UITF Project Status Meeting

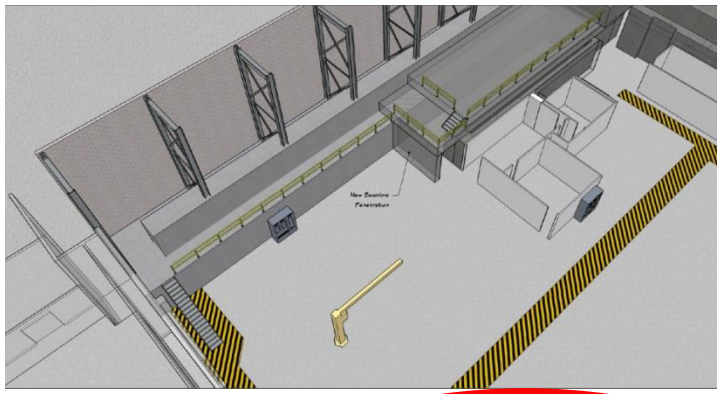
Matt Poelker

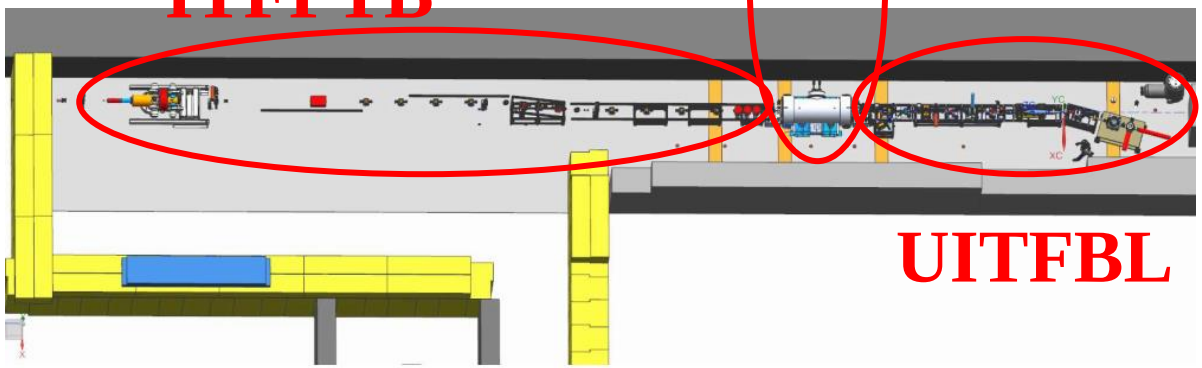
January 19, 2016

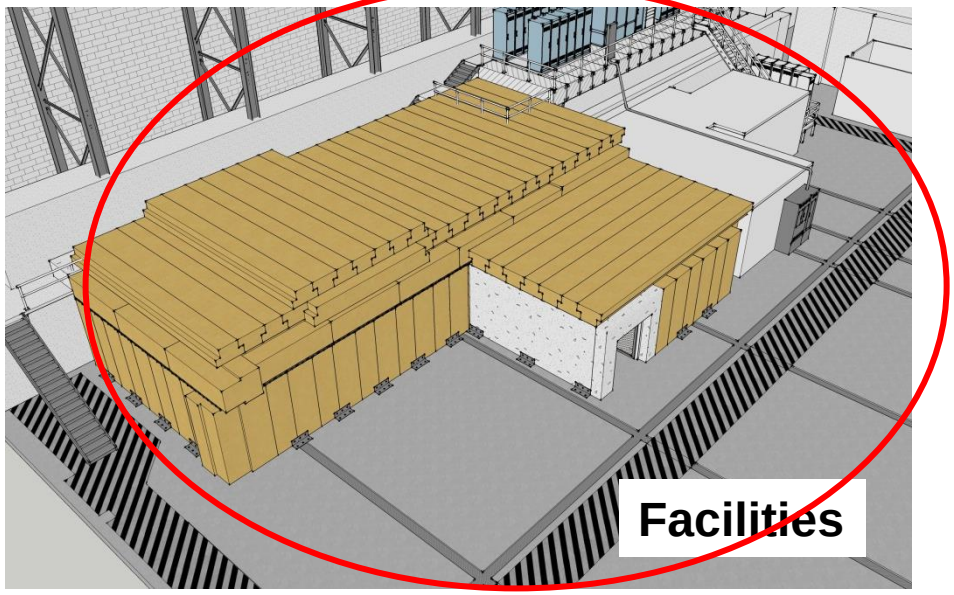
Outline

- Purpose: to inform Lab Leadership of the UITF status
- Action Items (from previous meetings)
- Project Update
  - Progress Update
  - Milestones Update
  - Budget Update
  - Highlights & Concerns
  - Next meeting agenda

Proposed re-scoping







- Facilities
- Cryo Infrastructure including some RF
- Polarized Target Beamline
- UITF

Action Items – November 23, 2015 Minutes

New Action Items:

- **Finalize the budget for each fence**
- **Provide new "deltas", how does revised budget differ from older budgets?**

Cryo and Installation Groups

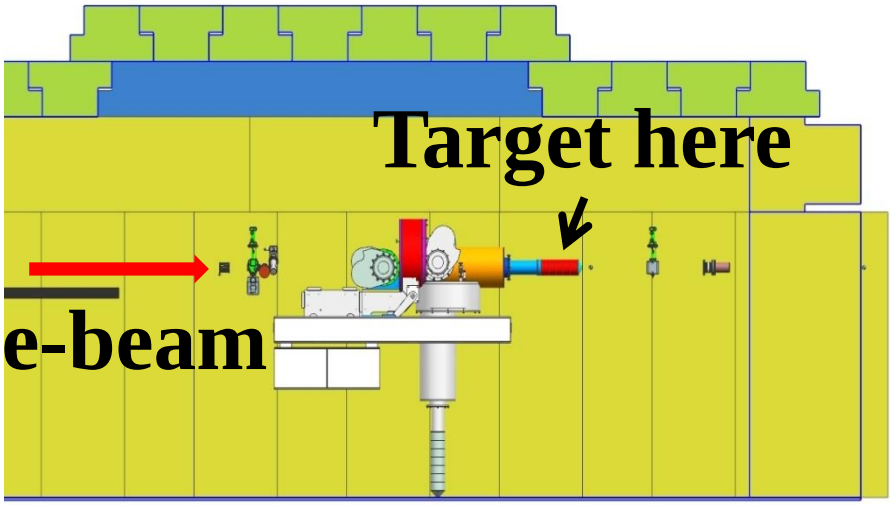
- **Cryo Group working on transfer line and heat exchanger, weld into place soon**
- **Install group can finish Cave1 cable tray and PSS conduit once Cryo Group out of way**

Facilities

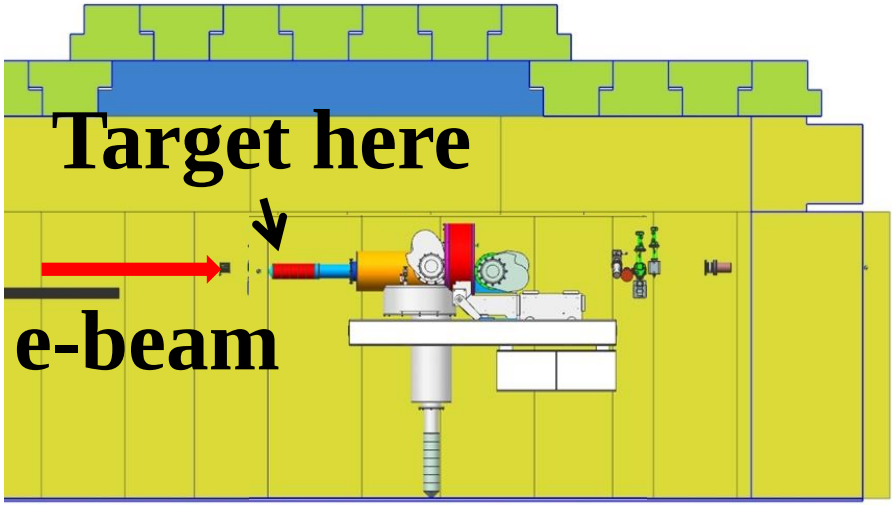
- **Electricians waiting for a transformer,**
- **Cave 1 electric and network complete in ~ 1 wk**

Status HDIce

- Some back and forth re: target orientation and target dimensions
- Cave2 design will be modified to accommodate both
- M. Zarecky to layout the target, work with S. Gregory

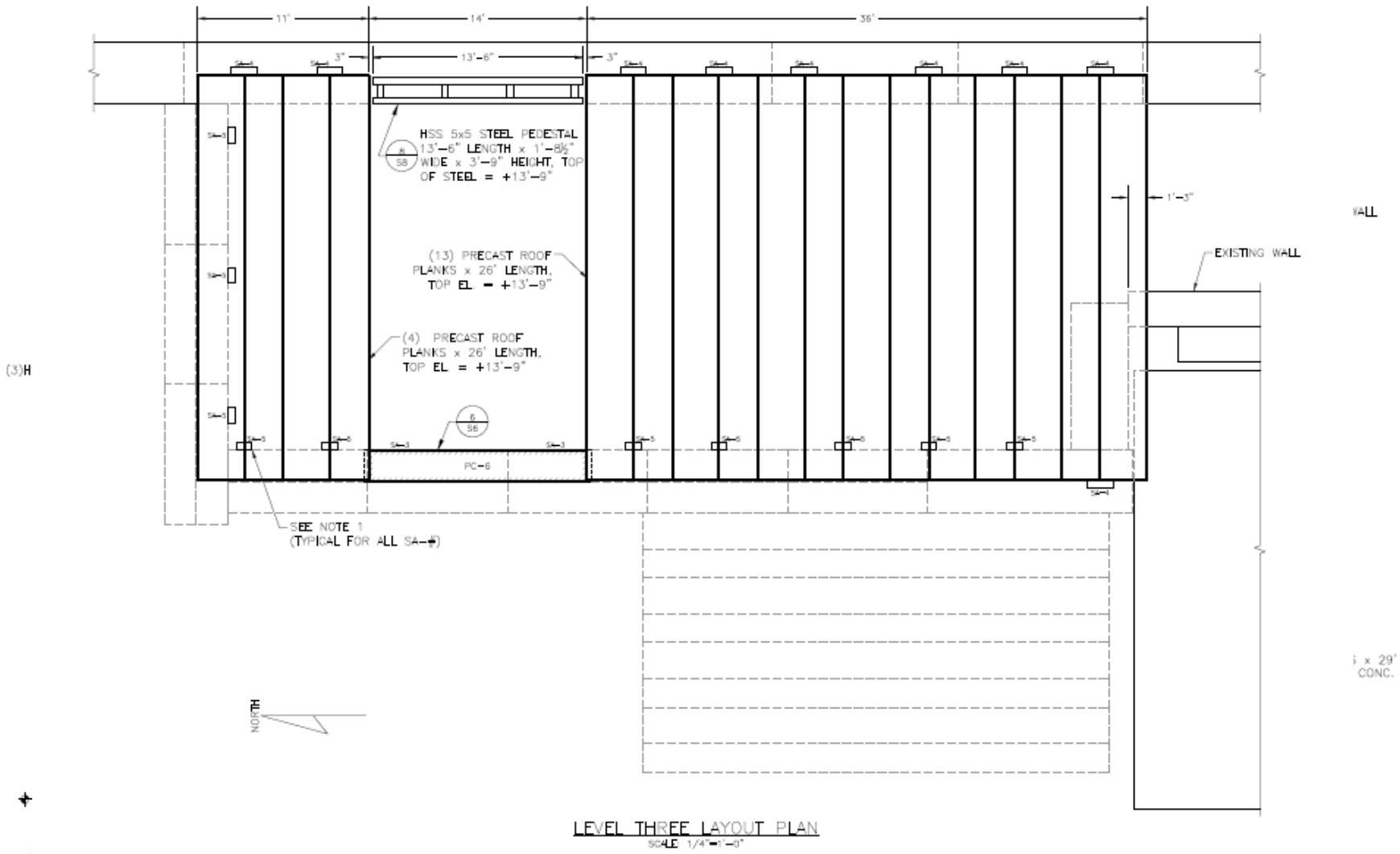


Upstream radiation baffle blows up beam



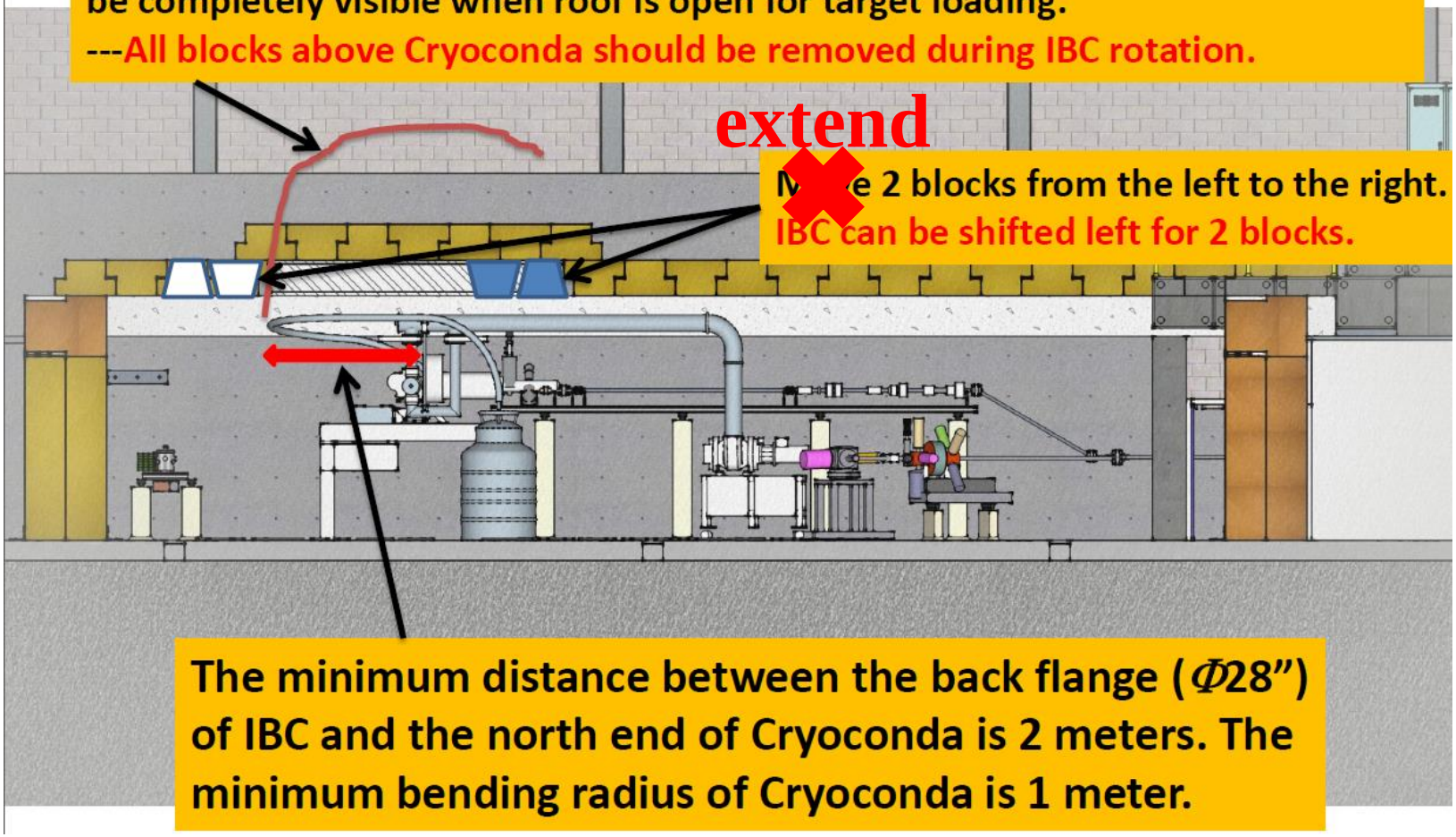
In this configuration, target might need to be thinner

Facilities (T. Renzo)



Facilities (T. Renzo)

Cryoconda will swing up when rotating cryostat rotation, which is a standard procedure for loading/unloading the target. Therefore the Cryoconda should be completely visible when roof is open for target loading.
---All blocks above Cryoconda should be removed during IBC rotation.



The minimum distance between the back flange (Φ28") of IBC and the north end of Cryoconda is 2 meters. The minimum bending radius of Cryoconda is 1 meter.

Facilities: Updated Schedule

Cave 1 Electric – complete by end January

- includes network (then engineering groups can install electronics, Ops can install network and software)

Cave2 Structural – complete by end of May

- Revise drawings, submit for approval this week
- Precast concrete arrives early April
- Precast set in May (then SSG can install ODH and PSS)

Cave2 utilities – complete by end of August

- Move IPC (power panel)
- Cave 2 electric, including spigot for Big Bertha
- Paint, lights, fire suppression, LCW, GN2, compressed air (then Gun Group can begin building MeV beamline)

- **"Beam on HDIce" won't happen in August**

Status Cryo

- Agreed on means to "park" the ¼ CM when not accelerating beam: circulate 80K LN2 through 35K shield line. That means UITF should not be a burden on CTF 34 wks per year
- How to cool HDIce? need to downselect - Purchase LHe versus connect HDIce to CTF
- Hari and Will believe UITF will be ODH0 unless we are stabbing U-tubes of swapping dewars (some caveats)
- Cryo Group inside Cave1 installing transfer lines – Gun Group can start building the keV beamline soon
- Cryo Group working on controls….
- CTF work should not impact Building 58 until October 2016, right?

Status Cryo

- **Message1:** Cold ¼ CM milestone - April 2016 is a more realistic time frame from Cryo Group point of view
- **Message2:** but won't have a shielded and lockable enclosure with CARMs, ODH system and PSS until sometime after May, and Facilities will want to be working inside Cave2 installing utilities through August. Have been discussing with Bob May (and indirectly SCMB) the idea of turning ON ¼ CM and gun without PSS but suspect lack of ODH system will be an issue
- **Message3:** so far, the CTF work does not seem to represent an obstacle for UITF in terms of reaching our "cold ¼" milestone. But can impact "beam on HDIce" milestone

Status RF

Related to ¼ Cryomodule

- RF control boards will be ready…
- Biggest issue: designing and building the high power rf control board. Who to do the work? Chad Seaton has been assigned the job
- Next biggest issue: designing the waveguide layout, Shaun Gregory to do this (after Hall B work)
- Software controls….
- Need statement from EES High Power RF – when will klystrons be ready to operate, when will we be ready to apply RF to ¼ CM?

Status SSG

- ODH system relatively simple: but need Cave2 structural work complete (at least the lower portion) and power panel removed. Can be installed ~ May, June
- PSS system more complicated: need Cave2 with a door, to install maglocks, ~ May, June
- Henry thinks his group can do the work if CEBAF work doesn't get in the way (Hall A ion chambers, Hall C in spring?)

Status: Other

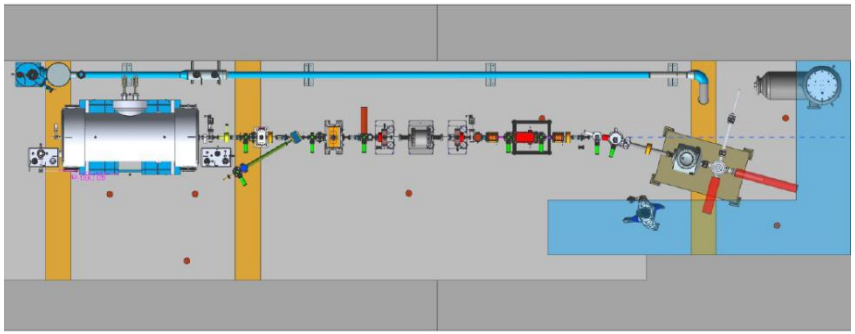
- DC Power and I&C Groups:
  - Trim racks can get worked once electricity available
  - Stripline BPMs will get attention now
  - Controls for viewers, valves and current monitoring can get worked soon
- Ops Sys Admin and Software:
  - Ready for network stuff, terminals and software
- Installation Group:
  - Cable trays and PSS box conduit, interleaved with Cryo group

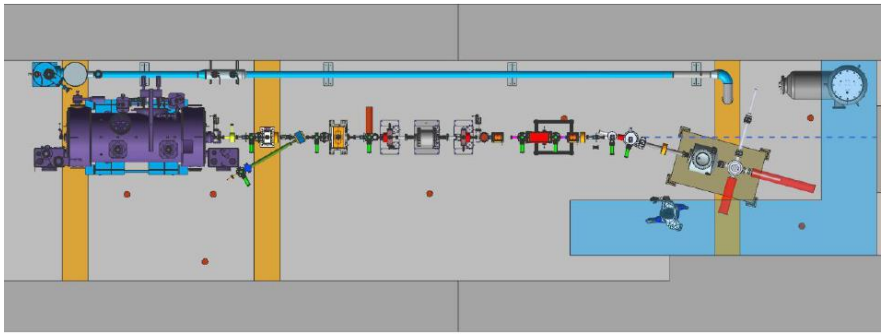
Status Gun HV Power Supply

Ready for pressurized Leak Check with GN2, approval from Pressure Vessel Committee

Status Gun and Beamline

- In light of progress on other fronts, I prefer we install the new ¼ CM first - still expect it to be complete by June
- Gun HV power supply installed inside SF6 tank, Gun Group has identified a good insulator, electrode and NEG pump configuration. Want to begin HV processing inside Cave2 as soon as possible, March. But need epics-based controls and diagnostics, temporary shielding that limits access and approval from SCMB since Cave 2 enclosure won't be ready till June, and an OSP

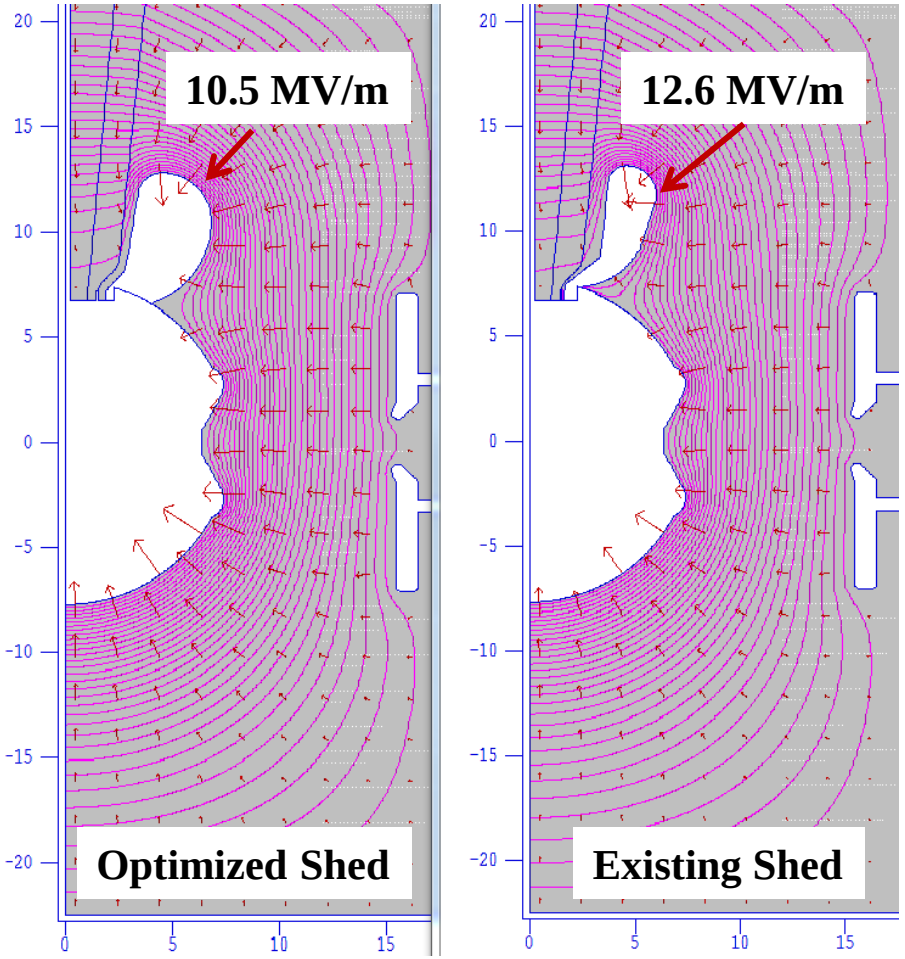




Building the electron gun for UITF

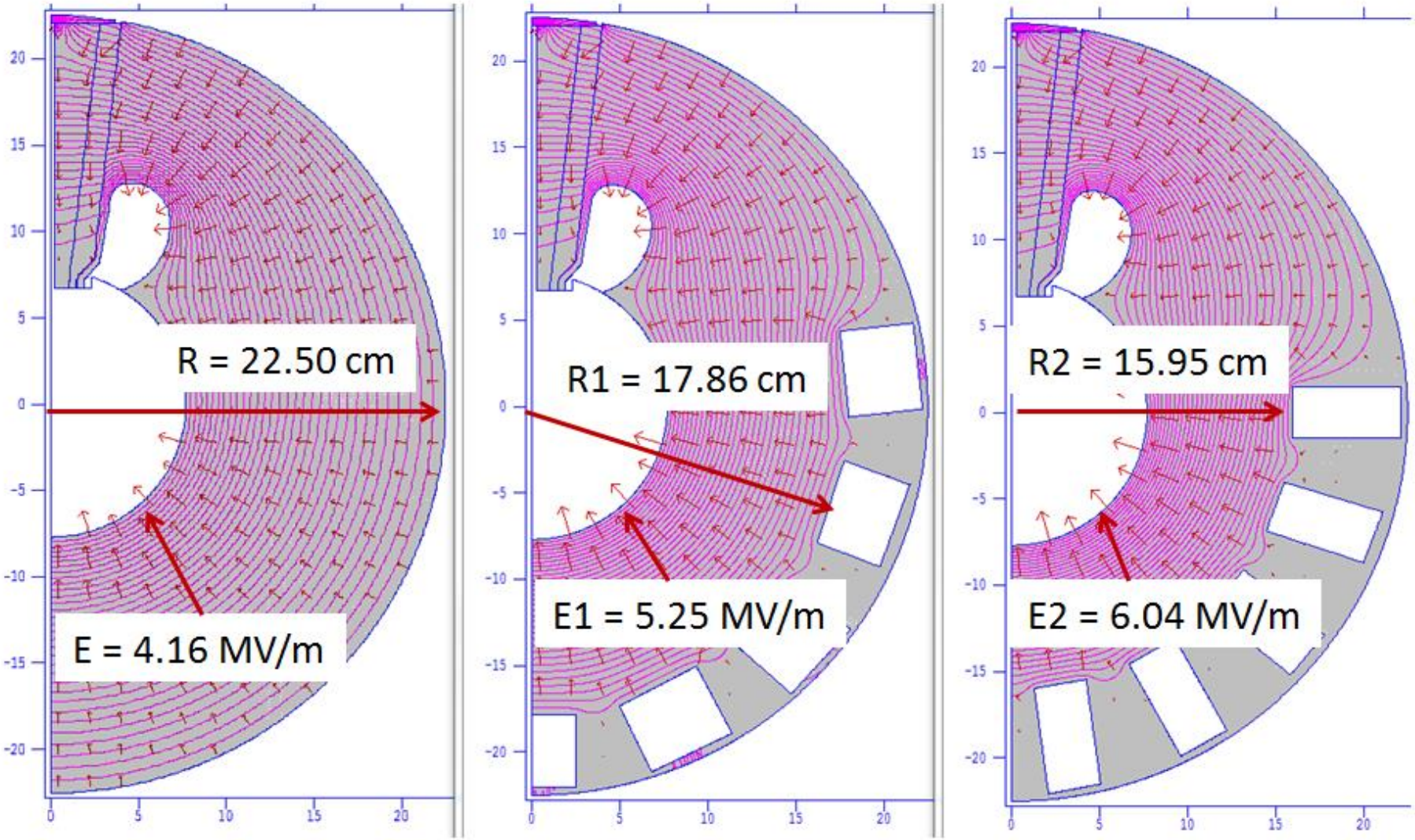
- The gun for magnetized beam tests at LERF GTS is happy at 325 kV, with white insulator and shed electrode designed by Hansknecht
- UITF gun will employ the mildly conductive insulator and shed electrode optimized by Yan Wang
- Because we will use GaAs at UITF, we will line the bottom of the vacuum chamber with NEG pumps
- Can we high voltage condition between now and August, with Facilities work on-going?
- (BNL no longer asking me to demonstrate 10mA polarized beam, perhaps this means they are moving to Ring-Ring EIC design?)

Optimization of John's Shed



Work of Yan Wang

E Field Changes with NEG pumps



E1/ E = R / R1 = 1.26, E2 / E = R/ R2 = 1.45

Status: EHS&G

- Productive meeting with Facilities and subset of SCMB (Bob May, Vashek Vylet, Henry Robertson)
  - Some reluctance to approve Cave2 design package without approval from Safety Configuration Management Board (SCMB)
  - Provide Vashek locations of all “normal” radiation sources (cups, dumps, apertures)
  - Chief Concern: the Gun and ¼ CM can generate more beam than our shielding is designed to accommodate
  - Solutions: lots of local shielding at places where we intentionally dump beam, and PSS BCM(s)
- Need SCMB to provide guidance NOW

Milestones Update – previous month

WBS	Item	Milestone Description	Start Date	Projected Finish	% Complete	Days Float?	Change (%)	Change (Days)
1.04.xx x	Facilities	Civil work complete	6-4-15	Feb 2016	50%		10 to 50%	
	Gun	Demonstrate gun ok at 350 kW at FEL GTS		Dec 2015	80%		0	
	CM	Commission cold ¼ CM, no beam		Jan 2016	20%		10 to 20%	
		Beam from Gun to Cup in front of ¼ CM		Mar 2016	20%		10 to 20%	
		Beam thru ¼ @ MeV energy delivered to cup in front of HDIce		Jun 2016	0			
		Beam to HDIce		Aug 2016	0			

- Hope to see Facilities work complete by March
- Hope to see Cryo done by April (at least with the ¼ CM portion)
- Hope to see SSG and RF work complete by April

Milestones Update - new

WBS	Item	Milestone Description	Start Date	Projected Finish	% Complete	Days Float?	Change (%)	Change (Days)
1.04.xx x	Facilities	Civil work complete	6-4-15	August 2016	50%		50%	
	Gun	Demonstrate gun ok at 200kV at FEL GTS		Dec 2015	100%		From 80 to 100%	
	CM	Commission cold ¼ CM, no beam		July or August 2016	30%		20 to 30%	
		Beam from Gun to Cup in front of ¼ CM		July 2016	20%		20%	
		Beam thru ¼ @ MeV energy delivered to cup in front of HDIce		Sept 2016 Or Winter 2016	0			
		Beam to HDIce		After CTF work	0			

Schedule Drivers:

- Cave 2 enclosure complete May, Cave 2 utilities by August
- CARMs, ODH and PSS ready June or July
- New ¼ CM complete June, installed July, add waveguides, test klystrons and controls….

Budget

New Action Items:

- **Nov. 11, 2015: meet to re-scope the project, distribute costs within four "fences"**
- **Dec. 4, 2015: Poelker submitted FY16 budget request for each fence**
- **Dec. 21, 2015: Lab Management asks for "deltas", new and old cost estimates**

For clarification:

- **May 13, 2015: informed Management that UITF would cost more than original estimate ("Hari's estimate")**
- **Jul. 31, 2015: provided the "procurement deltas" between old and new estimate**
- **Aug. 20, 2015: Sent Lyn a quick estimate for FY16. $759k and 12.3 FTE**
- **Dec. 21, 2015: We discussed my FY16 budget request, stemming from a more detailed assessment, $1063k and 13.2 FTE**
- **Discussed with Will and Andrew Kimber today's cost estimate versus Poelker estimate #1 (also updated today's cost estimate versus Hari's)**

Presented at UITF meeting May 13, 2015

- **Original request to DOE: $2.6M (loaded)**
- **Current estimate for completion: $5.6 M (loaded)**
- **Delta increase of $2.9M (loaded)**

- **Labor estimates**
  - **Underestimated effort by 11.5 FTEs**
  - **Increased labor by $1.7M (loaded)**
- **Procurements**
  - **Underestimated by ~$1M (loaded)**
  - **Several sub-system components were not included in the original estimate and later determined were necessary to complete the scope**

Original vs Current Cost Estimate

Presented at UITF meeting May 13, 2015:

Original Est. by Hari Areti on 2-7-2014		Direct $ FTEs	Direct $ Labor	Direct $ Proc	Direct $ Total	Loaded $ Labor	Loaded $ Proc	Loaded $ Total	
	FY14	3.7	462.54	478.95	941.49	682.70	671.23	1,353.94	
	FY15	2.5	312.08	557.10	869.18	465.00	830.07	1,295.07	
	FY16	0	-	-	-	-	-	-	
	Total	6.2	774.62	1,036.05	1,810.66	1,333.458	1,501.306	2,649.011	
Revised Est. by Matt Poelker on 5-13-2015		FTEs	Labor	Proc	Total	Labor	Proc	Total	
	FY14	1.2	160.32	189.48	349.80	233.08	274.29	507.37	47.6%
	FY15	8.6	937.36	611.17	1,548.53	1,396.67	907.95	2,304.62	49.0%
	FY16	7.9	940.39	881.33	1,821.72	1,422.80	1,333.46	2,756.26	51.3%
	Total	17.7	2,038.07	1,681.98	3,720.05	3,052.56	2,515.70	5,568.26	
Dfference from original estimate		**(11.5)**	**(1,263.46)**	**(645.93)**	**(1,909.39)**	**(1,719.10)**	**(1,014.40)**	**(2,919.25)**	

Total cost estimate. The specific allocations for FY15 and 16 are not correct

Comparison Procurement Estimates (Direct $)

System	Prev	Now	Delta	Comment
Facilities	305	300	-5	(numbers are Proc and Labor)
Safety System	59	46	-13	
RF Systems	125	253	+128	rf control boards, klystron PS
Cryogenics	40	91	+51	Pipe, heat exchanger
Polarized Source	255	262	+7	Gun insulators, beamline parts
I&C	131	220	+89	BPMs, viewers, picoammeters
DC Power	0	145	+145	Trim cards and parts
Magnets	58	120	+62	Addl. quads, correctors, dipoles
SRF	50	0	-50	
HDIce	5	0	-5	
Network, IOCs	0	58	+58	
CIS FY14 Actuals	0	189	+189	FY14 actuals
Total	**1,028**	**1,684**	**+656**	

FY16 Cost estimate

	Facilites			
	procurements	Labor	TOTAL cost Procurement + Labor	
		34 PW		
		0.77 FTE		
	$317k	$103.035k	$420.035k	

	Cryo			
	procurements	Labor (PW)	Labor ($)	TOTAL cost Procurement + Labor
cryo	68	111	$224.83k	
high power rf	40	22	$55.35k	
odh	2	9.5	$23.2525k	
survey	0	2.1	$7.1638k	
srf	10	4	$17.65k	
TOTAL	120	148.6	$328.25	$448.25
		3.4 FTE		

	Pol Target Beamline			
	procurements	Labor (PW)	Labor ($)	TOTAL cost Procurement + Labor
cryo	50	81	$162.592k	
mech design	0	20	$63.88k	
I&C	60	21	$46.356k	
DC power	70	9	$17.397k	
mag meas	0	12	$41.94k	
gun group	60	0	0	
survey	0	4.8	$14.7264k	
TOTAL	240	147.8	$403.5578k	$643.5578k
		3.4 FTE		

FY16 Cost estimate

Pol Target Beamline				
	procurements	Labor (PW)	Labor ($)	TOTAL cost Procurement + Labor
cryo	50	81	$162.592k	
mech design	0	20	$63.88k	
I&C	60	21	$46.356k	
DC power	70	9	$17.397k	
mag meas	0	12	$41.94k	
gun group	60	0	0	
survey	0	4.8	$14.7264k	
TOTAL	240	147.8	$403.5578k	$643.5578k
		3.4 FTE		

UITF				
	procurements	Labor (PW)	Labor ($)	TOTAL cost Procurement + Labor
install	25	21	$43.81k	
ops software	32.5	50	$145.769k	
low level rf	24	42	$102.35	
pss	35	63	$241.576k	
mech design	0	10	$31.94k	
I&C	100	28	$61.808k	
dc power	10	13	$29.668k	
mag meas	0	8	$27.96k	
gun group	160	0	0	
survey	0	15.1	$46.2194k	
TOTAL	386.5	250.1	$731.10	$1,117.60
		5.7 FTE		

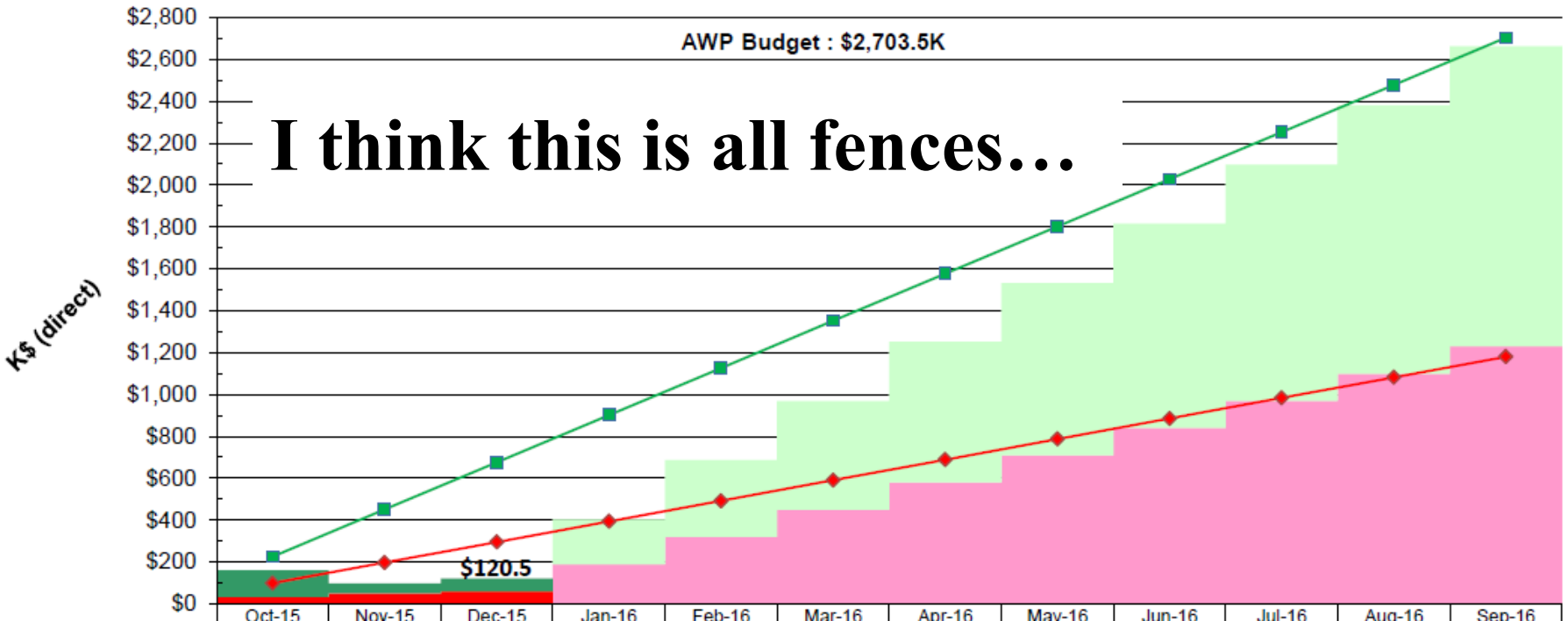
Yes, labor will be charged

						Matt's previous estimate for FY15 and 16			
				Hari's estimate		Numbers directly from service providers			
						remember to add FY14 for a TOTAL cost (350k$ v			
Facilities	procurements	Labor (PW)		procurement	Labor (PW)	procurement	Labor (PW)		
	367.6	43.8		298	65	300	28.2		
Cryo				(+69.6)	(-21.2)	(+67.6)	(+15.6)		
	145.5	235.6		40	11.5	90.5	109		M
Installation Group				(+105.5)	(+224.1)	(+55)	(+126.6)		W
	47.2	35.5		15	15	0	0		
Ops: network and software				(+32.2)	(+20.5)	(+47.2)	(+35.5)		
	56.9	50		0	21	58	53.8		
High Power RF				(+56.9)	(+29)	(-1.1)	(+3.8)		
	107	23.2		100	1.5	252.5	177.6		
Low Level RF				(+7)	(+21.7)	(-78.5)	(-107)		
	67	47.4		25	6.5				
SRF				(+42)	(+40.9)				
	10	4.8		50	16	0	4		
SSG: ODH				(-40)	(-11.2)	(+10)	(+0.8)		
	3	13.2		59	21	13	10.7		
SSG: PSS				(+8.1)	(+55.2)	(+2.9)	(+2.5)		
	47.9	63				35	68.2		
Mech Design							(+5.2)		
	15.9	73.5		0	5.5	0	66		
Magnet Measurement				(+15.9)	(+68)	(+15.9)	(+7.5)		
	0	22.4		0	0	0	0		
I&C					(+22.4)		(+22.4)		
	175.2	50.6		126	12	219.5	96.8		
DC Power				(+49.2)	(+38.6)	(-44.3)	(-46.2)		
	80	27.1		0	3	144.5	14.6		
Gun Group				(+80)	(+24.1)	(-64.5)	(+12.5)		
	544	54.2		278	76	381.8	68		
Survey and Alignment				(+266)	(-21.8)	(+162.2)	(-13.8)		
	2	24		0	13.5	0	22.2		M
	1669.2	768.3		(+2)	(+10.5)	(+2)	(+1.8)		
	1735.8	769.6	HDIce	45	0				
						189.5	52.8	from FY14	
				738	267.5				
						1684.3	771.9	Total cost	

UITF Budget

Budget vs Actuals - thru December 31, 2015
1.04.11 Upgrade Inj Test Facility

Mgr: M. Poelker



	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16
Spent Proc	$127.6	$47.6	$61.3									
Spent - Labor	$32.2	$50.1	$59.3									
Proj - Proc				$213.6	$366.0	$518.4	$670.7	$823.1	$975.5	$1,127.8	$1,280.2	$1,432.6
Proj - Labor				$189.4	$319.5	$449.5	$579.6	$709.7	$839.8	$969.9	$1,100.0	$1,230.1
Spent/Proj - Total	$159.8	$97.7	$120.5	$403.0	$685.5	$967.9	$1,250.4	$1,532.8	$1,815.3	$2,097.7	$2,380.2	$2,662.6
Budget - Total	$225.3	$450.6	$675.9	$901.2	$1,126.4	$1,351.7	$1,577.0	$1,802.3	$2,027.6	$2,252.9	$2,478.2	$2,703.5
Budget - Proc	$127.0	$253.9	$380.9	$507.8	$634.8	$761.8	$888.7	$1,015.7	$1,142.6	$1,269.6	$1,396.5	$1,523.5
Budget - Labor	$98.3	$196.7	$295.0	$393.3	$491.6	$590.0	$688.3	$786.6	$885.0	$983.3	$1,081.6	$1,180.0

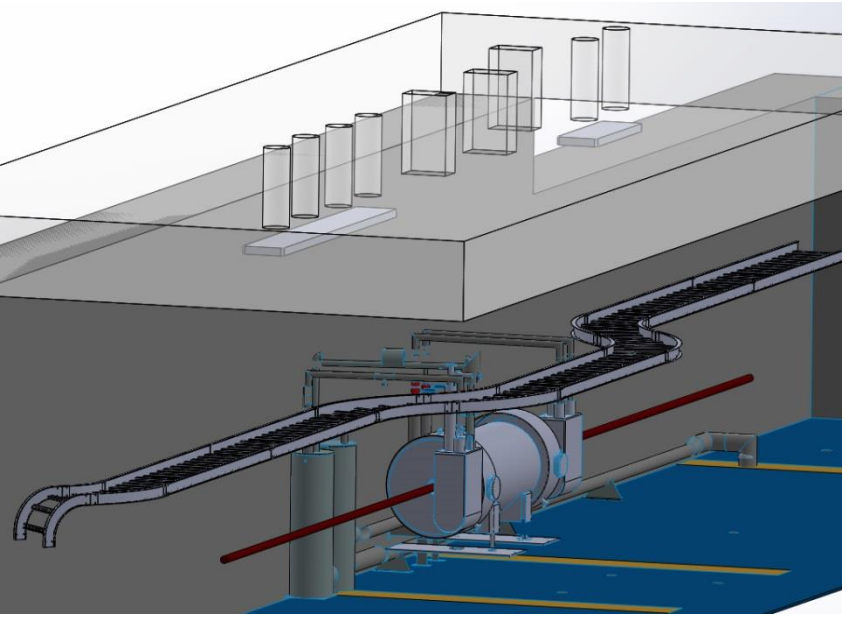
Schedule Ramifications

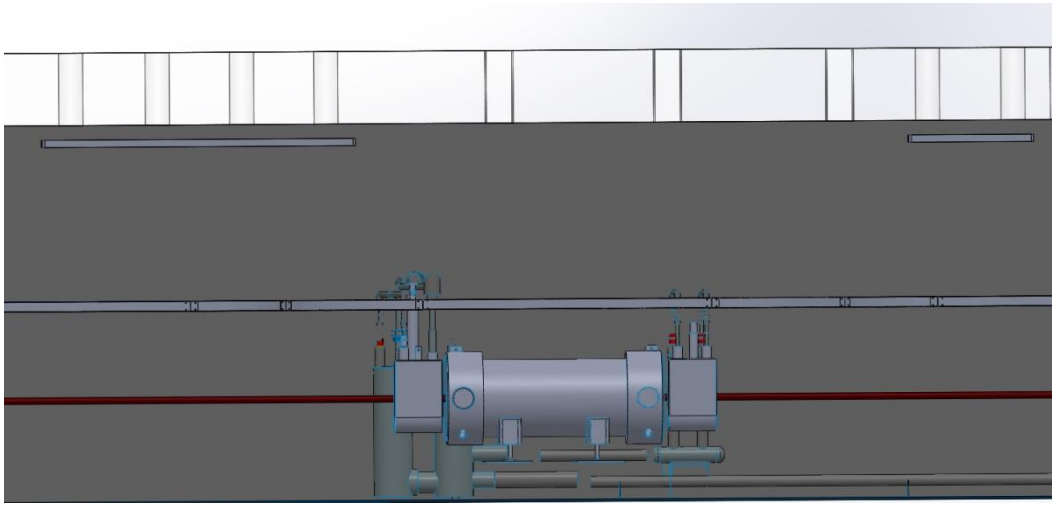
- **Current status:**
  - **It's clear that Hari and I need to begin addressing Safety requirements NOW: SCMB approval (and ODH assessment still pending, plus others)**
  - **Sorting out ramifications of Facilities Cave2 completion by August**
  - **Cryo making progress, still concerned about high power RF**
  - **Because of field emission and ODH, it is tough to turn ON ¼ CM and the gun without Cave2 enclosure, and functioning CARMs, ODH system and PSS**
  - **I like installing the new ¼ CM first…**
  - **In coming months, will push Installation, DC Power and I&C groups, to get work done while CEBAF is locked up**

Backup Slides

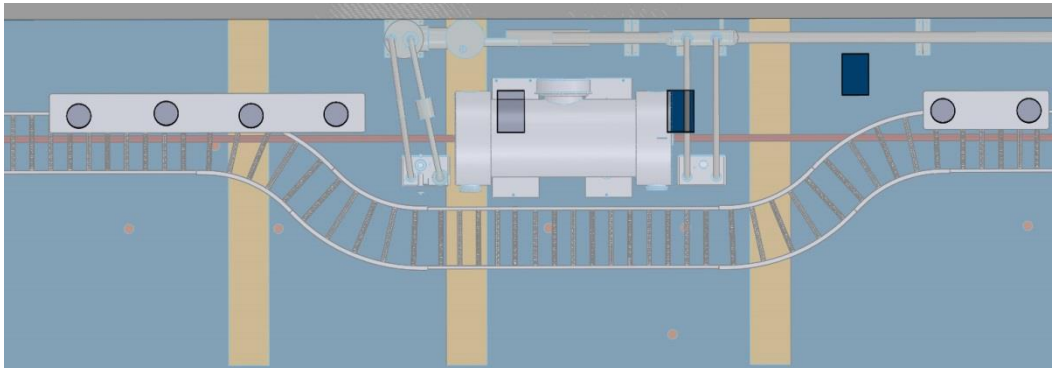
- **Backup slides from past meetings, P&C meetings**

Shielding at Penetrations



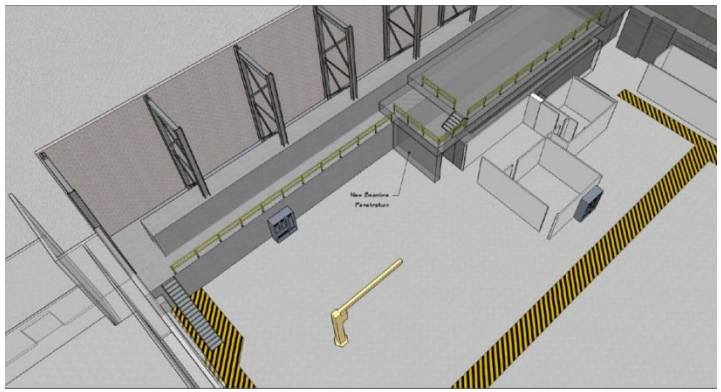


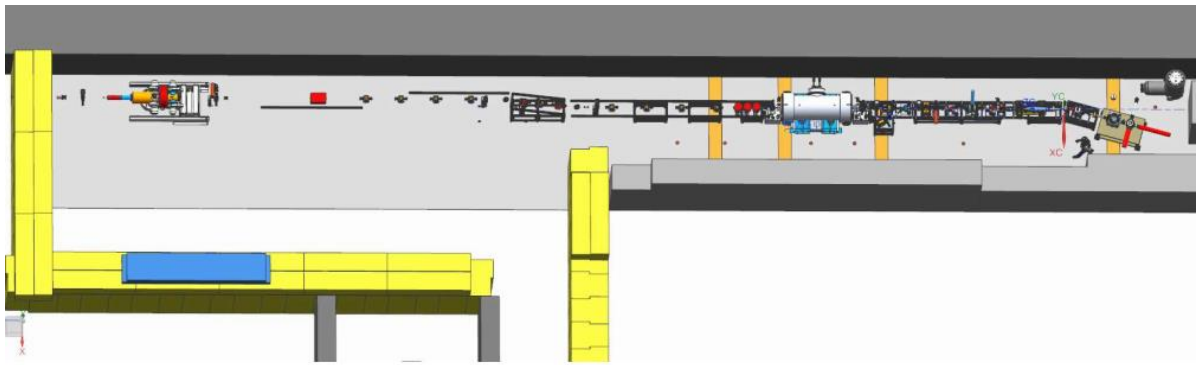
- **Shielding installed below penetrations**
- **Some cable tray**

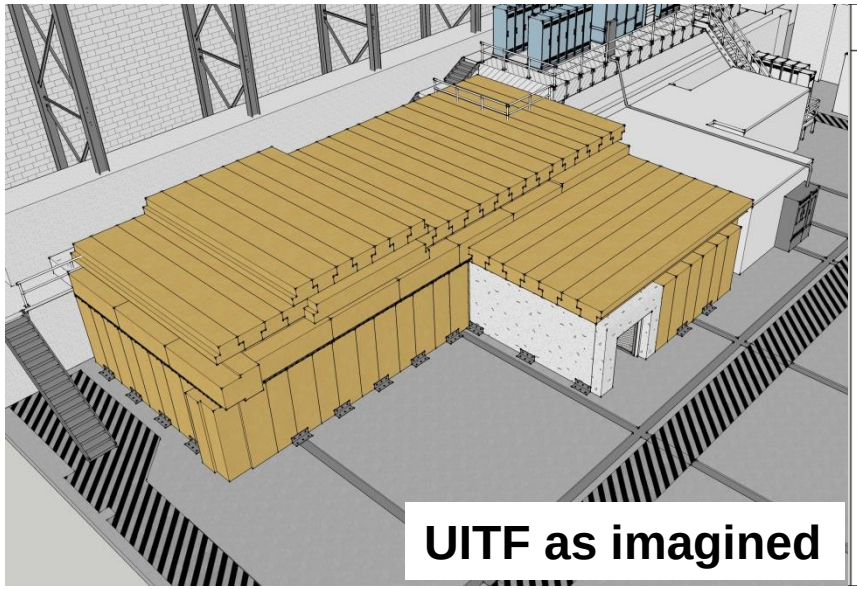


To refresh your memory…

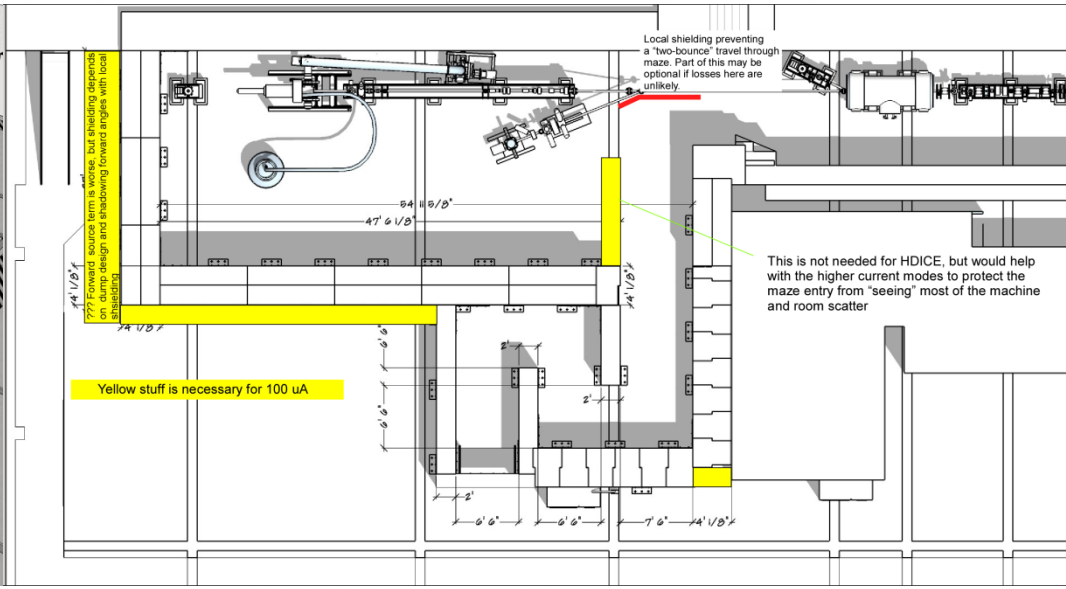
What we started with…



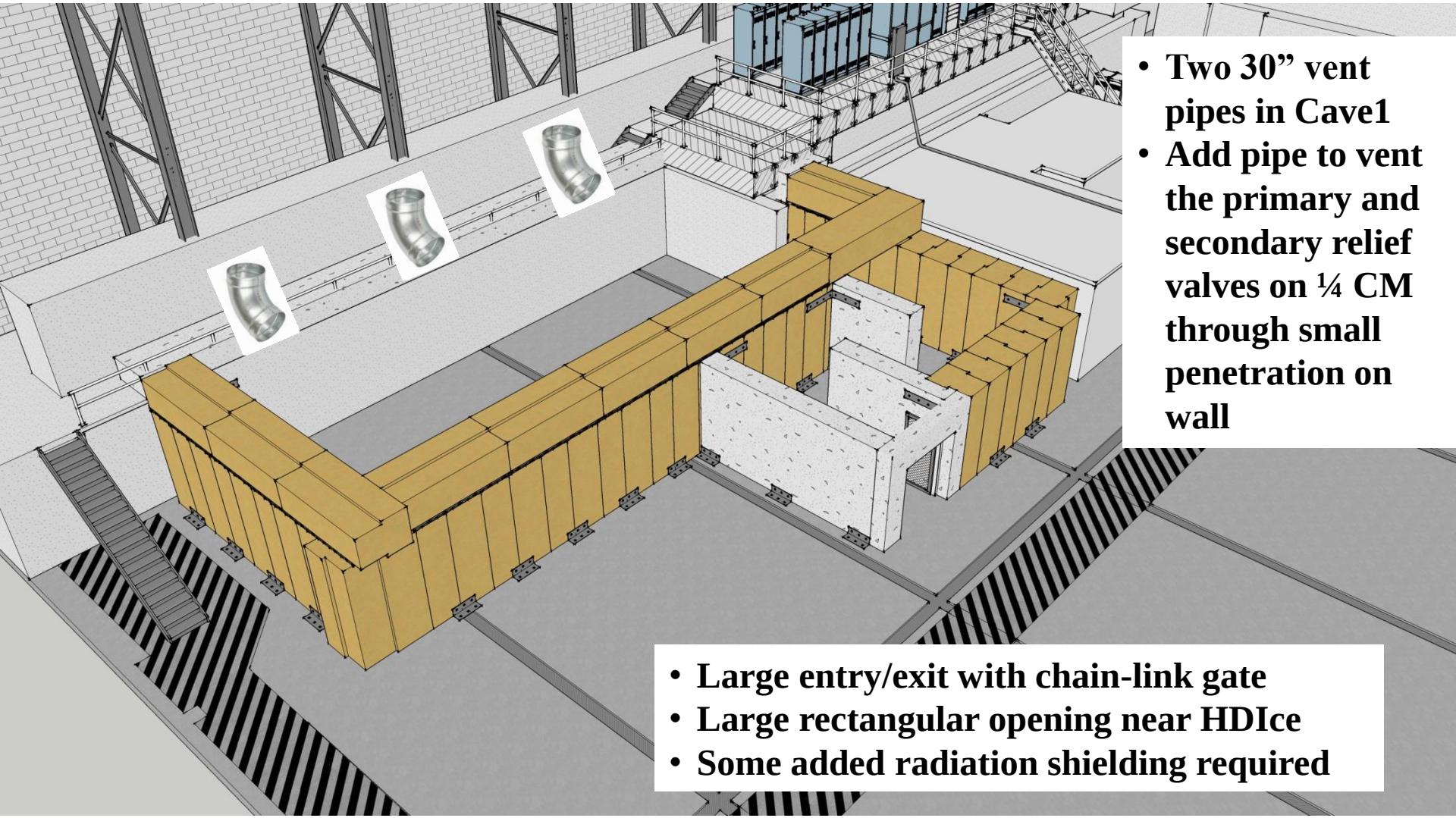




UITF as imagined

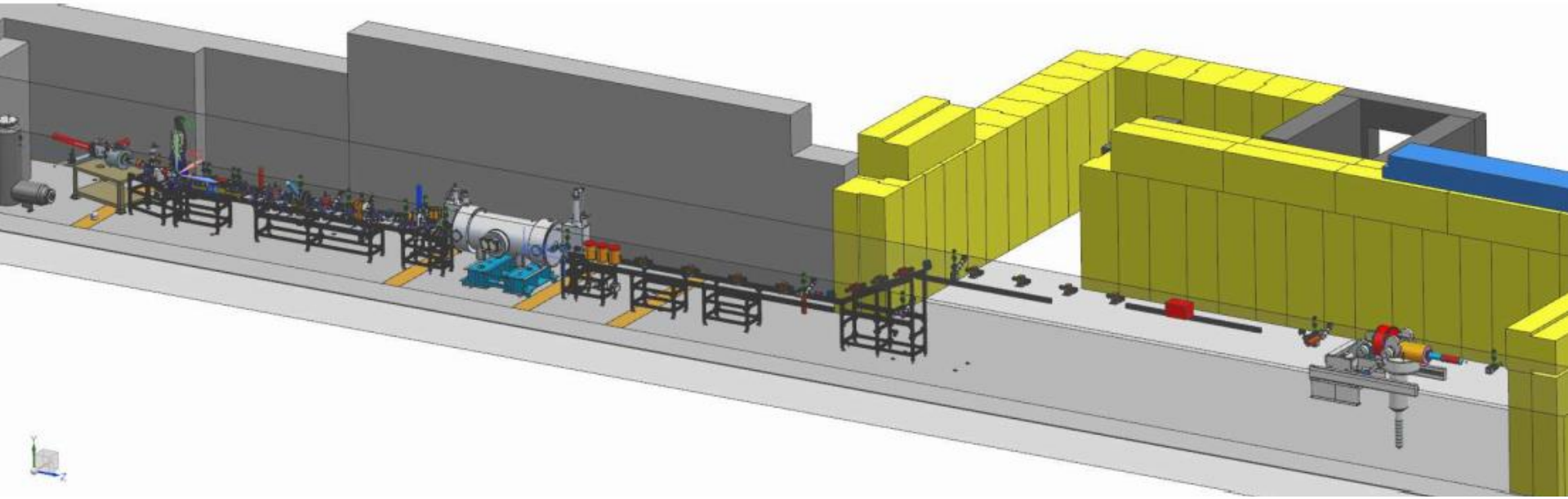


Simple ODH solution: passive venting



- Two 30” vent pipes in Cave1
- Add pipe to vent the primary and secondary relief valves on ¼ CM through small penetration on wall

- Large entry/exit with chain-link gate
- Large rectangular opening near HDIce
- Some added radiation shielding required



Design work was stopped…would like it to continue

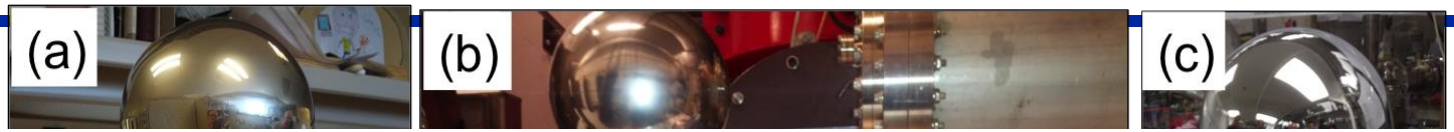
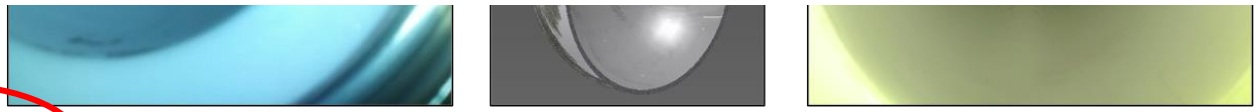


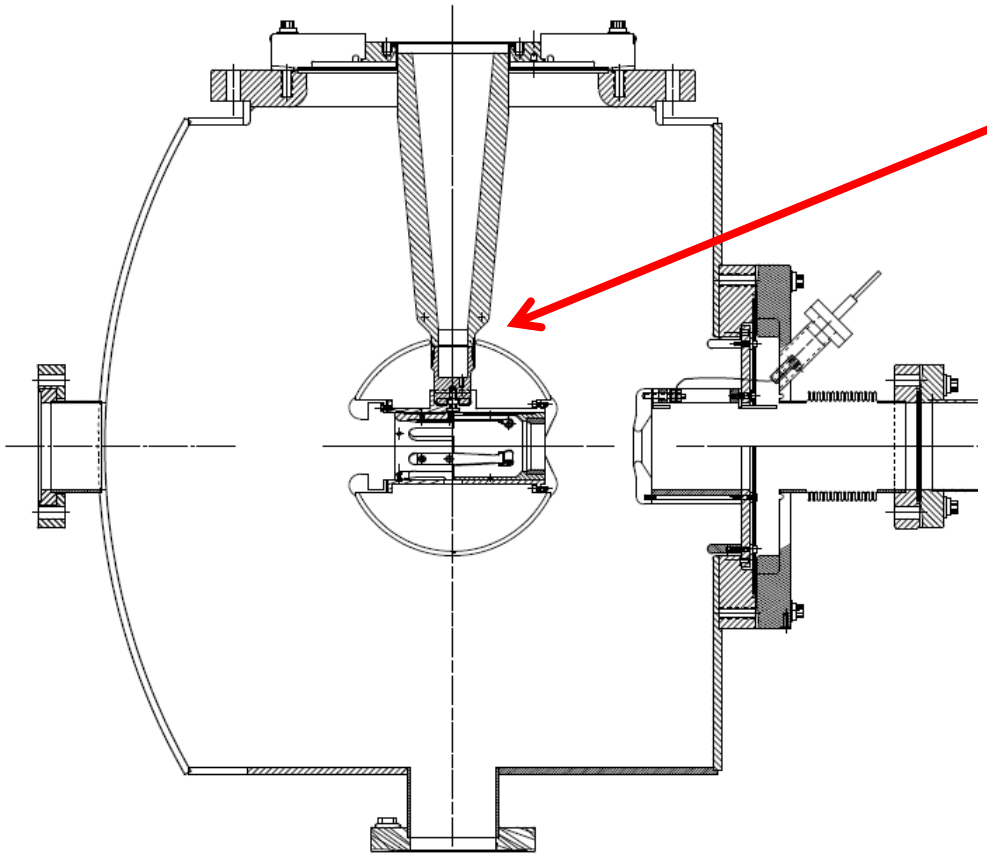
Table 1. Material properties for each insulator/electrode test configuration and corresponding high voltage performance. The R30 insulators were composed of unaltered 97.7% alumina, while the R28 doped insulator was 94.7% alumina. The manufacturer provided the alumina concentration for each insulator type and corresponding transversal resistivity and dielectric constant. All test were performed using the same spherical test electrode.

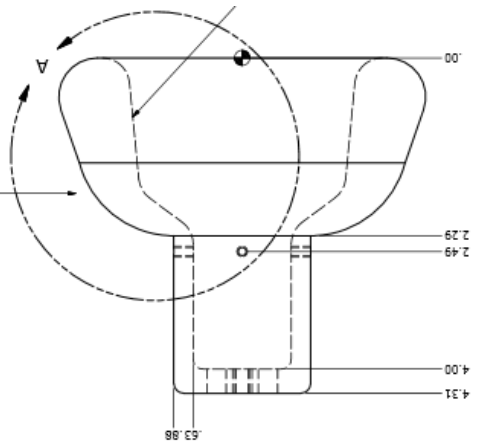
Insulator type	Length (cm)	Transversal resistivity (Ohm-cm)	Dielectric constant $\varepsilon_1/\varepsilon_0$	Maximum voltage (kV)	Performance
R30 sample 1	20	5.0×10^{15}	9.1	329	Breakdown and puncture near high voltage end
R30 sample 2	20	5.0×10^{15}	9.1	300	Breakdown
R30 with additional screening electrode	20	5.0×10^{15}	9.1	375	370 kV with krypton 4-hr soak, 350 kV in vacuum 4-hr soak. Significant field emission in both cases
R30 ZrO-coated	20	5.0×10^{15}	9.1	340	Breakdown and puncture near ground end
R28 doped	13	7.4×10^{15}	8.4	360	360 kV with krypton 1-hr soak, 350kV in vacuum 5-hr soak, 2 times Minimal field emission in both cases
R30 doped	20			360	Breakdown originating at high voltage end and puncture near ground end



Next test late Sep[redacted]ber

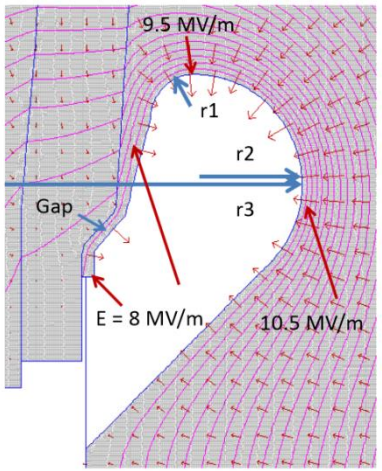
- **Combine the two features that provided incremental success: shed and doped insulator**





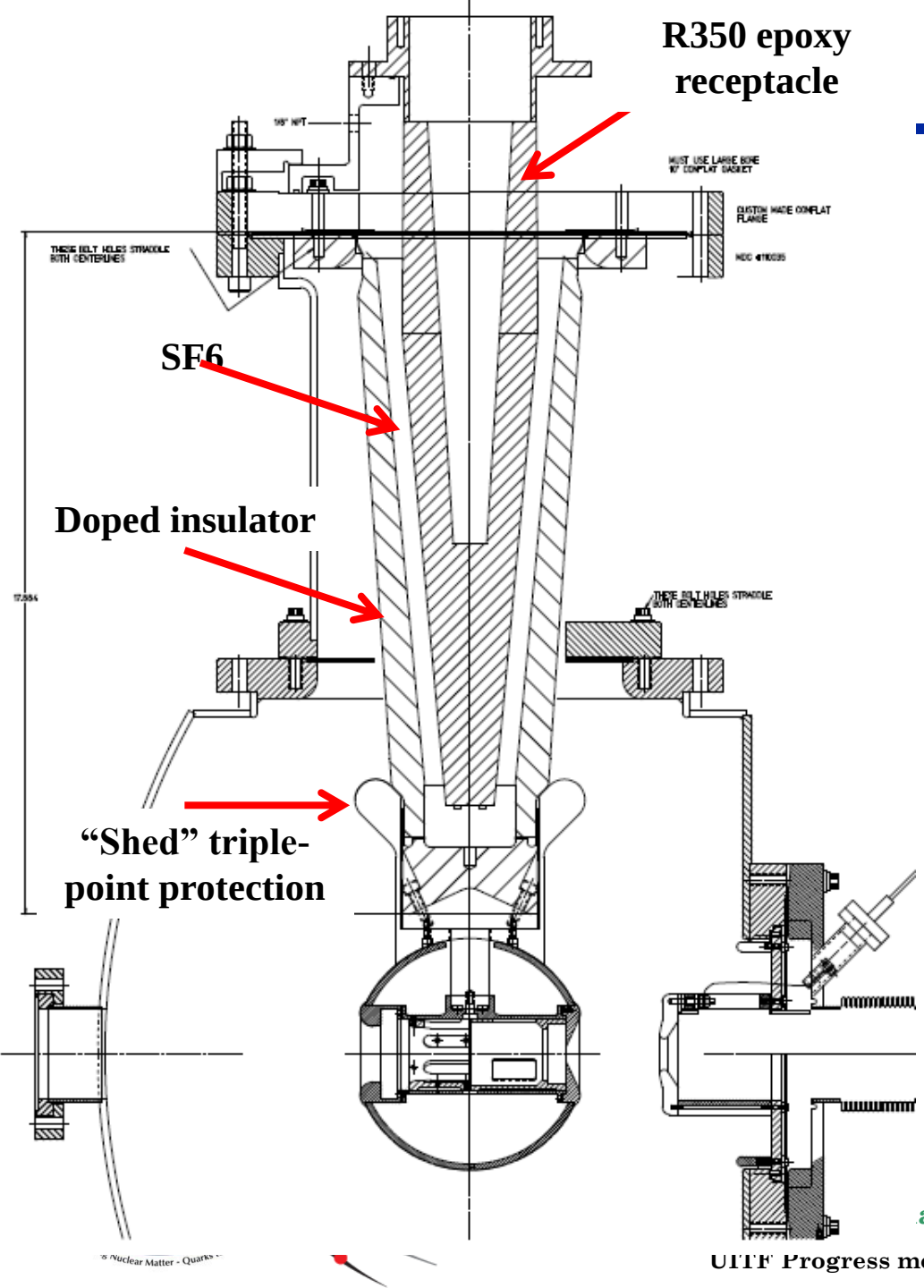
A Good Shed

- r1 = 1 cm
- r2 = 2.5 cm
- r3 = 9.5 cm
- 3 mm gap



…then in October

- Combination of doped insulator and shed, SF6 and epoxy receptacle, plus added length
- Yan Wang has modeled the shed, a good design…



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