

UITF Project Status Meeting

Matt Poelker

December 21, 2015



Thomas Jefferson National Accelerator Facility

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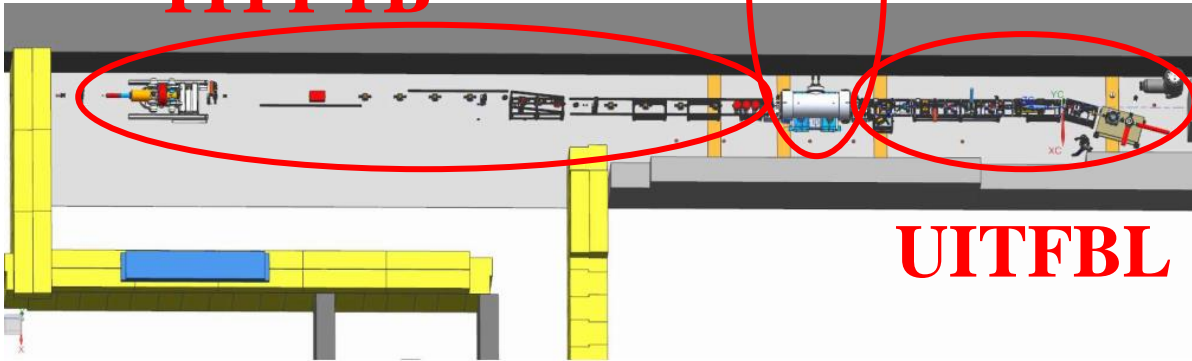
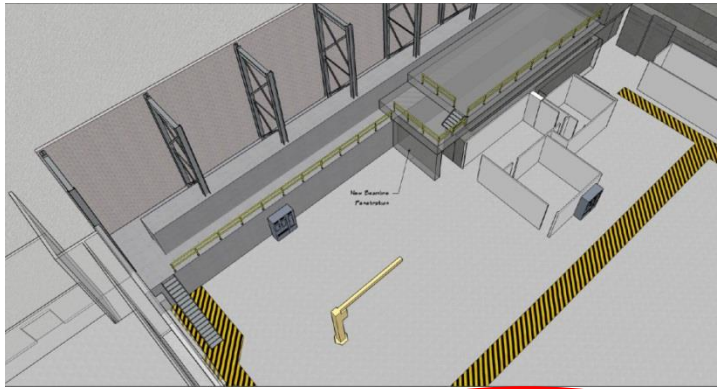


UITF Progress meeting

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

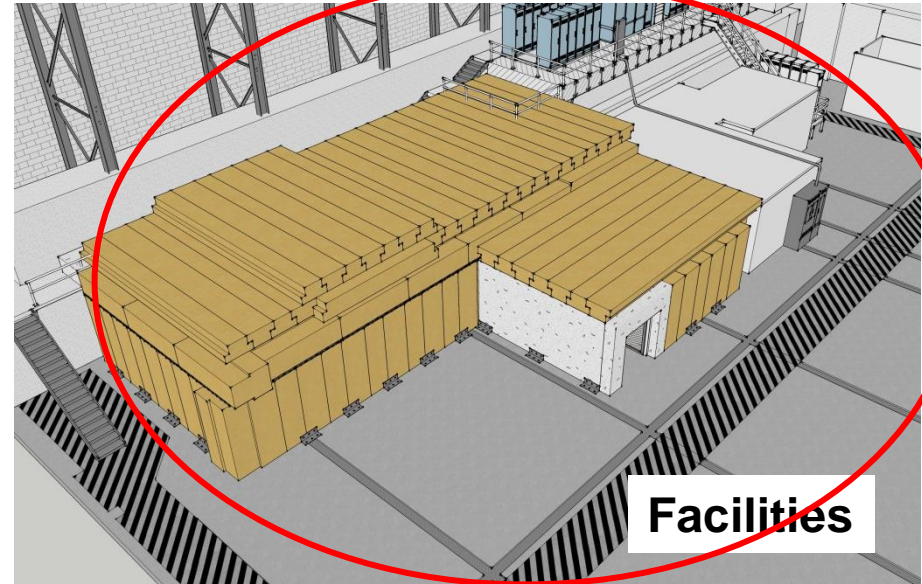
Proposed re-scoping



ITFPTB

ITFCRY

UITFBL



Facilities

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

Action Items – November 23, 2015 Minutes

New Action Items:

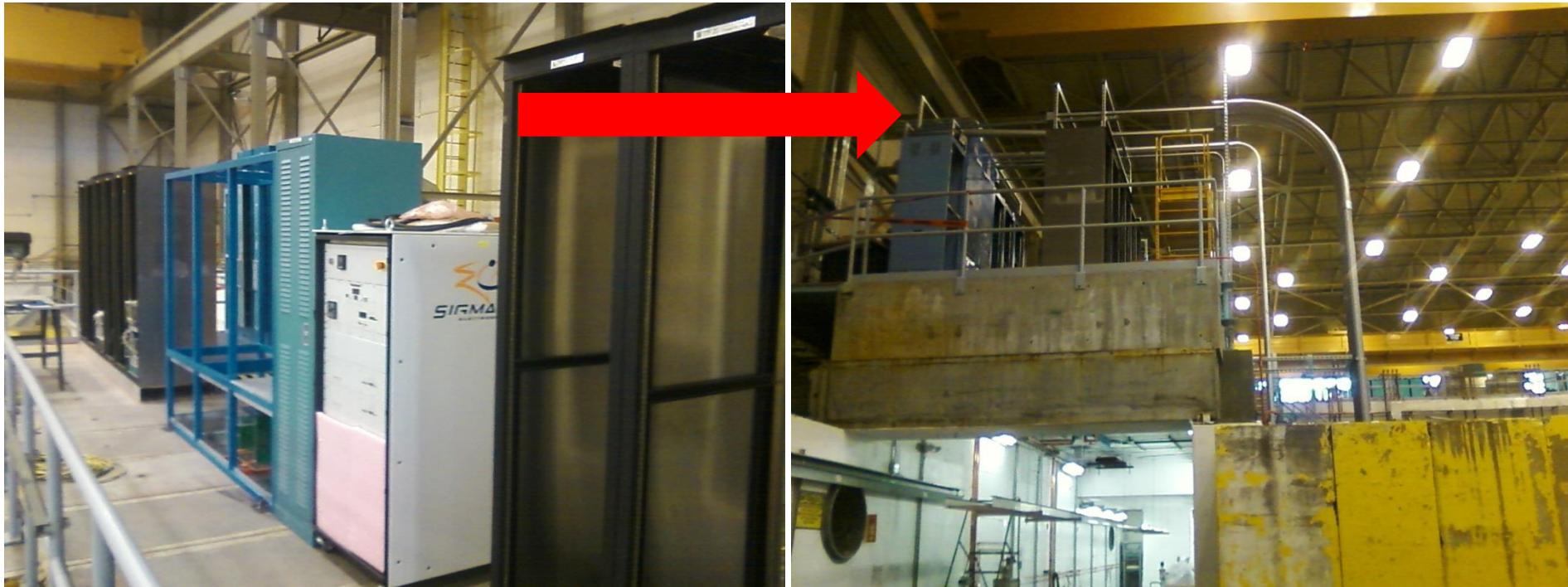
- **Nov. 11, 2015:** meet to re-scope the project, distribute costs within four “fences”
- **Dec. 4, 2015:** Poelker submitted new budgets for each fence. Now revising these budgets per guidance from Lyn and Allison

Installation and Cryo Groups



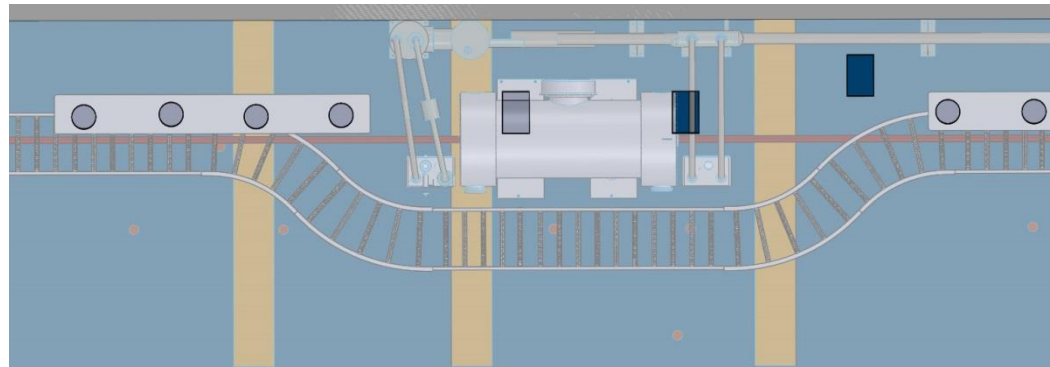
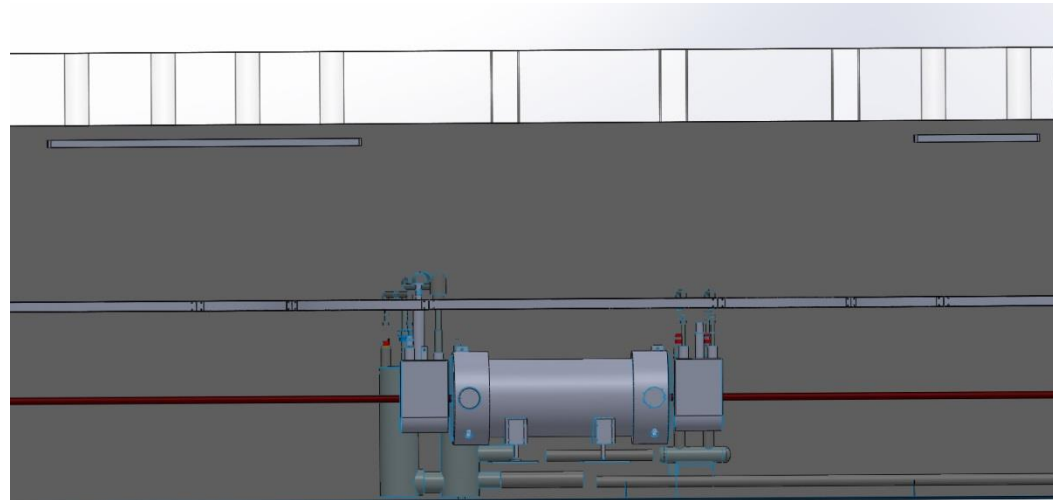
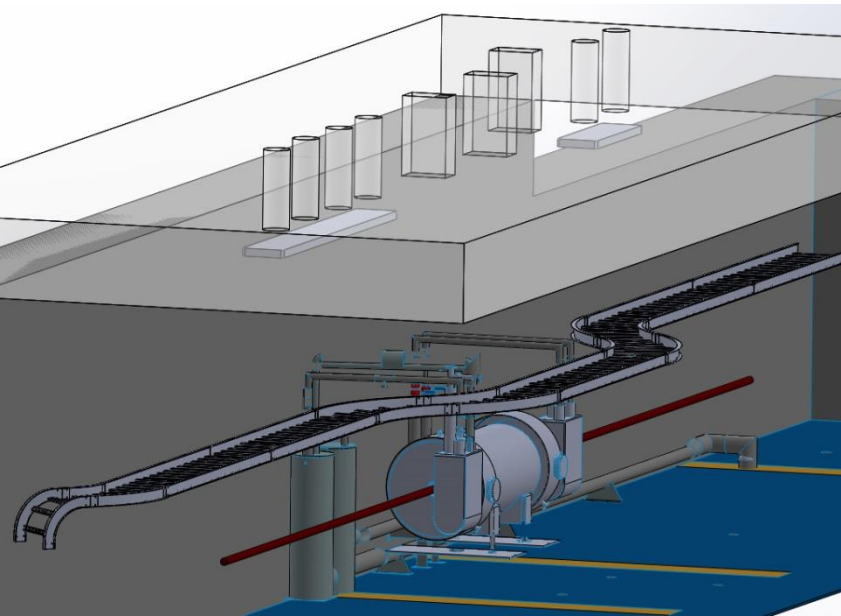
- **Cryo removed some transfer line**
- **Install group added shielding and some cable tray**
- **Need transfer line, more PSS conduit, more cable tray, electricity, waveguides, etc.,**

Facilities



- **Electricians installing conduit, transformer and breaker boxes**
- **Expect power to racks and inside Cave1 early January. Network conduit being installed too**

Shielding at Penetrations



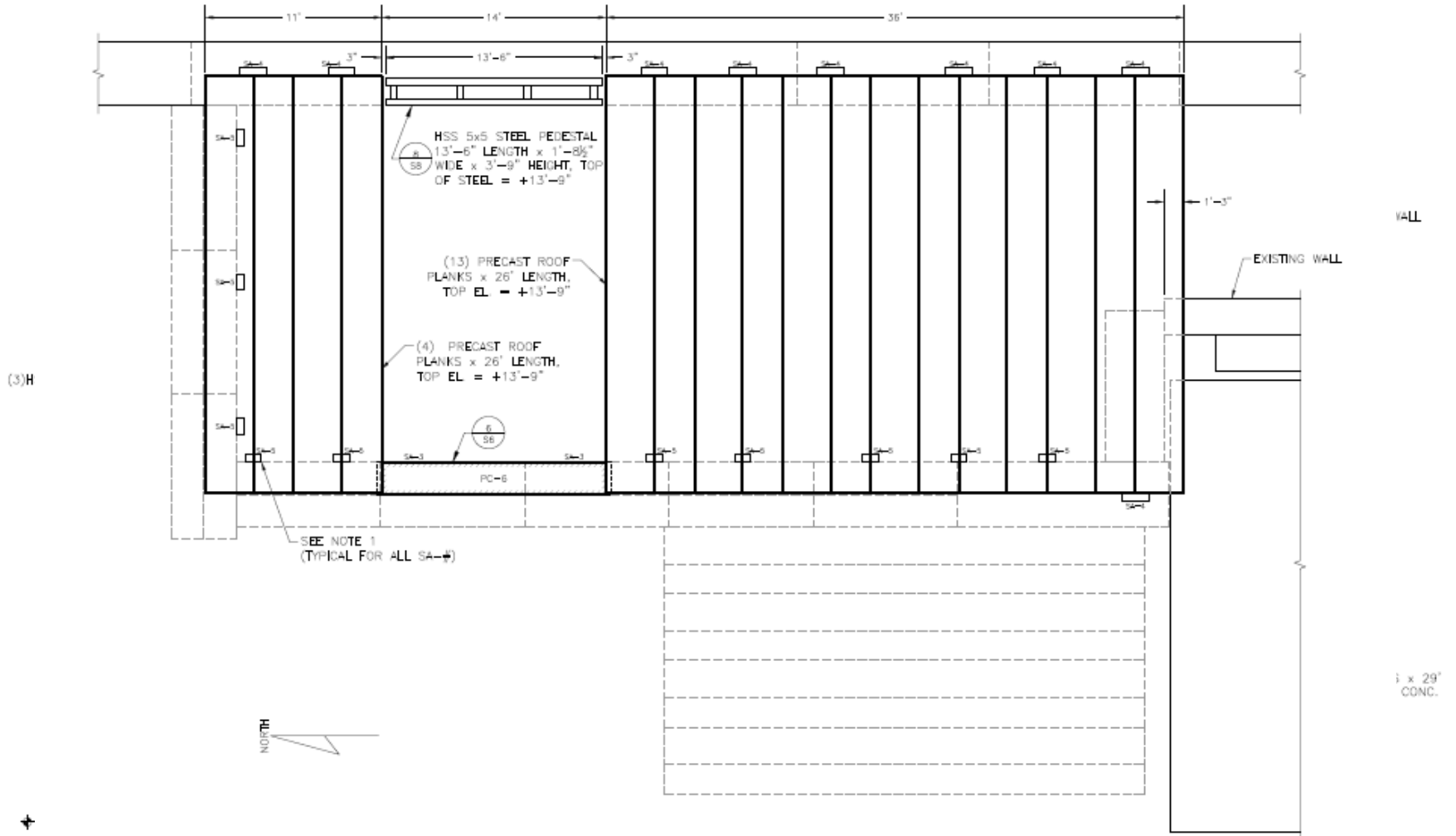
- **Shielding installed below penetrations**
- **Some cable tray**

Cave 2



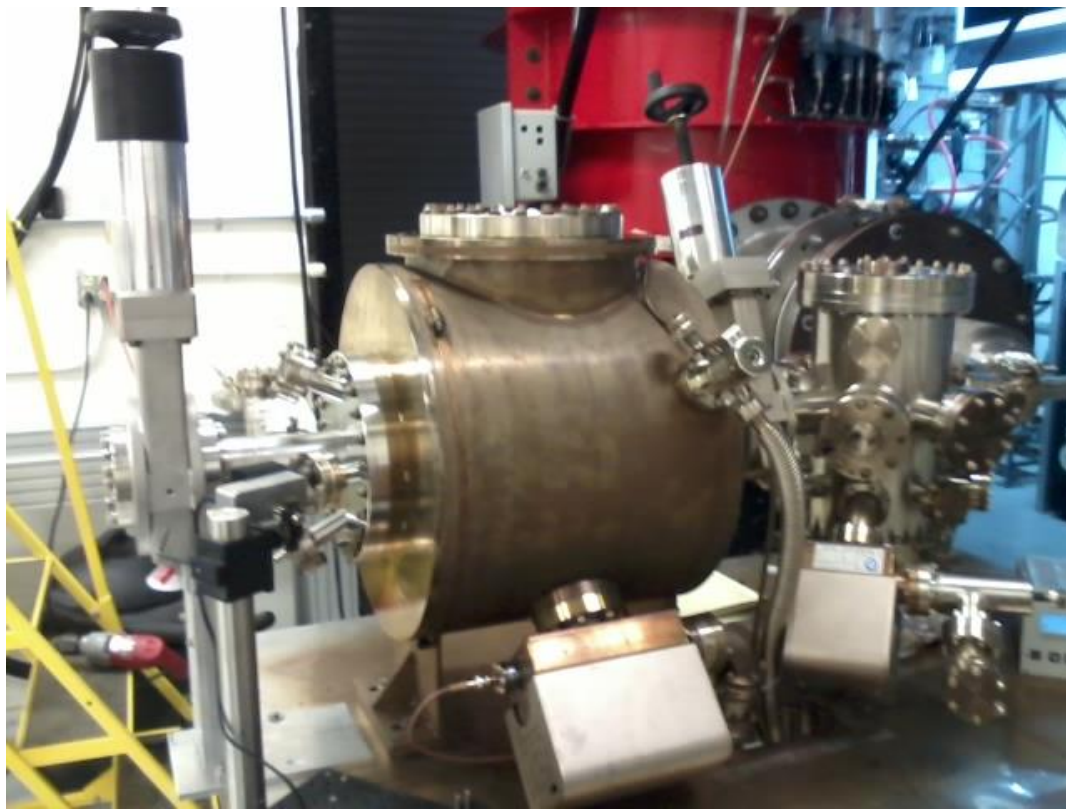
waiting for Facilities to secure 2nd layer, add ceiling, move power distribution panel, paint

Facilities (T. Renzo)



LEVEL THREE LAYOUT PLAN
SCALE 1/4" = 1'-0"

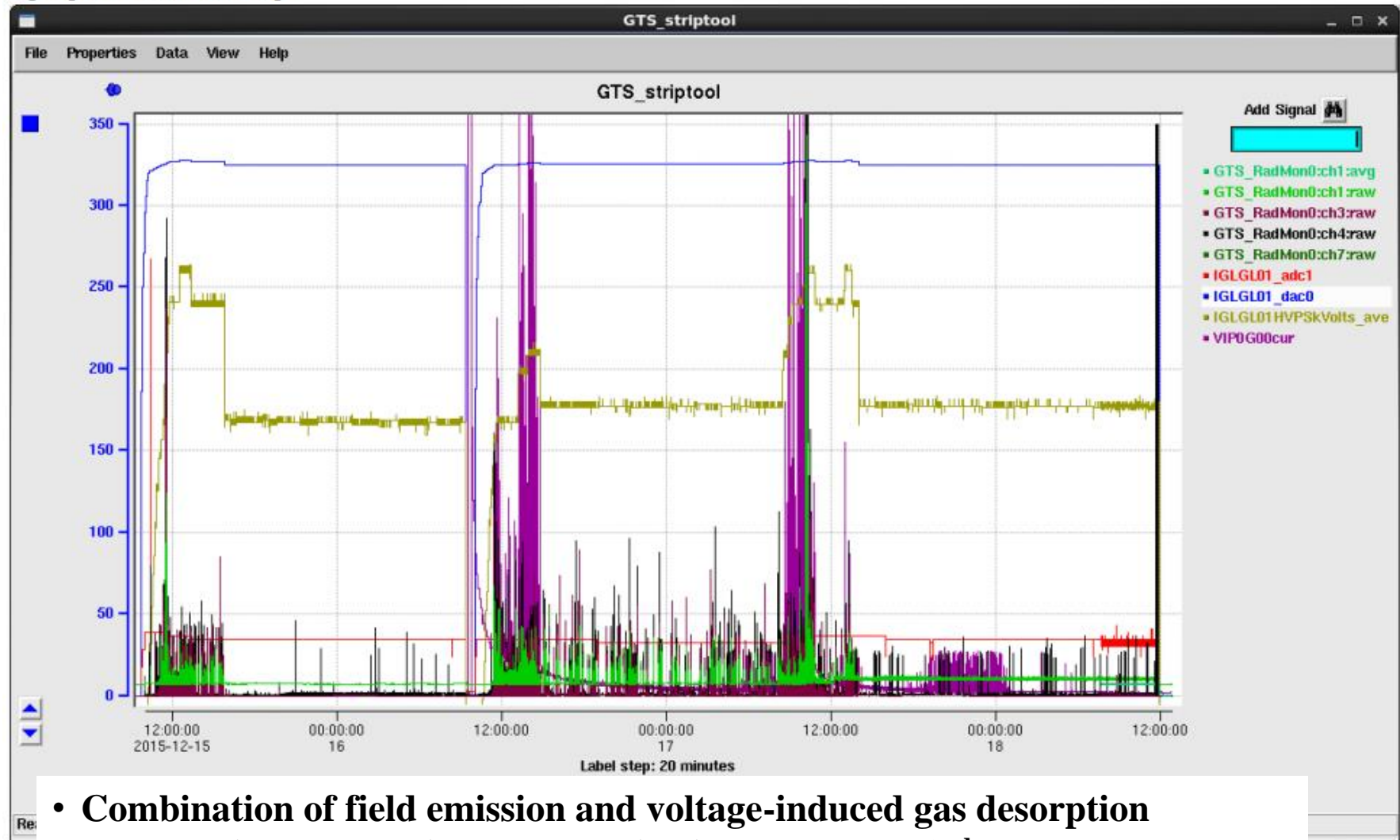
Building the electron gun at LERF GTS



- **The new gun happy at 325 kV, stopping at this voltage for now. Shifting focus to building the beamline and photocathode deposition chamber (LDRD magnetized beam tests)**

Low field emission at 325 kV

Fig. 2 [12/18/2015 12:46:44]



- **Combination of field emission and voltage-induced gas desorption**
- **Repeat with black, mildly conductive insulator, and 2nd gun chamber. Do this work at UITF.**

Status Cryo

- Agreed on means to “park” the $\frac{1}{4}$ CM when not accelerating beam: circulate 80K LN2 through 35K shield line. UITF should not be a burden on CTF 34 wks per year
- How to cool HDIce? need to downselect - Purchase LHe (expensive) versus connect HDIce to CTF
- Hari and Will believe UITF will be ODH0 unless we are stabbing U-tubes of swapping dewars (some caveats)

Message1: Cold $\frac{1}{4}$ CM milestone...April 2016 is a more realistic time frame (two month delay)

Message2: 4K cold box work does not represent a problem in terms of our stated goal to deliver beam to HDIce August 2016 (other things represent bigger obstacles)

Status Facilities

- **Electric Part 1, top of cave, and inside Cave1, complete early January. Great! Can start populating racks, especially Cryo Controls, RF, ODH, PSS and network communications**
- **Network conduit. Once installed, Cumbia and Cuffe ready to go**
- **Need to move power box from Cave2, to complete the ODH conduit**
- **Concrete structural package needs to happen soon, to finish PSS**

Status RF

Related to 1/4 Cryomodule

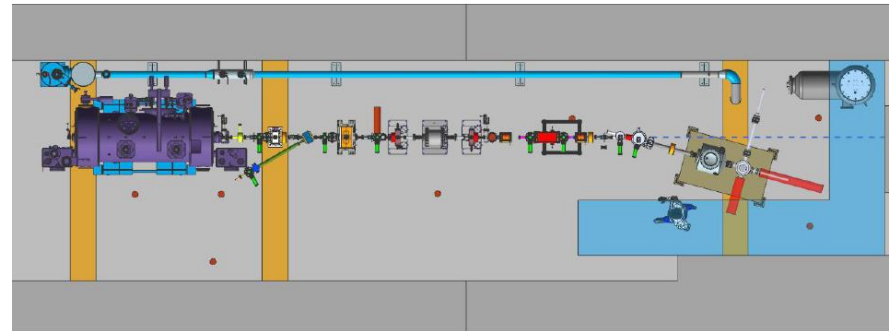
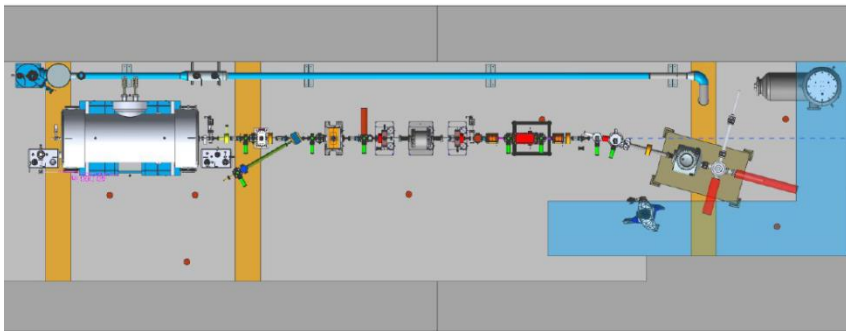
- Seidman making good progress on rf control boards
- Biggest issue: designing and building the high power rf control board. Who to do the work?
- Next biggest issue: designing the waveguide layout

Status SSG

- **ODH system relatively simple: but need the power box removed from Cave2**
- **PSS system more complicated: need Cave2 with a door, to install maglocks**
- **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?)**

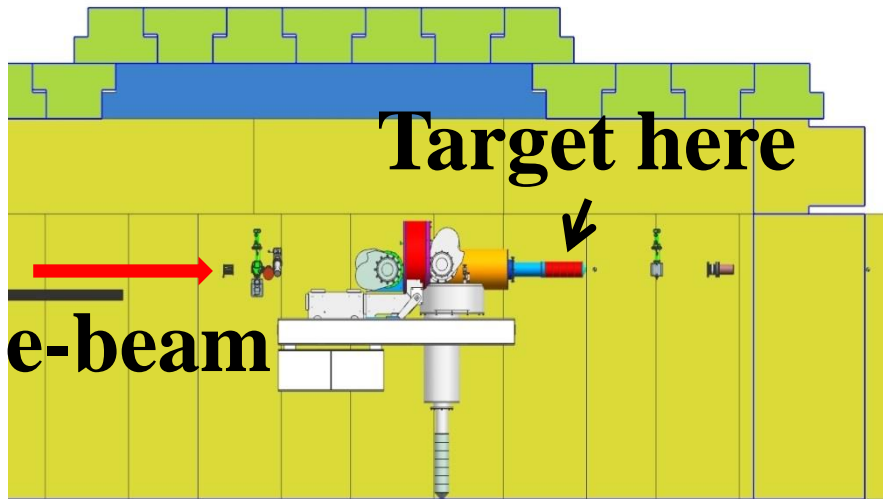
Status Gun and Beamline

- Build and test 350 kV gun with conductive insulator, optimized shielding electrode and lots of NEG pumping at UITF (testing with high voltage will require a PSS)
- Need to downselect which ¼ CM to install and commission: old ¼ CM requires 350 kV gun, new ¼ CM requires 200 kV gun
- Old ¼ CM ready for testing ~ now, New ¼ CM won't be ready till June 2016
- Beamline design to be reviewed by Ops/CASA in January

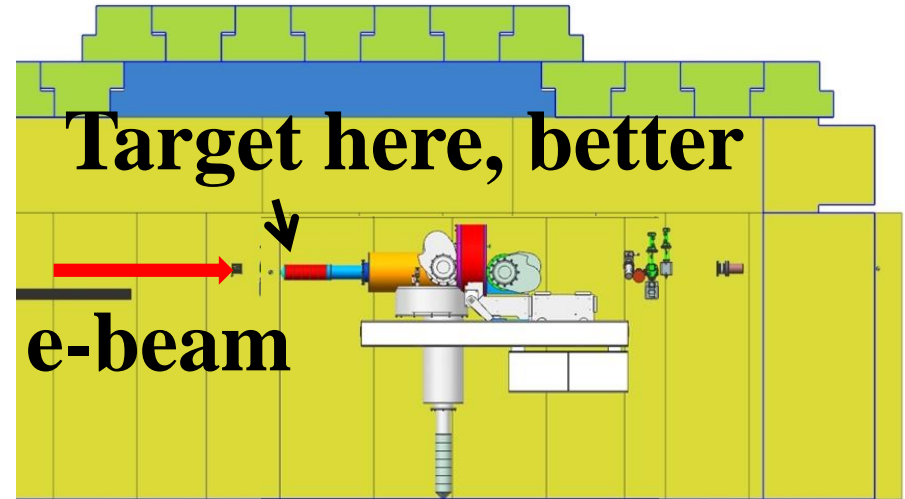


Status HDIce

- Lots of scattering at MeV energy. Beam size very large at target. Decided to flip the orientation of the target
- Cave2 design seems fine either way, need a Physics designer to be responsible for installation at UITF



Upstream radiation baffle
blows up beam



In this configuration, we can
achieve desired small beam
size at target

Milestones Update

| 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

Month by Month Spending Profile

Facilities

| procurements | Labor 34 PW 0.77 FTE | TOTAL cost Procurement + Labor |
|--------------|----------------------------|--------------------------------|
| \$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 3.4 FTE | \$328.25 | \$448.25 |

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 3.4 FTE | \$403.5578k | \$643.5578k |



Month by Month Spending Profile

| 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 | | |

Schedule Ramifications

- **Current status:**
 - **Installation Group continues to be very helpful for infrastructure work not performed by Facilities**
 - **T. Renzo needs to submit the structural package for Cave 2 soon, Need to have the power distribution box in Cave2 moved soon: then SSG can install ODH and PSS**
 - **Ops Network, DC power, Low Level RF, I&C waiting in wings to begin installing electronics**
 - **Cryo removed old transfer lines, need to have some portion of new plumbing installed by early January**
 - **Need someone assigned to build the klystron control panel**
 - **Oren and Areti finalizing ODH assessment (ODH0), need it reviewed and signed off by EHS&Q**
 - **Need a Physics Designer working with Shaun Gregory, to layout HDIce inside Cave2**

Schedule Ramifications

- Recall, next big milestone...commission 1/4 CM (no beam), scheduled for Feb. 2016 (cryo, ODH, LL and HP RF, software, adequate shielding, EHS&Q approvals)
- This requires:
 - Klystron rack finished, R. Nelson building control panel
 - Low level rf boards complete, installation in racks begins
 - IOCs installed, Software group installing software
 - Installation group working opportunistically: shield plates, PSS conduit, cable trays, waveguides, vent stacks for relief valves
 - Safety System Group working on ODH and PSS systems
 - Cryo group installing new transfer lines, control system
 - Facilities provide a space that can be locked up
 - **April seems like more realistic time frame**

Summary

- There's continued progress....

Backup Slides

- Backup slides from past meetings, P&C meetings

Progress Update

- Major components

- ✓ Facilities

- Engineering

- ✓ Mech Design

- ✓ Cryo

- ✓ Safety Systems

- ✓ I&C

- ✓ DC Power

- ✓ Low Level RF systems

- ✓ High Power RF

- ✓ Survey & Alignment

- SRF

- Commission with RF

- Operations

- ✓ Network and communications

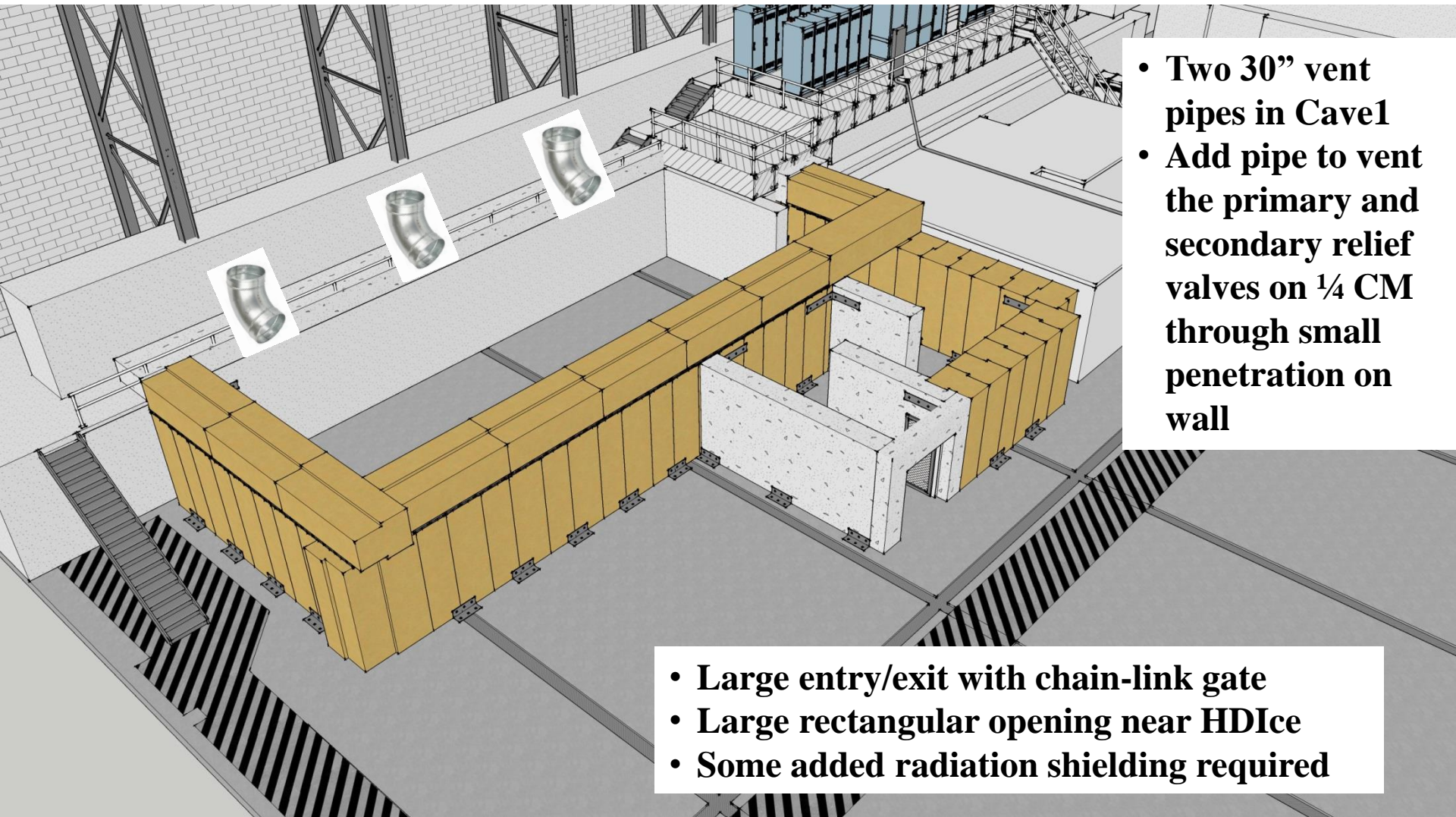
**Green means we
can see progress**

Progress Update

- Major components
 - Source Group
 - ✓ **Reliable 350kV ops**
 - ✓ Beam to cup in front of ¼ CM
 - ✓ Beam to cup in front of HDIce
 - **EHSQ**
 - ✓ **Shielding approval, ODH assessment**
 - Global hazard review
 - ✓ FSAD
 - Accel Readiness Review
 - Commissioning Plan
 - **HDIce**
 - Installation at Cave
 - Beam on HDIce

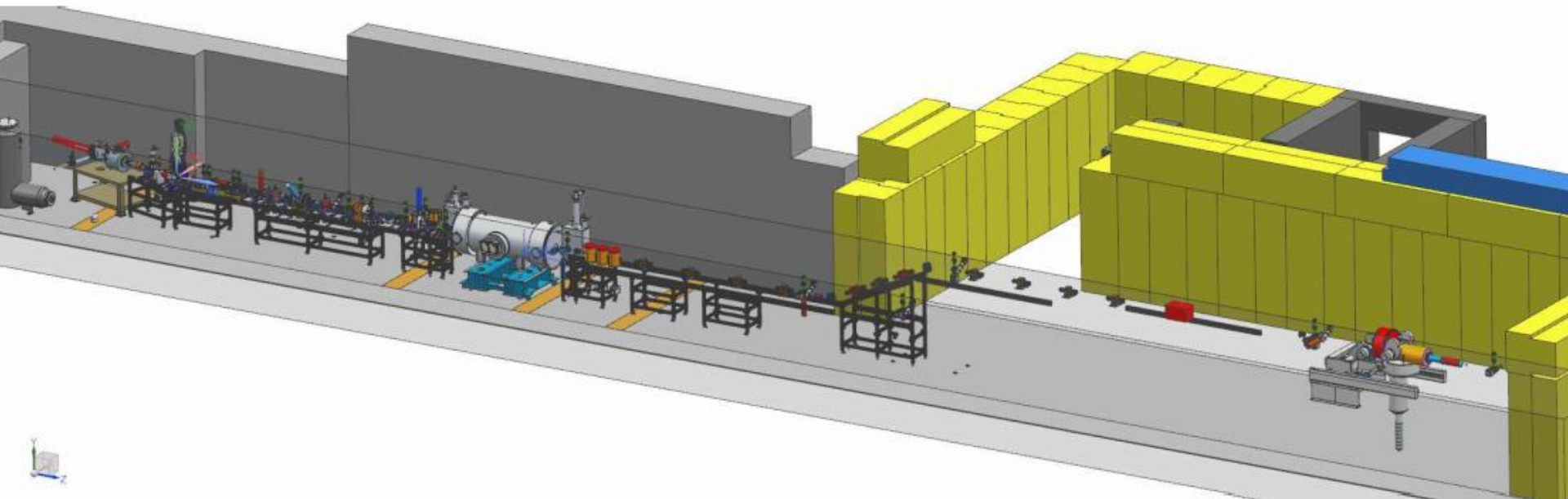
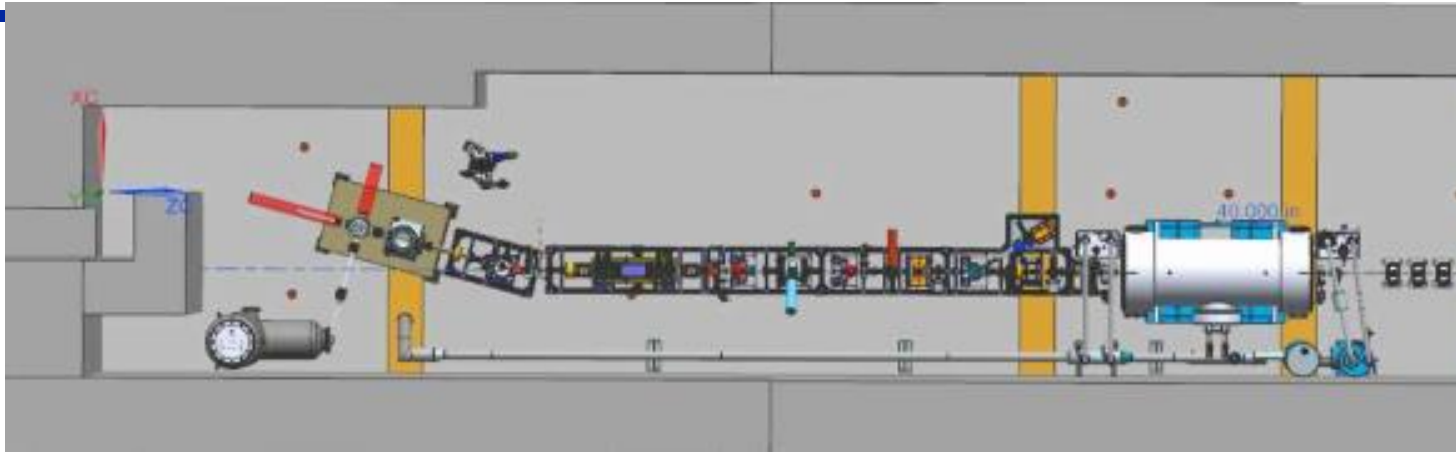
**Green means we
can see progress**

Simple ODH solution: passive venting



- Two 30" vent pipes in Cave1
- Add pipe to vent the primary and secondary relief valves on 1/4 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

UITF High Voltage Power Supply



- J. Hansknecht putting UITF 400 kV power supply together, inside SF6 tank

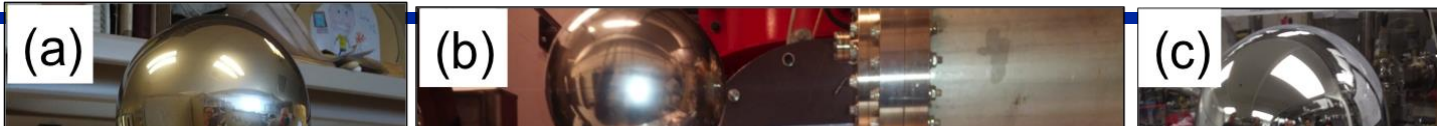


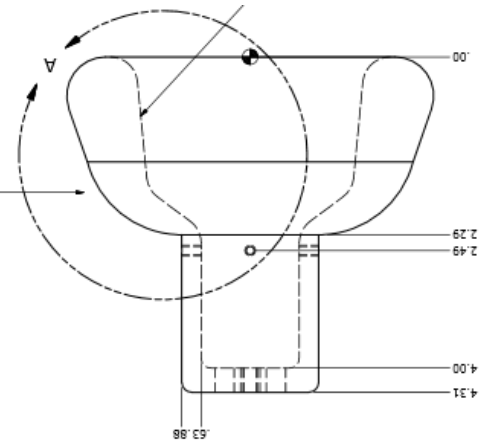
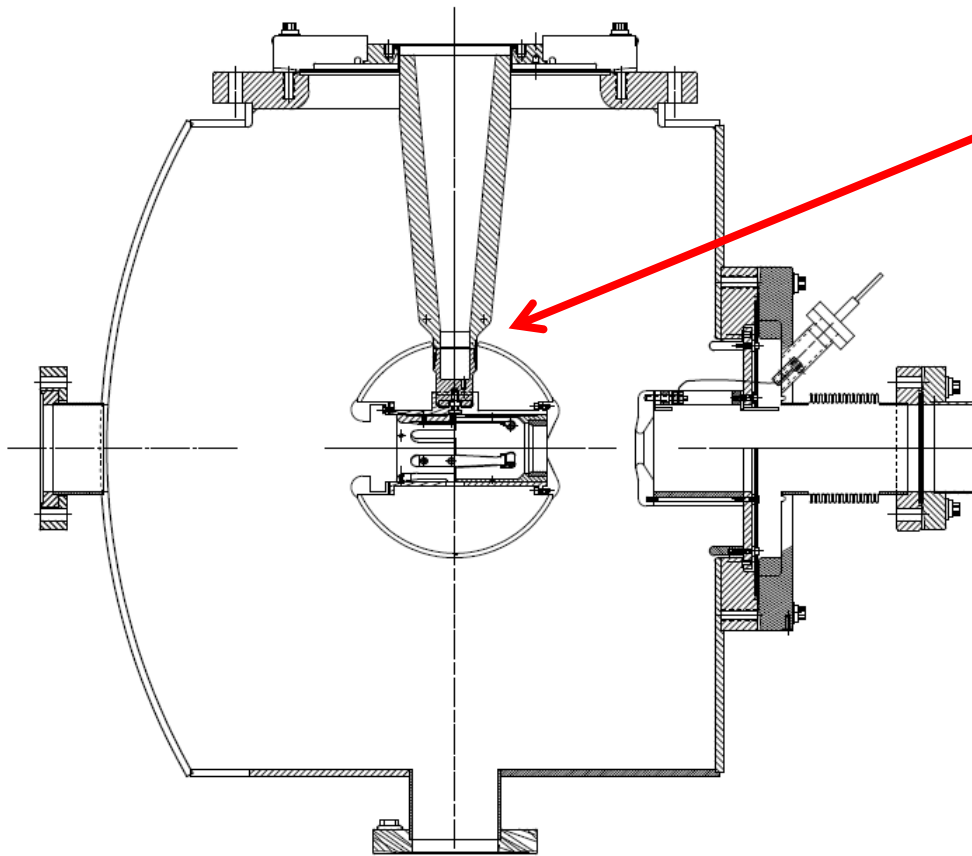
Table 1. Material properties for each insulator/electrode test configuration and corresponding high voltage performance. The R30 insulators were composed of unaltered 97.7% alumina, while the R28 doped insulator was 94.7% alumina. The manufacturer provided the alumina concentration for each insulator 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 ϵ_1/ϵ_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 360 kV with krypton 1-hr soak, 350kV in vacuum 5-hr soak, 2 times Minimal field emission in both cases |
| R28 doped | 13 | 7.4×10^{15} | 8.4 | 360 | |
| R30 doped | 20 | | | 360 | Breakdown originating at high voltage end and puncture near ground end |



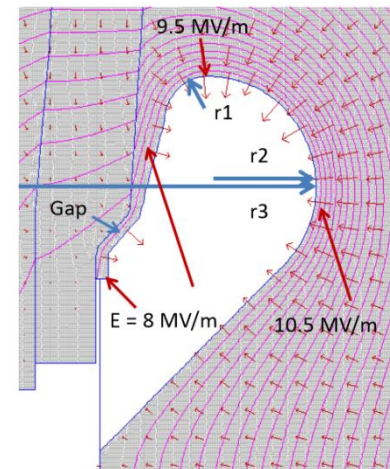
Next test late September

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



A Good Shed

- $r1 = 1 \text{ cm}$
- $r2 = 2.5 \text{ cm}$
- $r3 = 9.5 \text{ cm}$
- 3 mm gap

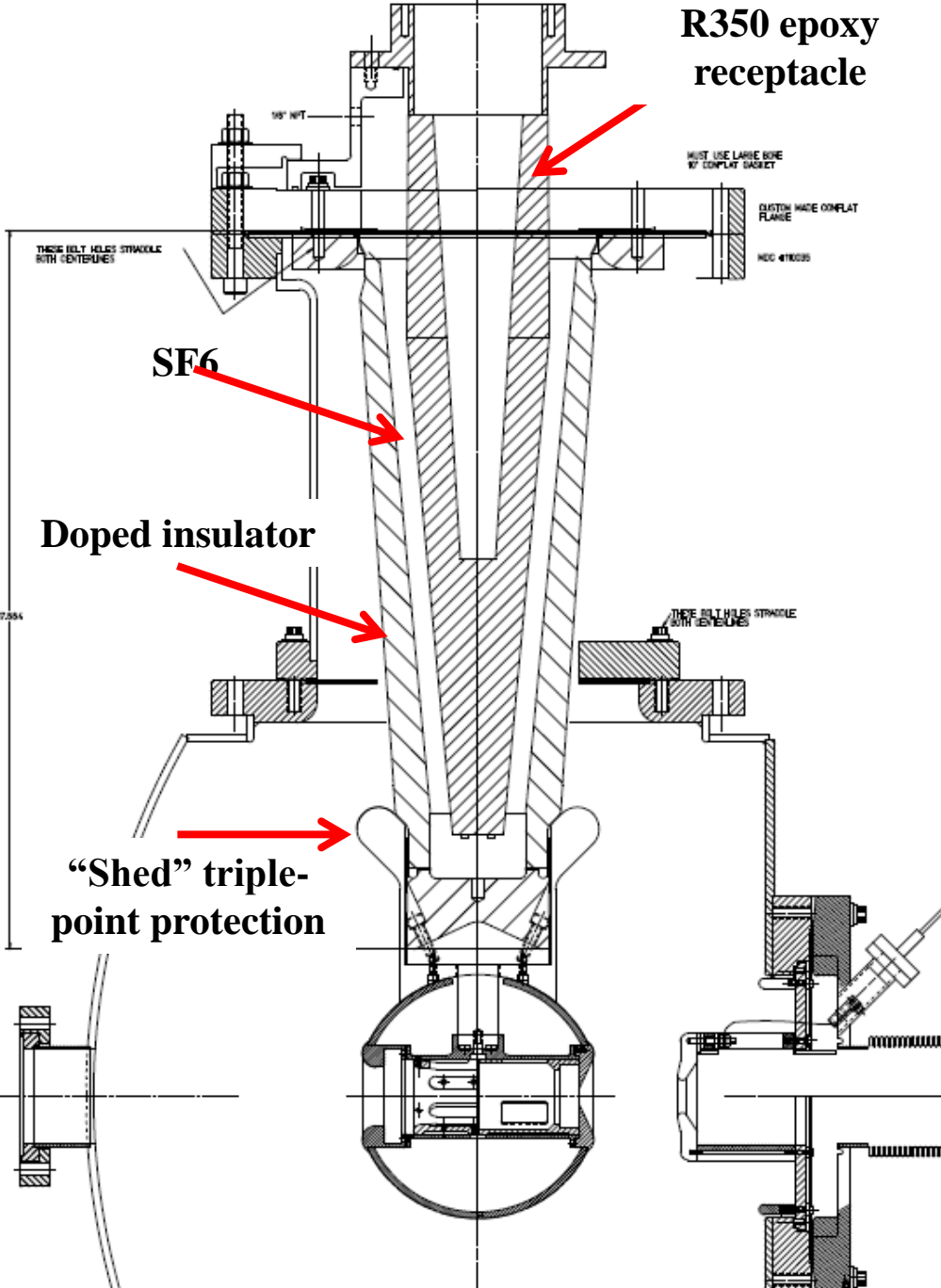
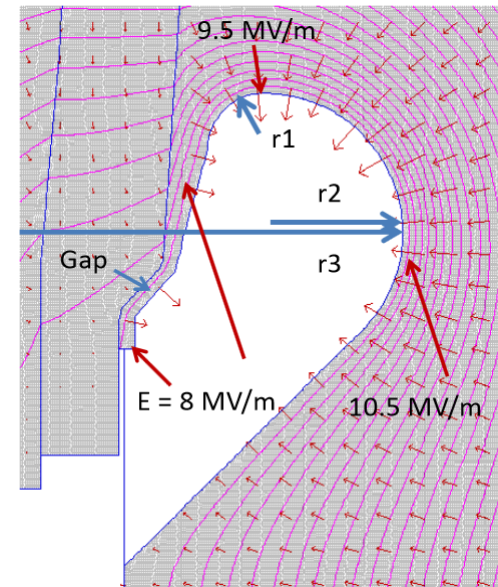


...then in October

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

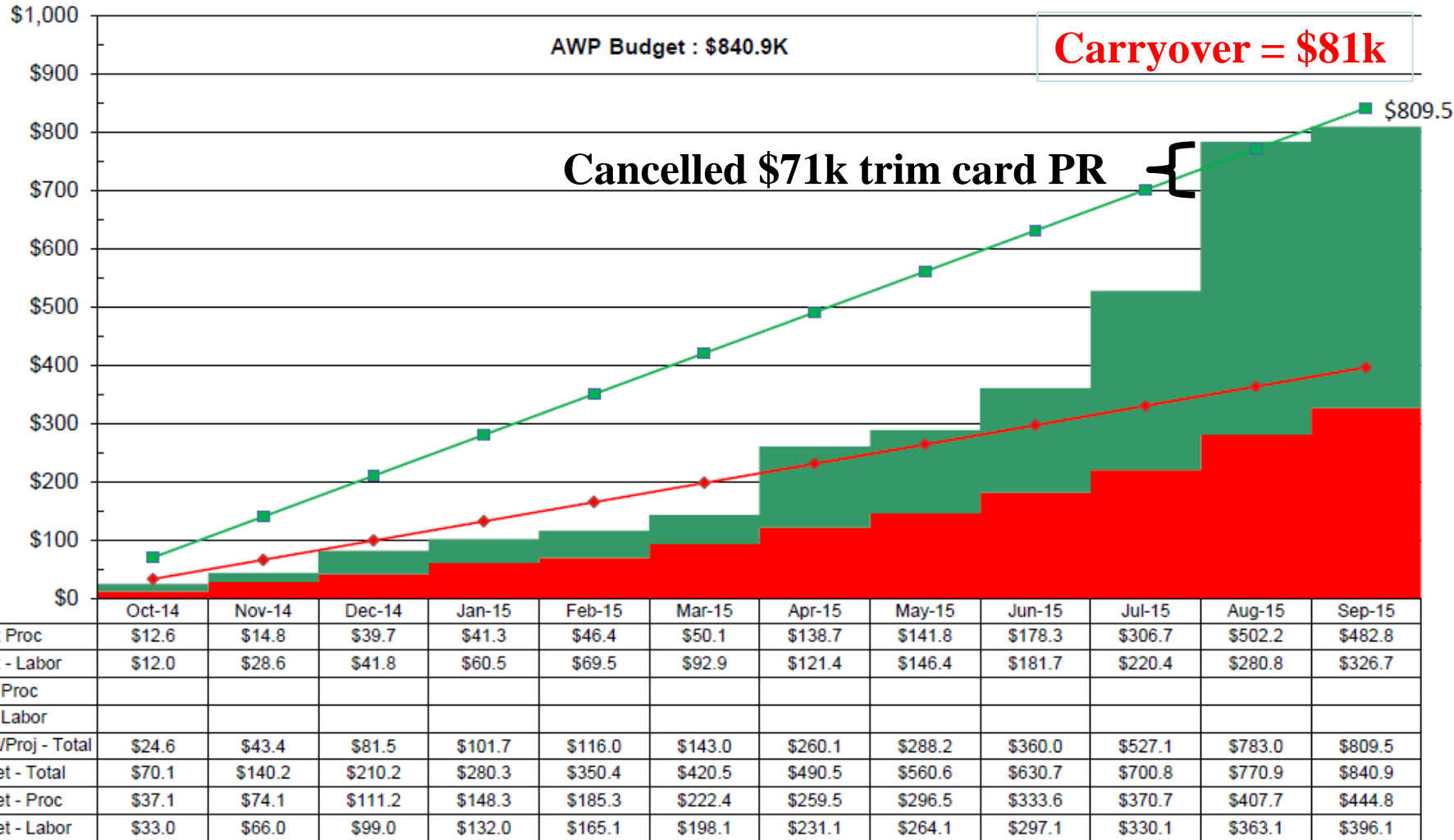
A Good Shed

- $r1 = 1 \text{ cm}$
- $r2 = 2.5 \text{ cm}$
- $r3 = 9.5 \text{ cm}$
- 3 mm gap



Budget vs Actuals - thru September 30, 2015
1.04.11 Upgrade Inj Test Facility

Mgr: M. Poelker



Spent includes \$90.9K current open commitments and \$0.0K pending costs

FY15

UITF Progress meeting



Schedule Ramifications

| | |
|---|----------------|
| • Commission ¼ CM (no beam), scheduled for Feb 2016 | |
| • Electric/FM – (\$78k + \$23k for com. conduit) | 101 k\$ |
| • Control room – | - |
| • SRF checkout of ¼ CM present condition – | - |
| • Low Level RF – | 16 k\$ |
| • High Power RF – | 25 k\$ |
| • Network controls – | 33 k\$ |
| • Software control of RF – | - |
| • adequate shielding (Cave2 with a roof) – | - |
| • Cryo – (controls and pipe) | 68 +/- k\$ |
| • Installation group | 9 k\$ |
| • ODH - SSG | 2 k\$ |
| • EHS&Q approvals... | - |
| Total | 254 k\$ |

FY16 Procurements?

| | ~ required | spent in FY14 FY15 | To purchase in FY16 | |
|-------------|------------|--------------------------|------------------------|---|
| Facilities: | 300 | 56.2 | 245 | |
| Cryo | 90.8 | 0 | 90.8 | waiting for update |
| RF | 252.5 | 121.4 | 131.1 | |
| Gun | 451.2 | 265.5 | 130 | includes beamline components + contract designer |
| I&C | 219.5 | 7.6 | 211.9 | Hope to reduce this number using PLC technology |
| SSG | 45.7 | 1 | 44.7 | |
| DC power | 144.5 | 100 | 8 | Trim cards... shop to make quads, assumed 100k but could be less |
| Magnets | 120 | 119.3 | 0 | Still need three dipoles |
| Network | 58 | 58 | 0 | |
| Total | 1682 | 671 | 862 | Of course, hope the number comes in lower: 750 k\$ |

Original vs Current Cost Estimate

Presented at UITF meeting May 13, 2015:

| Original Est. by Hari Areti on 2-7-2014 | FTEs | Direct \$ | | | Loaded \$ | | | | |
|---|------|-----------|------------|----------|------------|------------|------------|------------|--|
| | | Labor | Proc | Total | Labor | Proc | 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 | | |
| Difference 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



Revised Estimates Breakdown

- **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

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 | |

FY14 and FY15 UITF Procurements

| FY14 | | FY15 | | Addl. expected FY15 procurements | |
|--------------------------------|------------|----------------------------------|--------------|-------------------------------------|--------------|
| Solid Works CAD | 2.2 | Insulator flange | 1 | Contract Mech Designer | ~ 30 |
| 450kV HV power supply | 31.1 | bpm components | 7.6 | stairs | ~ 20 |
| semiconducting R30 insulators | 52.6 | semiconducting R30 insulators_v2 | 22.3 | trim cards | ~100 |
| gun HV chamber | 7.8 | Klystron HV power supply | 55.5 | quad magnets (machine shop) | 70 to 130 |
| ion pumps | 15.1 | concrete wall removal | 32 | Chopper rf amplifiers (x2) | 44 |
| beamline Y chamber | 5 | LLRF parts | 15.1 | water skid for chopper | 3 |
| photocathode prep chamber | 4.5 | steering magnets | 19.3 | keV beamline support structure | 6.5 |
| drill penetrations in concrete | 4.2 | SF6 tank | 11.3 | Addl. FY15 procurement total | 303.5 |
| assorted | 3.9 | waveguide | 3.8 | | |
| Credit card | 21.8 | SSG sensor | 1 | FY14 + FY15 Procurements: | 670.8 |
| Machine shop | 40.8 | assorted | 9.4 | UITF Total Procurements | 1682 |
| total | 189 | total | 178.3 | | |

Labor-focused Tasks

- **Installation Group**
 - Cable trays, PSS conduit, penetration shielding, rack prep in advance of electric work, removal of rails and LCW piping Cave2, silver solder the quad magnet cooling tubes, waveguides
- Have our electricians install network cable
- Ops staff to install network switches, IOCs and software
- Magnet Mapping, quads and solenoids
- Mechanical Design: finish keV region, resume MeV region design
- DC Power: refurbish the racks for trim cards, re-install trim cards
- Low Level RF – finish construction of rf control boards
- High Power RF – work on the control panel and klystron rack
- Cryo: remove old transfer lines, install new ones, controls

Schedule Ramifications

- **Current status:**
 - **Proposed re-scoping into four “fences”:** Facilities, Cryo infrastructure including high power RF, HDIce/Polarized Target Beamline, and new-UITF
 - **Facilities and Cryo fairly well defined. Need to itemize the HDIce and new-UITF costs.**
 - **Waiting for charge codes...**
 - **I think schedule has slipped by at least two months**
 - **No final word yet on CTF schedule, or whether Physics will support HDIce budget request for required work that precedes beam tests at UITF. These factor help gauge the relevance of August 2016 schedule milestone.**