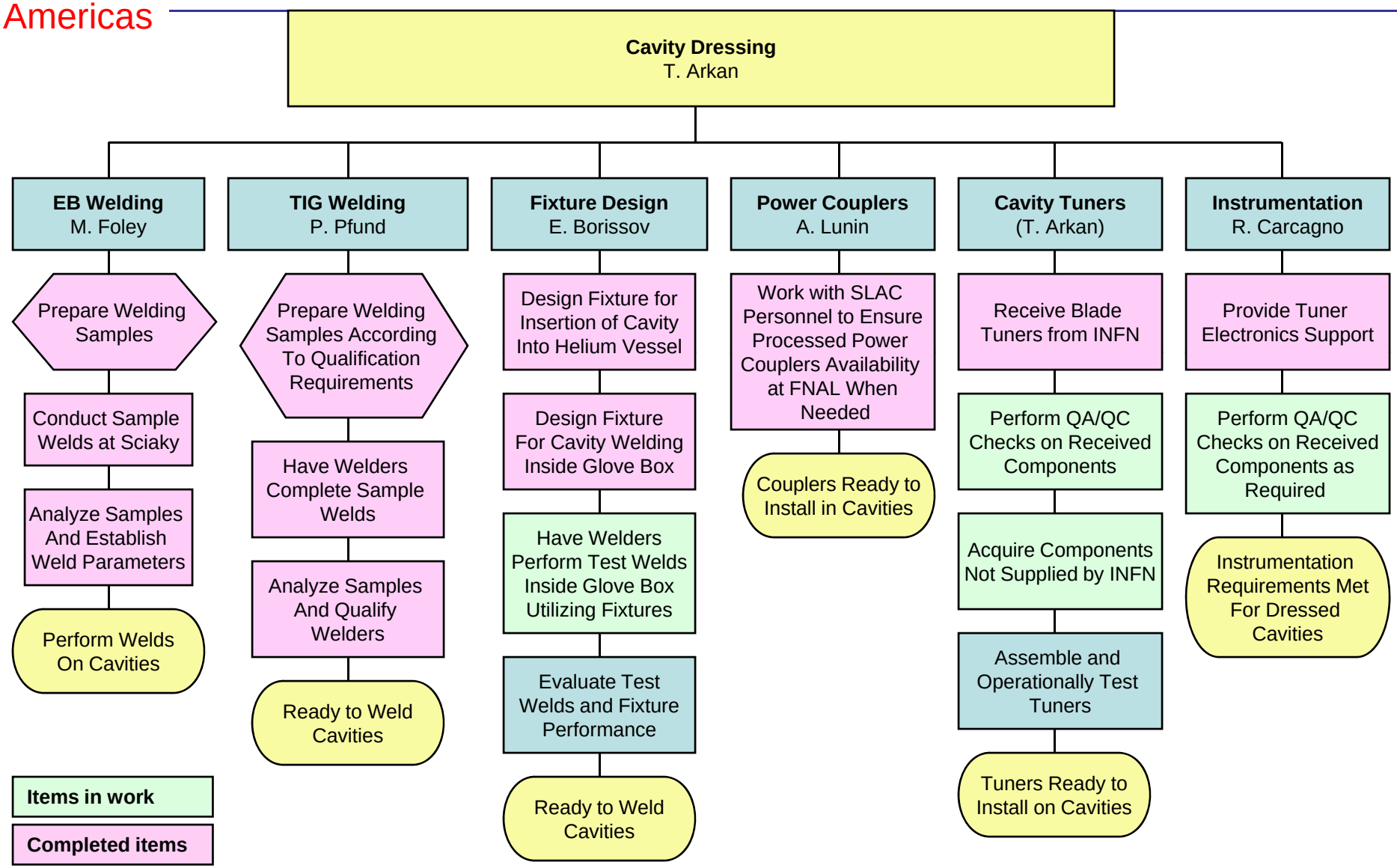
Americas

Workforce: 1.3GHz CM Program Org. Chart



Americas

Cavity Dressing: Tasks, Responsible Persons, & Status



Americas

FY09 ILC/SRF Priorities*

- Top five FY09 priorities
  - Finish 3.9 GHz CM and ship to DESY ✓
  - Finish & fully commission the ANL processing facility ✓
  - Test CM1 (cold and rf power) ⇦
  - Master SRF technology by maintaining constant throughput through ANL, VTS, HTS and CAF ⇦
  - Dress cavities in preparation for CM2 ⇦

***Source: R. Kephart FY09 budget presentation**

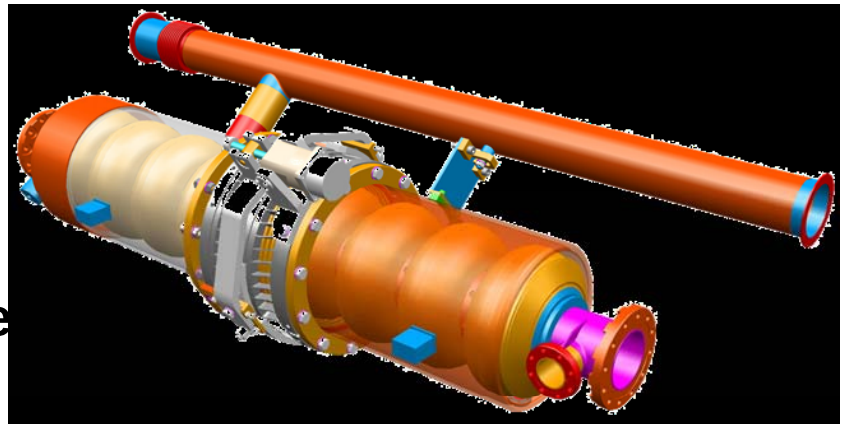
Americas

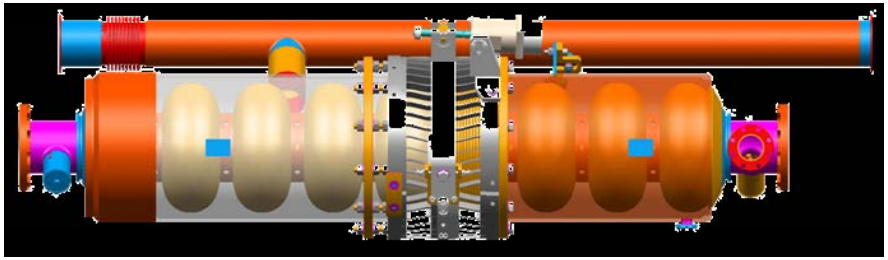
FY09 Accomplishments

- **3.9 GHz CM completed and shipped to DESY**
  - Required completion of extensive documentation to satisfy both FNAL ES&H and DESY safety requirements
- **The ANL processing facility was completed and commissioned, first with 1.3GHz single cell cavities and then with 1.3GHz 9-cell cavities**
- **Completed internal mini-reviews of the cavity dressing program and the CM2 assembly program**
- **Completed infrastructure installation for dressing 1.3GHz cavities at CAF-MP9**
- **Completed the generation 3 helium vessel design and procured parts to enable the dressing of twenty 1.3GHz cavities (for CM2, CM3, and S1 Global)**
- **Initiated a design effort to develop a stainless steel helium vessel for 1.3GHz cavities**
  - Based on the JLab 12-GeV concept
- **Collaborating with AES on their SBIR effort to develop a stainless steel helium vessel design**
  - Phase 1 complete
  - Phase 2 proposal submitted

Cavity Dressing

- **AES1 identified as first cavity to be dressed**
  - **Poor performing cavity**
  - **To be used develop our dressing process and improve**
- **AES4 will be second cavity to be dressed**
  - **Medium performing cavity**
  - **Will be used as a replacement cavity for the A0 photo injector CC1**

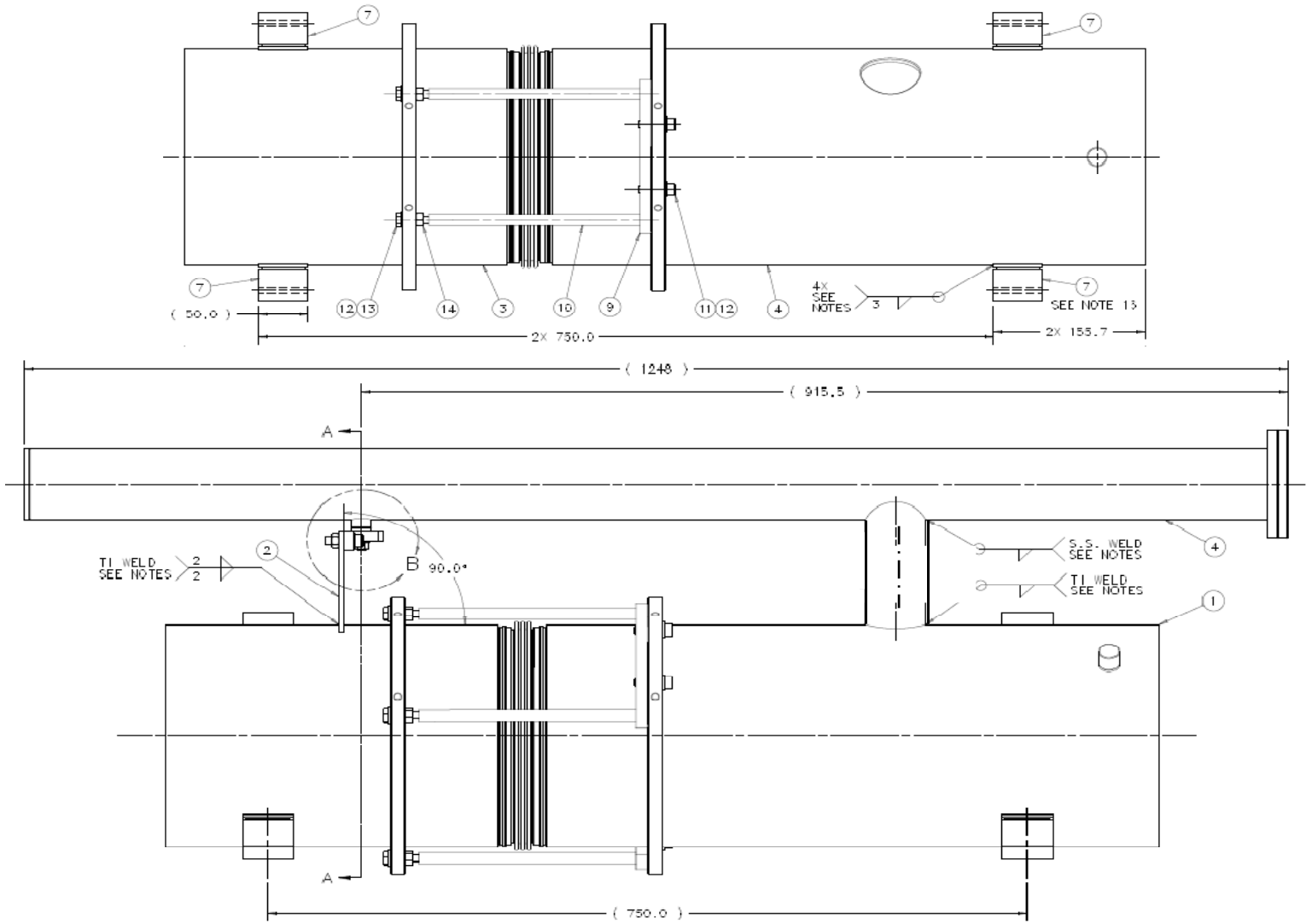




1st Cavity: Dressing Requirements

- **AES1 Bare Cavity**
  - **Standard Tesla Design with unequal length beam tubes**
- **EBW Titanium Rings to Nb-Ti Cones of Cavity End Groups**
- **G3 Design Titanium Helium Vessel Subassembly**
- **TIG welding infrastructure at CAF-MP9 Completed**
- **Processed power coupler from SLAC**
- **1.3 GHz Cavity Magnetic Shielding**
- **One Slim Blade Tuner with Piezos from INFN-Milano**
- **All Cavity seals, hardware, and RF components**

G3 VESSEL SUB-ASSEMBLY (FABRICATION AT HI-TECH)



- Local machine shop
- Adequate size glove box
- Certified welders for titanium TIG welding

Global design effort

Americas

1st FNAL built Cryomodules

Cryomodule 1 (From DESY kit; Type 3+ design)

3.9 GHz Cryomodule
Designed/built at FNAL
for DESY TTF/Flash

Americas

FNAL Cryomodule 2

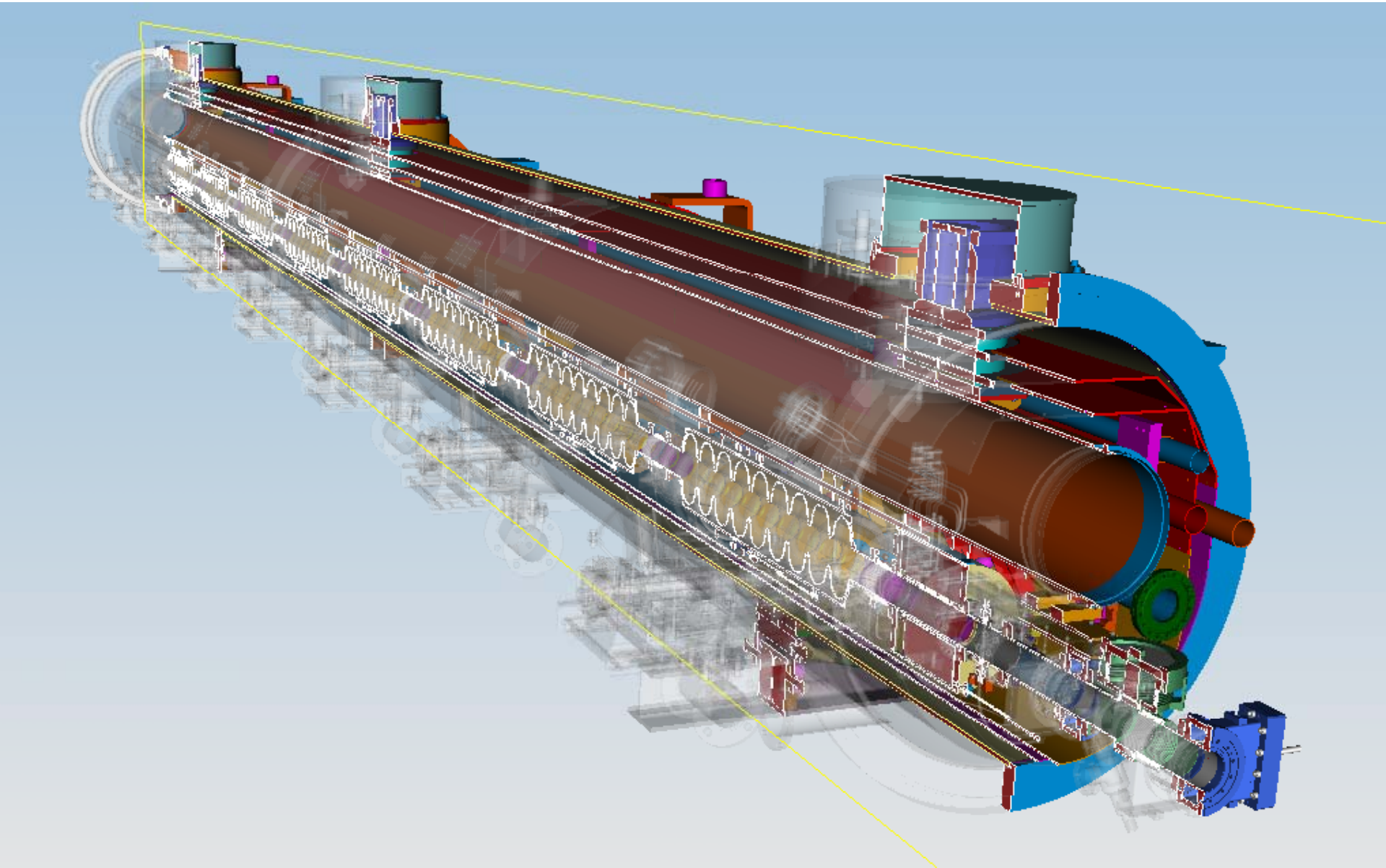
- Goals
  - –Build a cryomodule completely equipped with cavities processed in the U.S
  - –Type 3+ design with corrector coils at end
  - –1st attempt to achieve ILC S1 goal of 31.5 MV/m average gradient in a CM
  - –Cavities equipped with INFN blade tuners
- Eight cavities are good candidates for CM 2
  - –Average gradient in VTS is 36.5 MV/m
- Final cavities used will be selected based on upcoming process & test results
- CAF(MP9) will be used to Dress cavities
- 1st dressed cavity this month
- Dressed cavities to be horiz. tested at MDB
- Goal: Cryomodule 2 assembled late 2009

Vendor	Cavity #	Gradient* (MV/m)
ACCEL	6	37.8
	8	31.7
	11	40.0
	12	37.0
	13	40.0
	14	43.0
AES	2	32.8
JLab	J2	30.0
Average		36.5

* based on last process/test result at Jefferson Lab

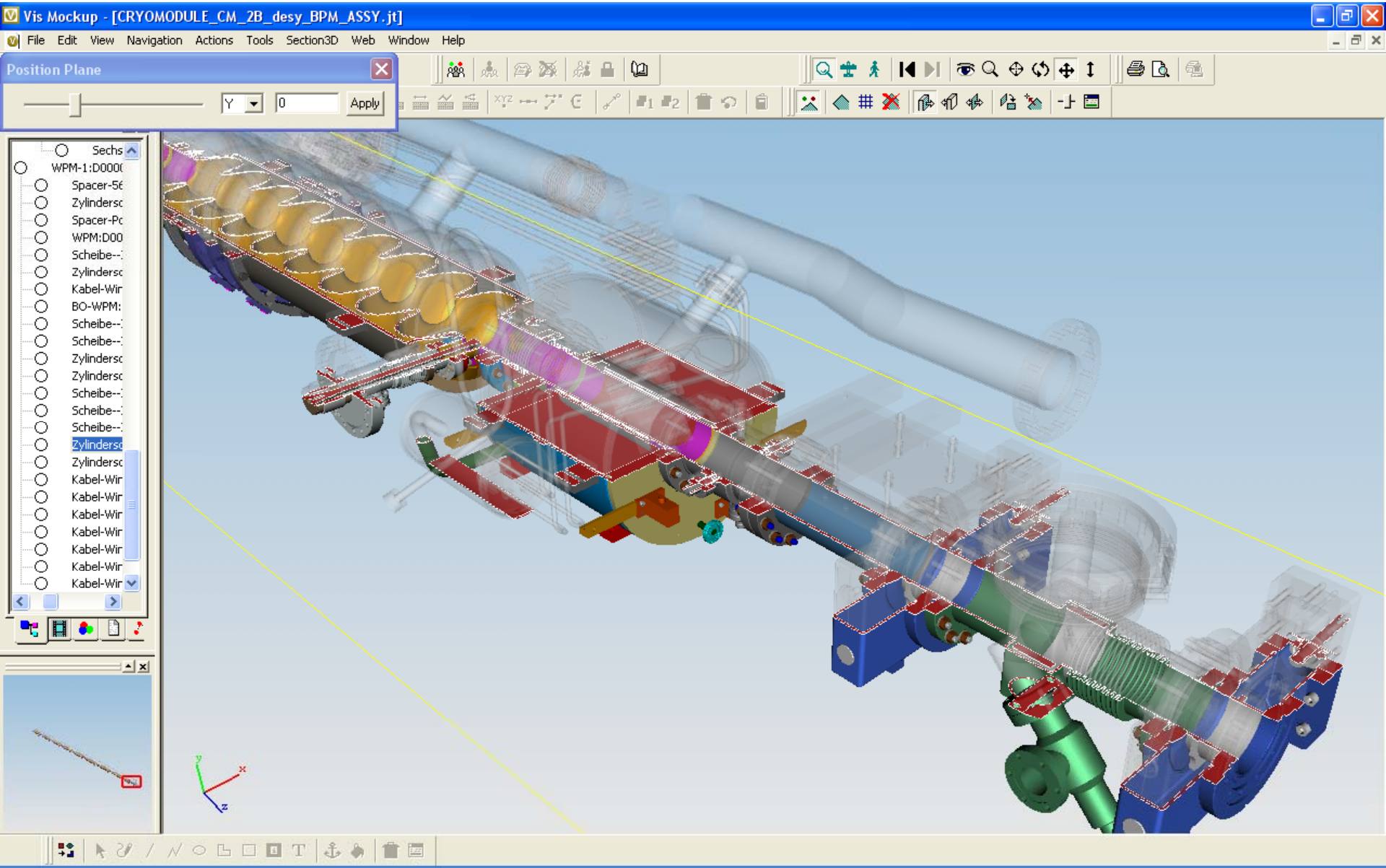
Americas

CRYOMODULE # 2. Design



Americas

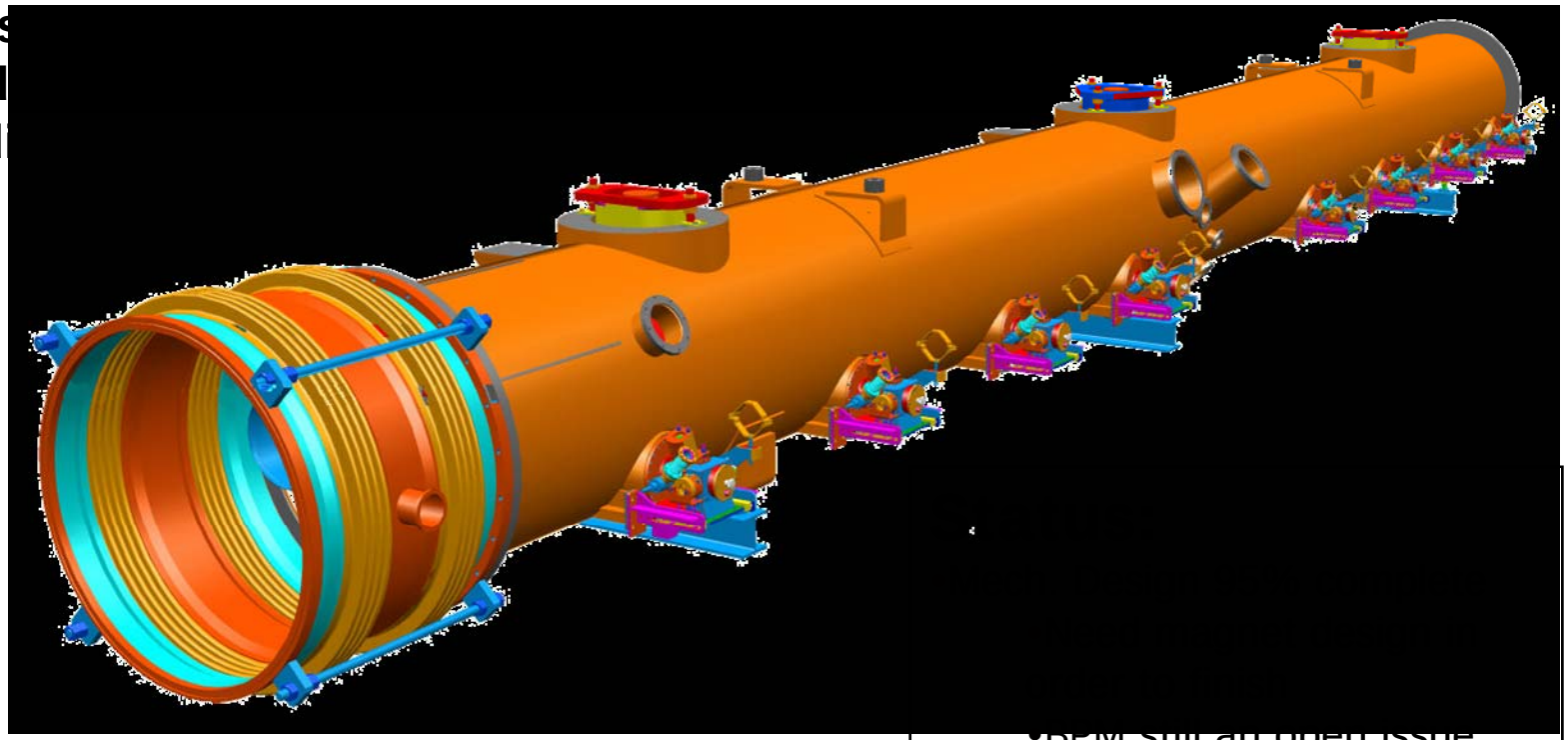
CRYOMODULE # 2. Design



Americas

Type IV Cryomodule Design Effort

- **International design effort led by FNAL**
- **Features**
  - **8 equal length beam tubes cavities, 1 quad magnet pkg**
  - **Magnet under center support post**
  - **ILC s**
  - **Blad**
  - **Mod**



•BPM still an open issue

FY10 ILC CM Planning for FNAL

At this time, an official set of FY10 ART milestones has not been established, primarily due to the welcomed infusion of ARRA funds and the ongoing assessment of their impact on the allocation of the FY10 ART funds, and hence goals.

In the next slide, taken from R. Kephart's FNAL integrated ILC/SRF/Px Plan, the general 1.3GHz CM plan for the next few years is presented.

Americas

1.3 GHz Cryomodule Plan

1.3 GHz Cryomodules

U.S. Calendar Year	2008	2009	2010	2011	2012
CM1 (Type III+)					
Assembly	in FY07 OMNIBUS delay	install			
Test			CM1 test@NML		
CM2 (Type III+)					
Cav Processing + VTS					
Dressing & HTS (# couplers)		6 6			
Assembly			install		
Test				S1 Demo@NML	
CM3 (Type IV)					
Design & Order Cav & CM Parts	OMNIBUS DELAY	Des Order Cav & CM parts			
Cav Processing + VTS					
Dressing HTS			5 5		
Assembly				install	
Test				S1 Demo@NML + 3 CM String	
CM4 (Type IV) ARRA					
Design & Order Cav & CM Parts		Order Cav & CM parts			
Cav Processing + VTS					
Dressing HTS			5 5		
Assembly					install RF unit
Test					S1 Demo + with beam
CM5 (Type IV) ARRA					
Design & Order Cav & CM Parts		Order Cav & CM parts			
Cav Processing + VTS					
Dressing HTS				5 5	
Assembly					install
S1 Global (2 Cav)					
Cav Processing + VTS					
Dressing & HTS?			2		

ILC 1.3GHz Cryomodule Planning

Planned in FY09

• Complete dressing infrastructure and dress 1st 1.3GHz cavity	Q3
• Complete CM1 ORC process and cool down	Q4
• Complete CM3 remaining design/drafting work	Q4
• Order major CM components for CM3-CM5	Q4
• 8 dressed 1.3 GHz cavities available for CM2	Q4/Q1-FY10

Forecast in FY10

• 8 dressed 1.3 GHz cavities available for CM2	Q1
• 2 dressed 1.3GHz cavities available for S1 Global	Q1/Q2
• Assemble CM2	Q2
• 8 dressed 1.3GHz cavities available for CM3	Q2/Q3
• All CM3 components available	Q3/Q4
• Assemble CM3	Q4/Q1-FY11

Issues

- **As usual, we expect a CR in FY10**
  - **Impact on CM2 assembly will be minimal**
  - **Impact on CM3 will be minimal if all long lead items are ordered in FY09 as planned**
  - **When ARRA funds become available, the impact of a CR on CM4 and CM5 parts procurements will also be minimal**
- **Envision resource problems as Fermilab R&D programs (Project X, Mu2e, NOvA, etc.) acquire project status and need more personnel**
- **ARRA funds, while providing much needed (and appreciated) relief from the austere period we suffered in FY08, will require manpower to responsibly obligate them and oversee technical progress on procurements with these funds.**
- **Upcoming Tevatron summer shutdown will have a slowing down effect on progress of ILC/SRF work. However, we have taken steps to protect critical personnel from being drafted in order to continue making progress**

Americas

Summary

- **FY08 omnibus cuts were disastrous:**
  - Cost us (minimally) a year in our ILC cryomodule program
  - Seriously limited U.S. participation in GDE TDP planning effort for cryomodules---the bulk of that effort shifted to the Asian Region.
  - Disrupted every part of the FNAL ILC program and recovery is slow at best in many program areas, primarily due to the reassignment of personnel many of which have not returned to the program. Since the key cryomodule personnel were able to continue work on the 3.9GHz cryomodule, the CM production team remained viable during this period.
- **Satisfying the ILC/SRF program manpower needs will remain a challenge. We are actively exploring alternatives (limited new hires, use of contract designers, drafters, technicians and engineers, etc.) to meet these needs.**
- **Cavity dressing effort just gaining momentum--expect to have 10-12 cavities dressed by the end of CY09, but that number is tied to availability of the large EBW at Sciaky**
- **Cryomodule design and construction is picking up, with CM2 and CM3 planned in the next two years. CM4 and CM5 will follow shortly thereafter (utilizing ARRA funds when they become available)**