FNAL Cavities for S1 Global

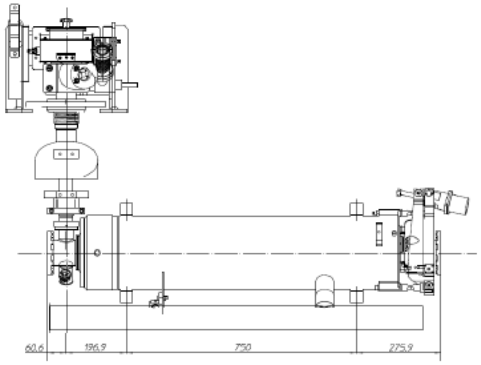
Jim Kerby

ALCPG 09

FNAL Deliverables

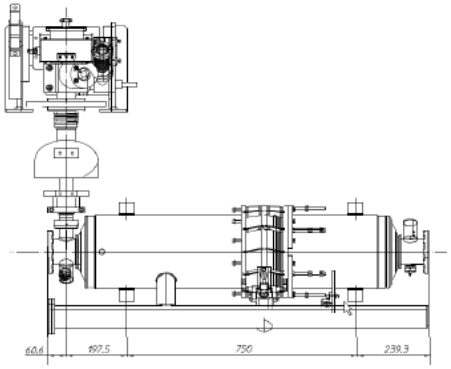
- Discussed in meetings 15/16 July and 10/11 Sept, and Webex and emails

FNAL/DESY cavities



- Two DESY cavities will be transported to KEK in December.
- The horizontal tests of two cavities will have been completed in DESY.
- The cold couplers will be assembled before transportation.

The preparation of DESY cavities will be presented by Denis Kostin.



- Two FNAL cavities will be transported to KEK in the end of December.
- Two cavities will be tested in the vertical cryostat, and the LHe supply pipe will be welded to the jacket before transportation to KEK.
- The cold couplers will be assembled before transportation.

The preparation of FNAL cavities will be presented by Jim Kerby.

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FNAL Cavities for S1 Global

- Major components well understood
- Working to complete cavity testing and assembly
- Working to identify ‘incremental’ pieces that can be supplied most efficient manner
- Assisting where possible to understand tooling requirements

Cavity Processing

- As discussed elsewhere is has been a difficult few months
  - processing cavities
  - dressing cavities
  - testing due to civil construction at the test facility
- A working plan has been developed, agreed to by the Americas team and is in use

Cavity Plan

(slides from C. Ginsburg after discussion among cavity group / subset of M. Champion talk tomorrow)

Cavity Proposal for CM2/S1G

- Identify and prepare 10 cavities + backups for dressing for CM2 and S1G cryomodules
  - For S1G, prefer long-short cavity design
- Timescale:
  - CM2: dressed cavities March 2010
  - S1G: dressed cavities ASAP or latest end of Dec.2009
  - Working backwards, subtract
    - A minimum of 2 weeks for dressing, and
    - 1 month if horizontally testing
- Favor cavities which have gradient performance >31.5 MV/m in vertical test
- Assume all 9-cell process/assembly through mid-November must be done at JLab
  - After FNAL VTS shutdown ends mid-Nov., must focus on qualifying FNAL/ANL processing facility for 9-cell cavities – facility not useful for CM cavity preparation until that happens

Cavity Plan

Cavity Data & Prioritization Method

Serial #	long-short?	Location	Latest	Best	current limitation	dress state	est. work required to 30 MV/m	est. weeks to >30 MV/m
TB9ACC011		MP9	38	38	administrative	to be dressed #3	ready	0
TB9ACC013		MP9	38	41.8	quench/FE	to be dressed #4	ready	0
AES002	*	MP9	32.8	32.8	quench	to be dressed #5	ready	0
TB9AES008		JLab	41	41	quench		ready	0
A8	*	JLab	31.7	31.7	quench limitation; unknown condition in box		tuning+straightness, HPR, test	2
TB9AES009		JLab	30	30	FE		opt. insp., tuning, "final" process, test	3
TB9ACC016		IB1			fresh		full process, test	3
TB9AES010		IB4			fresh		full process, test	3
TB9AES007		AES			fresh but HOM void		full process, test; some risk	3
AES001	*	MP9	21.8	21.8	quench/FE	dressed #1	N/A	
AES004	*	MP9	27	28	FE	dressed #2	N/A	
A9	*	Cornell	26	26	quench; multiple defects		R&D	
ACCEL6	*	ANL	23.2	39.7	quench/FE; in use for ANL 9-cell commissioning		R&D	
ACCEL7	*	ICB	22	41.2	Q-slope		tuning+straightness, "final" process; high risk: endflange acid damage	
AES003	*	KEK	11	21	quench/FE/scratches		aggressive defect correction	
JLab-1	*	JLab			cavity vacuum leak		N/A	
JLab-2	*	JLab	30.2	30.2	Q-drop; mode-mixing		N/A	
TB9ACC010		Cornell			VEP commissioning		R&D	
TB9ACC012		MP9	39.1	39.9	various; EBW accident during dress prep		N/A	
TB9ACC014		IB1	38.1	41.5	quench/FE; mechanical cell damage		N/A	
TB9ACC015		JLab	19	19	quench/HAZ defect		aggressive defect correction	
TB9ACC017		IB4			1st ANL proc cavity; in use for ANL 9-cell commissioning		R&D	
TB9AES005		Cornell	20.5	20.5	quench/defect		aggressive defect correction	
TB9AES006		JLab	14	14	quench/equator defect		aggressive defect correction	

total #cavities=	24
# long-short cavities=	10
# 30 MV/m CM candidate cavities=	9
total #weeks required for these candidate cavities=	14
#long-short 30 MV/m CM candidate cavities=	2

~14 weeks for 6 more cavities

substantial risk
in use for R&D
aggressive correction required
CM quality >31.5 gradient not poss

Table ordered by time estimate

- To get as many qualified cavities as quickly as possible,
  - Prioritize first in terms of fastest preparation, then
  - Take lowest risk cavities first
- In case of poor performance, put cavity aside and start with the next one

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Cavity Plan

Proposed Prioritization for JLab Request

1. TB9AES008: send clean/sealed to Fermilab immediately
2. A8*: tuning, USR&HPR, test
3. TB9AES009: optical inspection, tuning, "final" process, test
4. TB9ACC016: full treatment/test of fresh cavity
5. TB9AES010: full treatment/test of fresh cavity
6. TB9AES007: full treatment/test of fresh cavity; some risk from HOM void

- Out of 10 cavities plus backups for CM2 and S1G
  - 3 cavities are ready for dressing: AES002*, TB9ACC011, TB9ACC013
  - 6 additional cavities reasonably likely to make 31.5 MV/m could be available for dressing by end of Dec. 2009
  - 2 of the 9 are the long-short design preferred for S1G
- Additional one primary and ~five backup cavities required, including at least one more long-short design

* Means long-short cavity design

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Cavity Plan

Possible backup cavities and time scale

- Should have order of 5 backup cavities. Propose the following prioritization:

1. ACCEL7*: good cavity but arguable level of vacuum-leak risk due to flange acid damage
   - Just try to improve performance ignoring damage, or
   - Ask AES or another company to replace end tube (knocks it to lower priority)
2. 6 new RI cavities out of [TB9RI018:TB9RI029] fitted with transition ring and bulk-EP'd
   - Start arriving [Harry to find out, but I assume before end of CY09]
3. Some of the R&D cavities may be repaired, e.g.,
   - AES003 at KEK (~Oct. 2009)
   - A9*/TB9AES005/TB9AES010 at Cornell – (not before end of CY09)
4. [6 new AES cavities will not arrive in time]

* Means long-short cavity design

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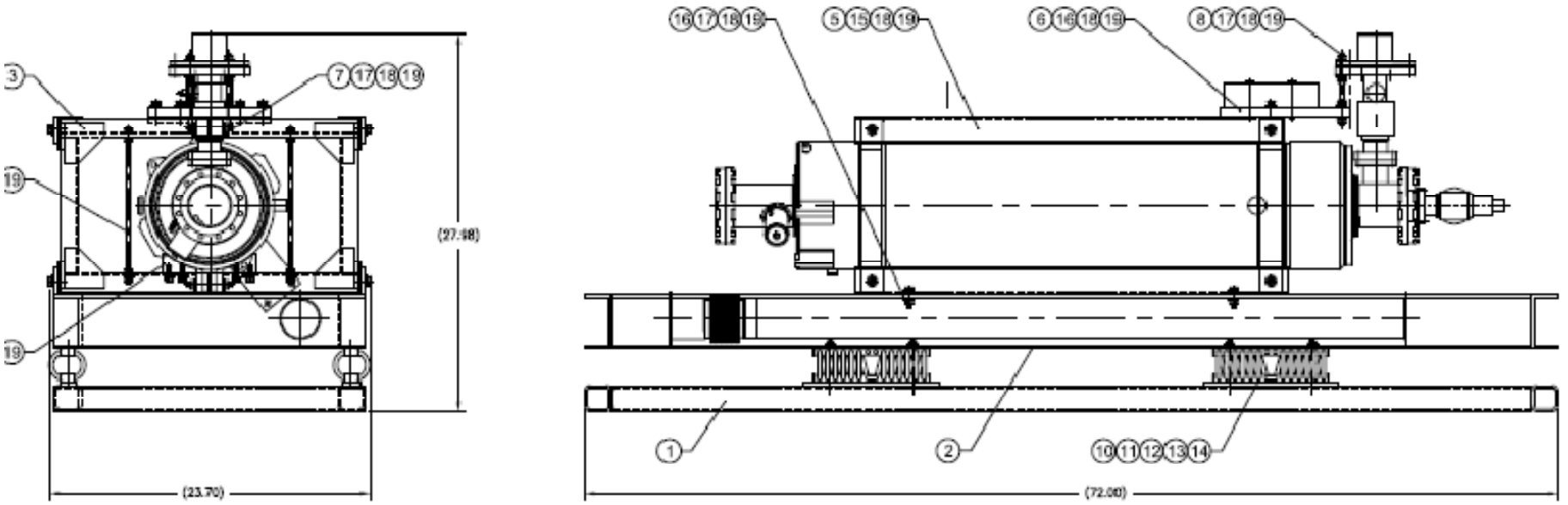
Cavity Plan

Summary

- S1G and CM2 cavity schedules appear to be achievable, with substantial risk, provided
  - Clear management-directed prioritization
  - Well-coordinated effort across facilities and Labs
  - No system failures
- This effort is largely compatible with S0 production yield data accumulation: 3 of 5 requested-to-be-done cavities in primary batch add data points to production yield plot
  - For last primary cavity and backups, S0 compatibility depends largely on RI cavity delivery schedule, but we might expect a comparable ~3 or 4 fresh cavities out of 6
- Note: All cavities sent from JLab to Fermilab must be clean/sealed in cleanroom condition

Cavity Shipment (thanks to T. Arkan)

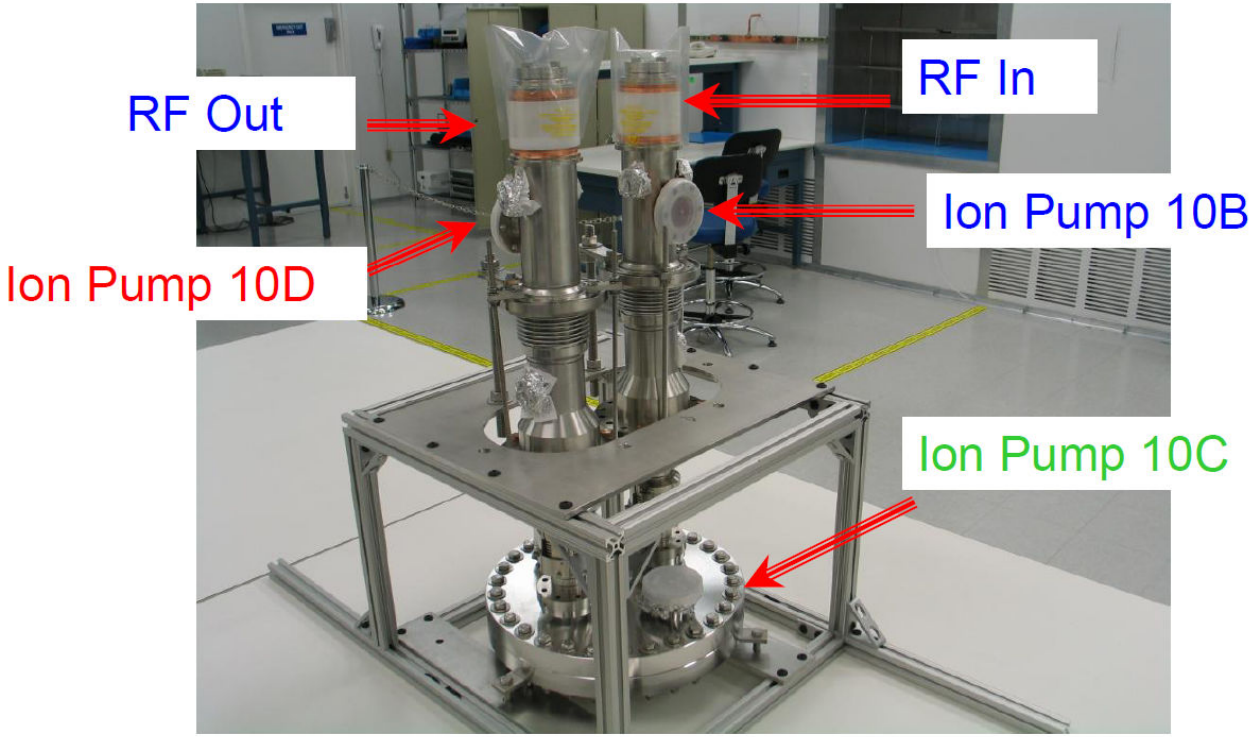
- The cavities will be shipped to KEK with the configuration as below:
  - Outfitted with helium tank, w/ the bellows in the middle of the tank supported with 4 spanner rods. (These rods should not be removed until the blade tuner assembly task).
  - All flanges are blanked-off with peripheral components, cavity ready to be assembled into the string. Cavity will be under vacuum during transportation.
  - 2-phase pipe welded to the helium tank, cold end of the coupler is supported with an arm support fixture through the 2-phase pipe. (Do not remove this support until string is ready to be assembled to the GRHP.)
  - Blade tuner and magnetic shielding pieces (will be assembled at KEK.)



Cavities will be shipped with these fixtures to KEK

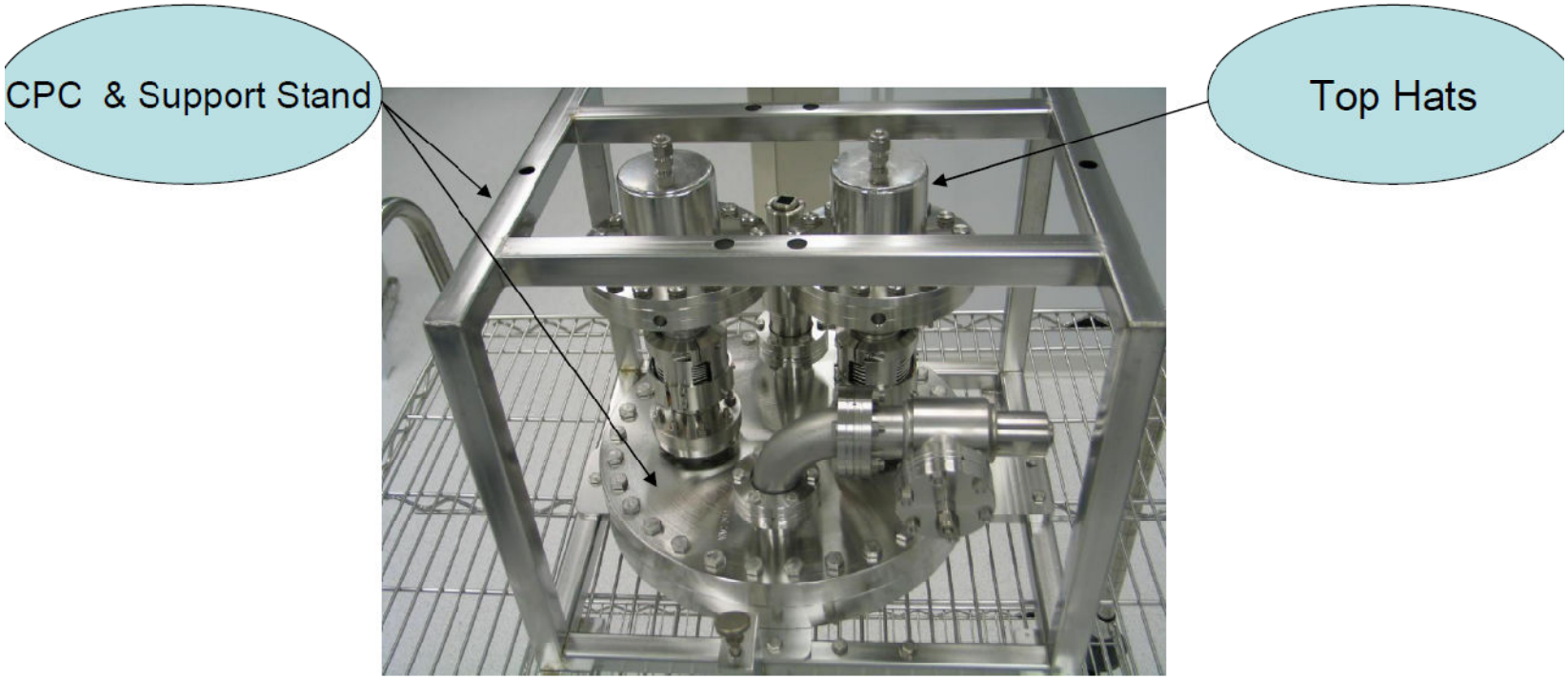
Power Couplers-I

Coupler Pair Test Setup



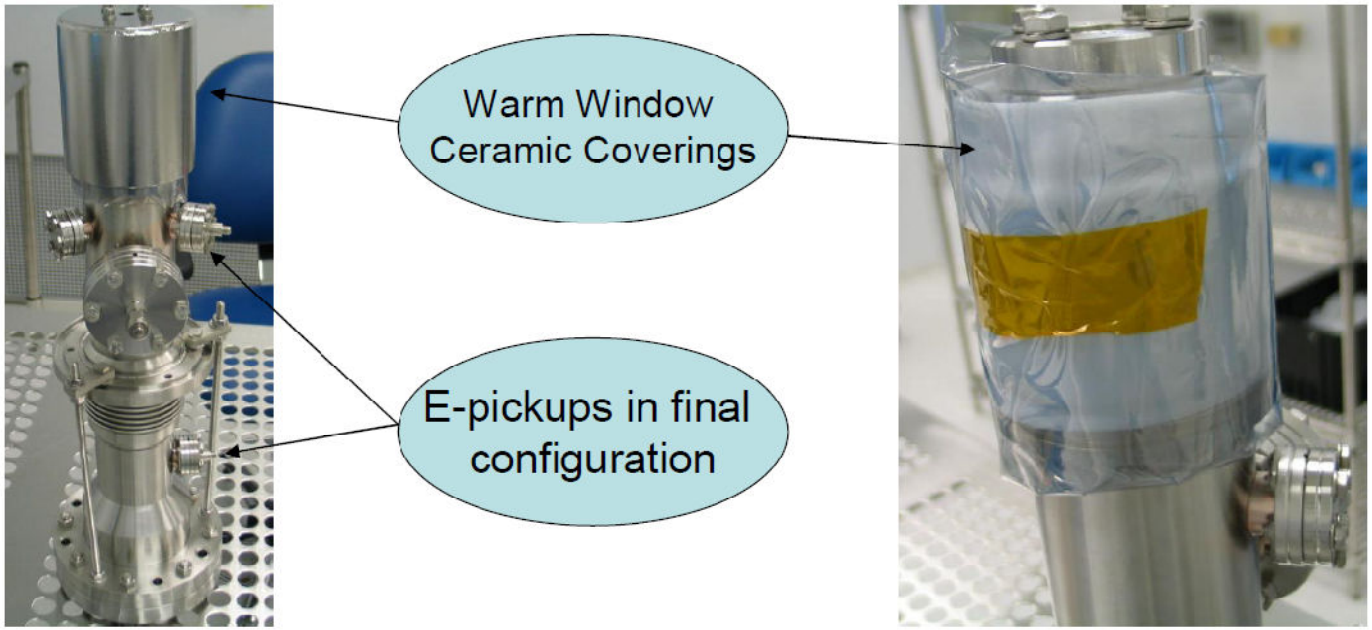
Power Couplers are high power cleaned, assembled and high power processed at SLAC

Power Couplers-II



Cold End of the couplers will be assembled to the cavities that we will send for S1 Global

Power Couplers-III



• Warm Parts are delivered NOT under vacuum but have been Nitrogen purged and bagged.

• The Warm Window is protected for shipment with a class 10 wipe, then MIL-PRF-81705D Type III bagging material covered with a S.S. cover.

• The CF-16 (e-pickup ports) do not need to be removed and have been leak tested. Installed two e-pickups per DESY print 0 98 8356/0.000 configuration. The phototube port is blanked off.

• All other Con-Flat flanges need new copper gaskets installed for final configuration.

Power Couplers-IV

Cold Parts will be installed at FNAL, we will not send Case A to KEK

- Cold Parts in Case A
- Warm Parts in Case B
- Wave Guides and parts in Case C
- Hardware in Case D

- All parts should be removed from shipping case and outer most layer of bagging material removed before bring into cleanroom (Cold Parts have three layers). Parts that CPI delivered are singled bagged and should be blown-off and wiped down before entering cleanroom.
- All bagged parts have been Nitrogen purged then vacuumed sealed (some of the larger bags we did not vacuum seal as the sharp edges would puncture the material).

Case B, C and D will be sent to KEK as they are shipped from SLAC to FNAL. FNAL will not send any assembly fixtures to KEK.

Cold Mass Assembly Procedures

- Procedures will be provided for:
  - Ti 2-phase pipe & Ti bellows welding
  - Blade Tuner & motor assembly
  - Magnetic shielding assembly
  - Needle bearings assembly
  - Cavity Final Alignment
  - Instrumentation Flanges (A, B) wiring diagrams

Instrumentation Flanges / Additional Parts

- FNAL will provide 2 sets of T-configuration flanges with Flange A and B.
- Wiring diagrams will be provided along with all the coax cables and instrumentation wires. FNAL will provide components such that cavity instrumentation and RF connectors can be attached to the vacuum side of the Flange A and B.
- Bellows and transitions (piping and magnetic shielding) have been identified in Norihito's list
- The bracket on the coupler external to the vacuum vessel (discussed 10/11 Sept) will be sent.
- The transition to the Gate Valve region still must be clarified

Summary

- FNAL is working to supply two cavities and associated parts to S1 Global by December
- FNAL is willing to participate in assembly processes to the extent practical and as local needs allow
- Instrumentation List is in preparation for ‘CM2’ like cavities. Upon completion this should be reviewed for S1.
- FNAL Tooling is under review to accommodate design changes in the dressed cavities. Changes / lessons learned will be communicated to KEK