RPC gas system installation (step by step plan)

(CUHK, 6/11/2009)

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Muon schedule related to gas system(v10.8) (highlighted in red)

1.7.9	**Install Muon RPC in EH-1**	**100 days**	**Mon 9/21/09**	**Thu 2/18/10**		
1.7.9.1	**RPC module delivery to SAB**	**22 days**	**Fri 9/25/09**	**Tue 10/27/09**		
1.7.9.2	RPC gas room installation	20 days	Mon 9/21/09	Fri 10/16/09		
1.7.9.3	**RPC support installation**	**23 days**	**Thu 10/8/09**	**Tue 11/10/09**		
1.7.9.3.1	Transport individual supports through tunnel to EH	5 days	Thu 10/8/09	Wed 10/14/09	116,2191SS-1 day	64SF-5 days,2202,2134SS
1.7.9.3.2	Rig each unit from truck into EH	5 days	Fri 10/9/09	Thu 10/15/09	2192SS	2190SS-1 day
1.7.9.3.3	Block up each unit on floor and install wheels	5 days	Fri 10/9/09	Thu 10/15/09	2193SS-1 day	2191SS
1.7.9.3.4	Install drive system	5 days	Mon 10/12/09	Fri 10/16/09	2194SS-1 day	2192SS-1 day
1.7.9.3.5	Rig each unit onto rails	5 days	Tue 10/13/09	Mon 10/19/09	2195SS	
1.7.9.3.6	Roll each unit to far side of EH	5 days	Tue 10/13/09	Mon 10/19/09	2124	
1.7.9.3.7	Install individual module sub-supports on each unit	20 days	Tue 10/13/09	Tue 11/10/09	2195SS,220	
1.7.9.3.8	Install Cable Trays	20 days	Tue 10/13/09	Mon 11/9/09	2196SS	
1.7.9.3.9	Lay HV cables in trays	20 days	Tue 10/13/09	Mon 11/9/09	2197SS	
1.7.9.3.10	Lay signal cables in trays	20 days	Tue 10/13/09	Mon 11/9/09	2197SS	2203FS-3 days,2204
1.7.9.3.11	Lay gas pipes in trays	20 days	Tue 10/13/09	Mon 11/9/09	2197SS	2203FS-3 days,2204
1.7.9.4	**RPC module installation**	**4 days**	**Tue 11/10/09**	**Fri 11/13/09**		
1.7.9.5	**RPC utilities installation**	**10 days**	**Thu 11/12/09**	**Wed 11/25/09**		
1.7.9.5.1	Install Racks	5 days	Thu 11/12/09	Wed 11/18/09	2206SS+1	
1.7.9.5.2	Attach FEC & RPCIs	5 days	Thu 11/12/09	Wed 11/18/09	2208SS	
1.7.9.5.3	Install HV fanouts	8 days	Fri 11/13/09	Tue 11/24/09	2208SS+1 day	2099SF-1 day
1.7.9.5.4	Install gas distribution/digital bubbler	8 days	Fri 11/13/09	Tue 11/24/09	2208SS+1 day	
1.7.9.5.5	Install signal ROT	8 days	Fri 11/13/09	Tue 11/24/09	2208SS+1 day	
1.7.9.5.6	Connect cross links: HV & Signal Cables, Gas Pipes	7 days	Fri 11/13/09	Mon 11/23/09	2208SS+1 day	2214
1.7.9.5.7	Plug in RPC utilities	2 days	Tue 11/24/09	Wed 11/25/09	2213	2216
1.7.9.6	**Route utilities from rooms to poolside**	**12 days**	**Mon 11/30/09**	**Tue 12/15/09**		
1.7.9.6.1	Install flexible cable tray	2 days	Mon 11/30/09	Tue 12/1/09	2214	221
1.7.9.6.2	Route RPC HV cables	3 days	Wed 12/2/09	Fri 12/4/09	2216	
1.7.9.6.3	Route RPC signal cables	3 days	Wed 12/2/09	Fri 12/4/09	2216	
1.7.9.6.4	Route RPC gas pipes	10 days	Wed 12/2/09	Tue 12/15/09	2216	2220
1.7.9.7	Run & Test completed RPC array	40 days	Wed 12/16/09	Thu 2/18/10	2219	2399

RPC gas room instal. 9/21-10/16

Racks/Cable tray instal. 10/13 – 11/9

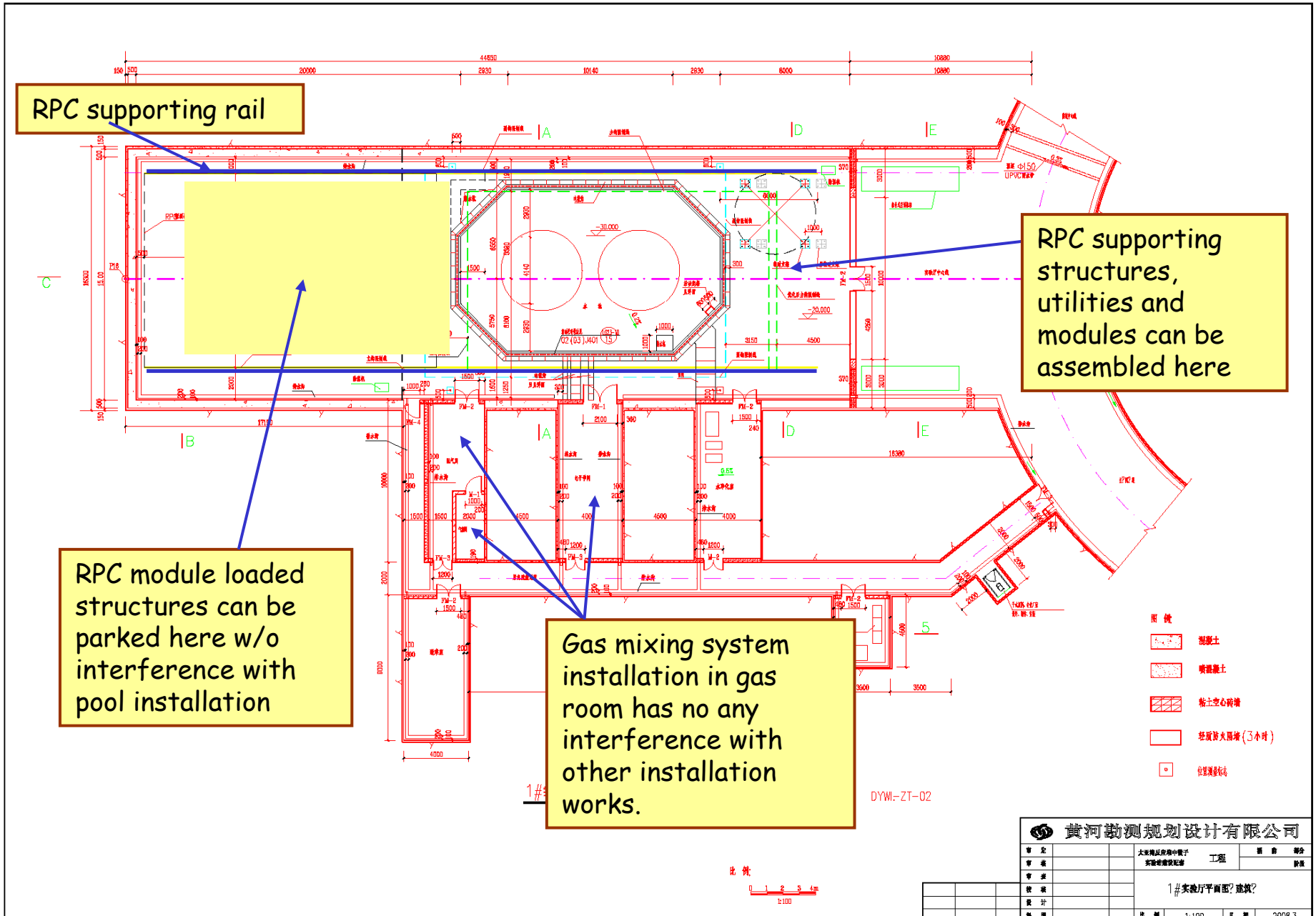
Lay tubing in trays. 10/13 – 11/9

Gas distri./bubbler instal. 11/13 – 11/24

Gas pipe instal. 12/2 – 12/15

RPC system test, 12/16 – 2/18/10

EH #1 floor plan (DYBEng-doc-53, Changgen Yang)



Step 1: Lay down gas tubing into cable tray.

Location: EH#1, Entrance area, where the supporting structure being assembled.

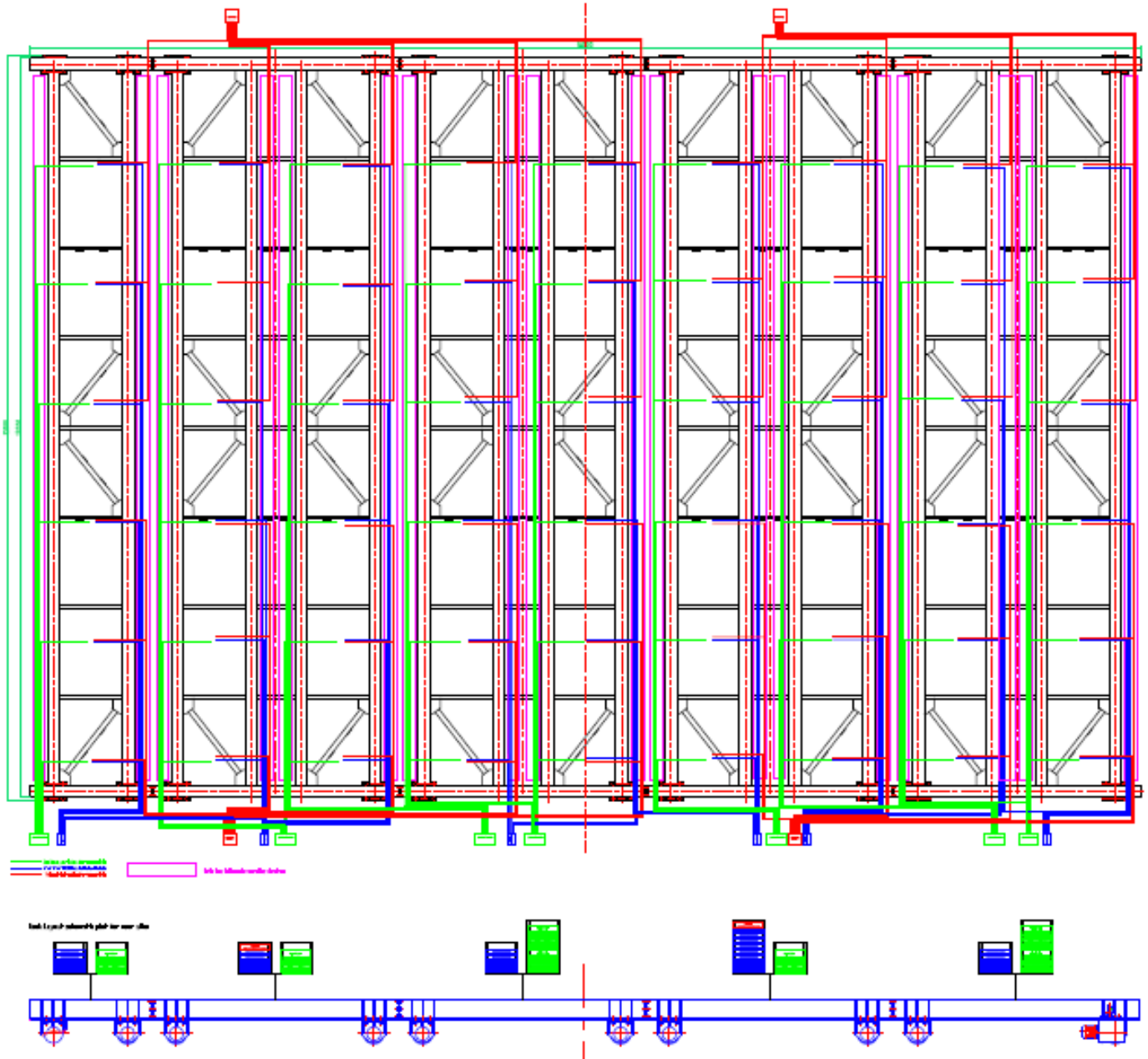
Supervisor: Princeton.

Installation team: Local.

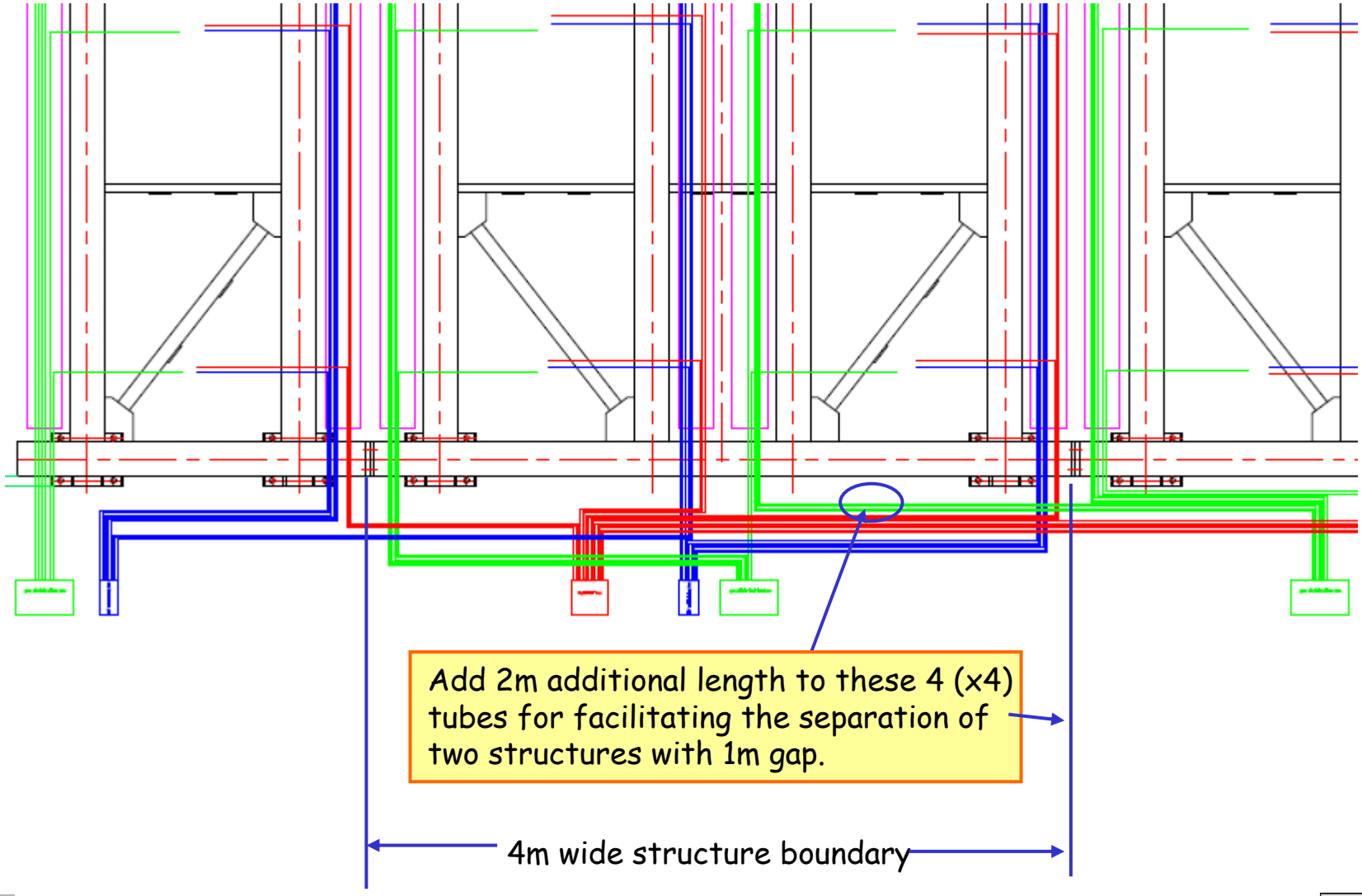
Task: Cut the tube to right length; cap and stick labels to two ends; lay down the tube into the right cable tray and tie a bundle together.

Work load: 216 tubes into 9 cable trays.

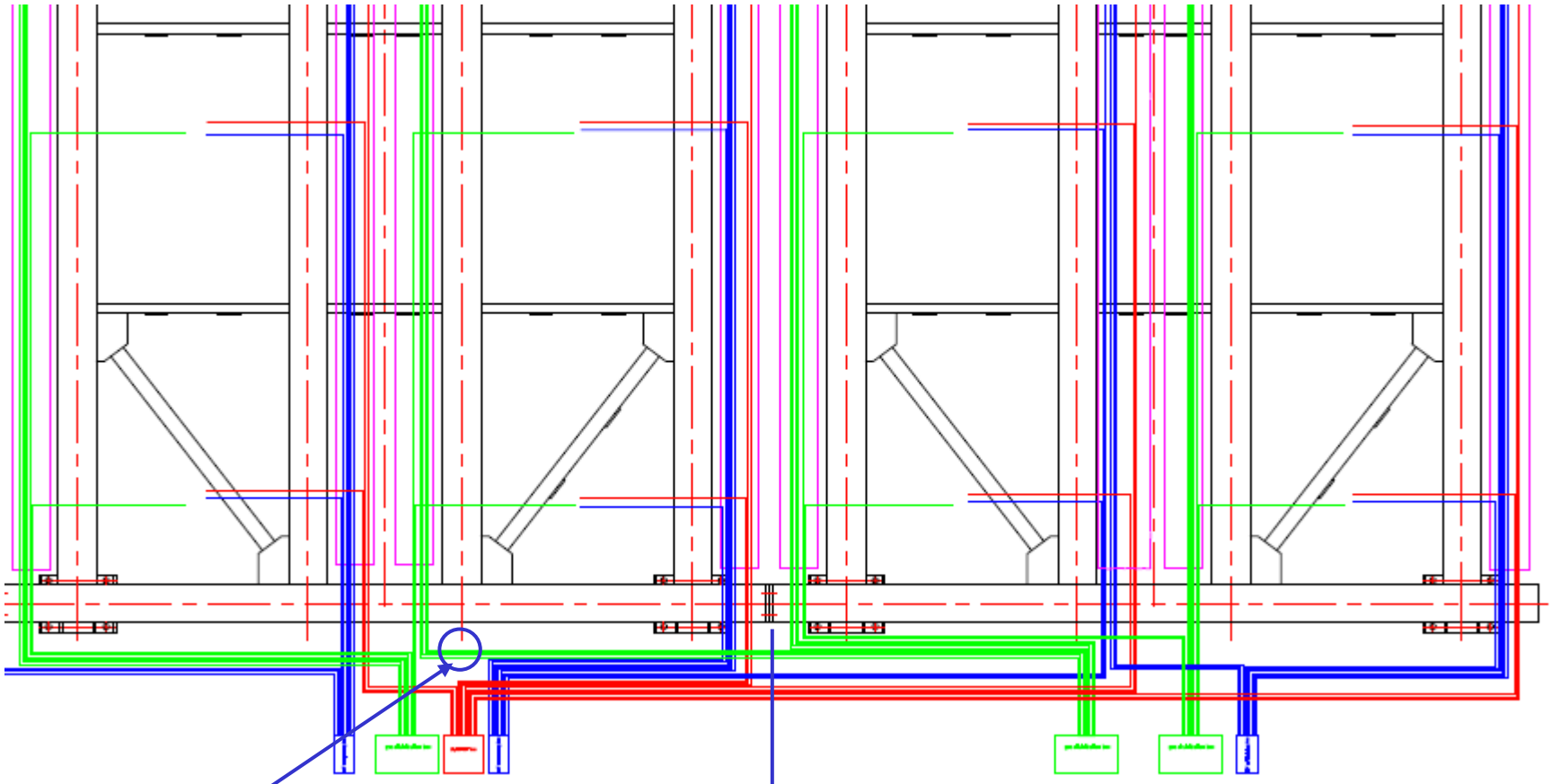
Layout of gas tubing



Separating two structures with 1m gap



Separating two structures with 1m gap (cont'd)



Add additional 2m length to these 4 (x4) tubes for facilitating the separation of two structures with 1m gap.

4m wide structure boundary

Individual tube length (m)

Tubing length	Column	Row1	Row2	Row3	Row4	Row5	Row6
	1	5.48	7.48	9.48	11.48	13.48	15.48
	2	6.39	8.39	10.39	12.39	14.39	16.39
	3	4.48	6.48	14.48	16.48	18.48	20.48
	4	6.79	8.79	10.39	12.39	14.39	16.39
	5	4.88	6.88	8.88	10.88	12.88	14.88
	6	6.39	8.39	10.39	12.39	14.39	16.39
	7	4.48	6.48	14.48	16.48	18.48	20.48
	8	6.79	8.79	10.39	12.39	14.39	16.39
	9	4.88	6.88	8.88	10.88	12.88	14.88

total inlet/outlet	618.16
total(2 inlet/outlet)	2472.6

Individual tube label

Inlet tubing label	Column	Row1	Row2	Row3	Row4	Row5	Row6
Branch 1	1	H1C1R1B1In	H1C1R2B1In	H1C1R3B1In	H1C1R4B1In	H1C1R5B1In	H1C1R6B1In
	2	H1C2R1B1In	H1C2R2B1In	H1C2R3B1In	H1C2R4B1In	H1C2R5B1In	H1C2R6B1In
	3	H1C3R1B1In	H1C3R2B1In	H1C3R3B1In	H1C3R4B1In	H1C3R5B1In	H1C3R6B1In
	4	H1C4R1B1In	H1C4R2B1In	H1C4R3B1In	H1C4R4B1In	H1C4R5B1In	H1C4R6B1In
	5	H1C5R1B1In	H1C5R2B1In	H1C5R3B1In	H1C5R4B1In	H1C5R5B1In	H1C5R6B1In
	6	H1C6R1B1In	H1C6R2B1In	H1C6R3B1In	H1C6R4B1In	H1C6R5B1In	H1C6R6B1In
	7	H1C7R1B1In	H1C7R2B1In	H1C7R3B1In	H1C7R4B1In	H1C7R5B1In	H1C7R6B1In
	8	H1C8R1B1In	H1C8R2B1In	H1C8R3B1In	H1C8R4B1In	H1C8R5B1In	H1C8R6B1In
	9	H1C9R1B1In	H1C9R2B1In	H1C9R3B1In	H1C9R4B1In	H1C9R5B1In	H1C9R6B1In

	Column	Row1	Row2	Row3	Row4	Row5	Row6
Branch 2	1	H1C1R1B2In	H1C1R2B2In	H1C1R3B2In	H1C1R4B2In	H1C1R5B2In	H1C1R6B2In
	2	H1C2R1B2In	H1C2R2B2In	H1C2R3B2In	H1C2R4B2In	H1C2R5B2In	H1C2R6B2In
	3	H1C3R1B2In	H1C3R2B2In	H1C3R3B2In	H1C3R4B2In	H1C3R5B2In	H1C3R6B2In
	4	H1C4R1B2In	H1C4R2B2In	H1C4R3B2In	H1C4R4B2In	H1C4R5B2In	H1C4R6B2In
	5	H1C5R1B2In	H1C5R2B2In	H1C5R3B2In	H1C5R4B2In	H1C5R5B2In	H1C5R6B2In
	6	H1C6R1B2In	H1C6R2B2In	H1C6R3B2In	H1C6R4B2In	H1C6R5B2In	H1C6R6B2In
	7	H1C7R1B2In	H1C7R2B2In	H1C7R3B2In	H1C7R4B2In	H1C7R5B2In	H1C7R6B2In
	8	H1C8R1B2In	H1C8R2B2In	H1C8R3B2In	H1C8R4B2In	H1C8R5B2In	H1C8R6B2In
	9	H1C9R1B2In	H1C9R2B2In	H1C9R3B2In	H1C9R4B2In	H1C9R5B2In	H1C9R6B2In

Question #1

The prototype gas system at IHEP has used 6mm OD tubing while the fitting used in this gas system is $\frac{1}{4}$" OD polyflo fitting.

Can we decide the tube size for the gas system at EH#1 (and near future #2 and #3) is 6mm OD, and ordered in China? Can IHEP provide the local company's name?

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Step 2: Install gas mixing system in gas room.

Location: Gas room.

Supervisor: Princeton.

Installation team: Princeton and local.

Task: Install the gas control crates and mixing panel onto racks, install gas cabinet, connect gas cylinders and exhaust duct, install GC system and connect to gas mixture, install 1 PC in gas room, test entire mixing system.

Work load: 1 mixing panel, 4 crates, 1 gas cabinet, 1 auto switchover, 3 manual switchover panels, 2 6-pack Ar, 2 isobutane, 2 SF6, 2 R134A cylinders, 1 exhaust duct.

Step 3: Install gas distribution/digital bubbler crates onto racks.

Location: EH#1 (Entrance area?) and gas mixing room.

Supervisor: Princeton.

Installation team: Princeton, local.

Task: Mount the distribution/digital bubbler readout crates onto racks, filling oil into bubblers, connect gas tubes into correct channels (both inlet and outlet), connect flat cable, USB extenders, Ethernet cable, USB-RS232 cables, install 1 PCs in electronics room. Test the entire system with Ar gas.

Work load: 7 gas distribution/digital bubbler crates, 108 gas inlet/108 gas outlet tubes connection, 1 PC, 1 Ethernet cable, 7 flat cables, 7 USB-RS232 converters.

Question #2

The PC installed in gas mixing room will have one Ethernet cable that needs to be connected to the digital bubbler readout crate at EH#1.

Can we use the same hole for the gas pipe on the wall to install this cable?

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Step 4: Install copper tubing from gas room to EH#1 :

Location: EH#1 and gas room.

Supervisor: Princeton.

Installation team: Local.

Task: Route $\frac{3}{4}$" copper tubing from gas room to EH #1 to reach the flexible gas hose. Install 12.3m long braided PTFE hose into flexible cable tray (see next slide).

Work load: Layout the route, cut copper tubing to right length, connect the copper tubes piece by piece, install the fixture at both ends.

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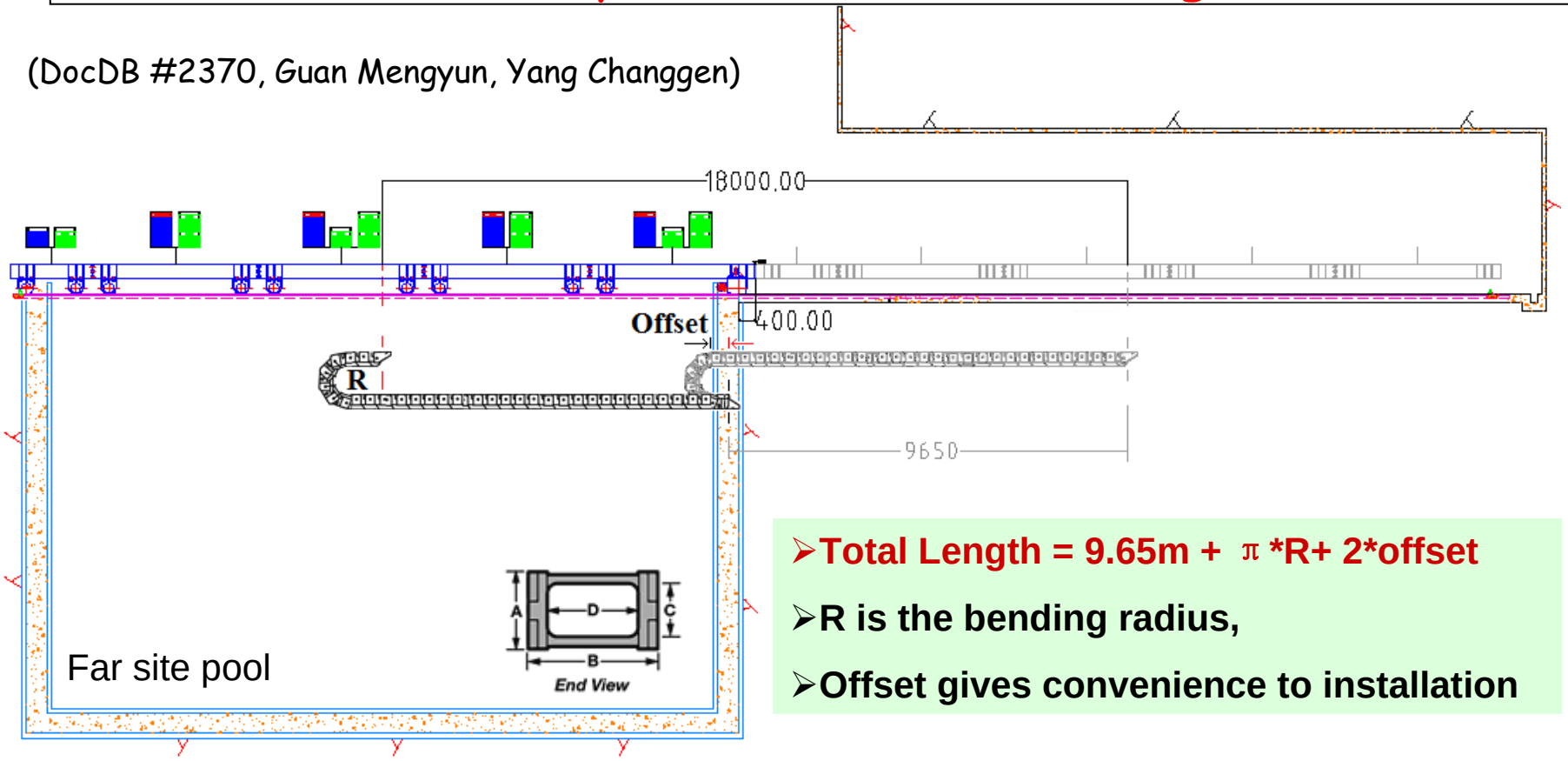
Flexible cable tray to avoid disconnecting the cables

(DocDB #2370, Guan Mengyun, Yang Changgen)



- **Total Length = 9.65m + π*R+ 2*offset**
- **R is the bending radius,**
- **Offset gives convenience to installation**

The configuration of the flexible cable tray is shown in the above plot,

One end of the flexible cable tray is fixed at the trench , the other end is fixed at the center of RPC support structure, *(details in next slides)*

Given R=0.2m, offset=1m, we need *12.3m* flexible cable tray for each site,

The RPC's will move as a single unit except for repairing.

Question #3

Can we decide the length of the flexible gas hose now? 12.3m?

Can we hire local skilled technician for installing the polyflo tubing, gas pipe, gas cylinders clamping fixtures, gas switchover panels? How to share the labor cost?

Step 5: Test entire system with RPC modules.

Location: EH#1, gas mixing room.

Supervisor: Princeton.

Installation team: Princeton, local.

Task: Install GC system, check the gas mixing ratio through GC; check the bubbling rate for each sub-branch, stability of the system, interlock system functioning.

Summary of the installation steps

Step #	Location	Supervisor	Instal team	Task	Work load	Start date	Finish date
1. Lay down gas tubing	EH #1, entrance area	Princeton	Local	Cut the tube to right length;	216 tubes,	10/13/2009	11/9/2009
into cable tray				cap and stick labels to two ends;	9 cable trays.		
				lay down the tube into the right cable tray,			
				tie a bundle together.			
2. Install gas mixing system	Gas room	Princeton	Princeton,	Instl gas cntrl crates and mix pnl on racks,	1 mixing panel,	10/13/2009	11/9/2009
			local.	install gas cabinet,	4 crates,		
				connect gas cylinders and exhaust duct,	1 gas cabinet,		
				install GC and connect to gas mixture,	1 auto switchover,		
				install a PC in gas room,	3 manual switchover,		
				test entire mixing system.	2 6-pack Ar cyl,		
					2 isobutane cyl,		
					2 SF6 cyl,		
					2 R134A cyl,		
					1 exhaust duct.		
3. Install gas distri.	EH #1 entrance area,	Princeton	Princeotn,	Mount the distri./bubbler readout crates onto racks,	7 gas distri/dgtl bubbler crates,	11/13/2009	11/24/2009
/digital bubbler crates	electronics room		local	filling oil into bubblers,	108 inlet/108 outlet tubes connection,		
				connect tubes into channels (inlet and outlet),	1 PC,		
				connect flat cable,	1 Ethernet cable,		
				USB extenders,	7 flat cables,		
				Ethernet cable,	7 USB-RS232 converters.		
				USB-RS232 cables,			
				install 1 PCs in electronics room,			
				test the entire system with compressed air.			
4. Install copper tubing	EH #1, gas room	Princeton	Local	Route ¾" copper tubing from gas room to EH #1,	Layout the route,	12/2/2009	12/15/2009
(gas room to EH#1)				install 12.3m long braised PTFE hose into flexible cable tray.	cut copper tubing to right length,		
					connect the copper tubes piece by piece,		
					install the fixture at both ends,		
					install 12.3m long hose into flexible tray.	11/30/2009	12/1/2009
5. Test entire system	EH#1,	Princeton	Princeton,	Check the gas mixing ratio through GC,		12/16/2009	2/18/2010
with RPC modules	gas room,		local	bubbling rate for each sub-branch,			
	electronics room			stability of the system,			
				interlock system functioning.			