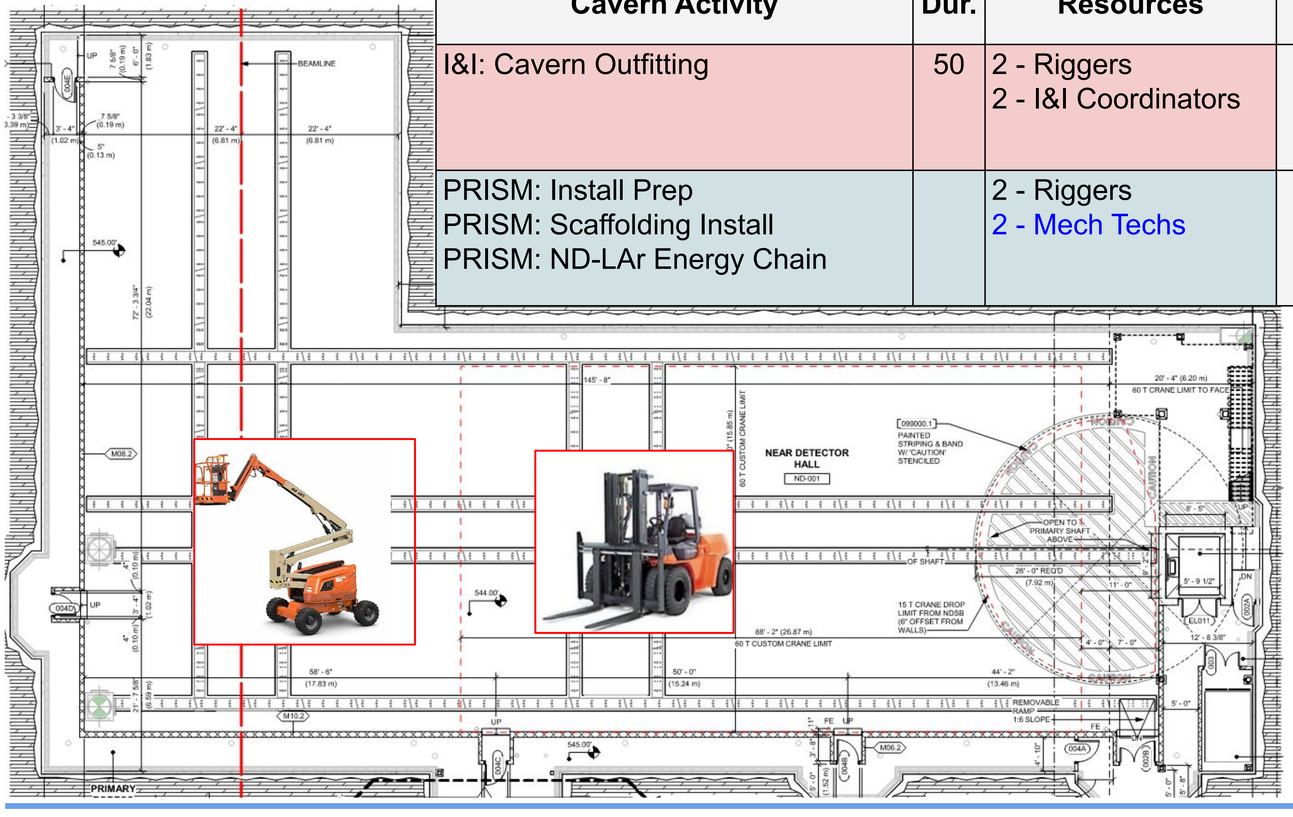
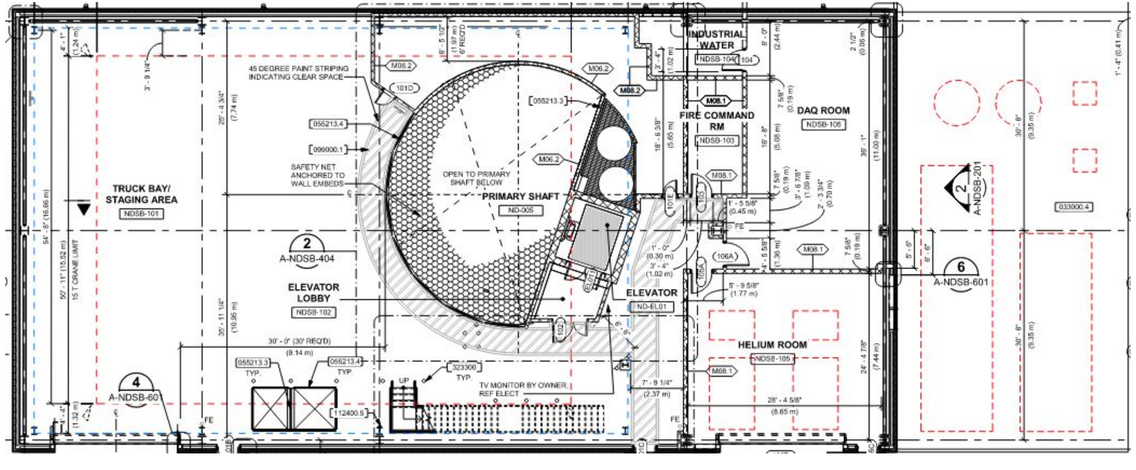
Step 1: Cavern Outfitting

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
I&I: Cavern Outfitting	50	2 - Riggers 2 - I&I Coordinators	**Critical Path**	Same as Cavern		No Add'l
PRISM: Install Prep PRISM: Scaffolding Install PRISM: ND-LAr Energy Chain		2 - Riggers 2 - Mech Techs	**Parallel**	Same as Cavern		No Add'l



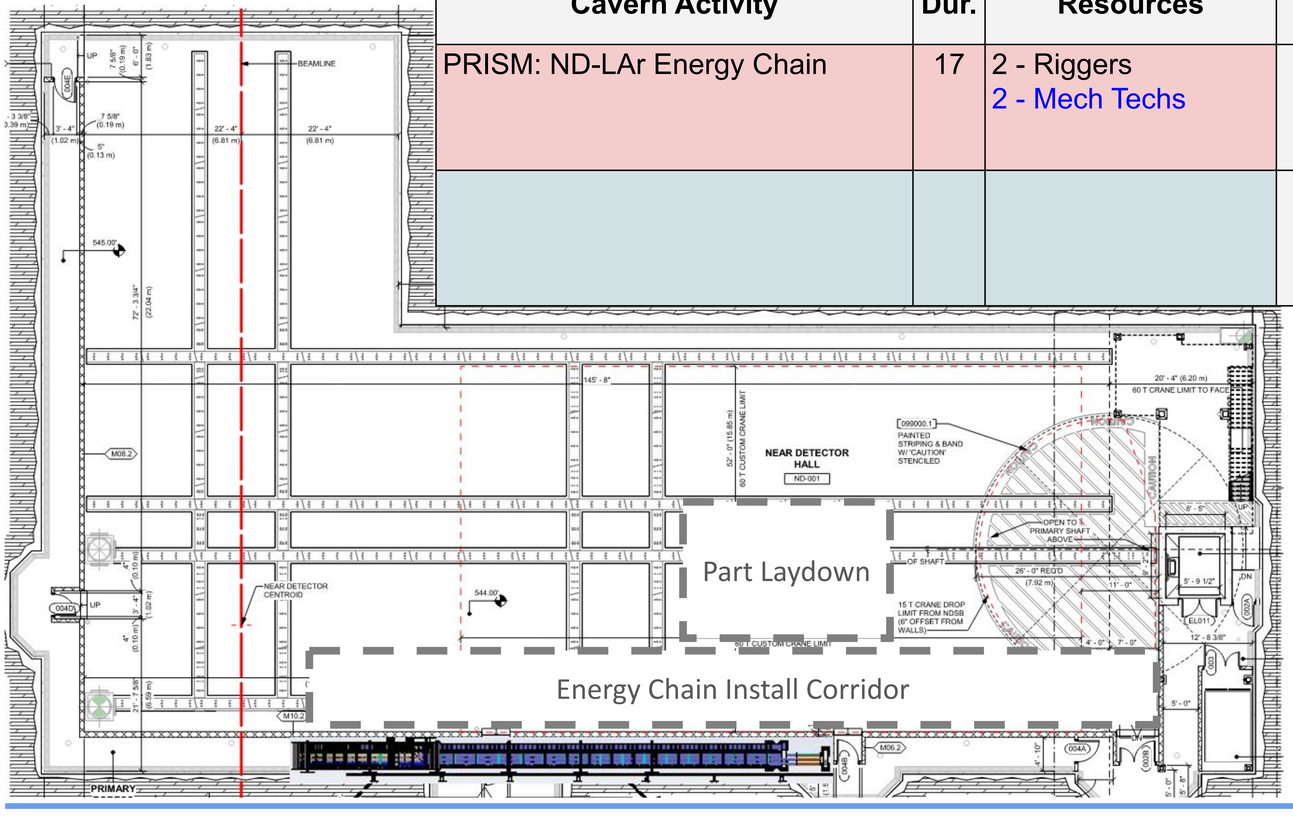


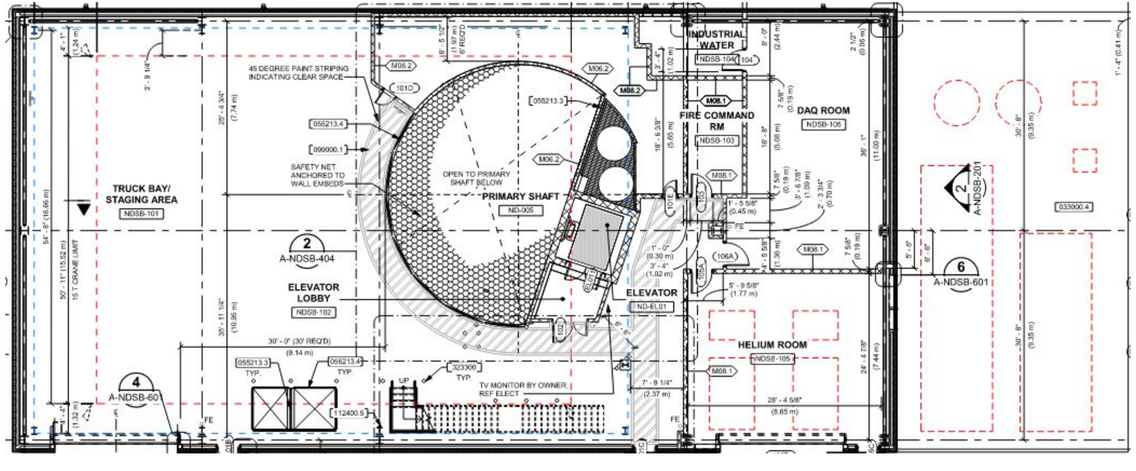
Inspect every feature that can affect integration or installation (Rails, Mezzanines, Corbels, any other NSCF/ND interface). 3D scan to update models where needed.

Step 2: ND-LAr Energy Chain Installation

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
PRISM: ND-LAr Energy Chain	17	2 - Riggers 2 - Mech Techs	**Critical Path**			
			Parallel	CRYO: External Cryogenic Tanks		1 - Riggers 2 - Mech Techs



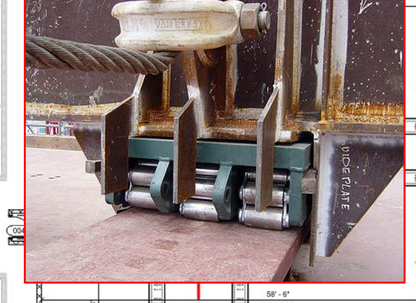


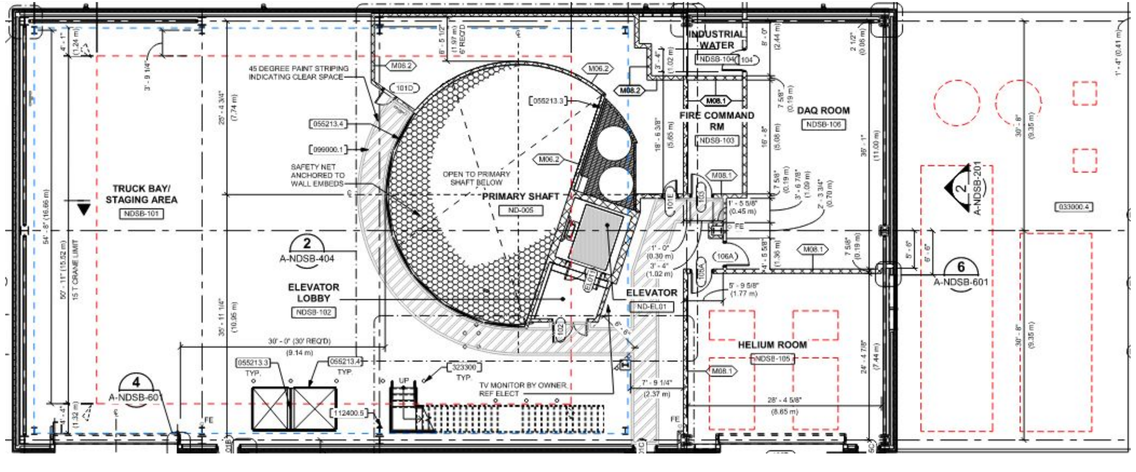
What equipment is required for installation?
What substeps are involved?

Step 3: Install the Cryostat PRISM Rollers

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
PRISM: ND-LAr Rollers	5	2 - Riggers	**Critical Path**			
CRST: Install Prep PRISM: Take down and re-assemble energy chain scaffolding	5	2 - Mech Techs	**Parallel**	CRYO: Cryo Controls (Surface)		2 - Mech Techs

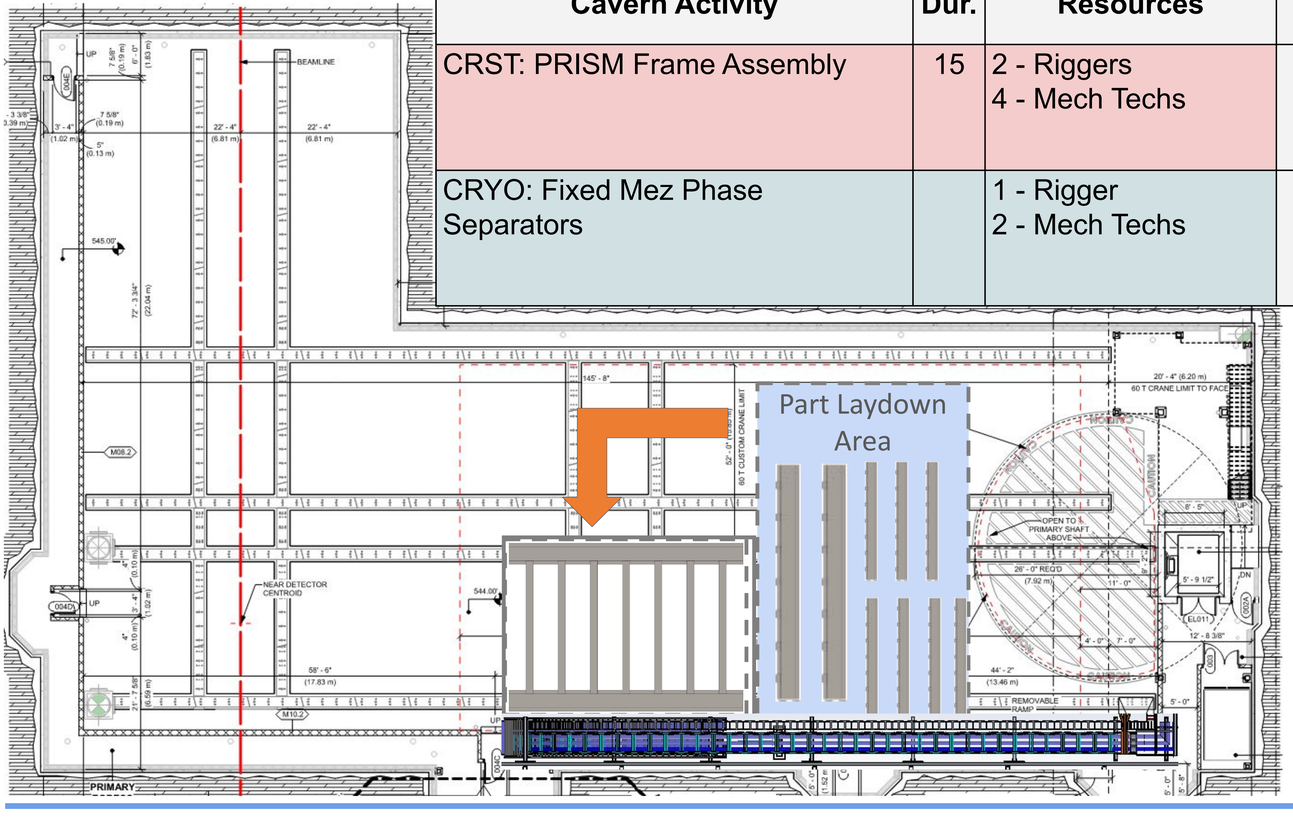


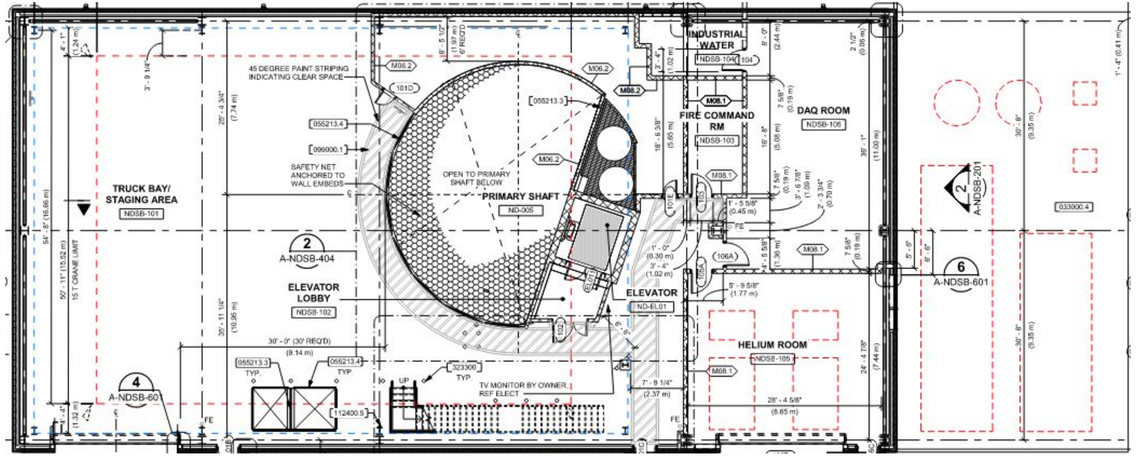


Step 4: PRISM Frame Assembly

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: PRISM Frame Assembly	15	2 - Riggers 4 - Mech Techs	**Critical Path**			
CRYO: Fixed Mez Phase Separators		1 - Rigger 2 - Mech Techs	**Parallel**			

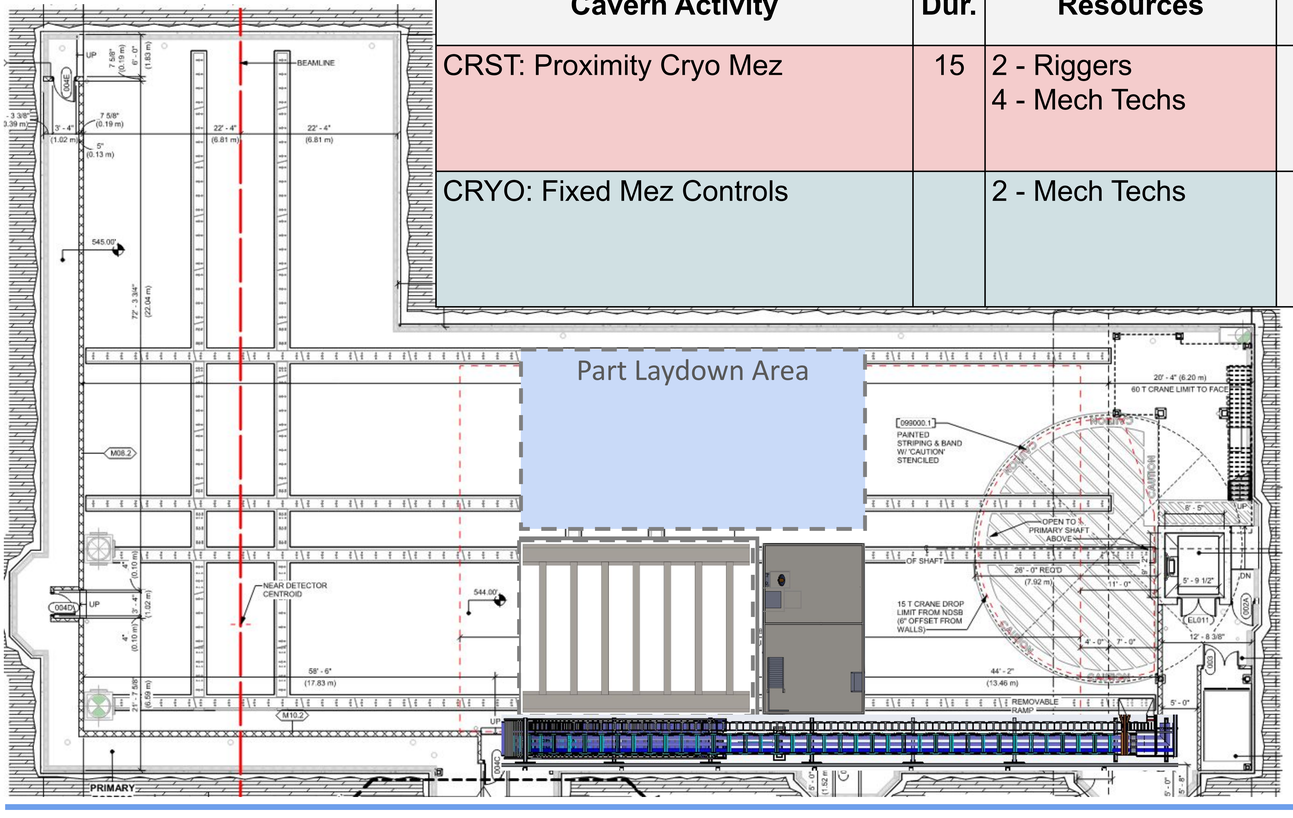


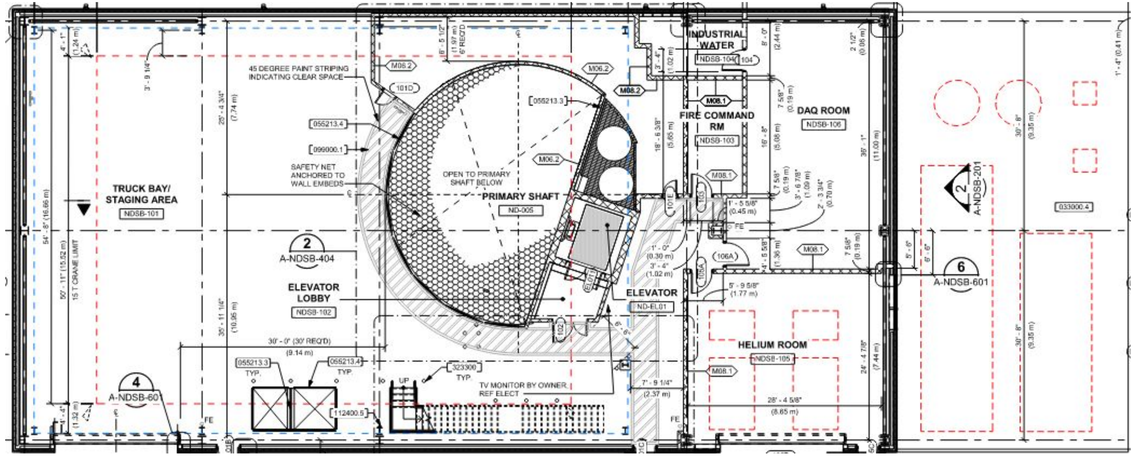


Step 5: Install the Cryostat Mezzanine

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Proximity Cryo Mez	15	2 - Riggers 4 - Mech Techs	**Critical Path**			
CRYO: Fixed Mez Controls		2 - Mech Techs	**Parallel**			

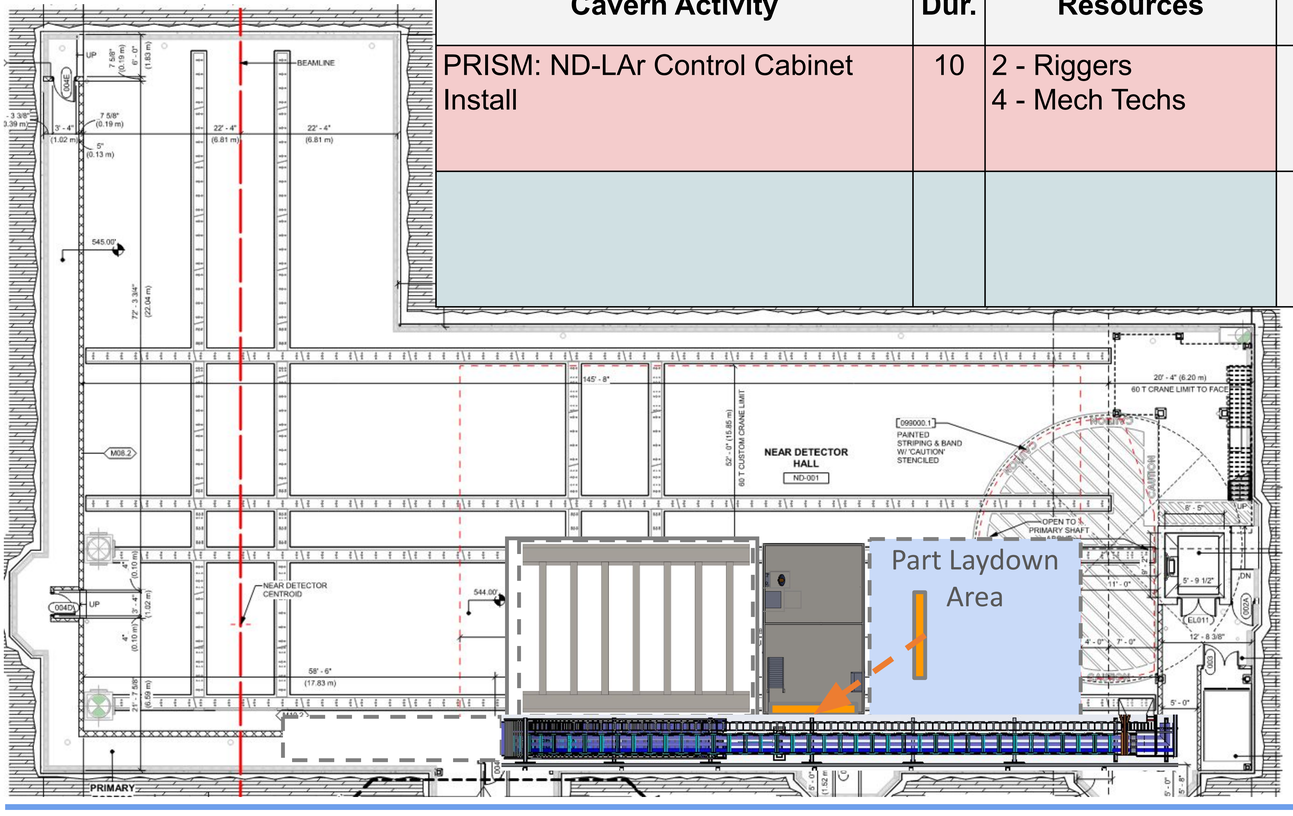


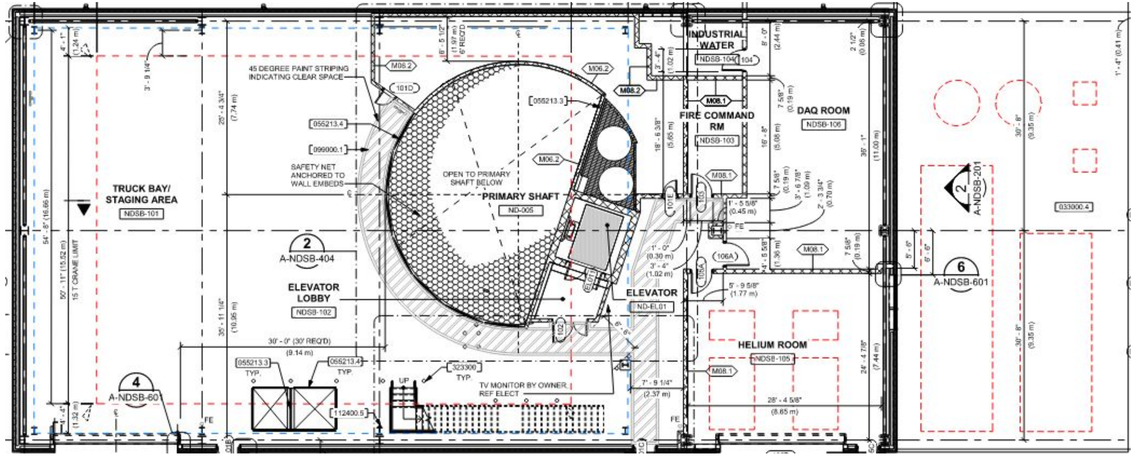


Step 6: ND-LAr Control Cabinet Install

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
PRISM: ND-LAr Control Cabinet Install	10	2 - Riggers 4 - Mech Techs	**Critical Path**			
			Parallel			





How much room will this need?

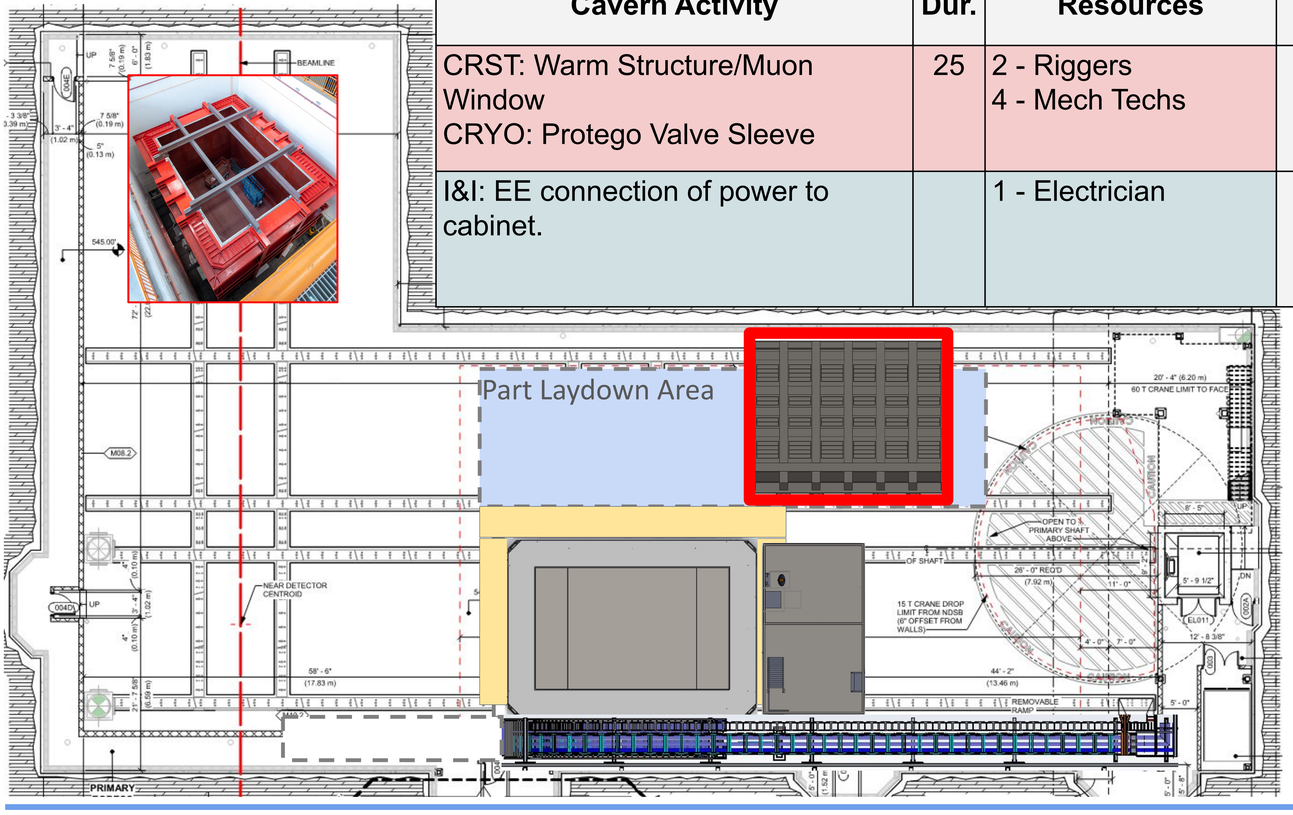
Where do we attach the cabinets?

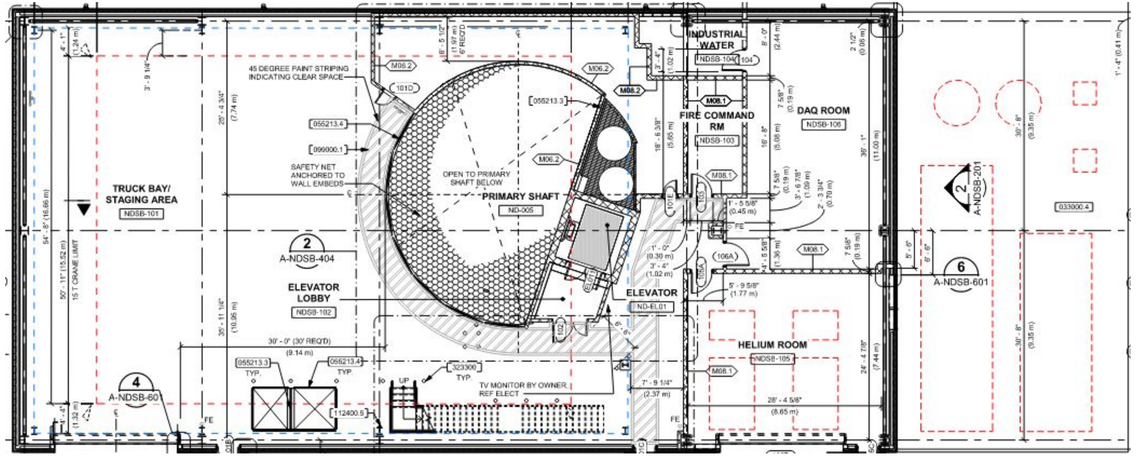
How do we connect the energy chain?

Step 7: Finish the Cryostat Warm Structure Walls

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Warm Structure/Muon Window CRYO: Protego Valve Sleeve	25	2 - Riggers 4 - Mech Techs	**Critical Path**			
I&I: EE connection of power to cabinet.		1 - Electrician	**Parallel**			



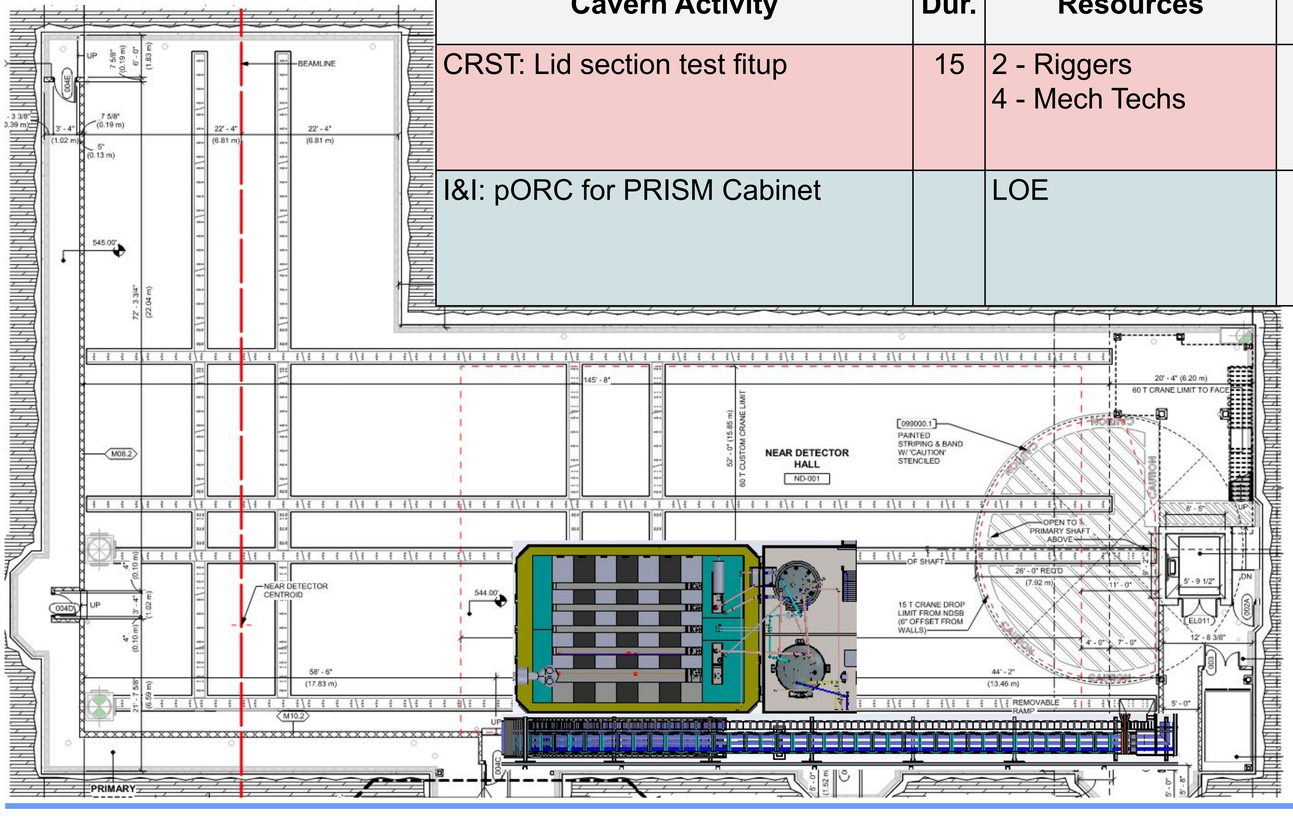


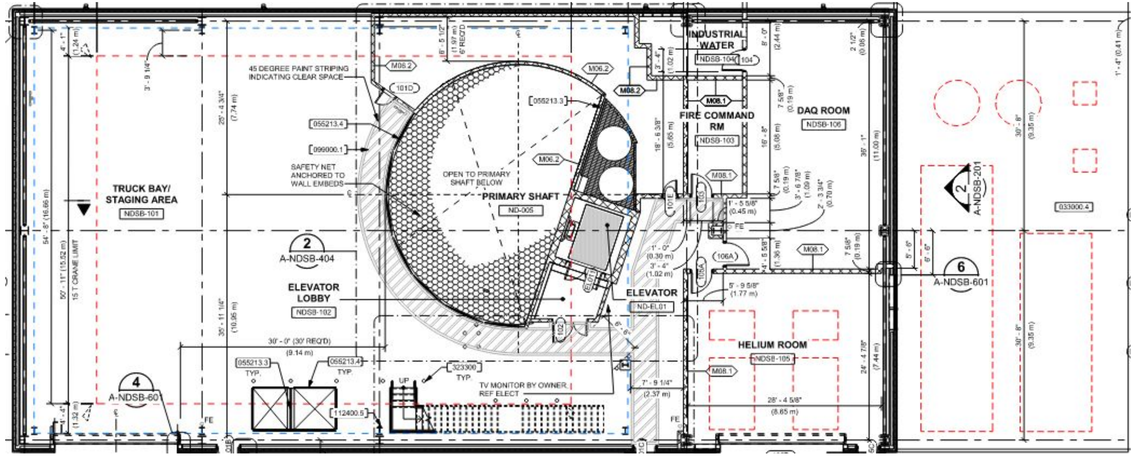
Scaffolding

Step 8: Lid Section Test

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Lid section test fitup	15	2 - Riggers 4 - Mech Techs	**Critical Path**			
I&I: pORC for PRISM Cabinet		LOE	**Parallel**			

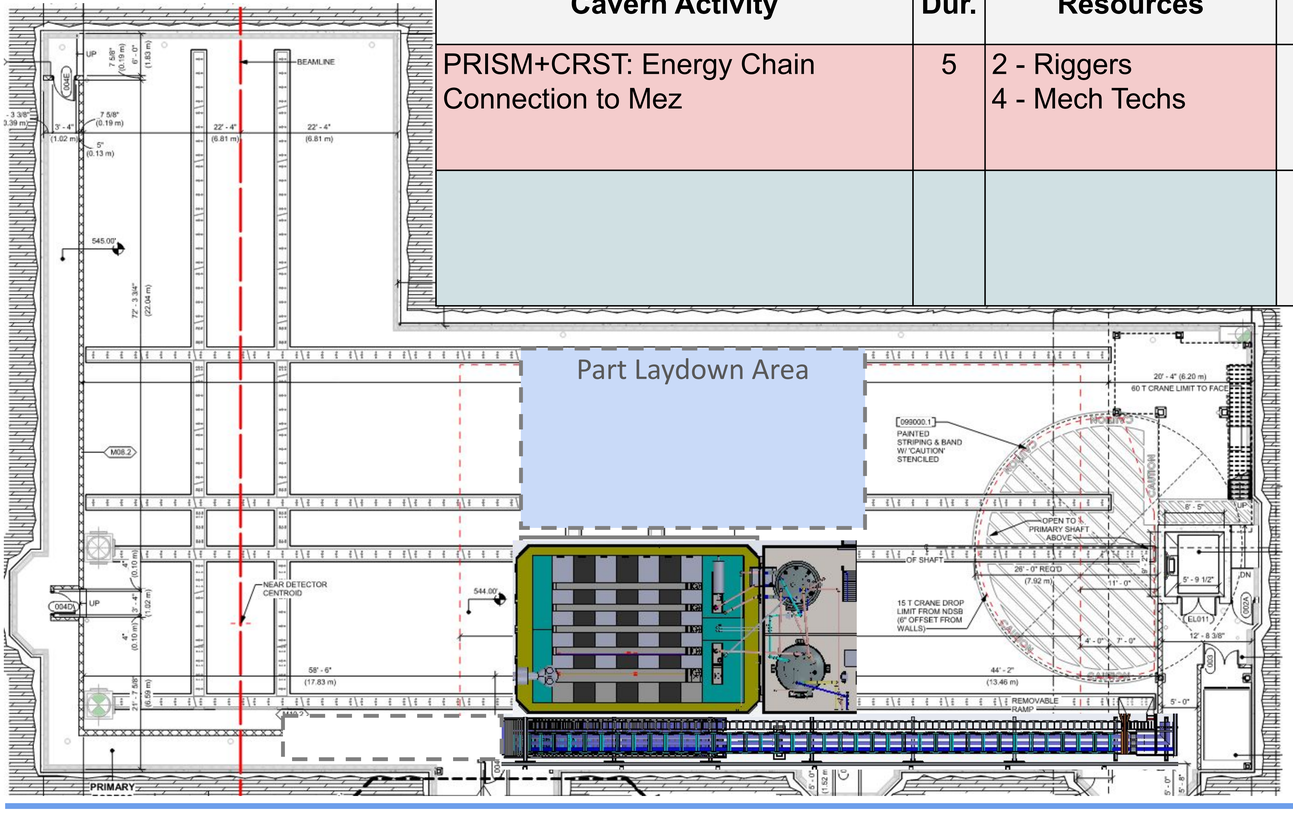


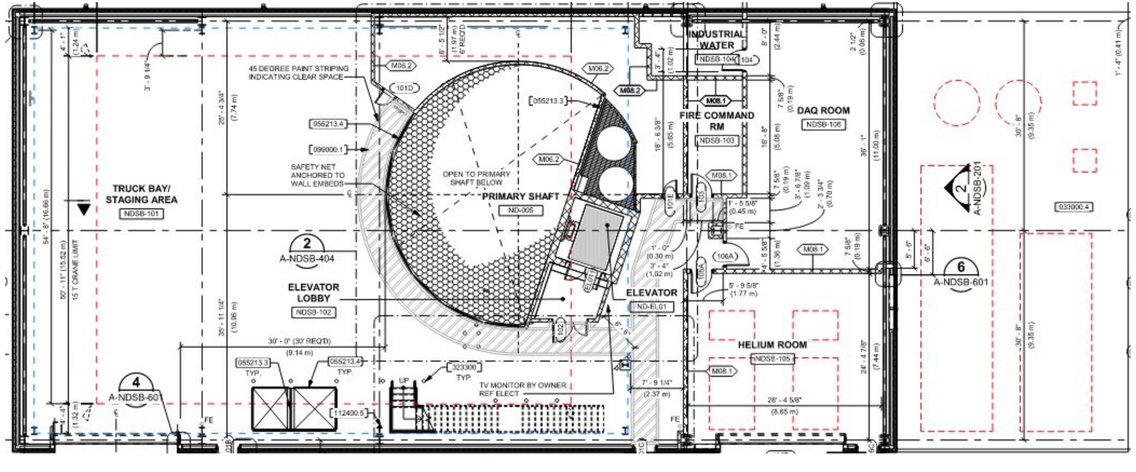


Step 9: Energy Chain Connection to Mez

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
PRISM+CRST: Energy Chain Connection to Mez	5	2 - Riggers 4 - Mech Techs	**Critical Path**			
			Parallel			

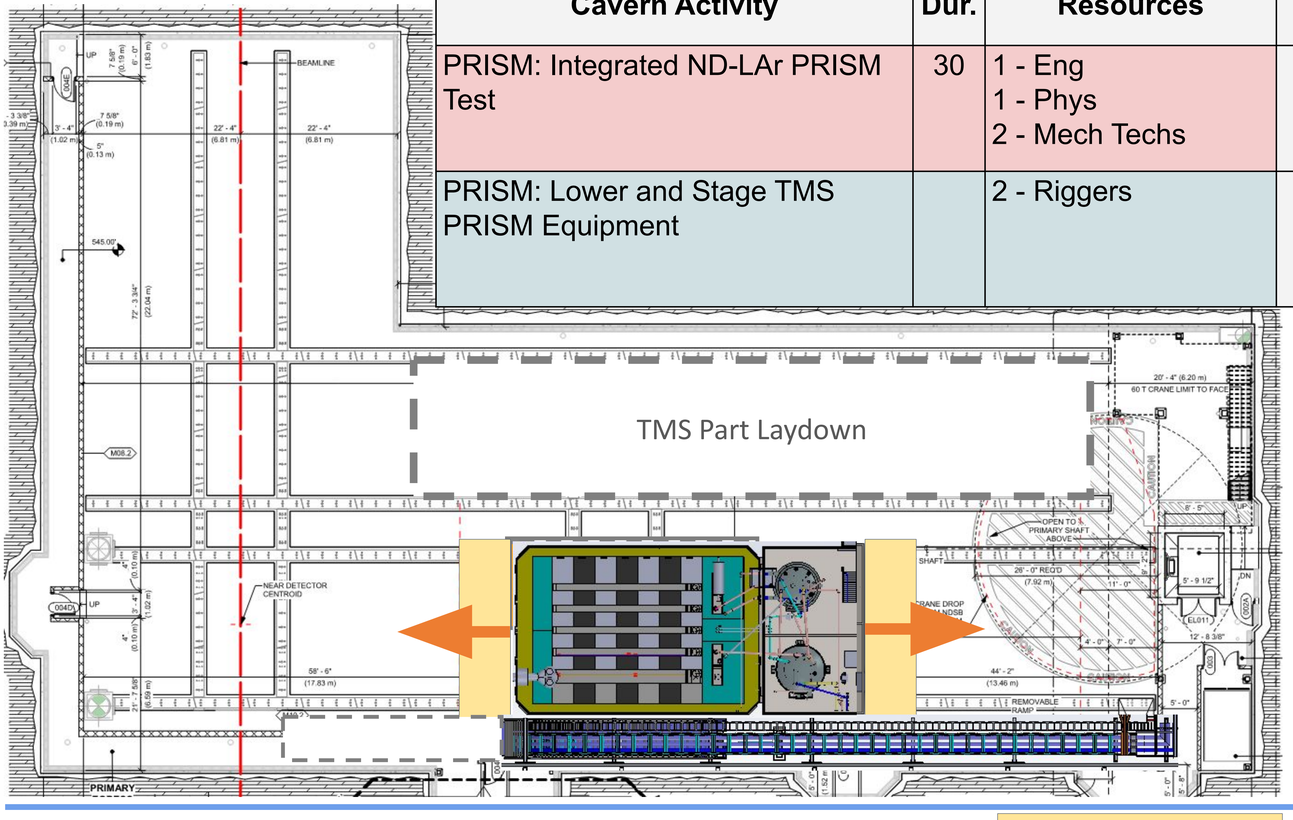


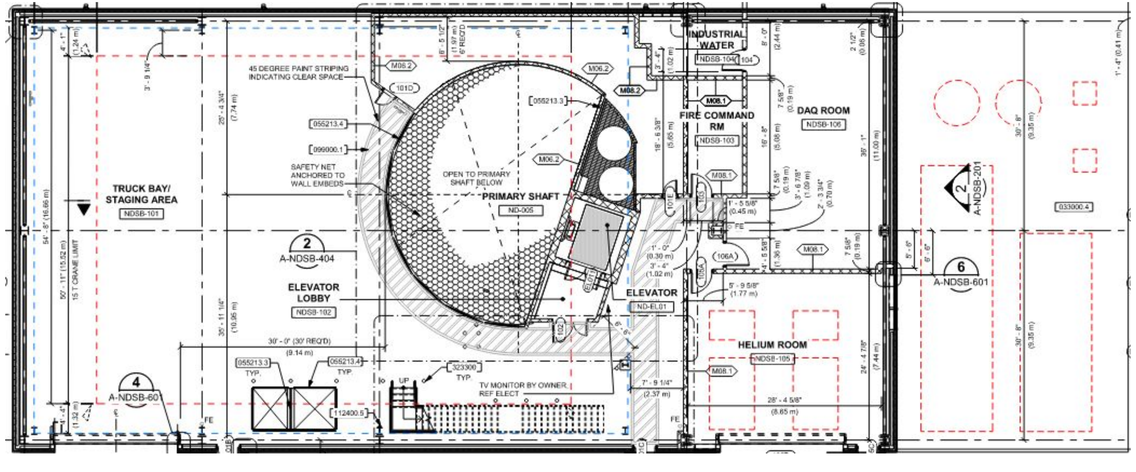


Step 10: Integrated ND-LAr PRISM Test

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
PRISM: Integrated ND-LAr PRISM Test	30	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
PRISM: Lower and Stage TMS PRISM Equipment		2 - Riggers	**Parallel**			



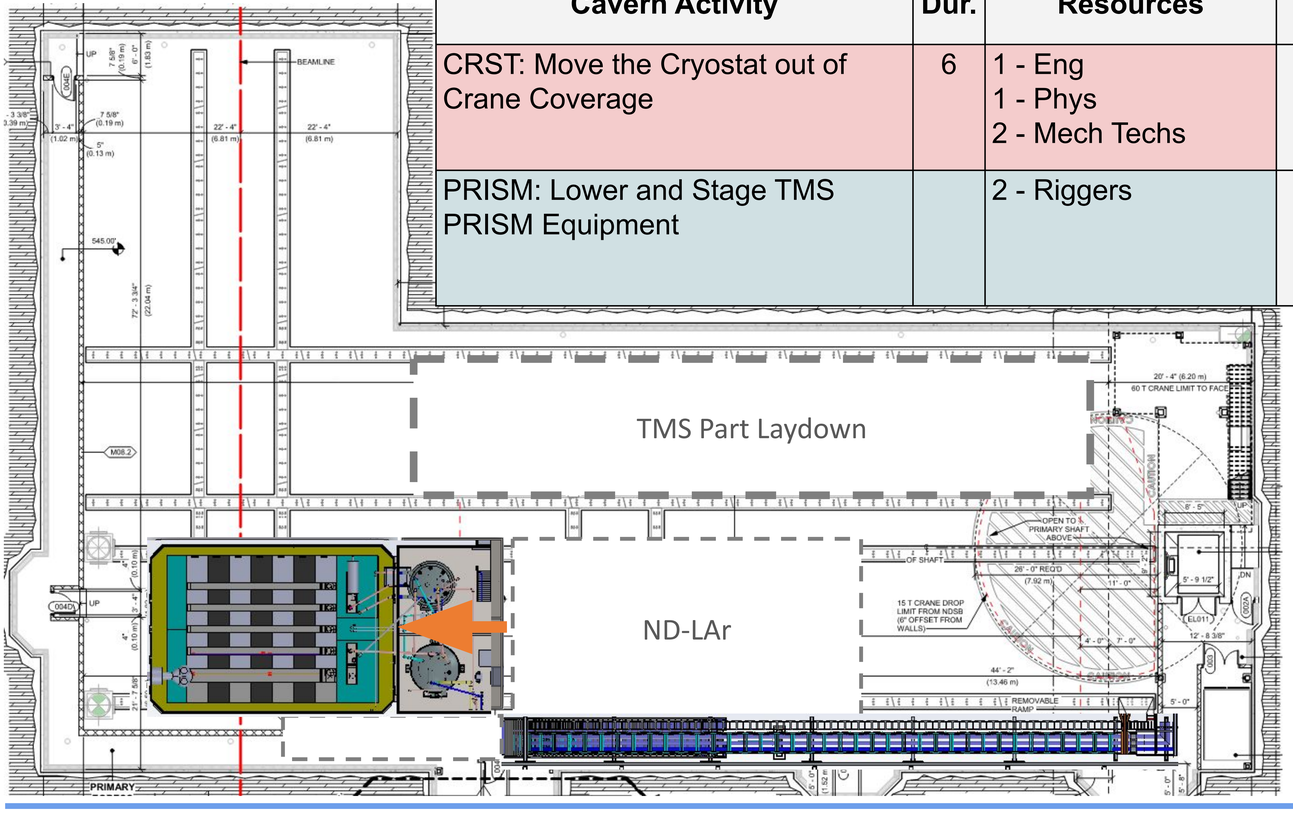


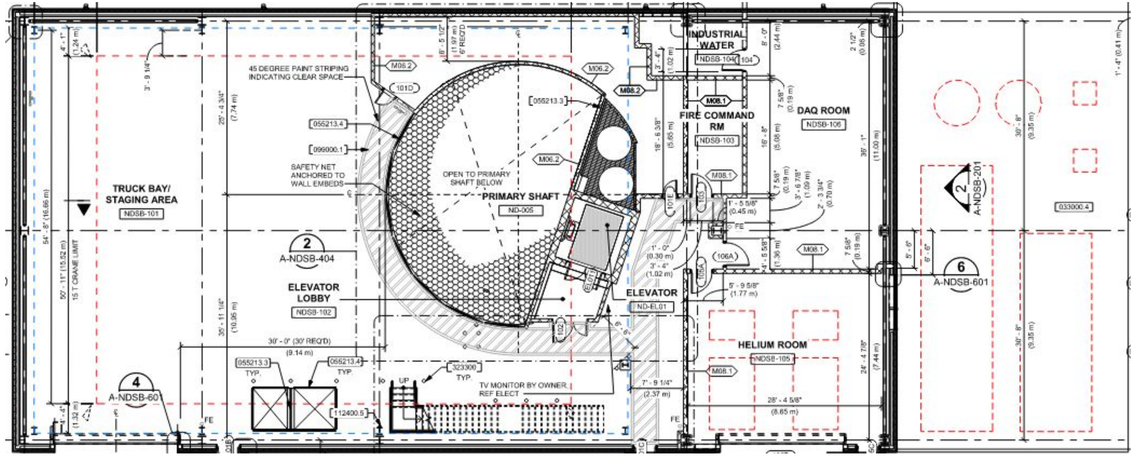
Movement Space

Step 11: Move the Cryostat out of Crane Coverage

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Move the Cryostat out of Crane Coverage	6	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
PRISM: Lower and Stage TMS PRISM Equipment		2 - Riggers	**Parallel**			

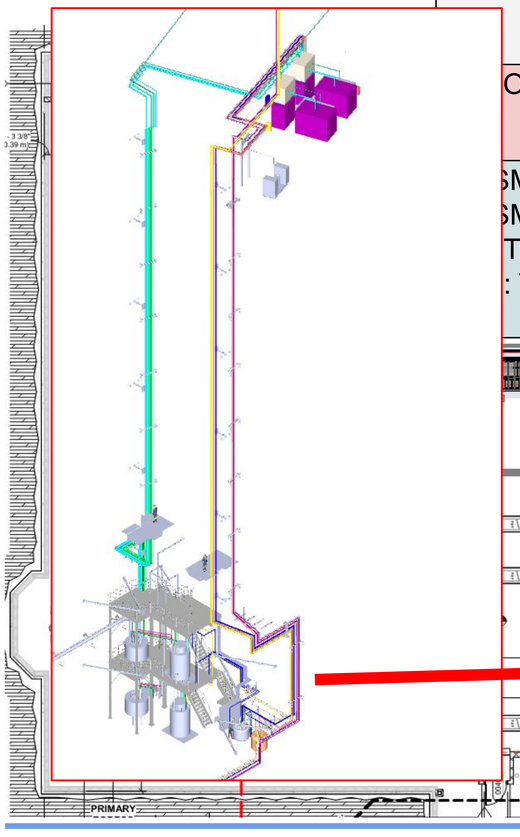


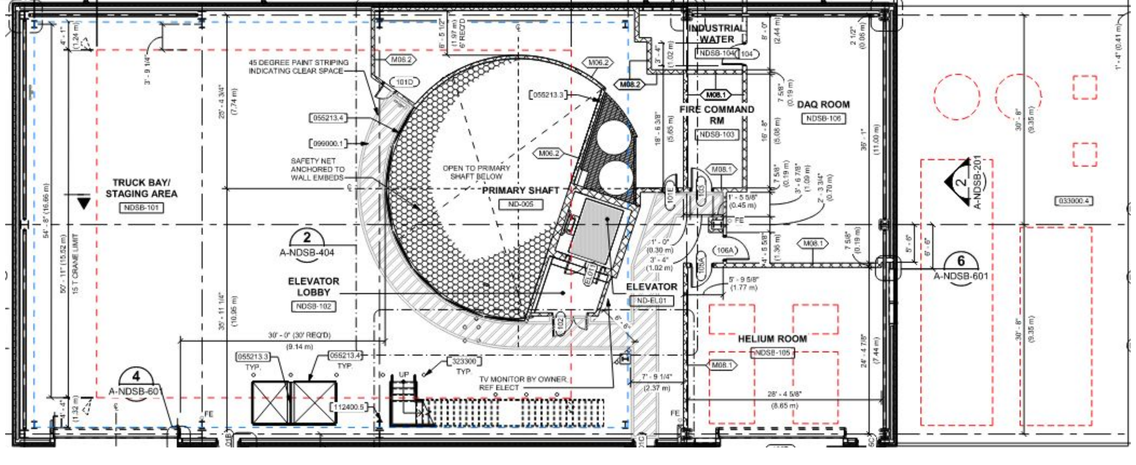


Step 12: LAr Shaft Piping Install

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
O: LAr Shaft Piping Install	65	Contract Labor	**Critical Path**			
SM: TMS Energy Chain SM: TMS Rollers T: Cryostat Warm Membrane welding : TMS Install Prep.		3 - Riggers 4 - Mech Techs	**Parallel**			



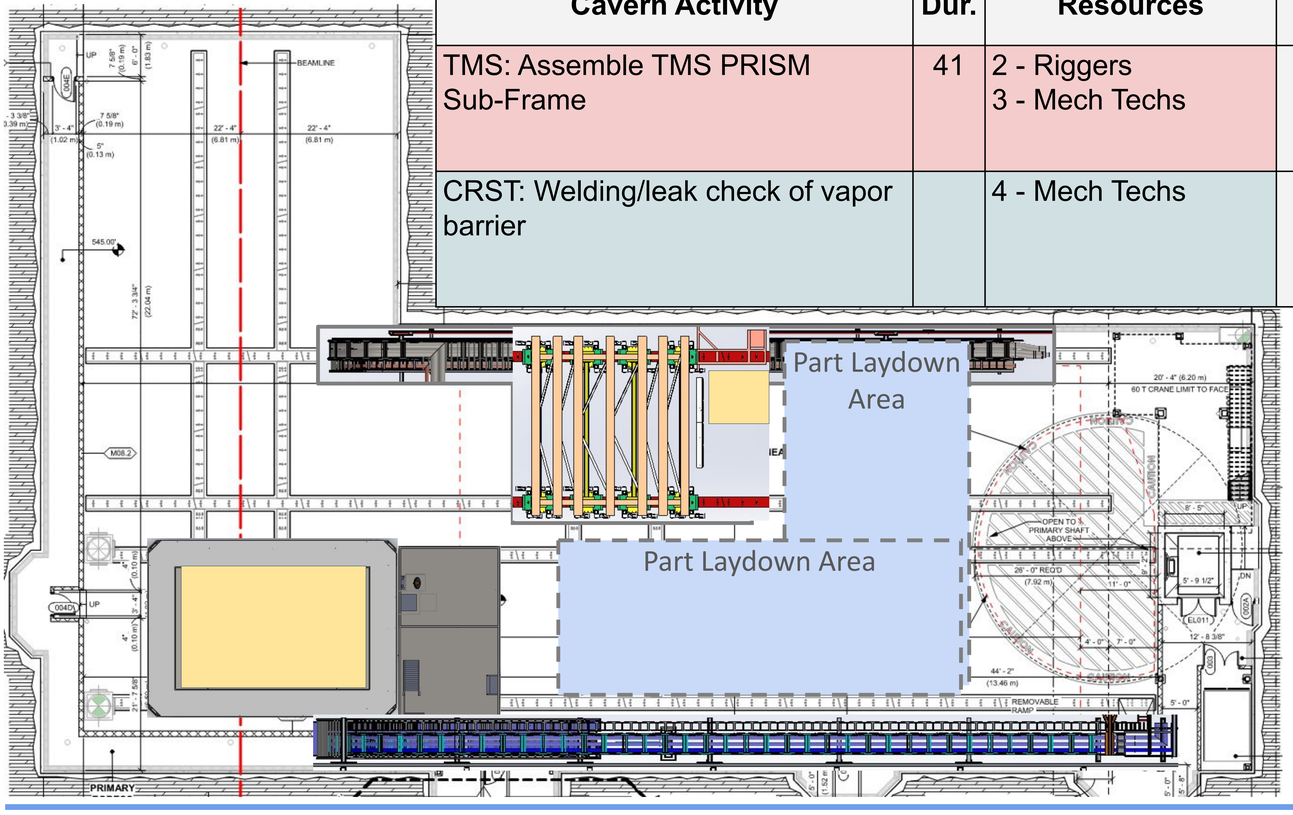


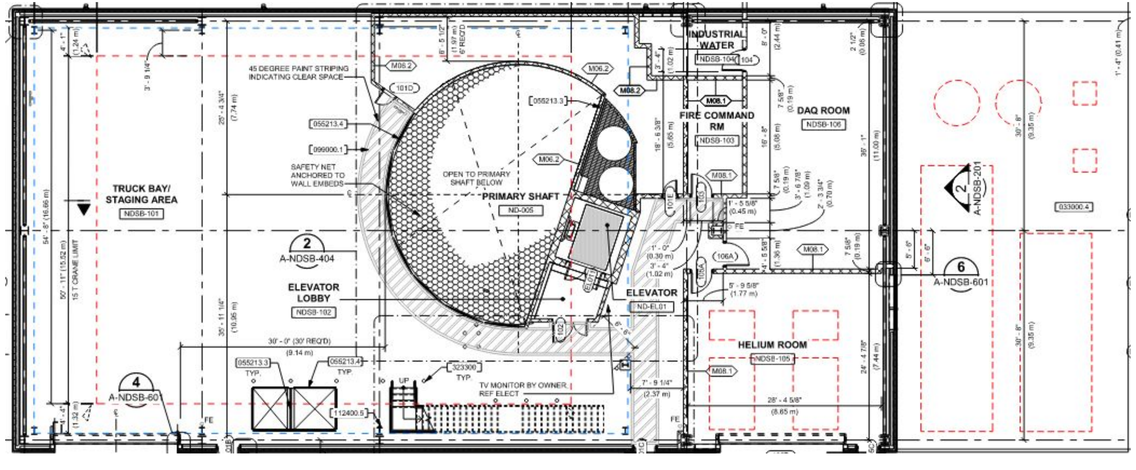
Exploring the possible scope transfer of 10 lines to NSCF.

Step 13: Assemble TMS PRISM Sub-Frame

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Assemble TMS PRISM Sub-Frame	41	2 - Riggers 3 - Mech Techs	**Critical Path**			
CRST: Welding/leak check of vapor barrier		4 - Mech Techs	**Parallel**			





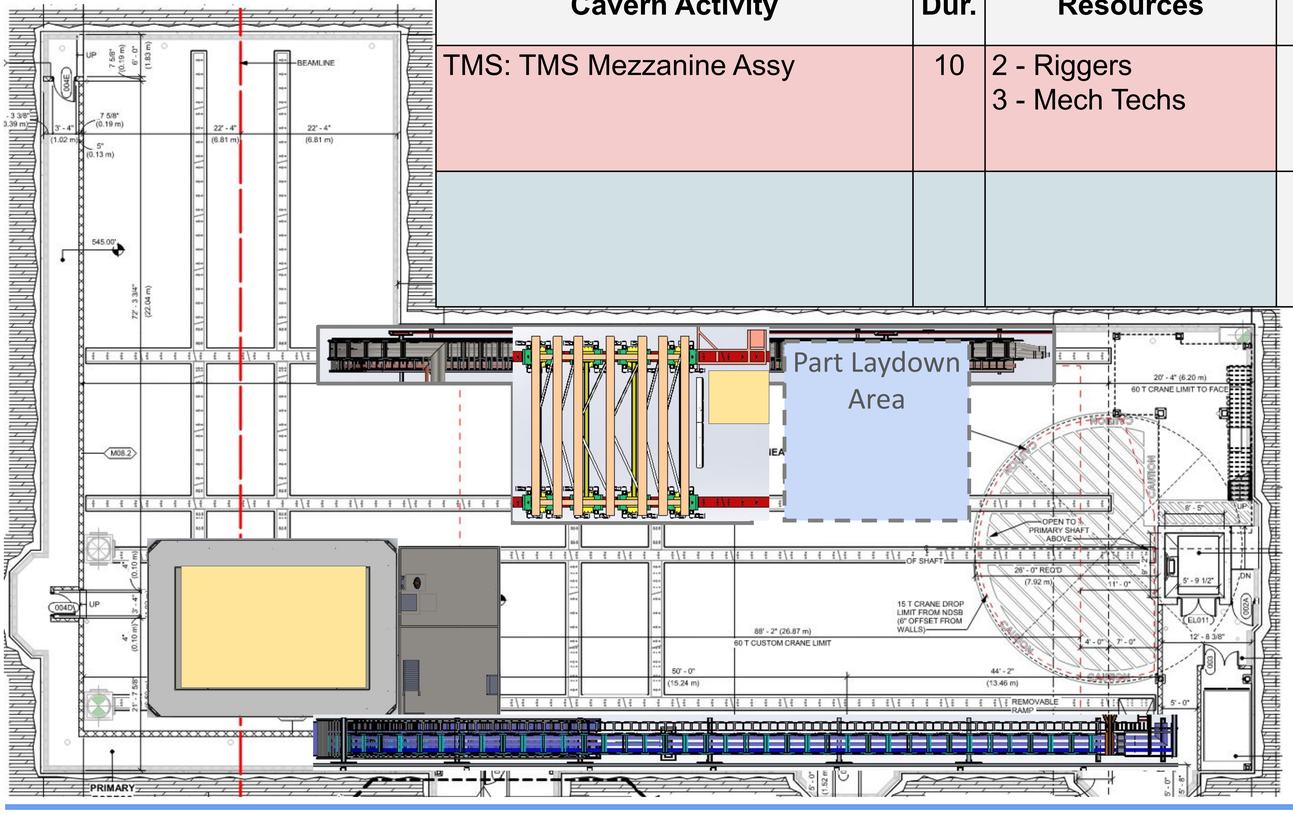
How many pieces will the frame be lowered in?
Will it be welded or bolted in the cavern?

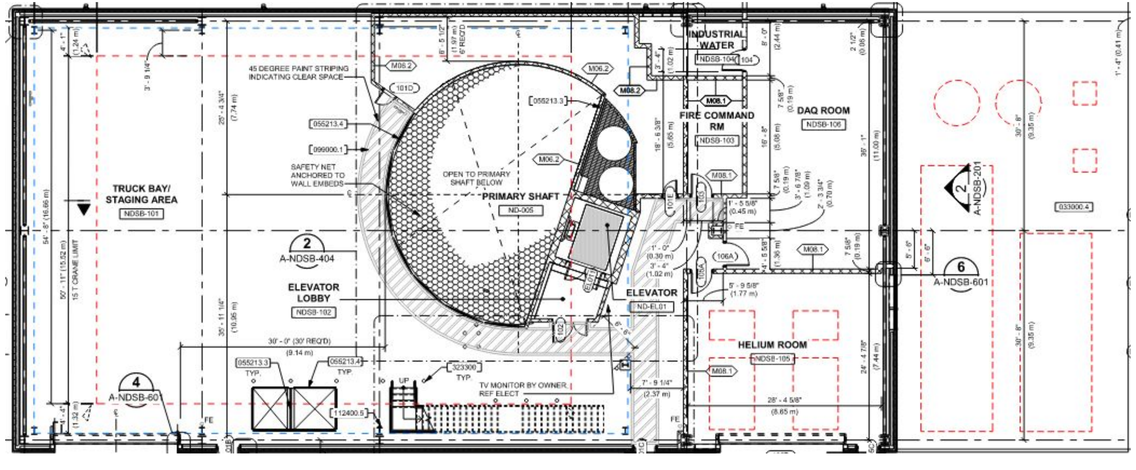
Scaffolding

Step 14: TMS Mezzanine Assy

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: TMS Mezzanine Assy	10	2 - Riggers 3 - Mech Techs	Critical Path			
			Parallel			





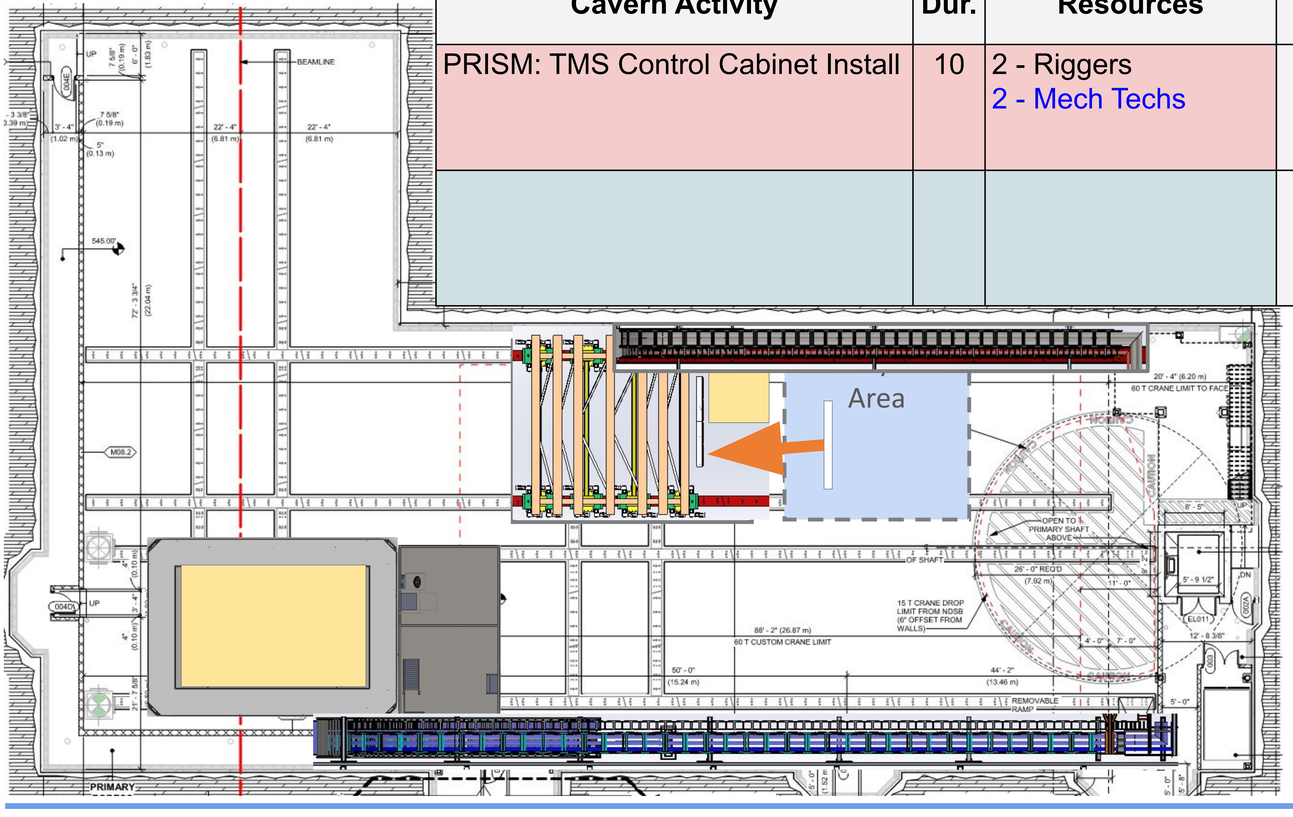
How many pieces will the frame be lowered in?
Will it be welded or bolted in the cavern?

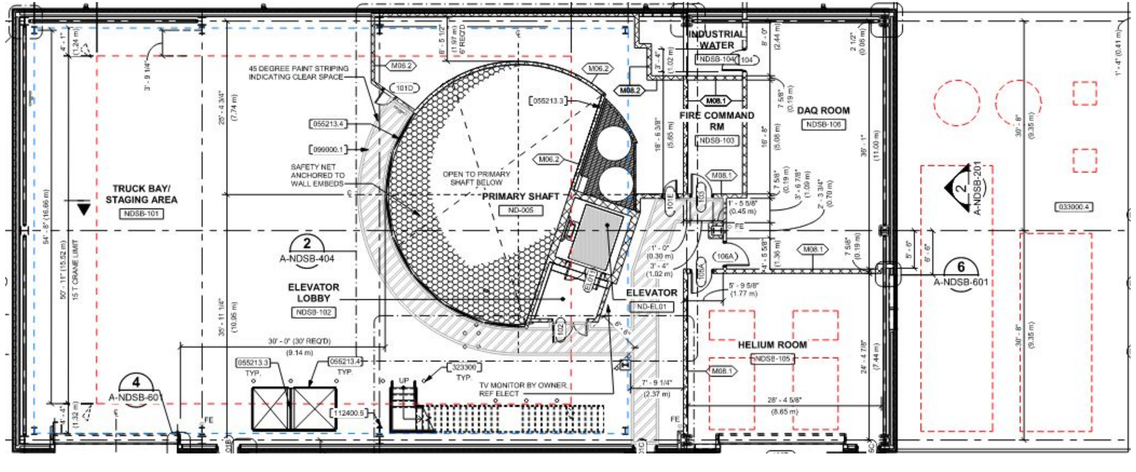
Scaffolding

Step 15: TMS Control Cabinet Install

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
PRISM: TMS Control Cabinet Install	10	2 - Riggers 2 - Mech Techs	Critical Path			
			Parallel			



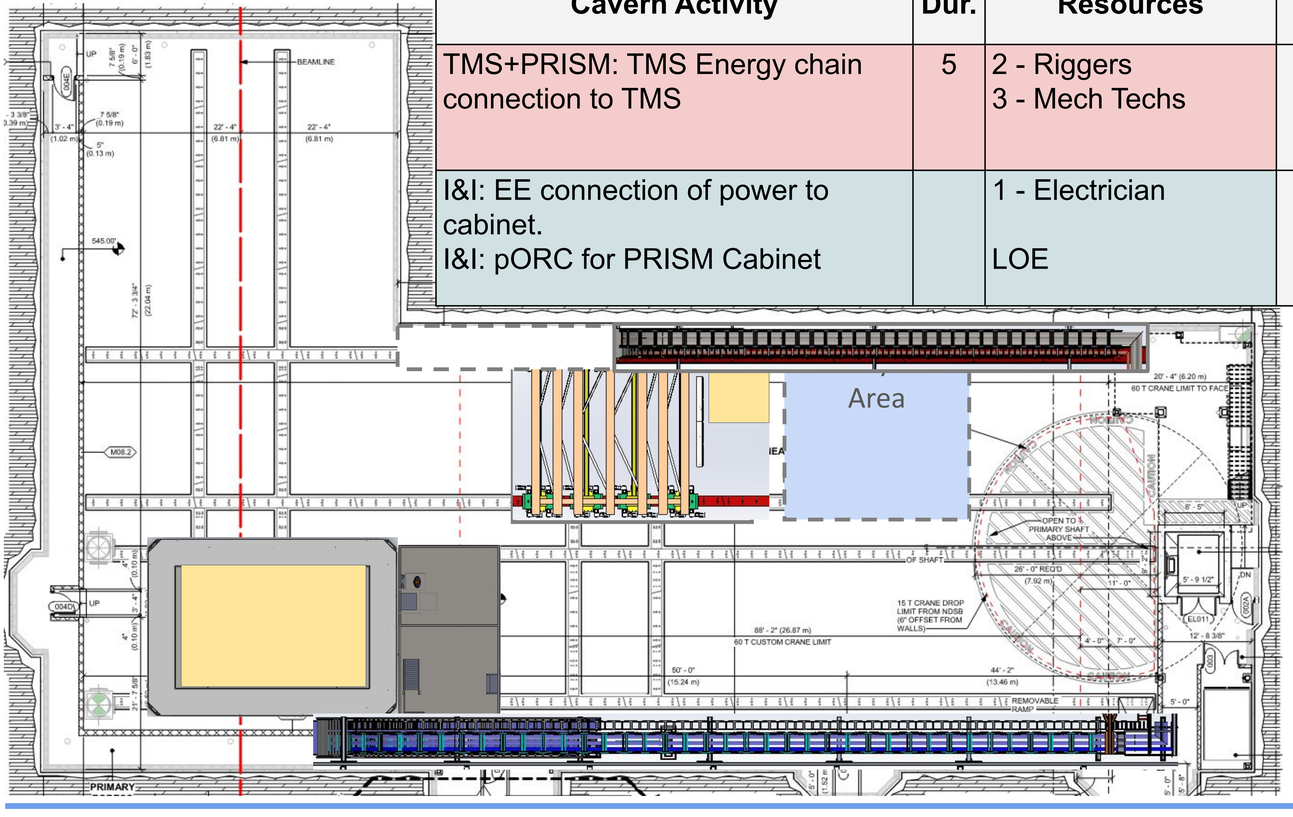


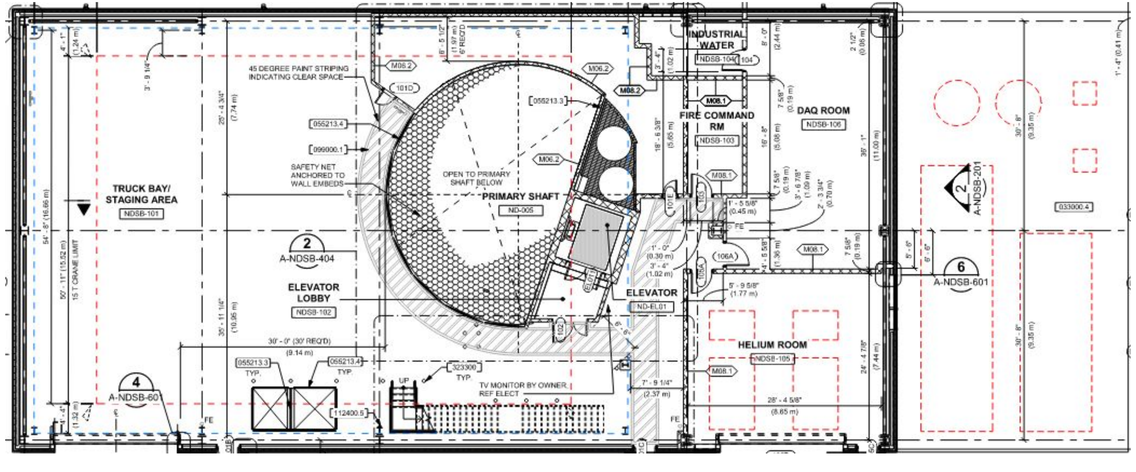
Energization?

Step 16: TMS Energy chain connection to TMS

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS+PRISM: TMS Energy chain connection to TMS	5	2 - Riggers 3 - Mech Techs	**Critical Path**			
I&I: EE connection of power to cabinet. I&I: pORC for PRISM Cabinet		1 - Electrician LOE	**Parallel**			

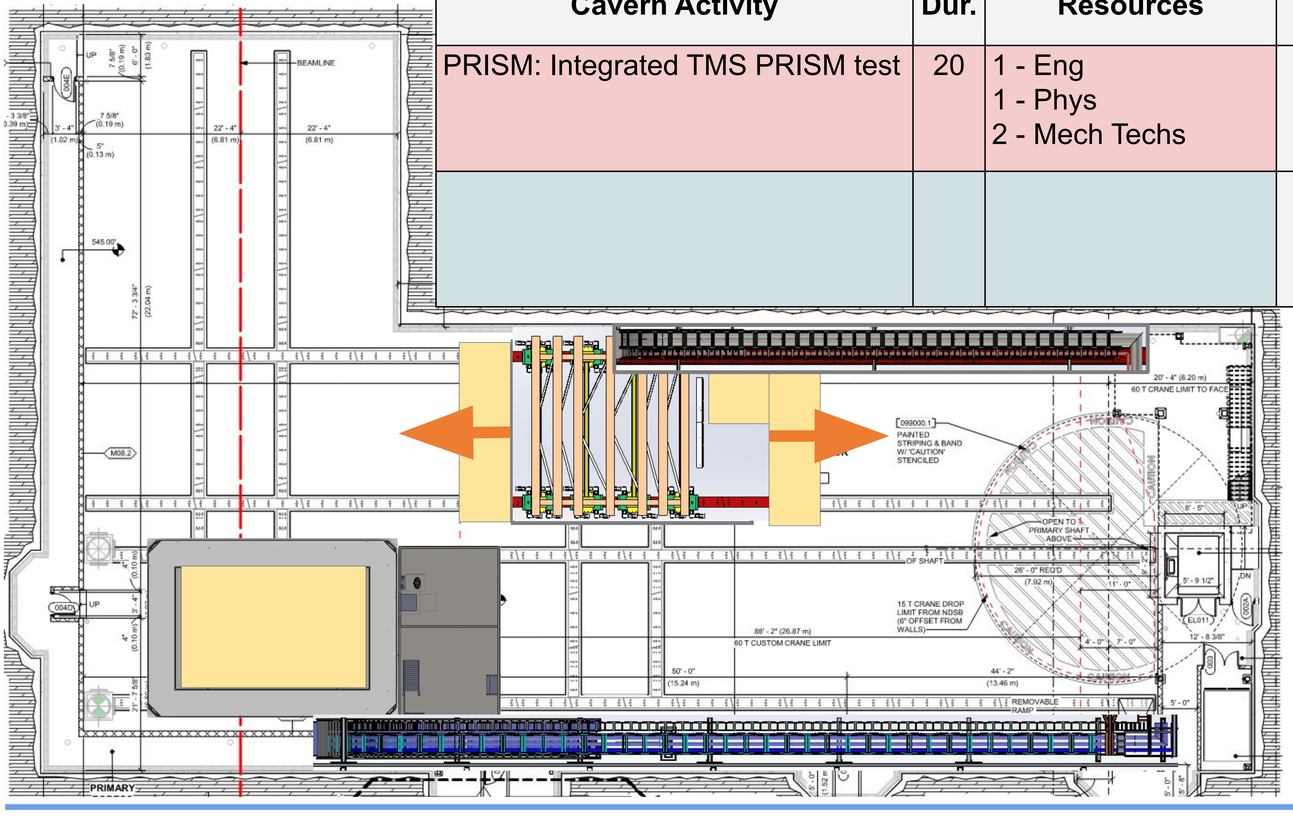


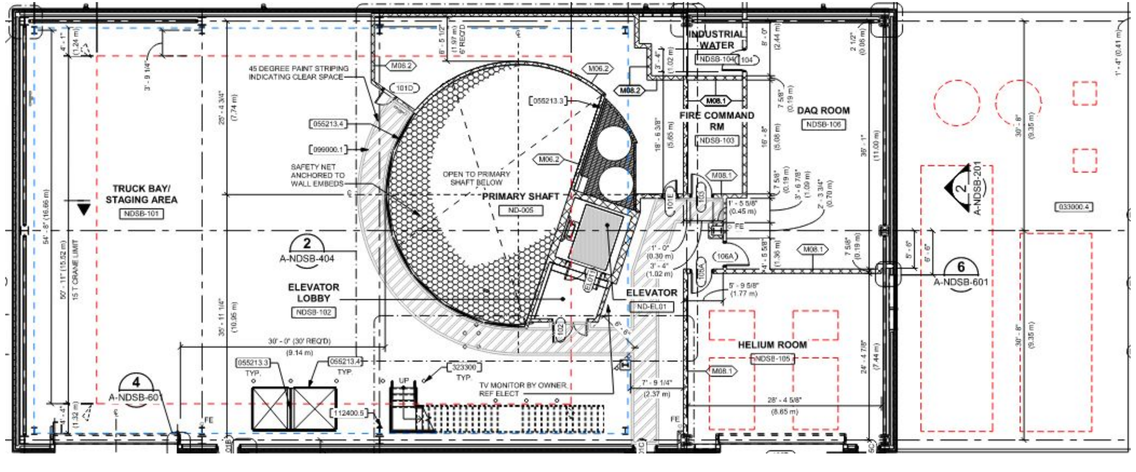


Step 17: Integrated TMS PRISM test

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
PRISM: Integrated TMS PRISM test	20	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
			Parallel	CRYO: Surface Cryo Piping		2 - Mech Techs

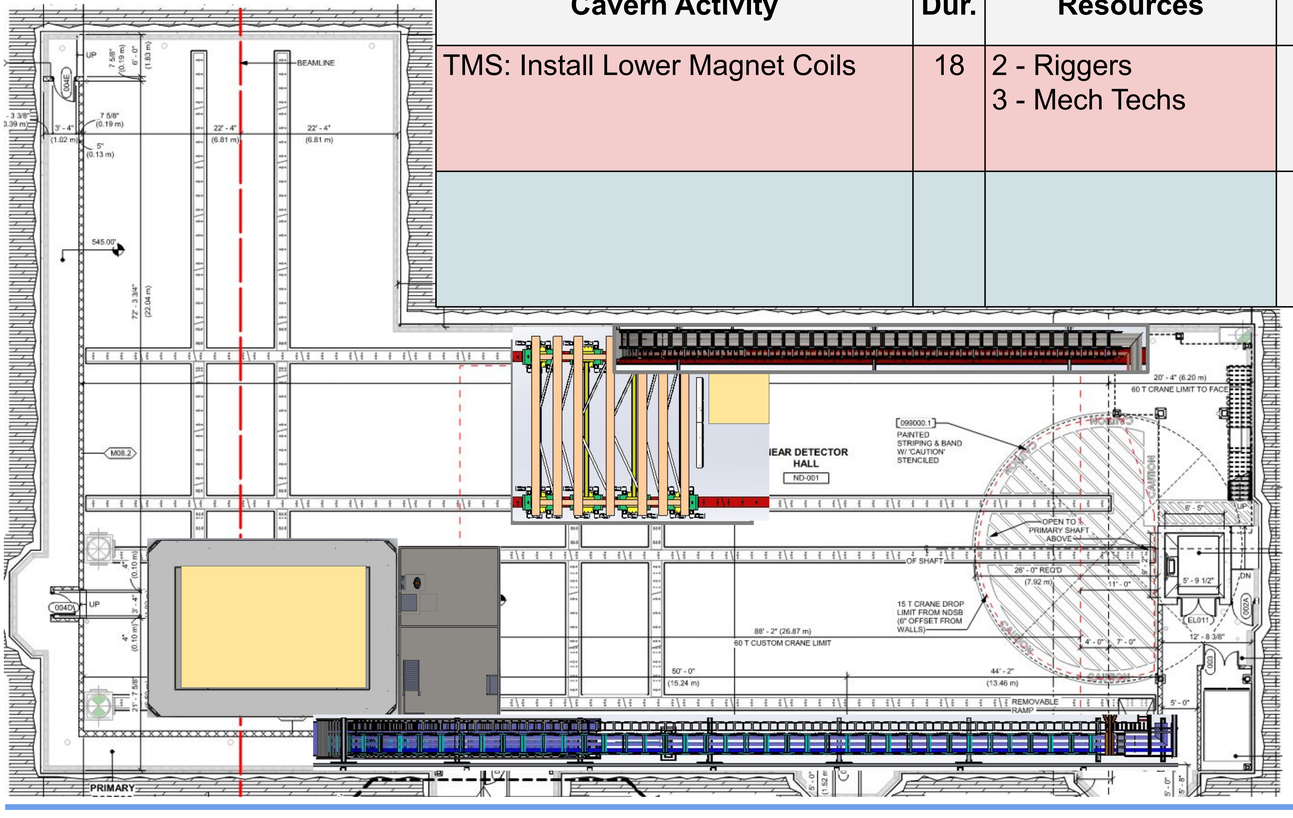


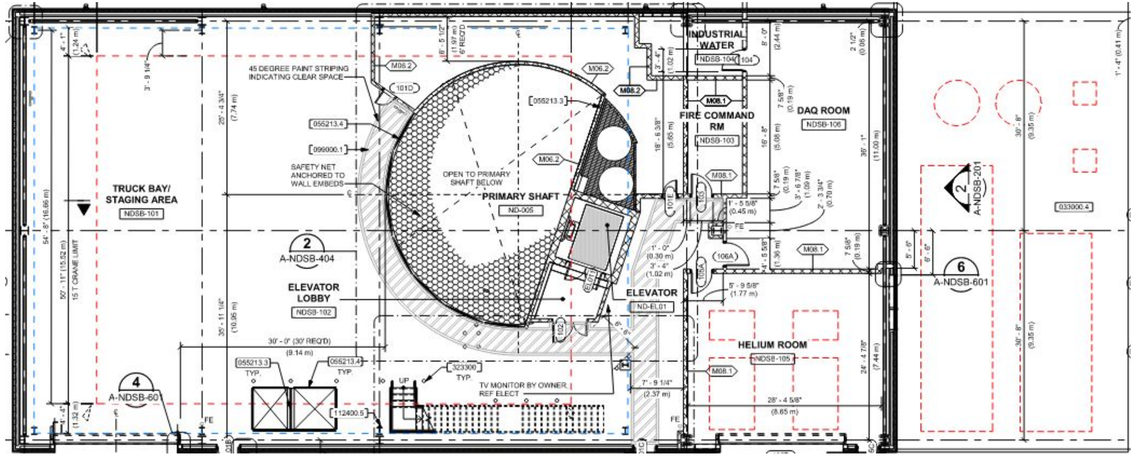


Step 18: Install Lower Magnet Coils

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Install Lower Magnet Coils	18	2 - Riggers 3 - Mech Techs	**Critical Path**			
			Parallel			

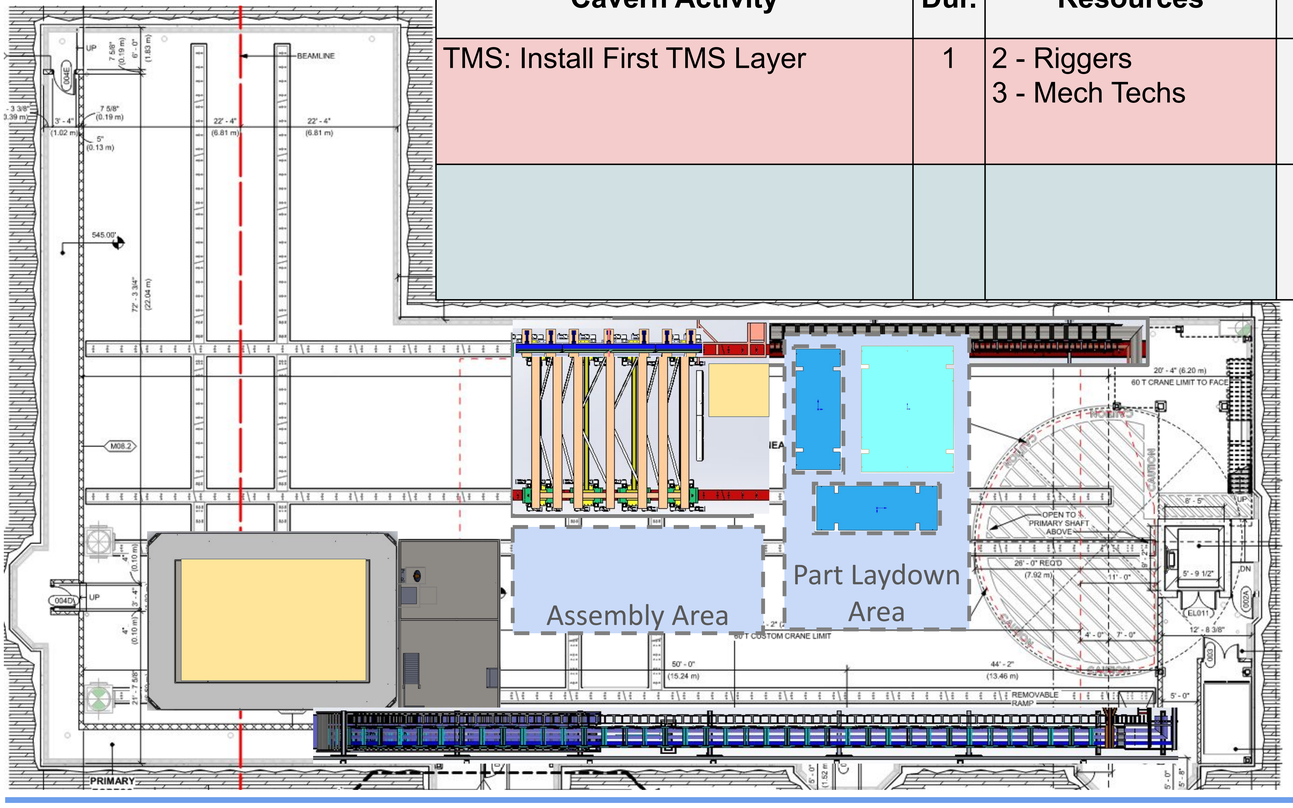


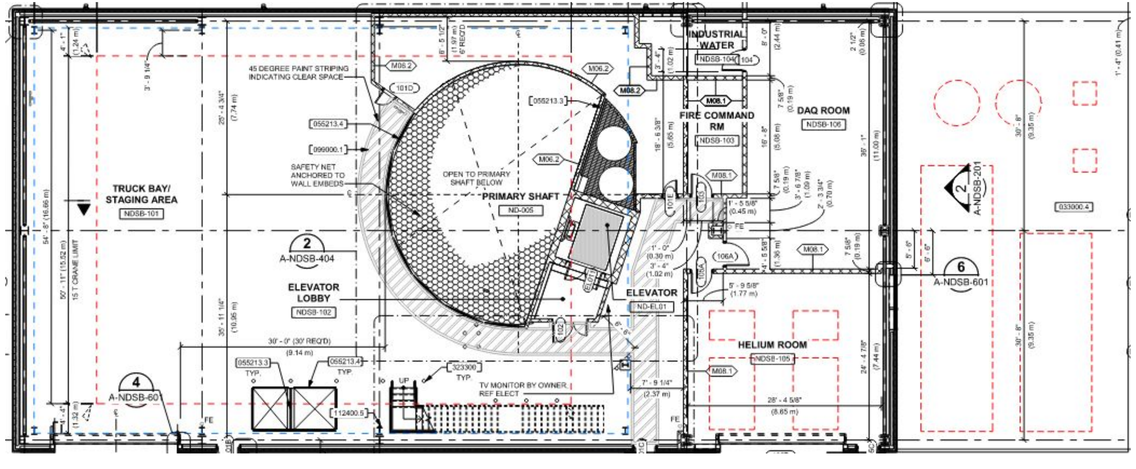


Step 19: Install First TMS Layer

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Install First TMS Layer	1	2 - Riggers 3 - Mech Techs	Critical Path			
			Parallel			



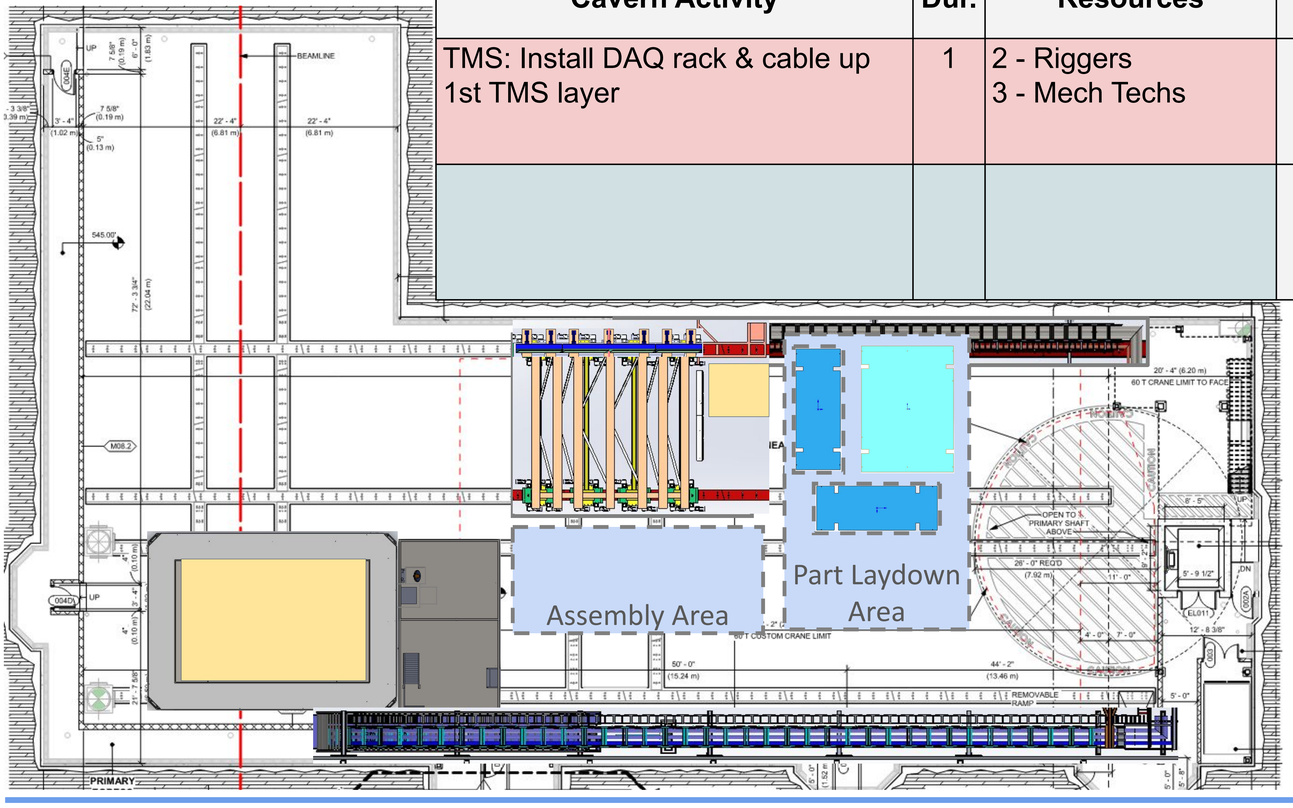


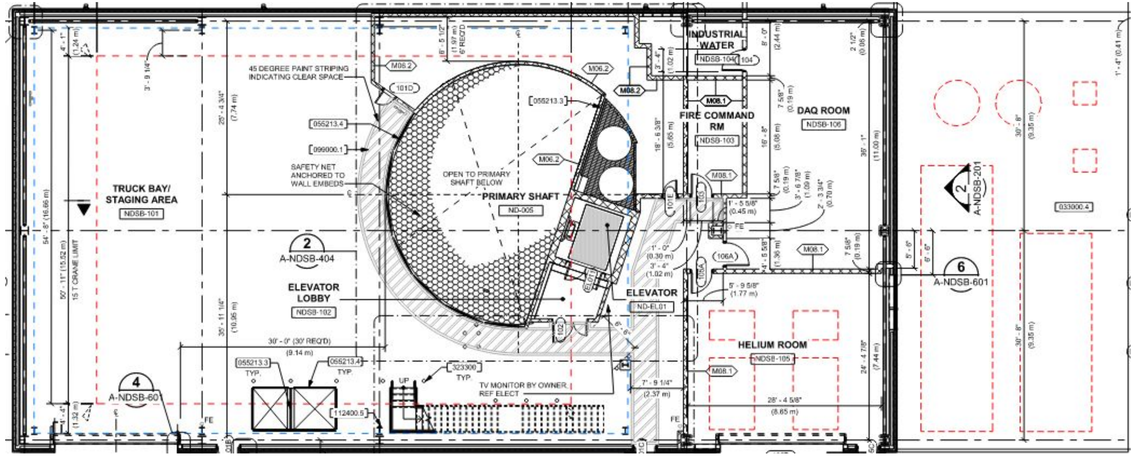
Scaffolding

Step 20: Install DAQ Rack and Cables for first TMS Layer

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Install DAQ rack & cable up 1st TMS layer	1	2 - Riggers 3 - Mech Techs	**Critical Path**			
			Parallel			



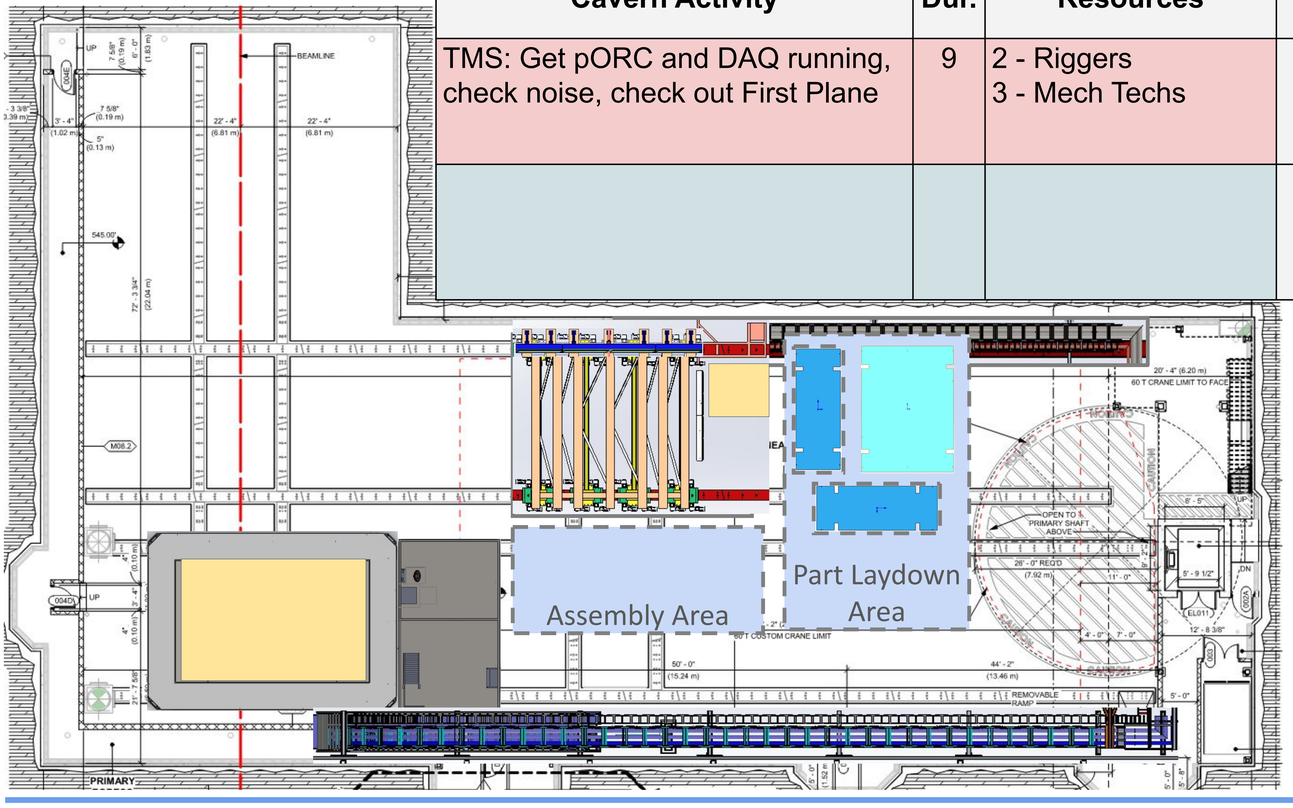


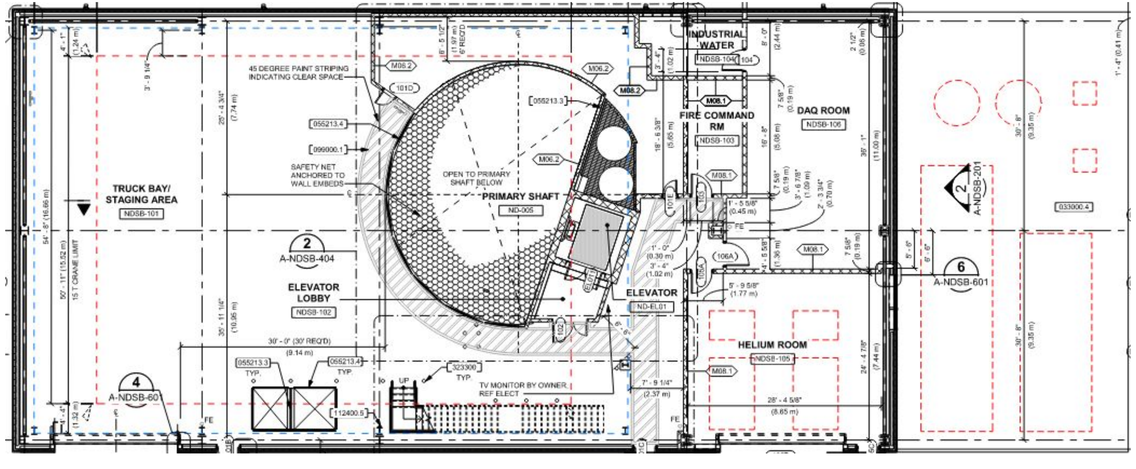
Scaffolding

Step 21: Get pORC and DAQ running, check noise, check out First Plane

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Get pORC and DAQ running, check noise, check out First Plane	9	2 - Riggers 3 - Mech Techs	Critical Path			
			Parallel			



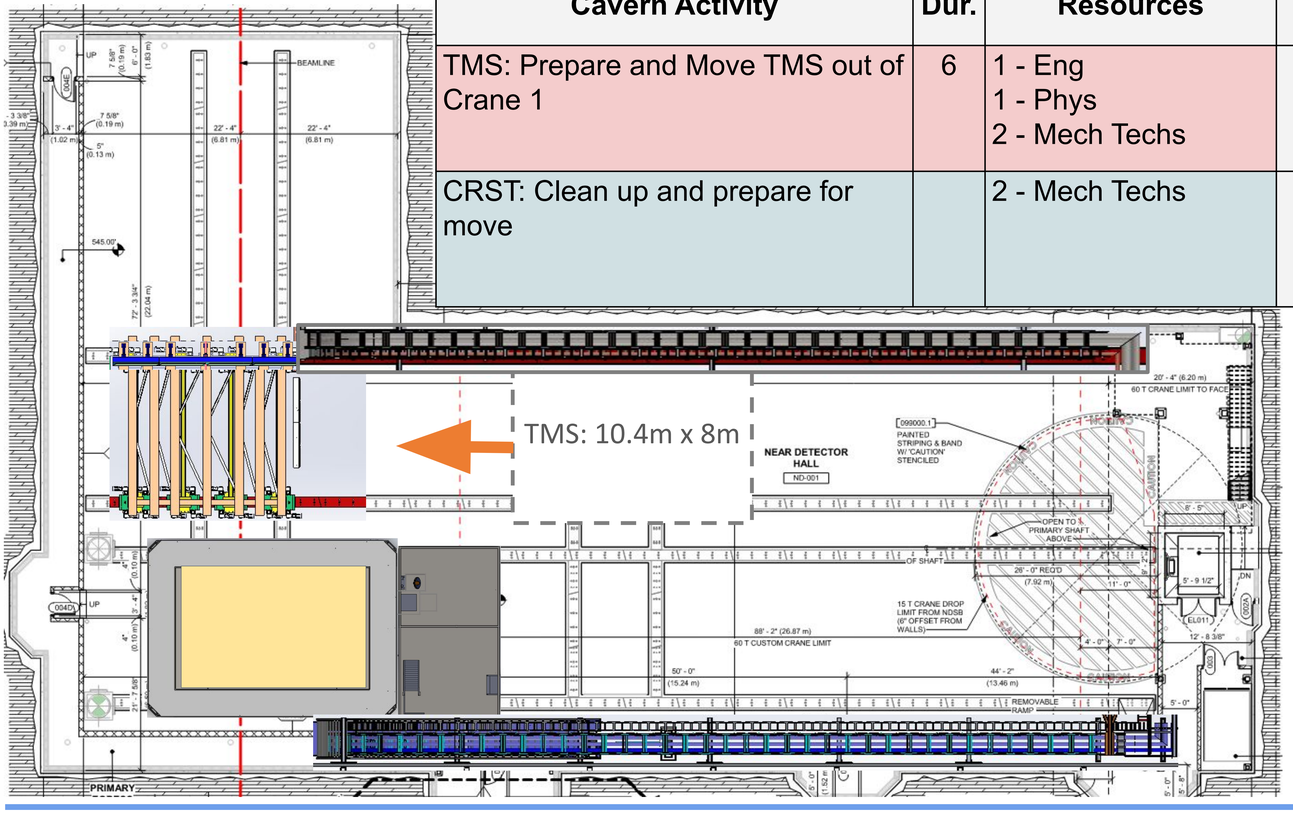


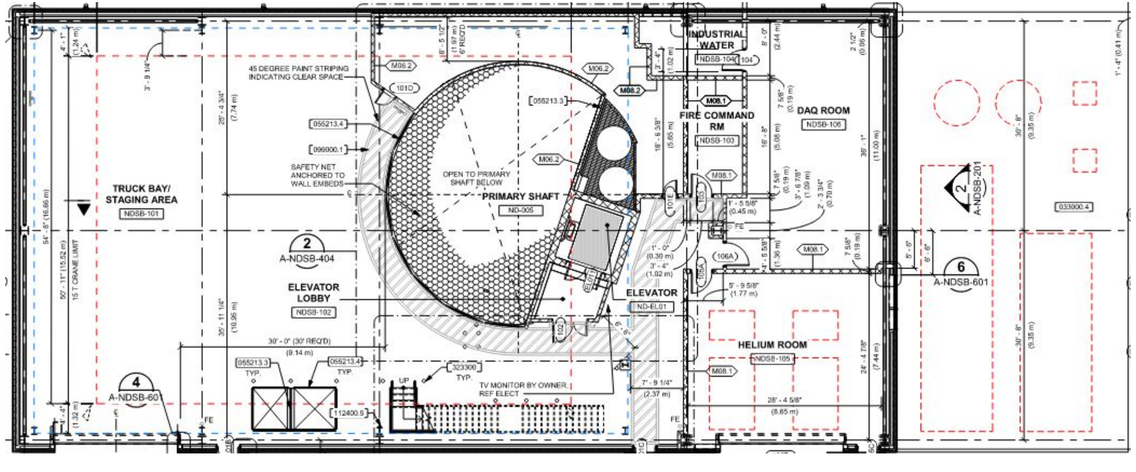
Scaffolding

Step 22: Prepare and Move TMS out of Crane 1

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Prepare and Move TMS out of Crane 1	6	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
CRST: Clean up and prepare for move		2 - Mech Techs	**Parallel**			

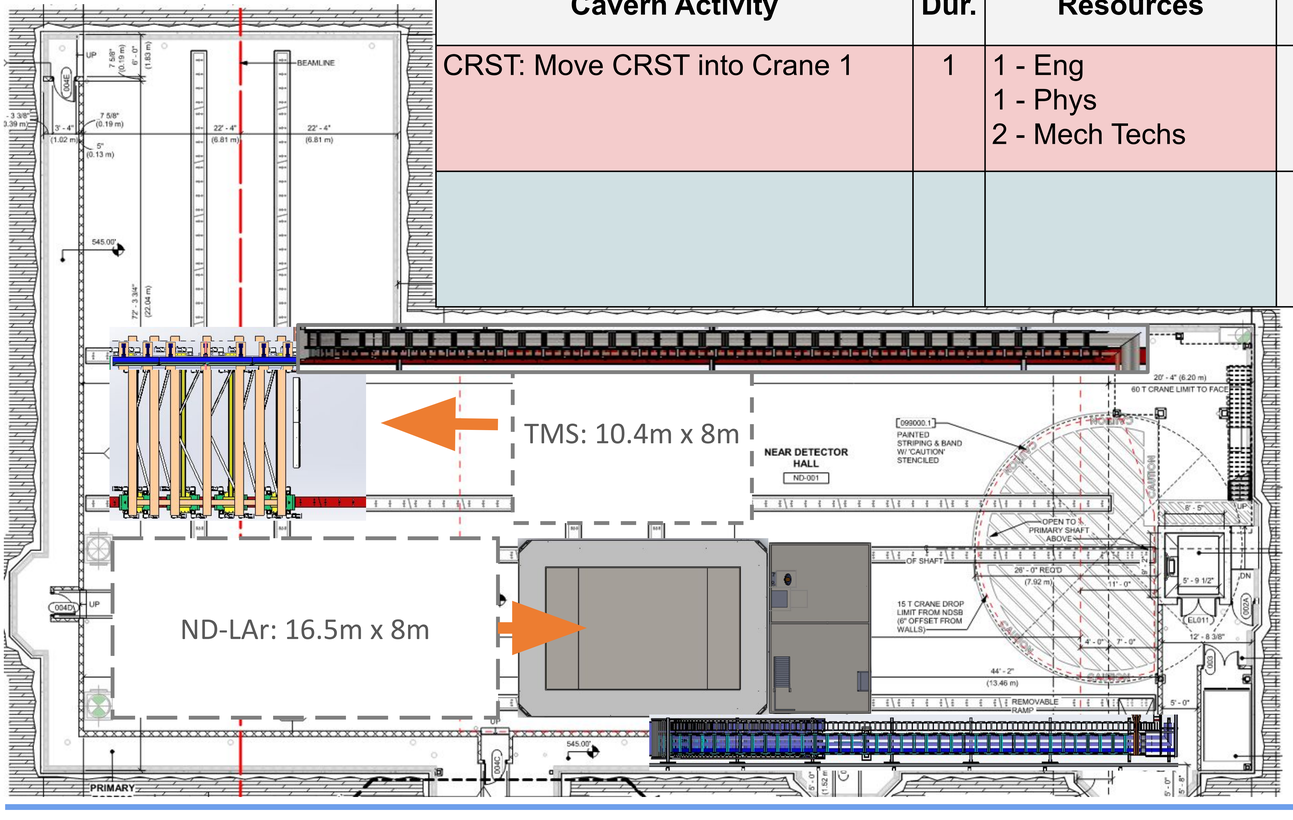


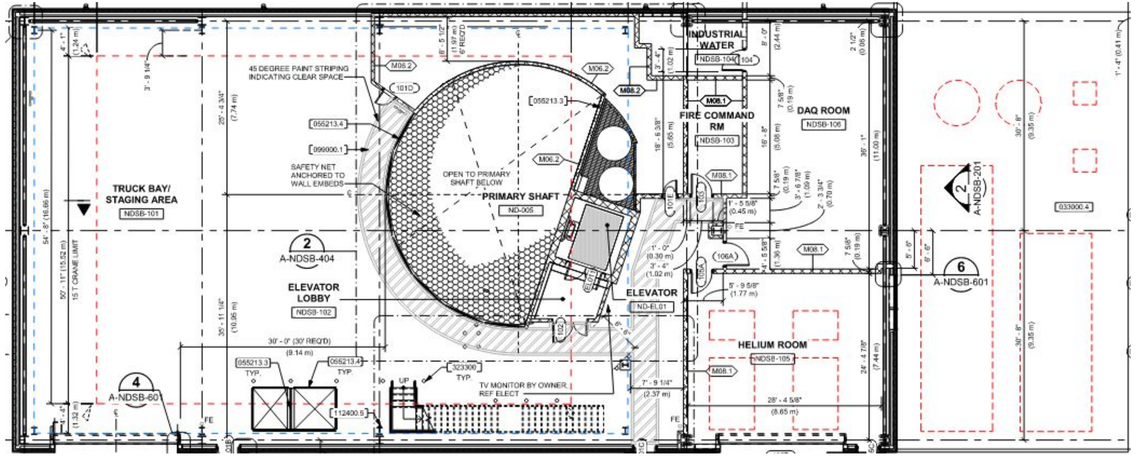


Step 23: Move CRST into Crane 1

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Move CRST into Crane 1	1	1 - Eng 1 - Phys 2 - Mech Techs	Critical Path			
			Parallel			

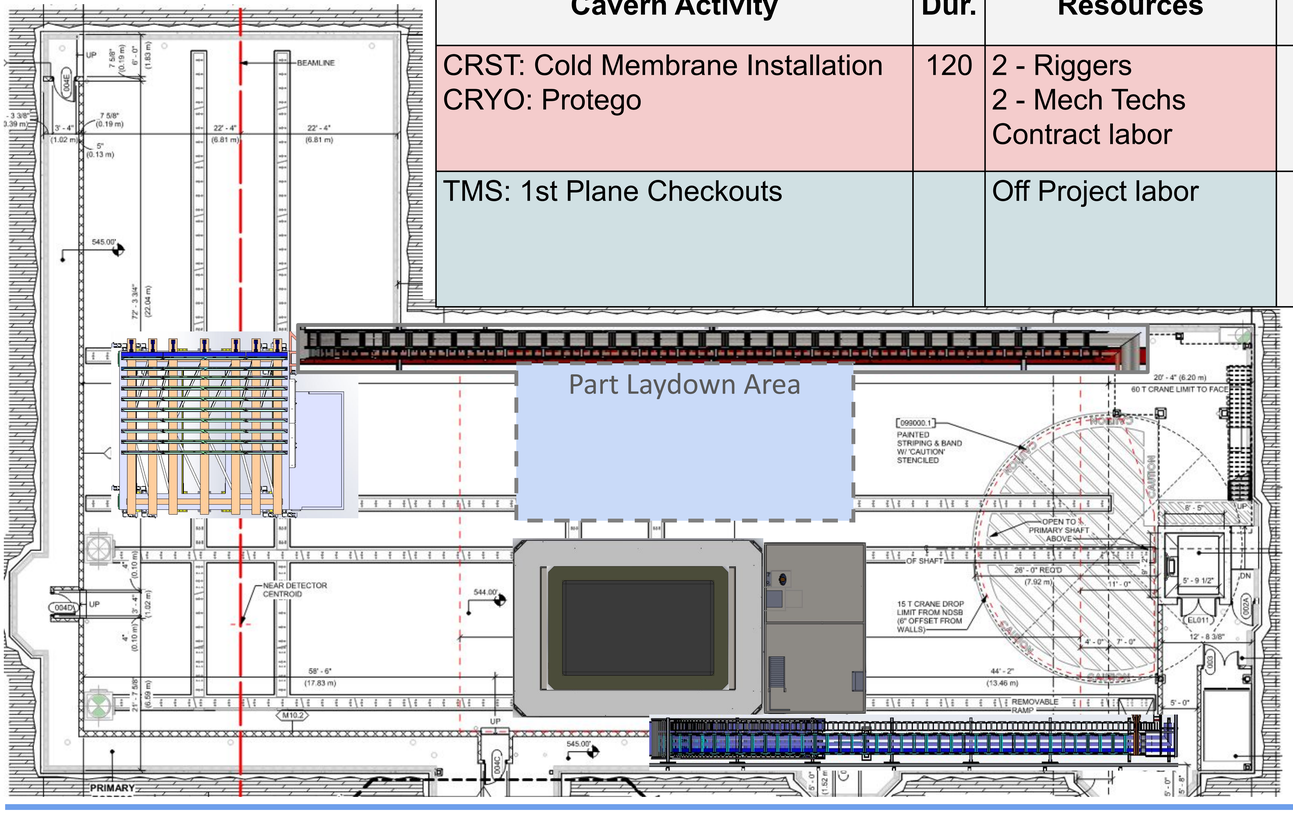


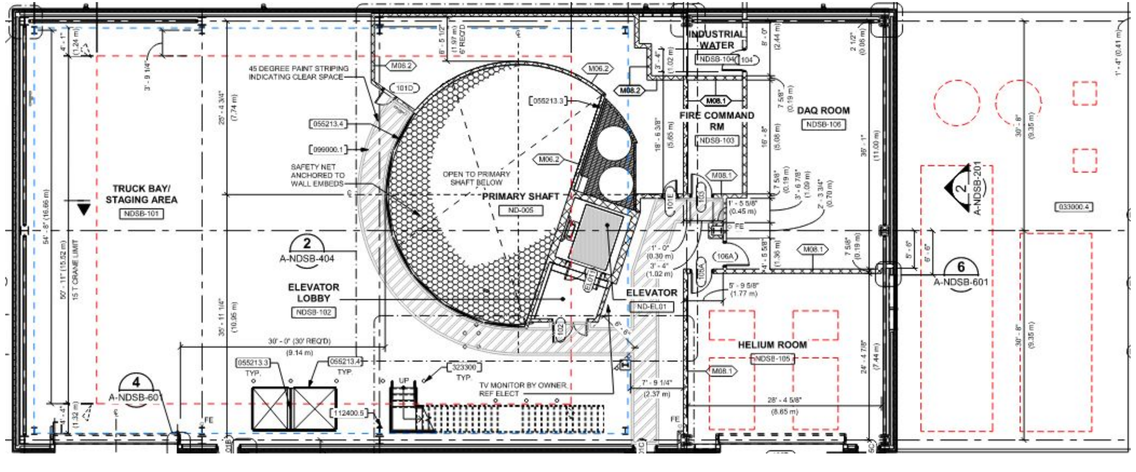


Step 24: Cold Membrane Installation, Protego

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Cold Membrane Installation CRYO: Protego	120	2 - Riggers 2 - Mech Techs Contract labor	**Critical Path**			
TMS: 1st Plane Checkouts		Off Project labor	**Parallel**			

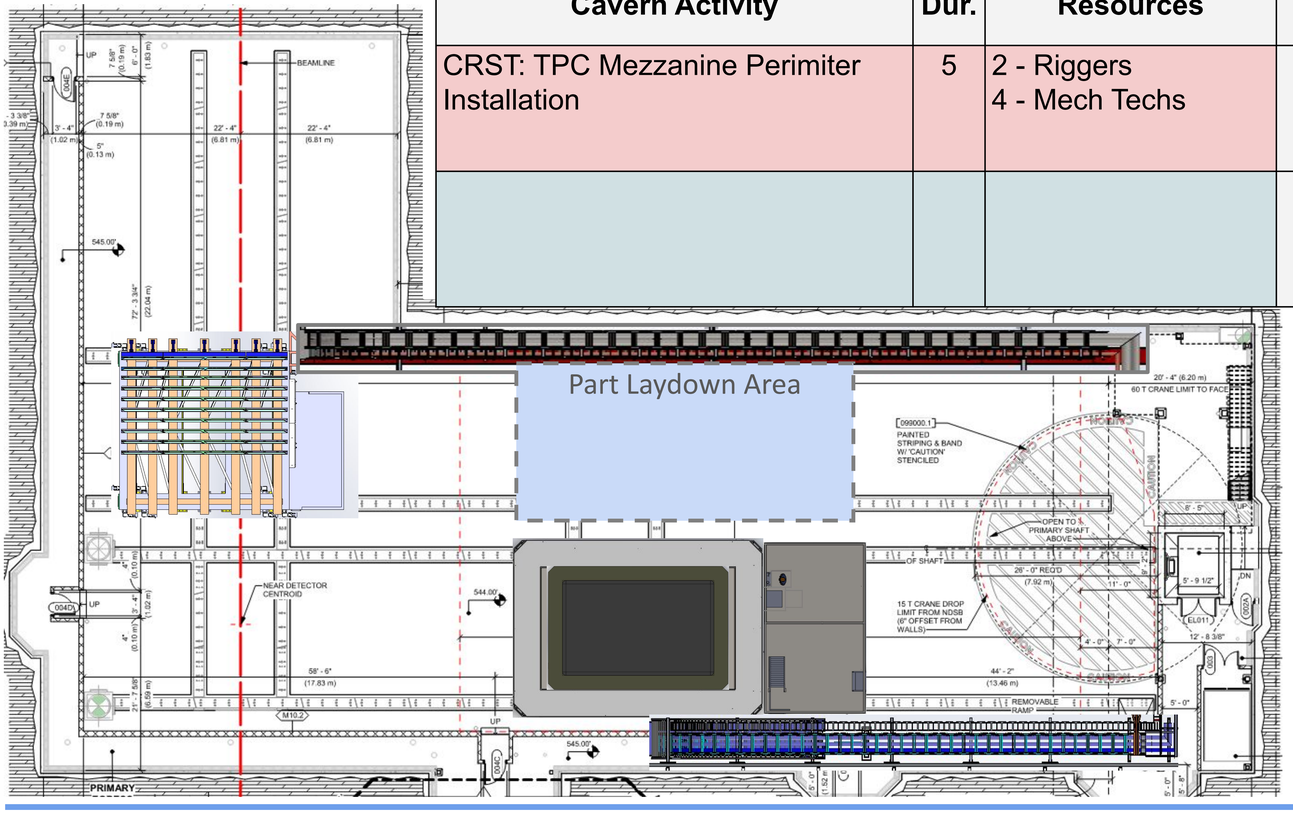


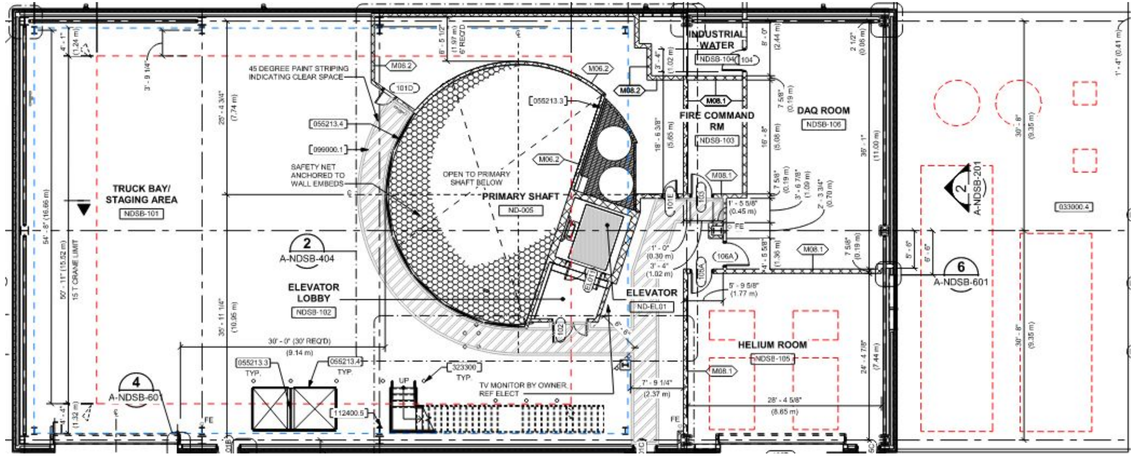


Step 25: TPC Mezzanine Perimiter Installation

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: TPC Mezzanine Perimiter Installation	5	2 - Riggers 4 - Mech Techs	**Critical Path**			
			Parallel			

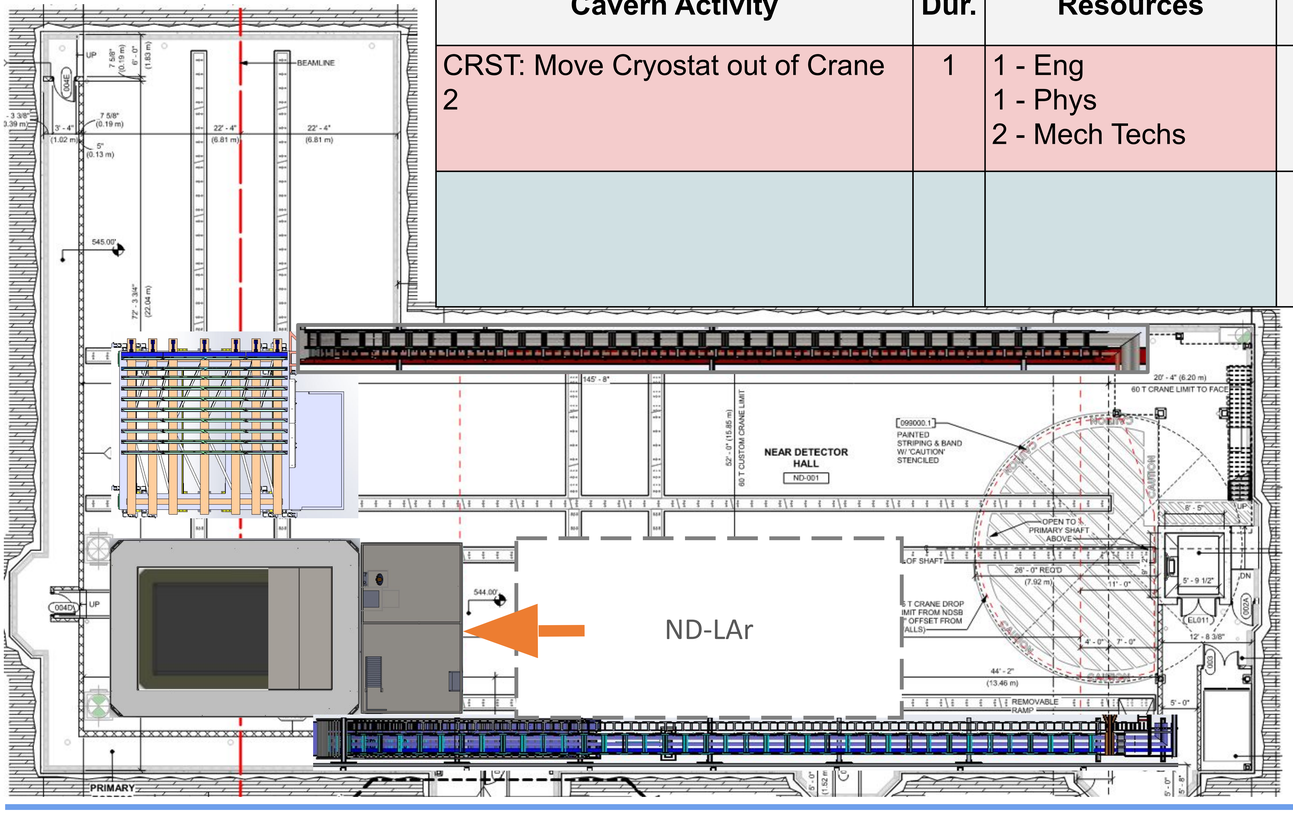


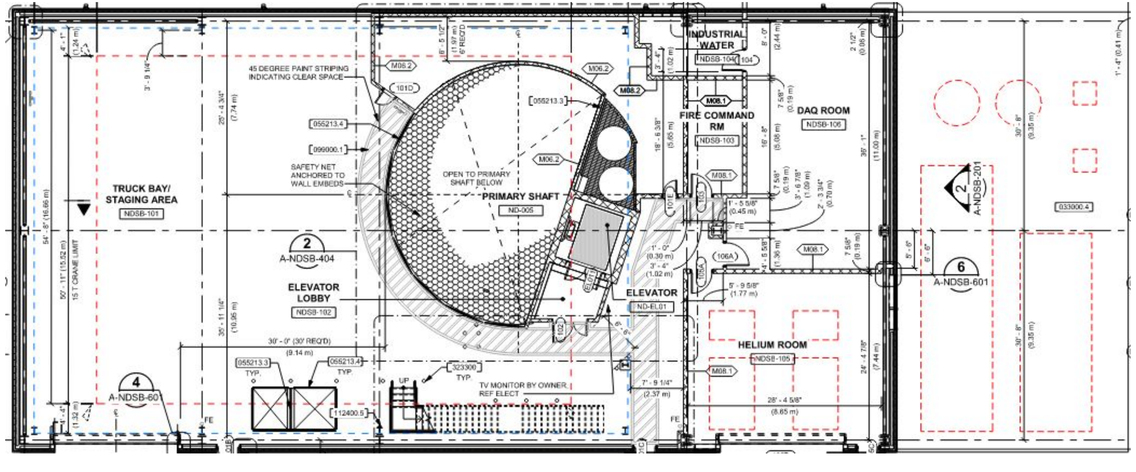


Step 26: Move Cryostat out of Crane 2

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Move Cryostat out of Crane 2	1	1 - Eng 1 - Phys 2 - Mech Techs	Critical Path			
			Parallel			

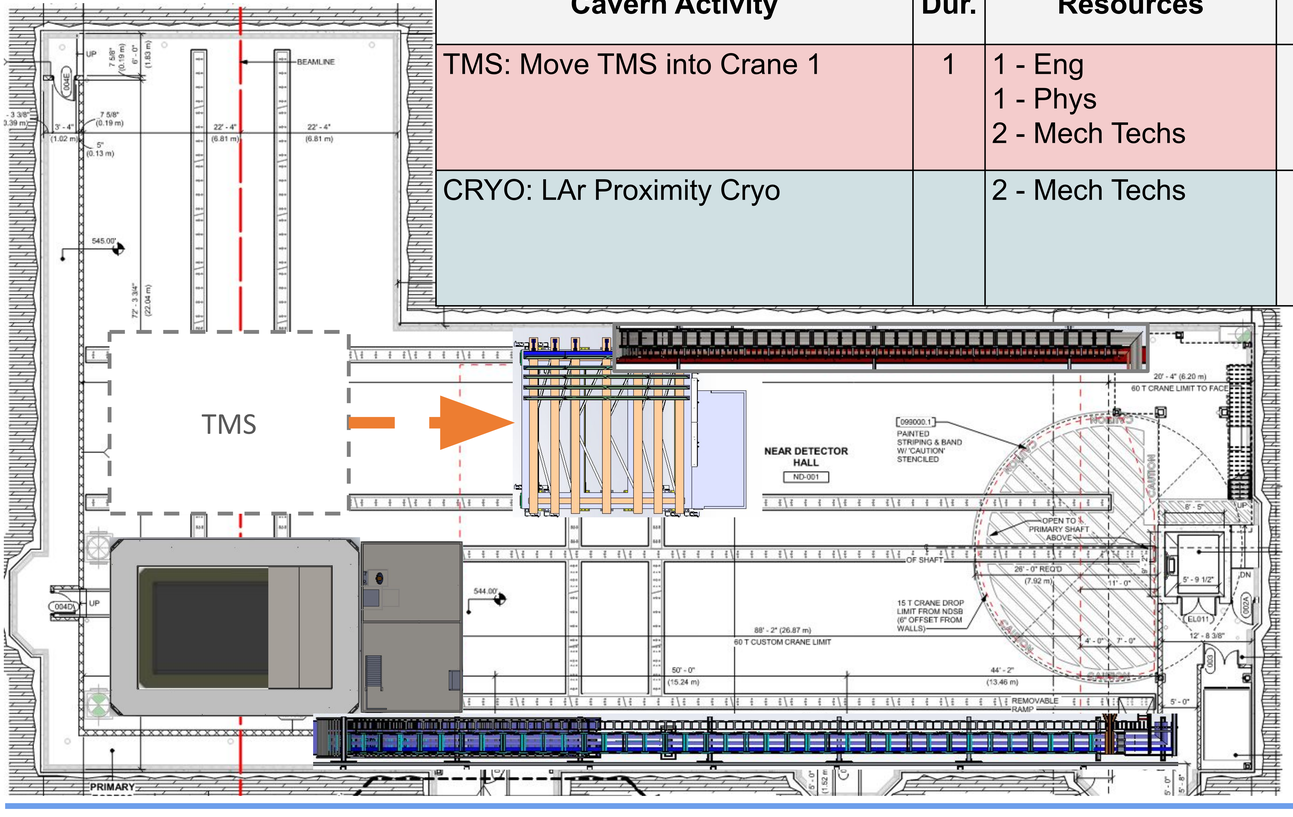


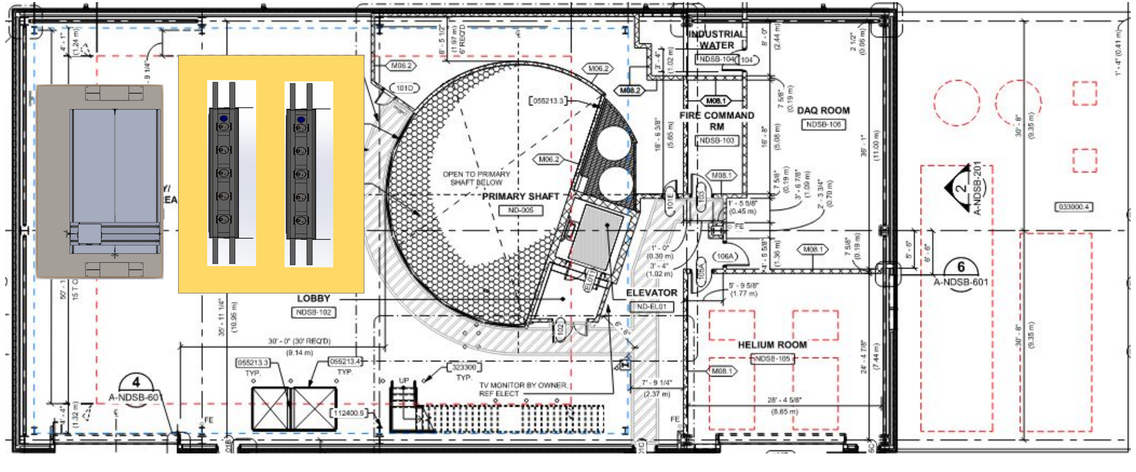


Step 27: Move TMS into Crane 1

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Move TMS into Crane 1	1	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
CRYO: LAr Proximity Cryo		2 - Mech Techs	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

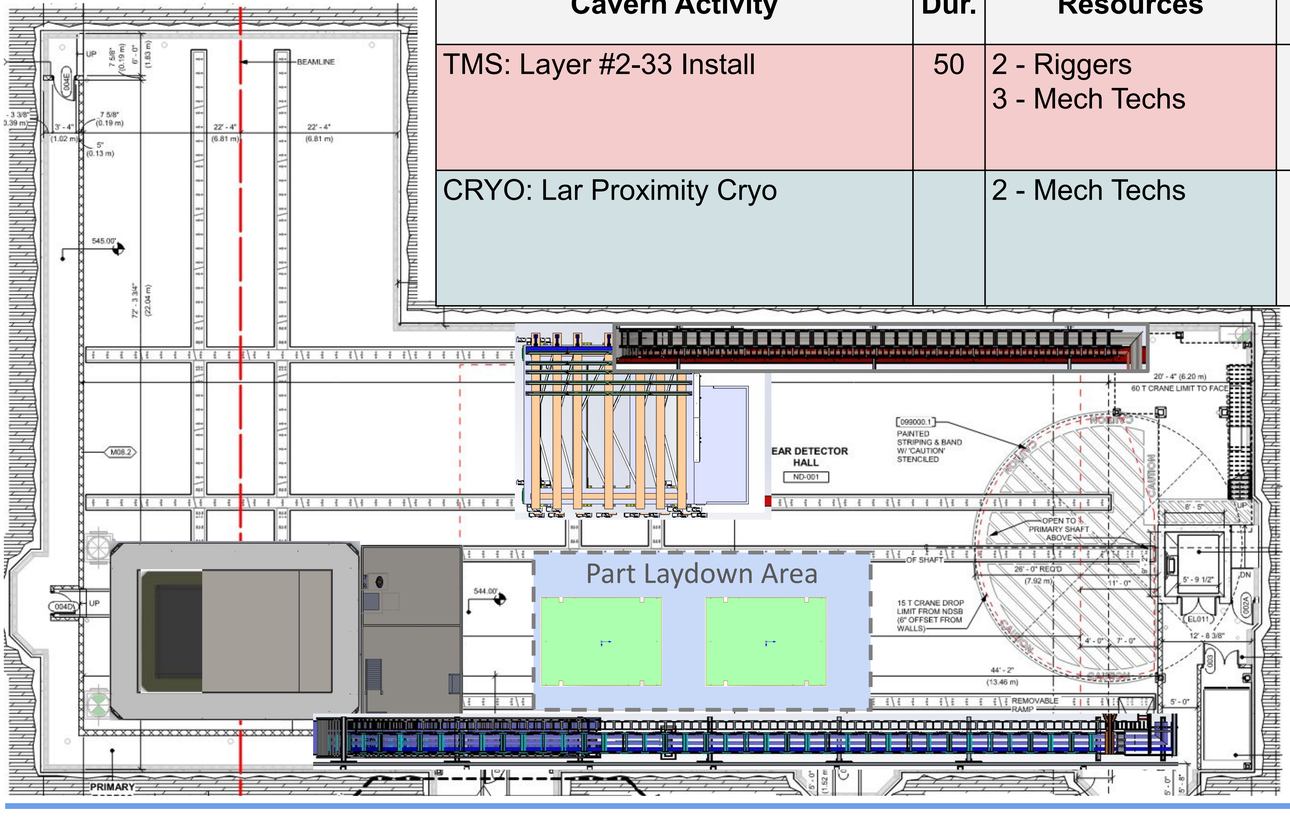


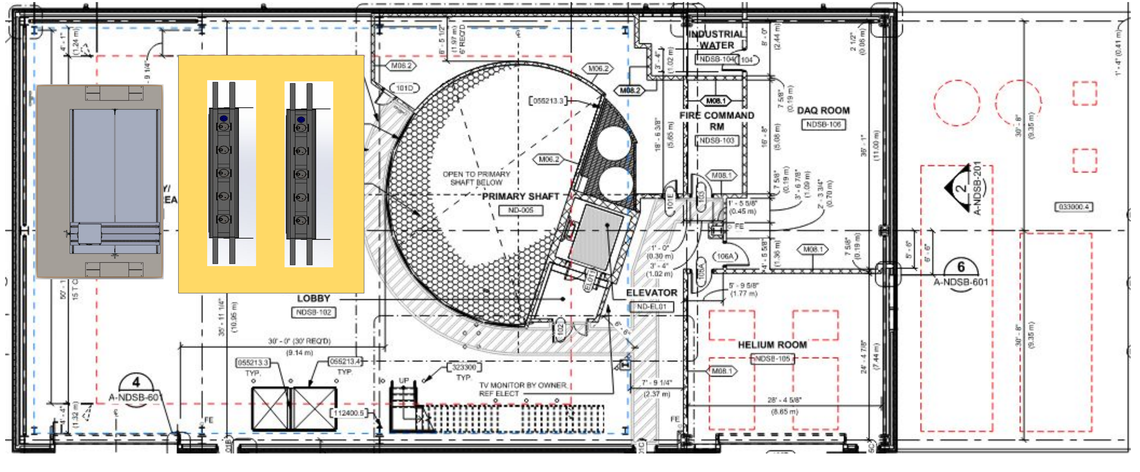


Step 28: Layer #2-33 Install

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Layer #2-33 Install	50	2 - Riggers 3 - Mech Techs	**Critical Path**			
CRYO: Lar Proximity Cryo		2 - Mech Techs	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

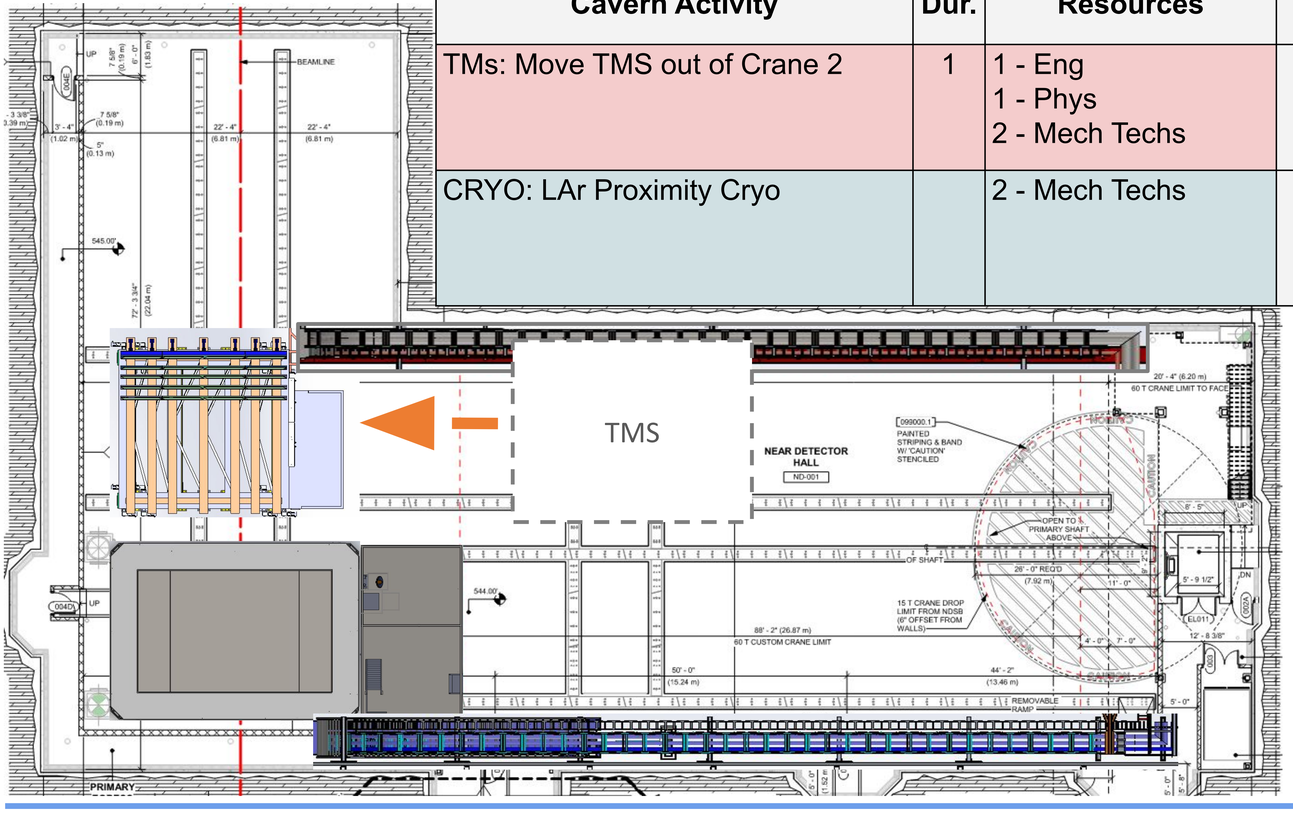


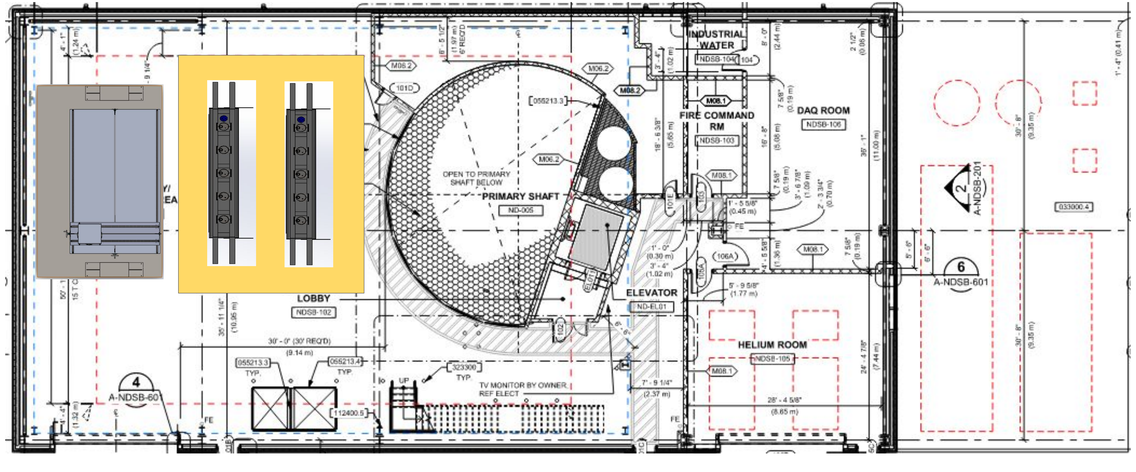


Step 29: Move TMS out of Crane 2

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMs: Move TMS out of Crane 2	1	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
CRYO: LAr Proximity Cryo		2 - Mech Techs	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

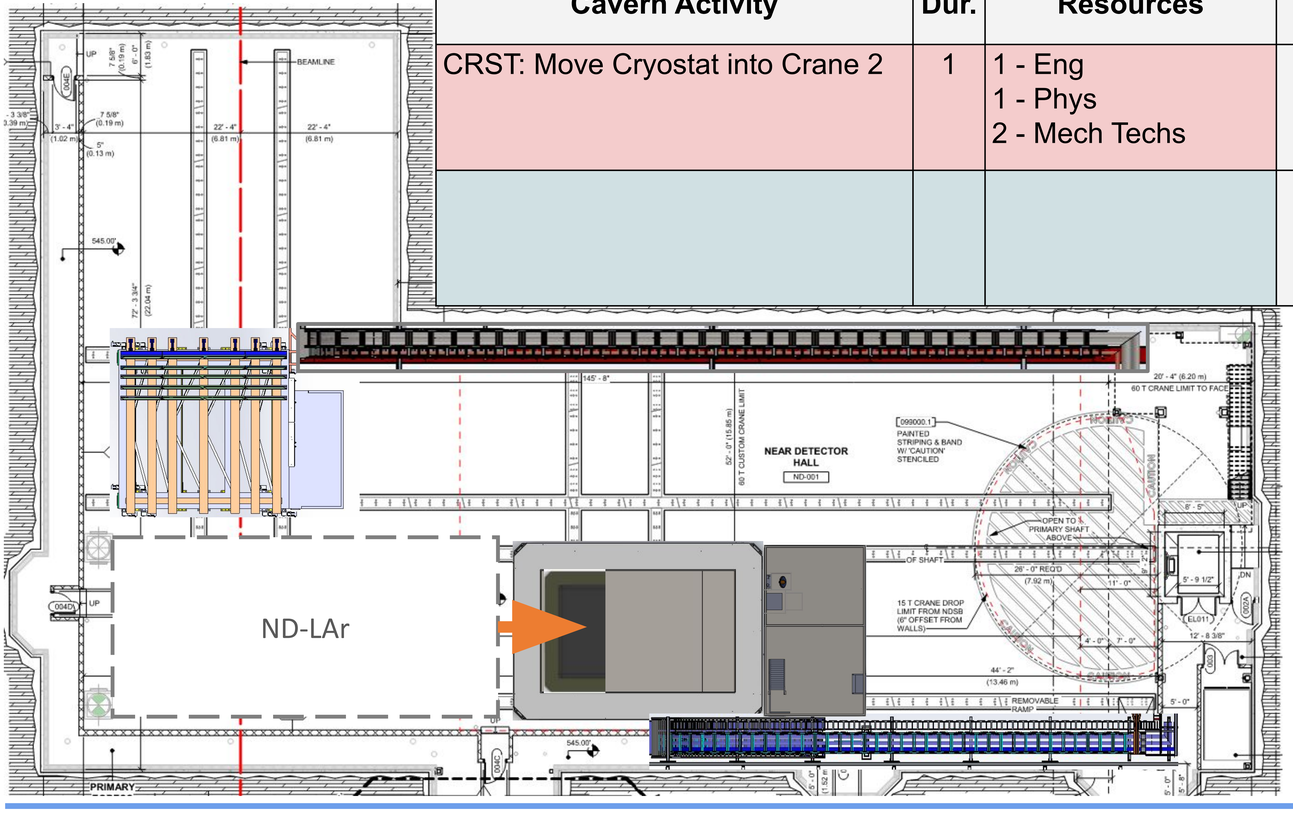


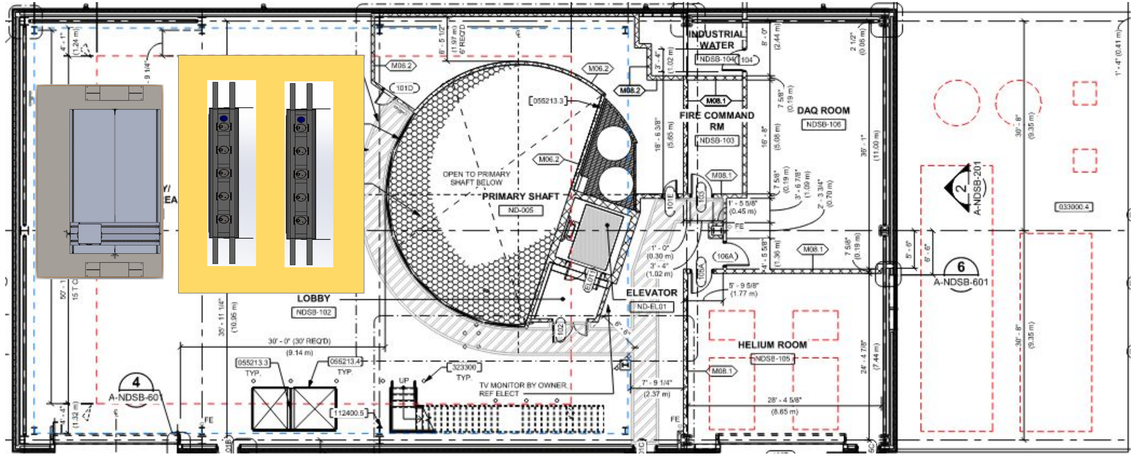


Step 30: Move Cryostat into Crane 2

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Move Cryostat into Crane 2	1	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
			Parallel	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

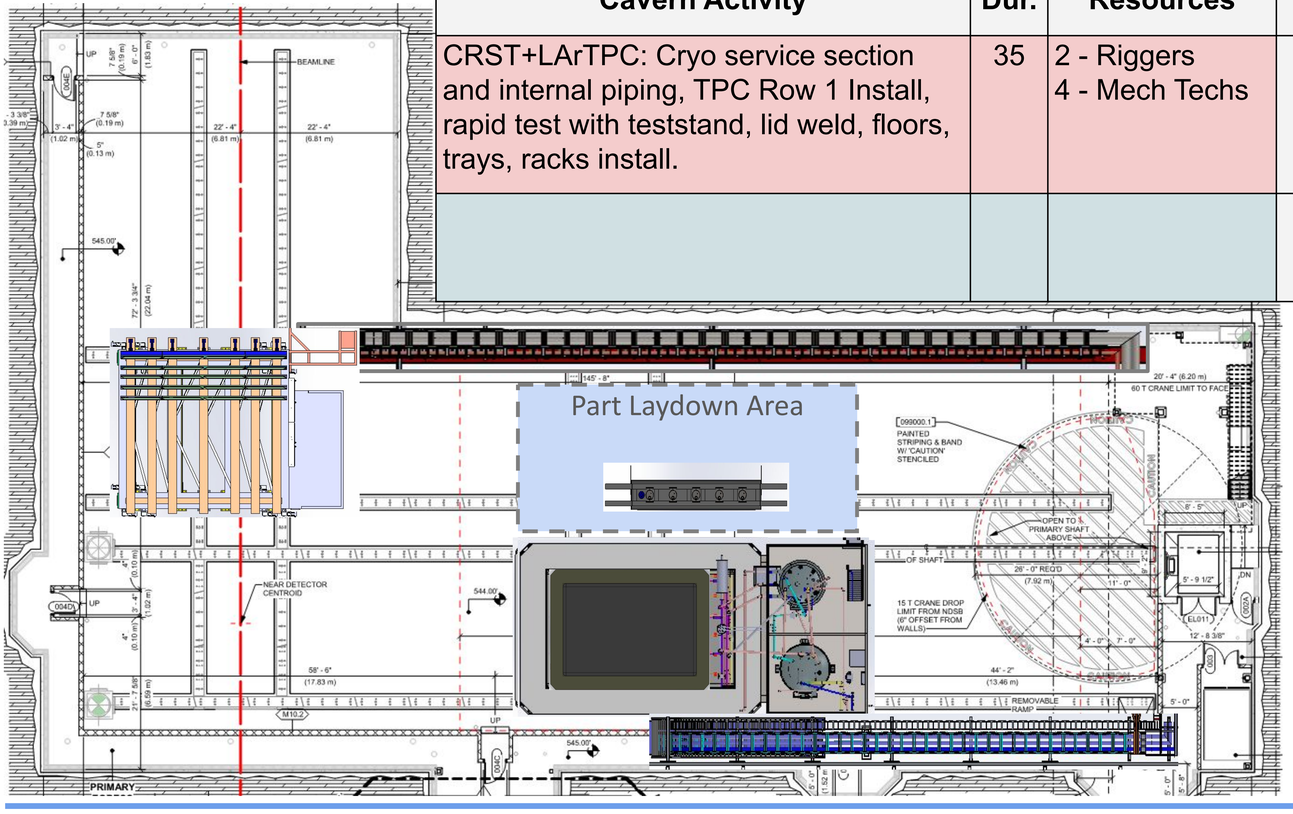


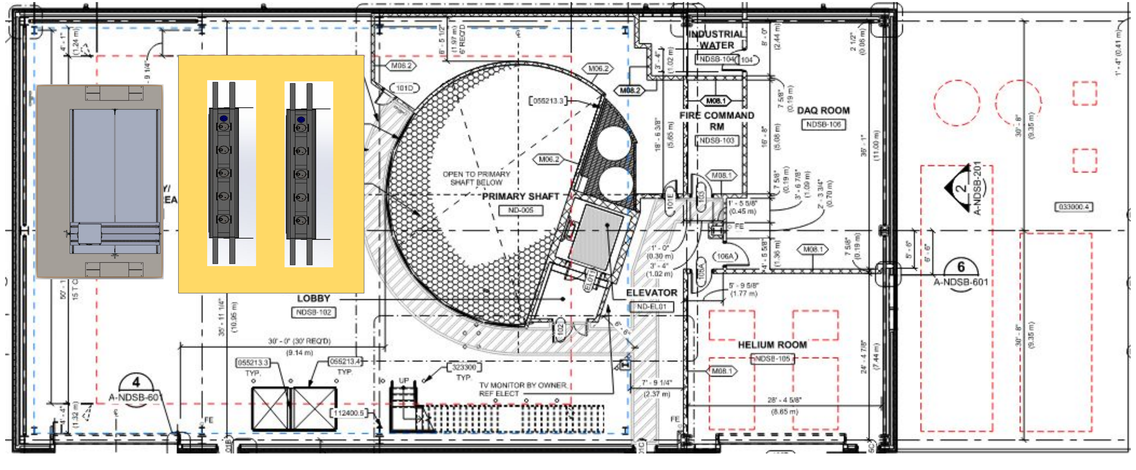


Step 31: Install the first TPC Module Row

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST+LArTPC: Cryo service section and internal piping, TPC Row 1 Install, rapid test with teststand, lid weld, floors, trays, racks install.	35	2 - Riggers 4 - Mech Techs	**Critical Path**			
			Parallel	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor



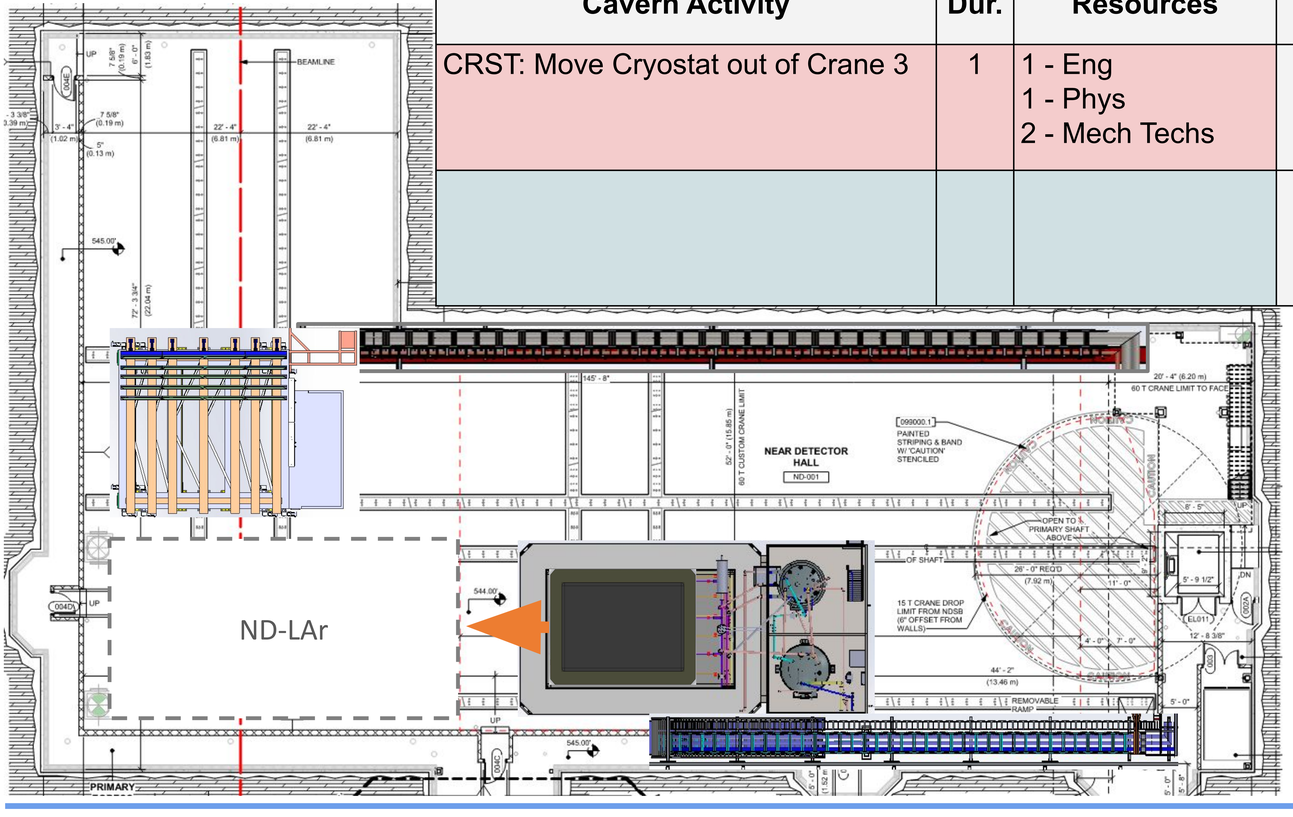


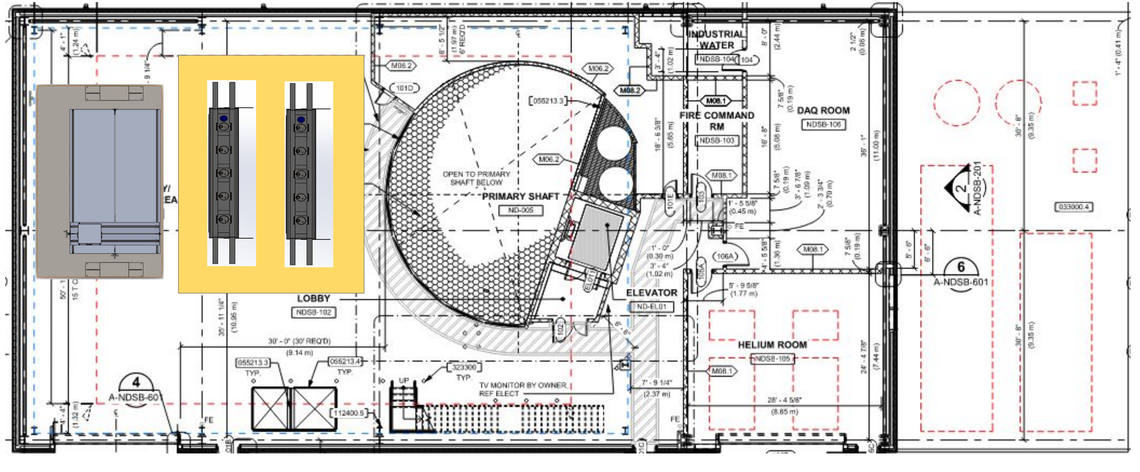
What installation activities will take place in the cavern vs. on the surface?

Step 32: Move Cryostat out of Crane 3

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Move Cryostat out of Crane 3	1	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
			Parallel	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

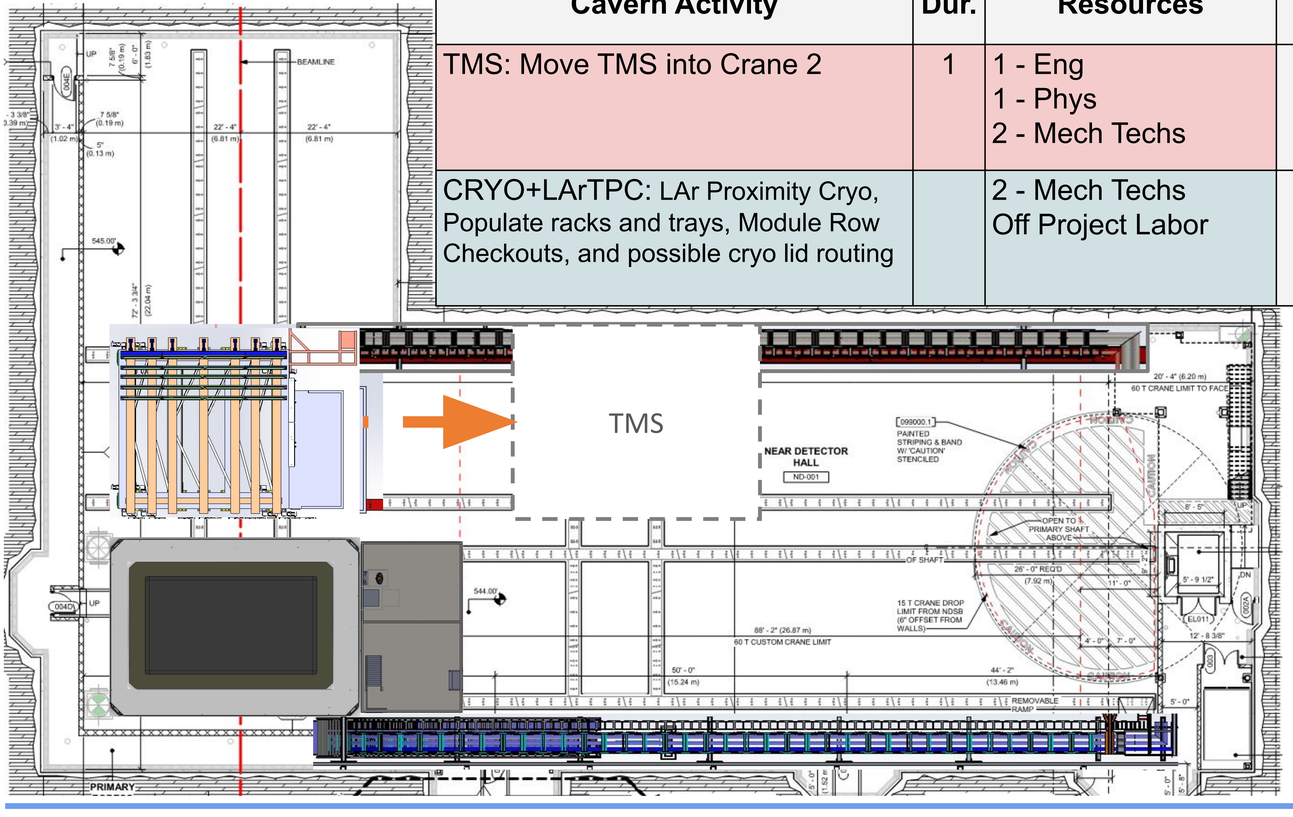


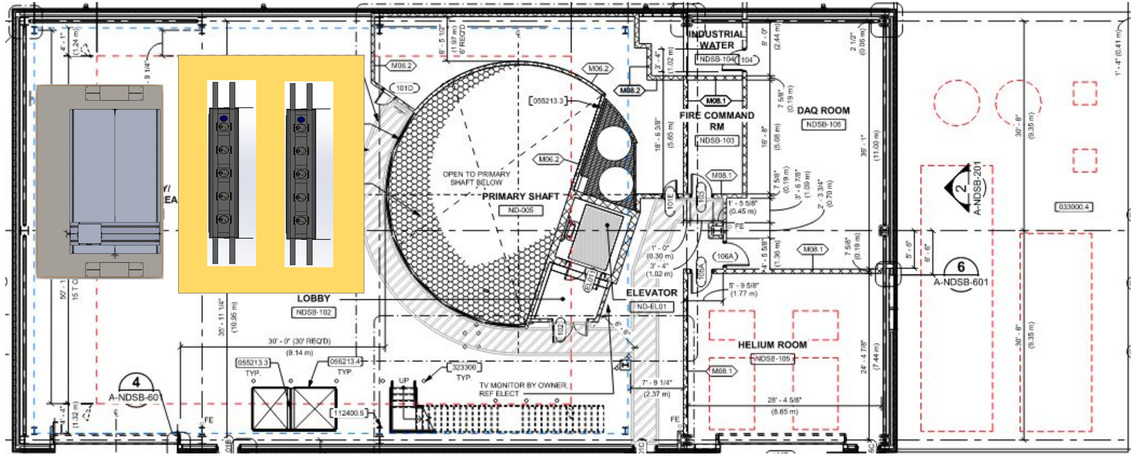


Step 33: Move TMS into Crane 2

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Move TMS into Crane 2	1	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
CRYO+LArTPC: LAr Proximity Cryo, Populate racks and trays, Module Row Checkouts, and possible cryo lid routing		2 - Mech Techs Off Project Labor	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

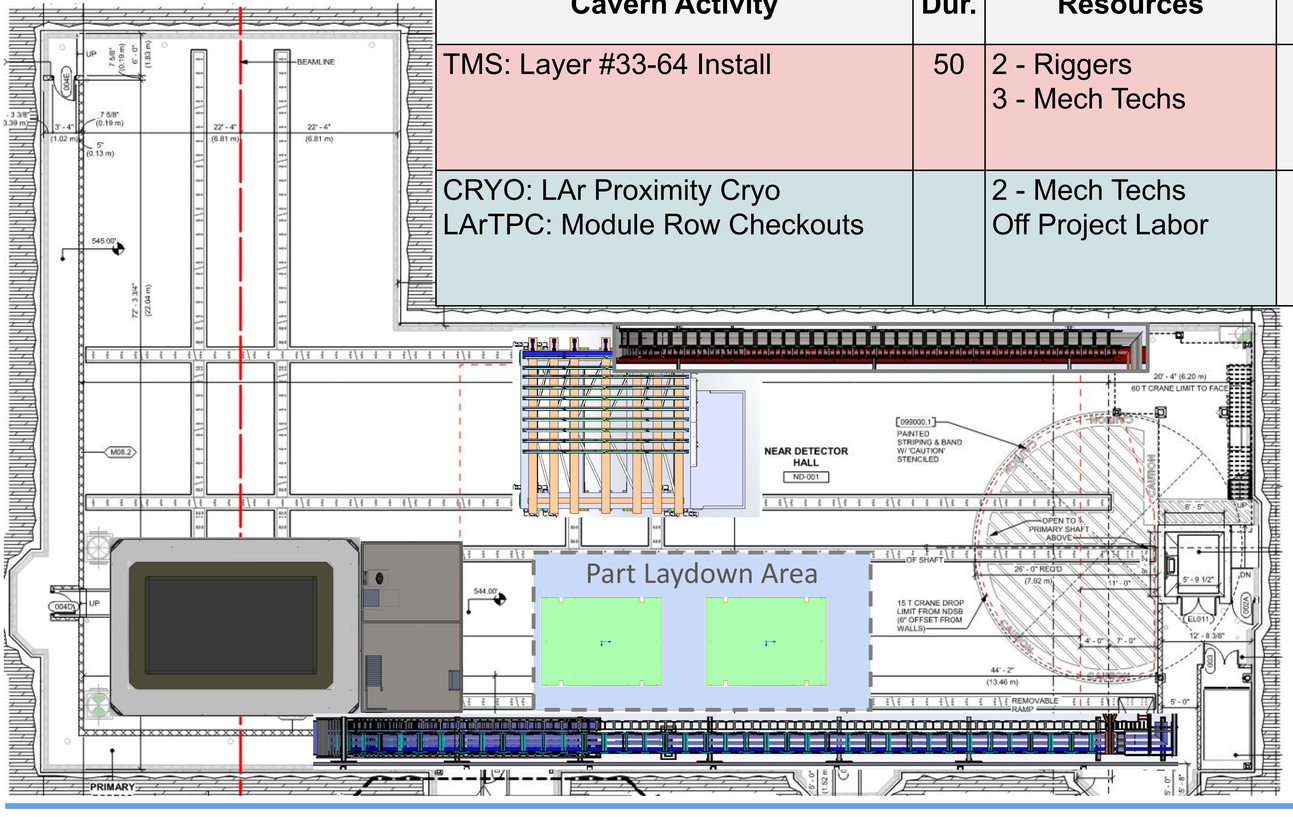


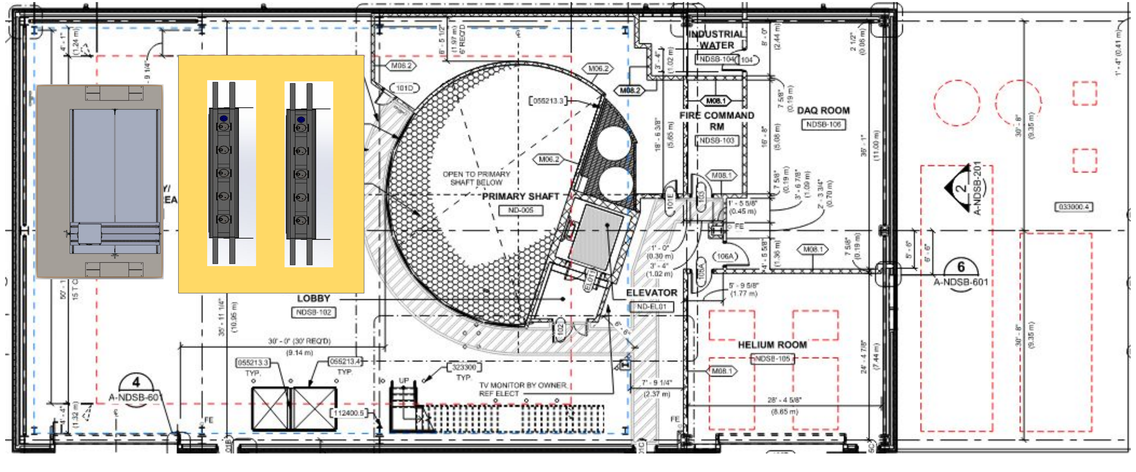


Step 34: Layer #33-64 Install

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Layer #33-64 Install	50	2 - Riggers 3 - Mech Techs	**Critical Path**			
CRYO: LAr Proximity Cryo LArTPC: Module Row Checkouts		2 - Mech Techs Off Project Labor	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

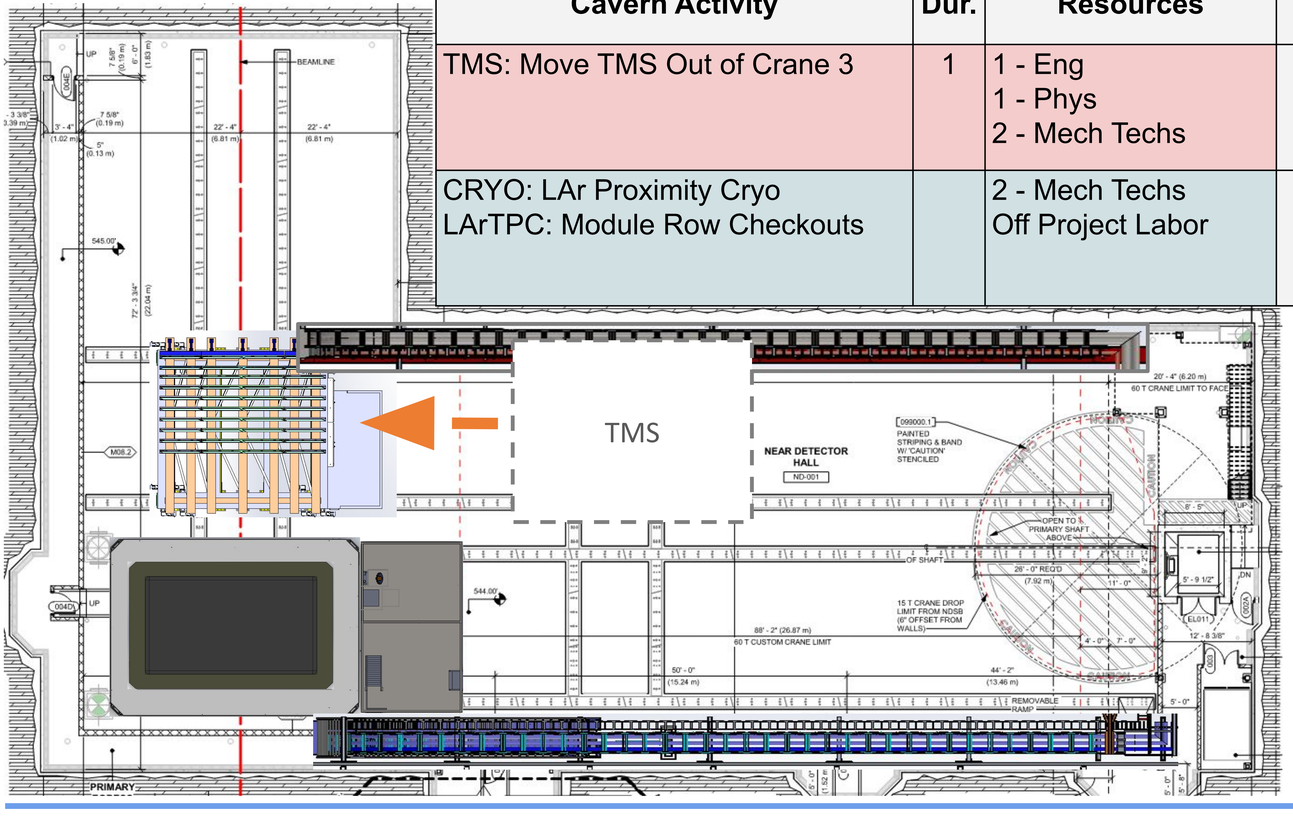


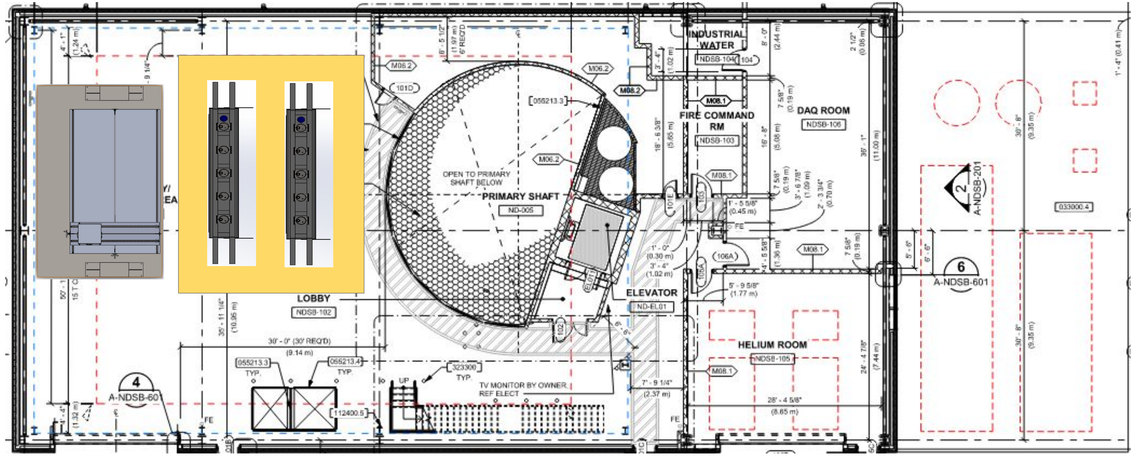


Step 35: Move TMS Out of Crane 3

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Move TMS Out of Crane 3	1	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
CRYO: LAr Proximity Cryo LArTPC: Module Row Checkouts		2 - Mech Techs Off Project Labor	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

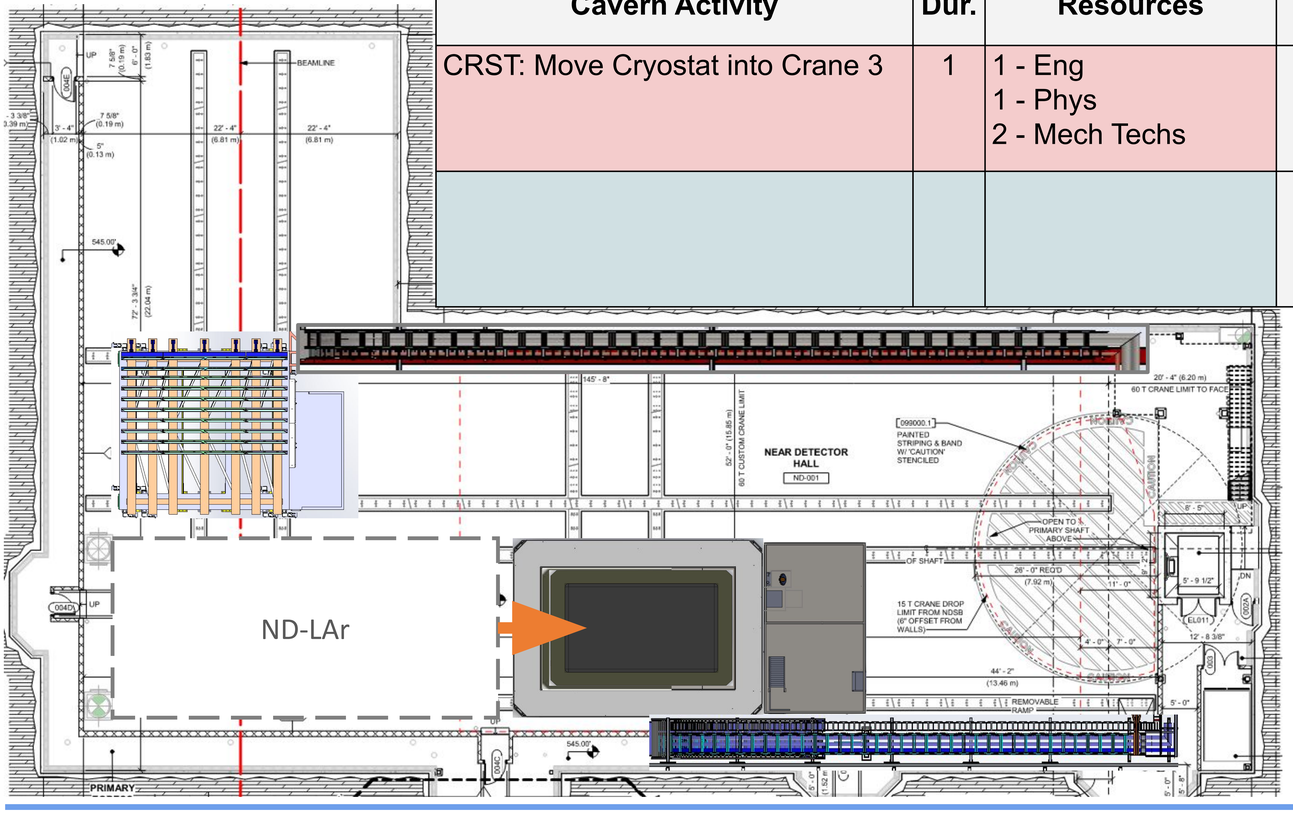


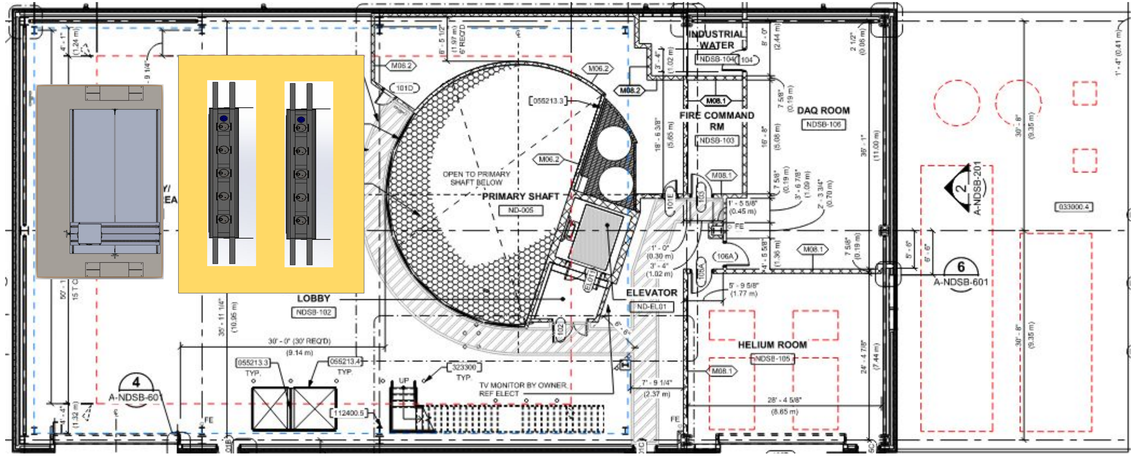


Step 36: Move Cryostat into Crane 3

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Move Cryostat into Crane 3	1	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
			Parallel	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

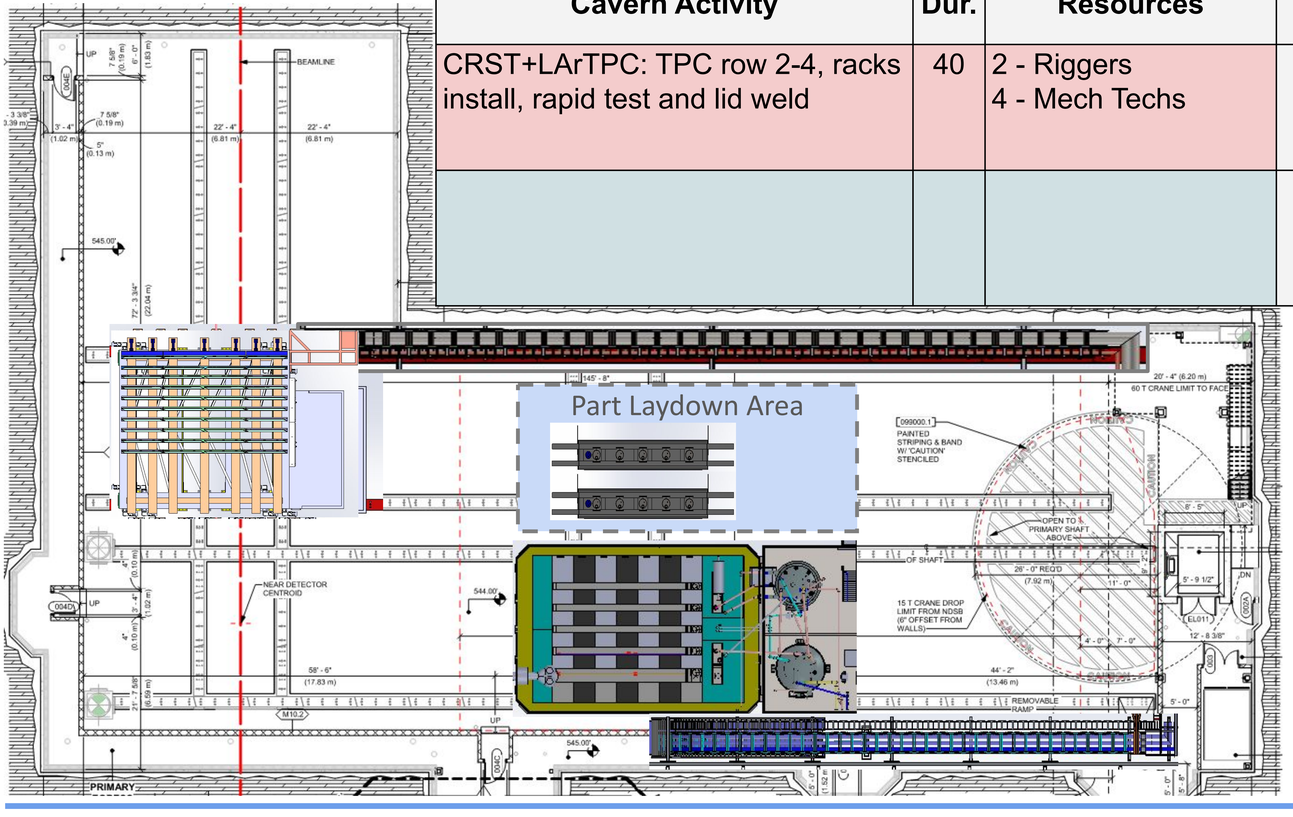


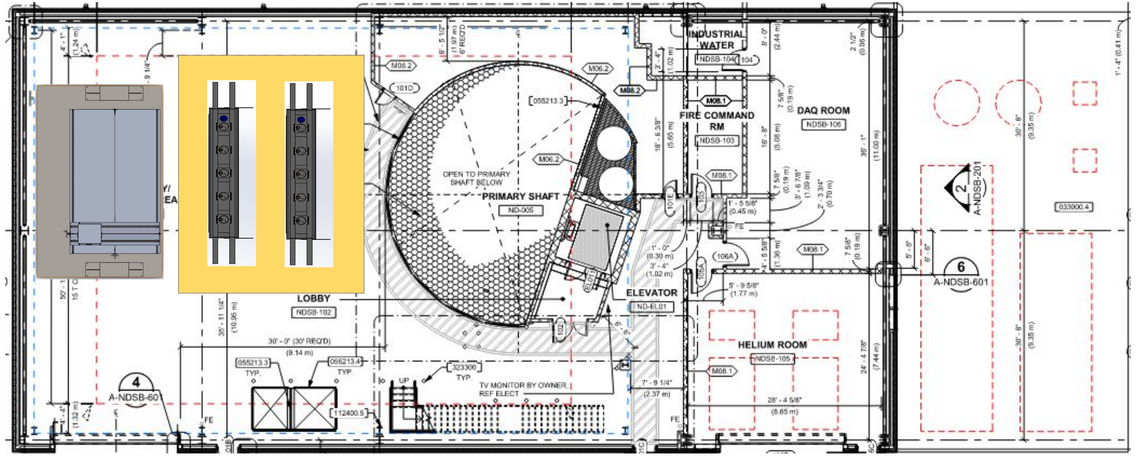


Step 37: TPC Row 2-4 Install

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST+LArTPC: TPC row 2-4, racks install, rapid test and lid weld	40	2 - Riggers 4 - Mech Techs	**Critical Path**			
			Parallel	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

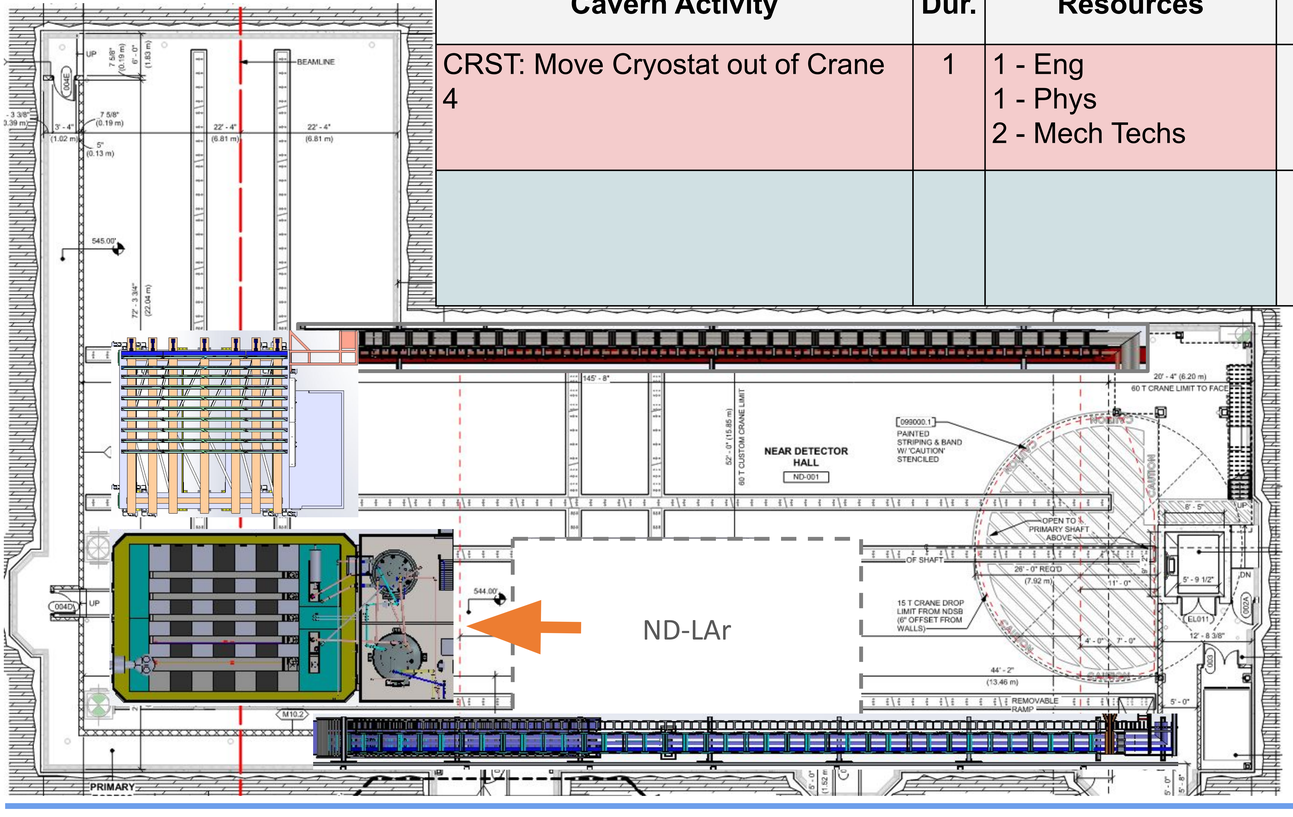


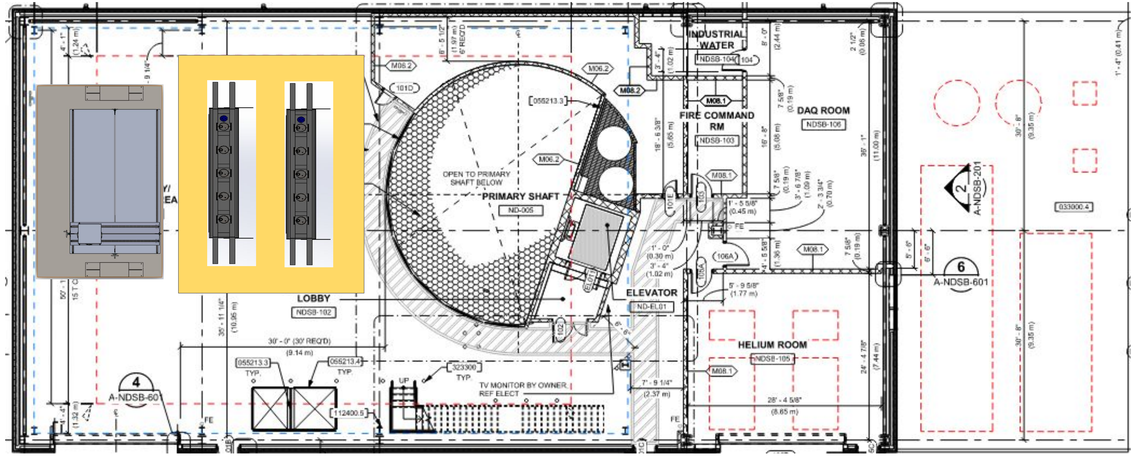


Step 38: Move Cryostat out of Crane 4

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Move Cryostat out of Crane 4	1	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
			Parallel	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

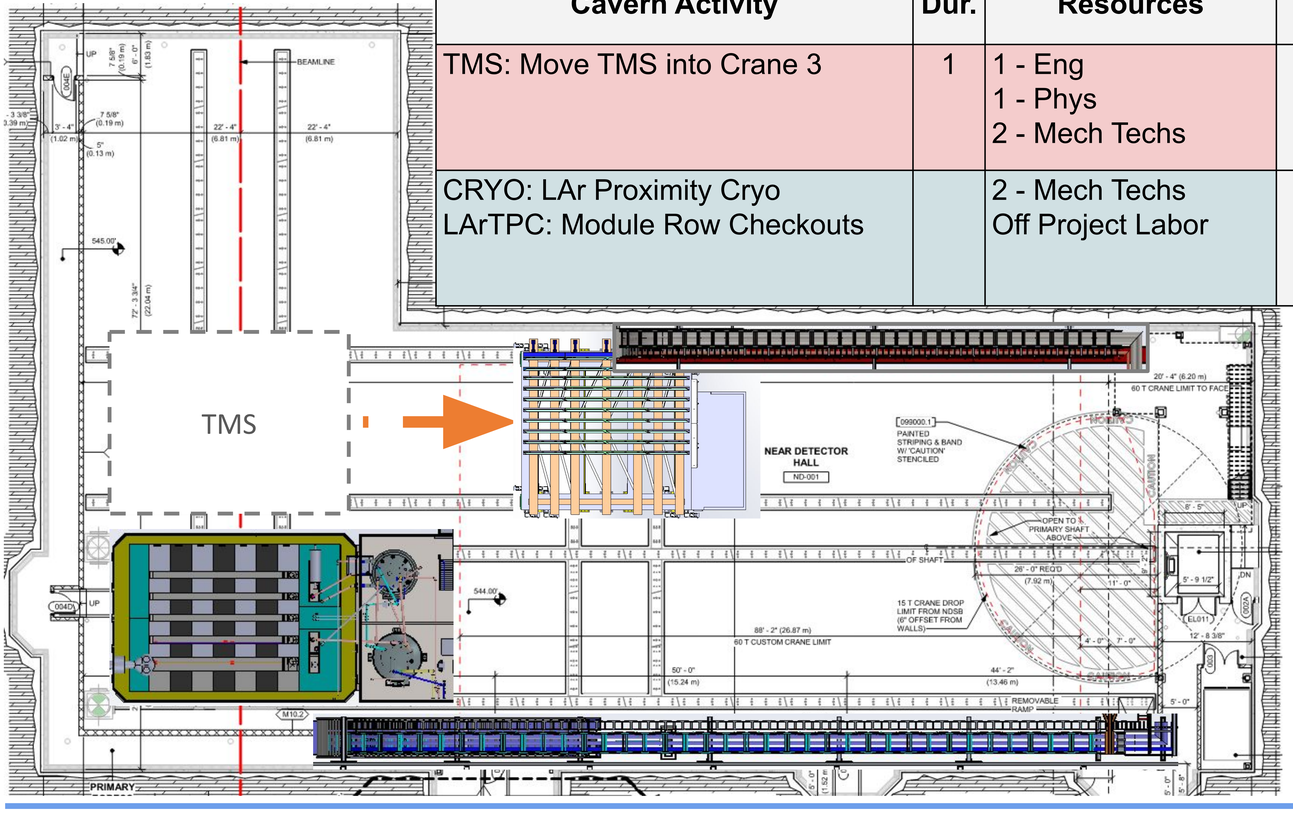


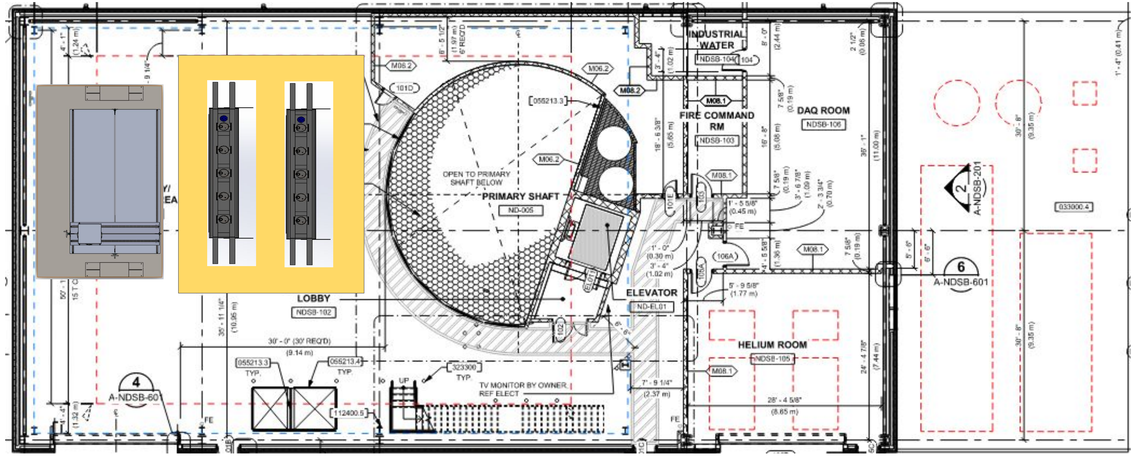


Step 39: Move TMS into Crane 3

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Move TMS into Crane 3	1	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
CRYO: LAr Proximity Cryo LArTPC: Module Row Checkouts		2 - Mech Techs Off Project Labor	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

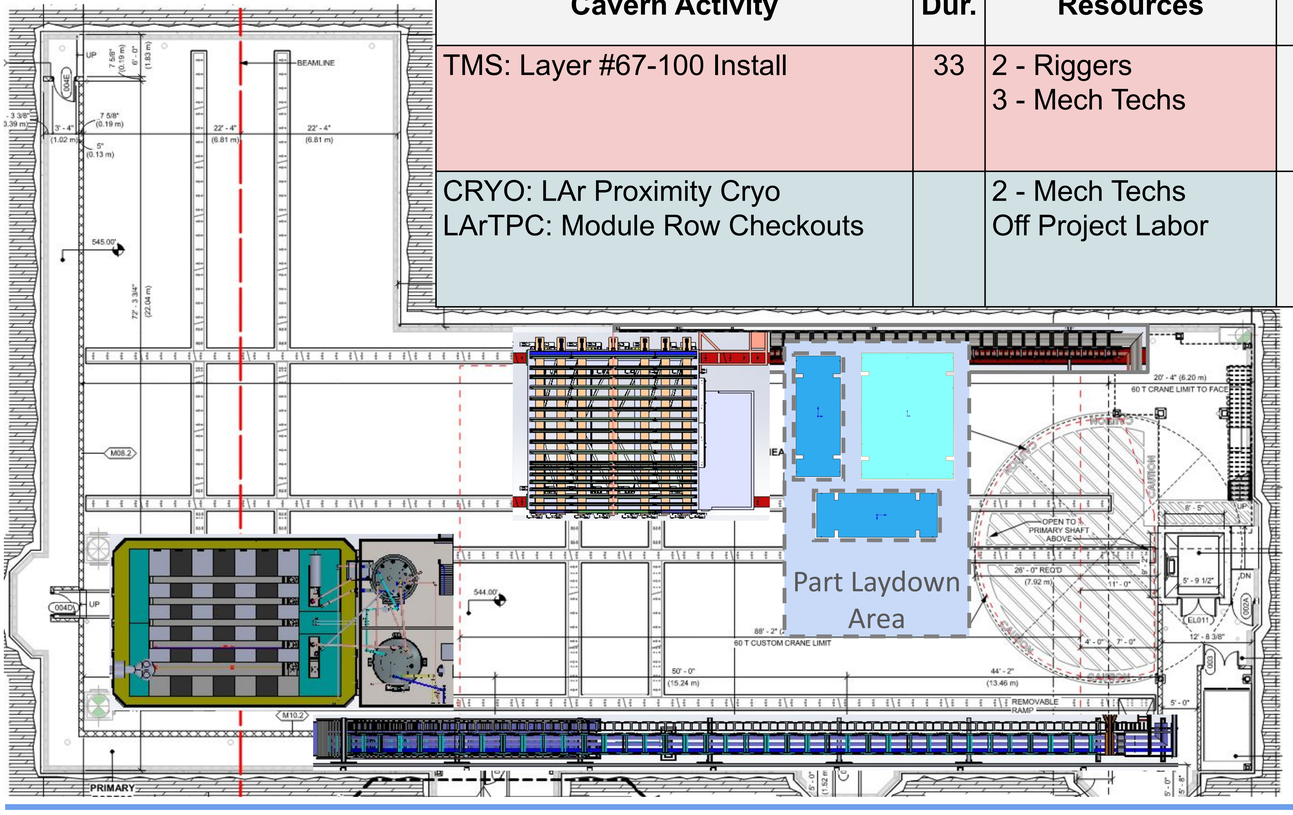


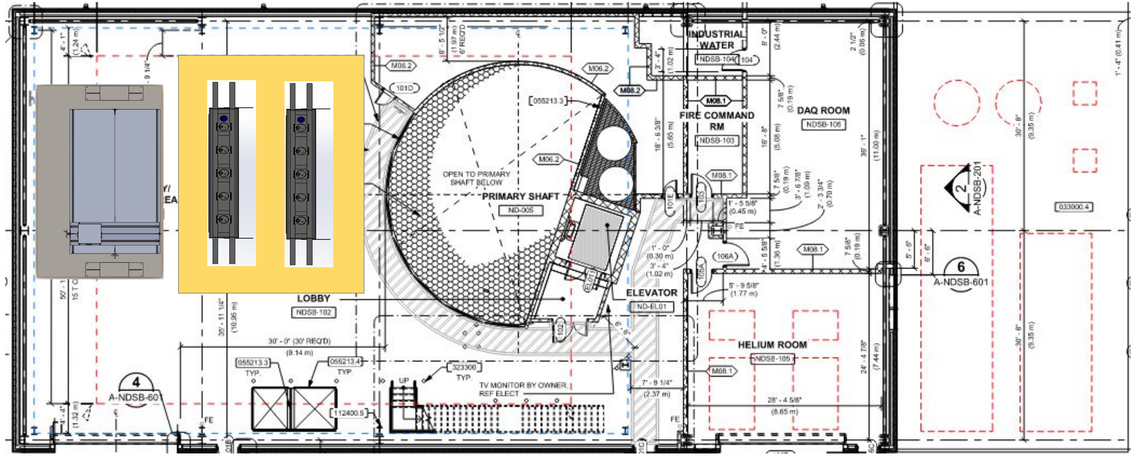


Step 40: Layer #67-100 Install

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Layer #67-100 Install	33	2 - Riggers 3 - Mech Techs	**Critical Path**			
CRYO: LAr Proximity Cryo LArTPC: Module Row Checkouts		2 - Mech Techs Off Project Labor	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor



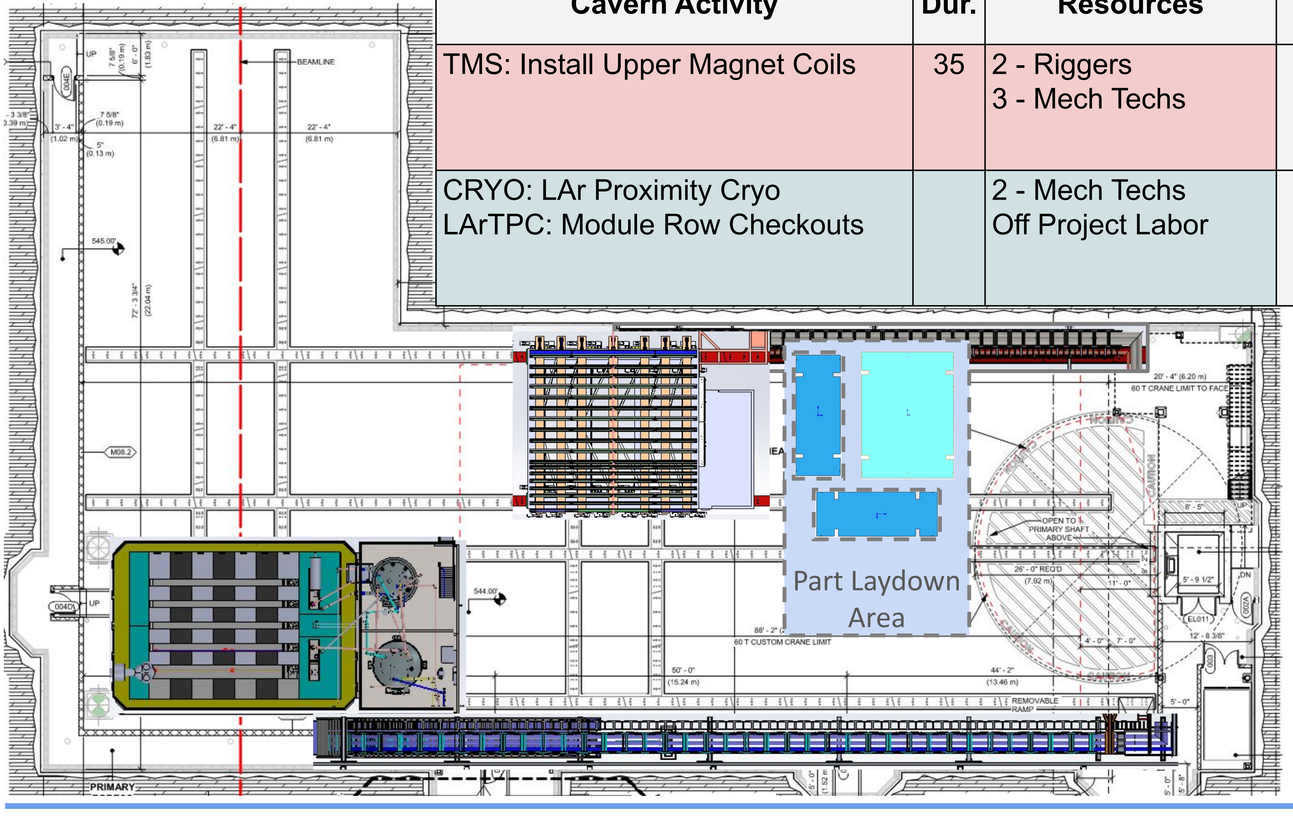


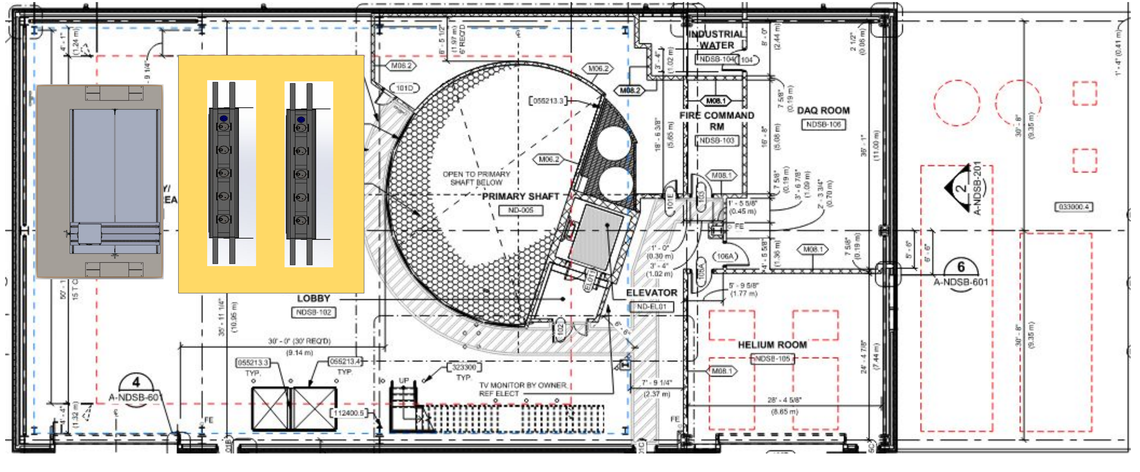
TPC Modules can be tested in parallel with TMS installation activities.

Step 41: Install Upper Magnet Coils

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Install Upper Magnet Coils	35	2 - Riggers 3 - Mech Techs	**Critical Path**			
CRYO: LAr Proximity Cryo LArTPC: Module Row Checkouts		2 - Mech Techs Off Project Labor	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor



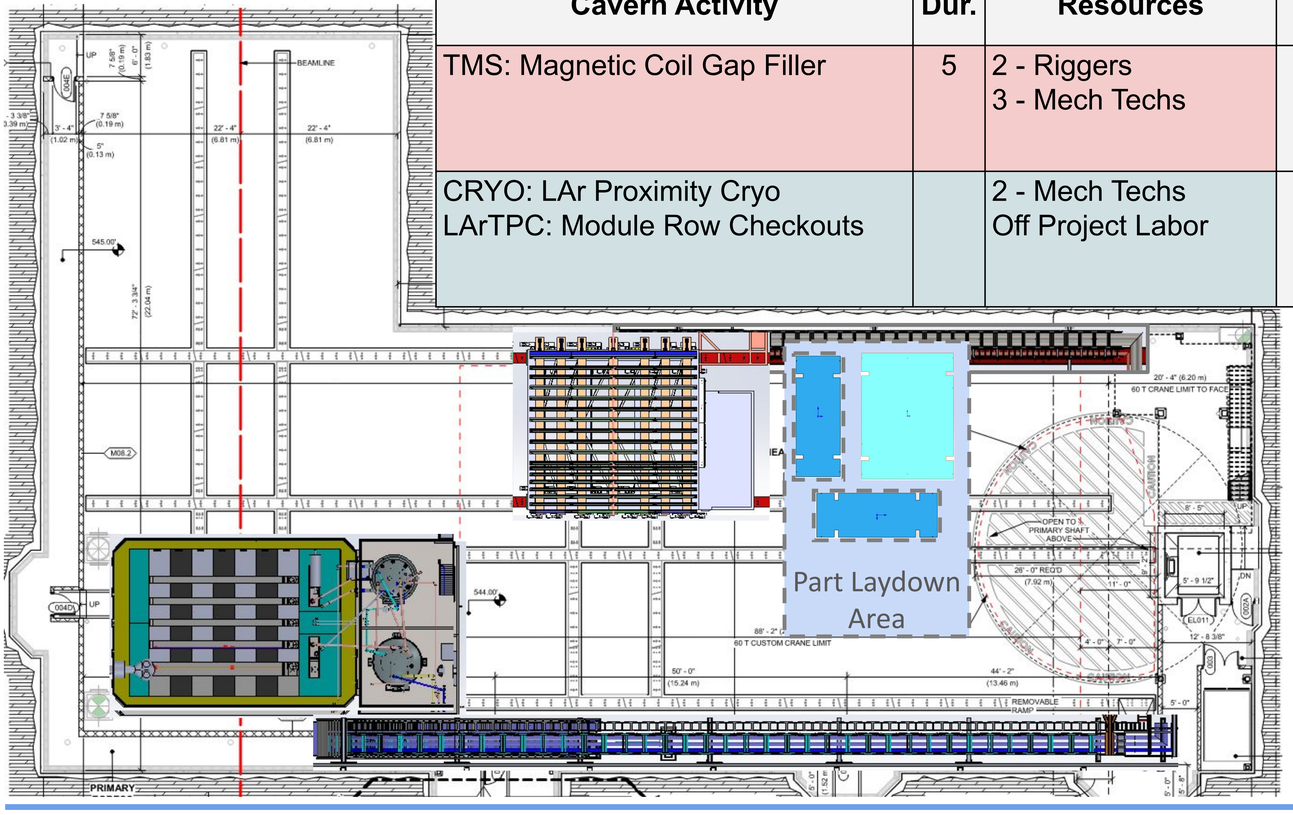


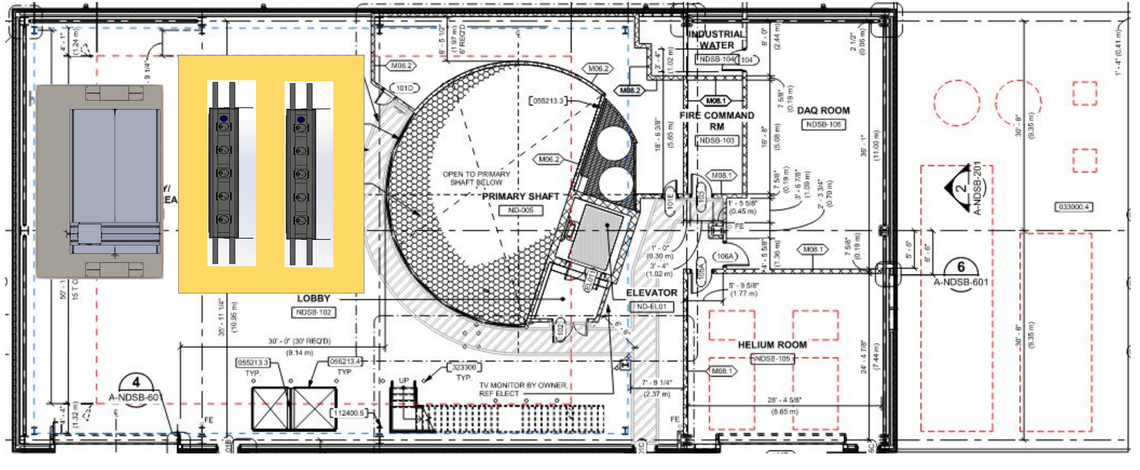
TPC Modules can be tested in parallel with TMS installation activities.

Step 42: Magnetic Coil Gap Filler

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Magnetic Coil Gap Filler	5	2 - Riggers 3 - Mech Techs	**Critical Path**			
CRYO: LAr Proximity Cryo LArTPC: Module Row Checkouts		2 - Mech Techs Off Project Labor	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor



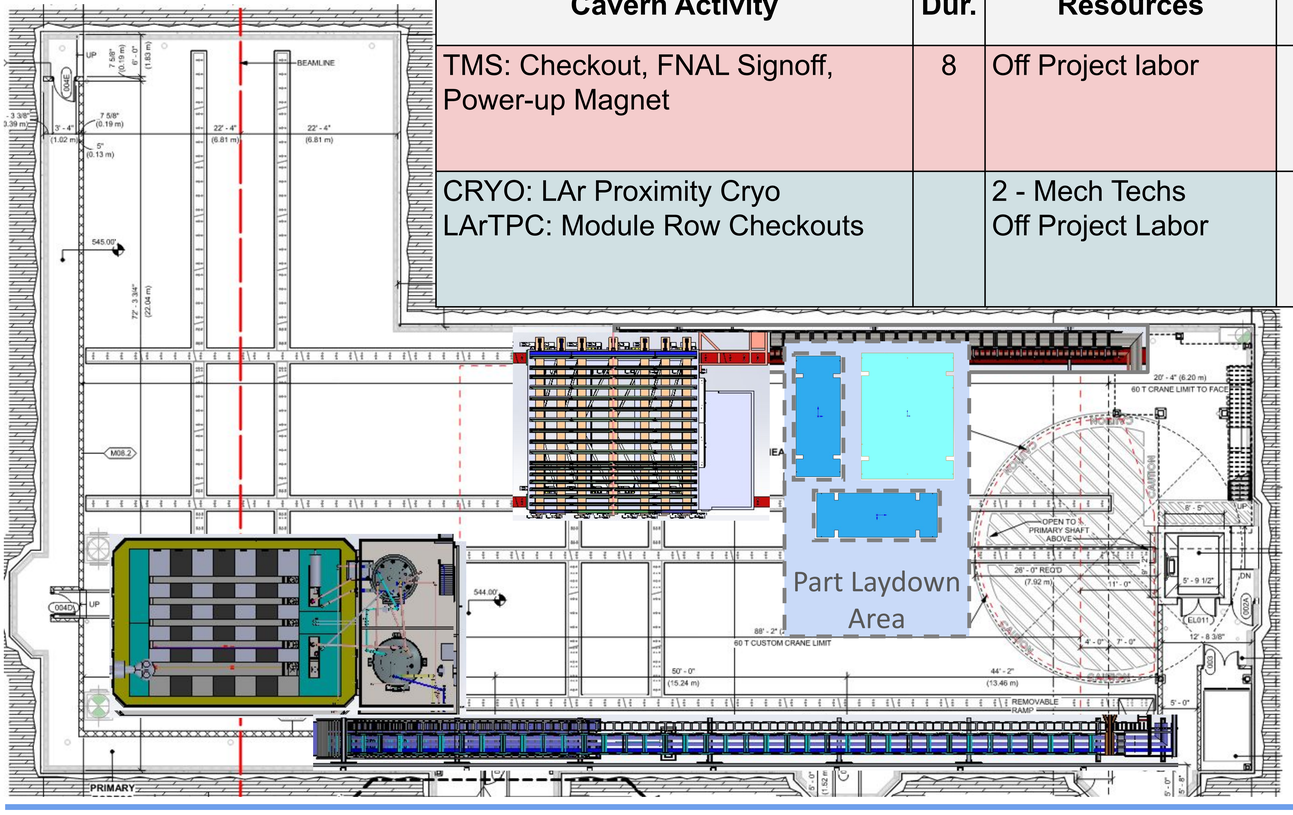


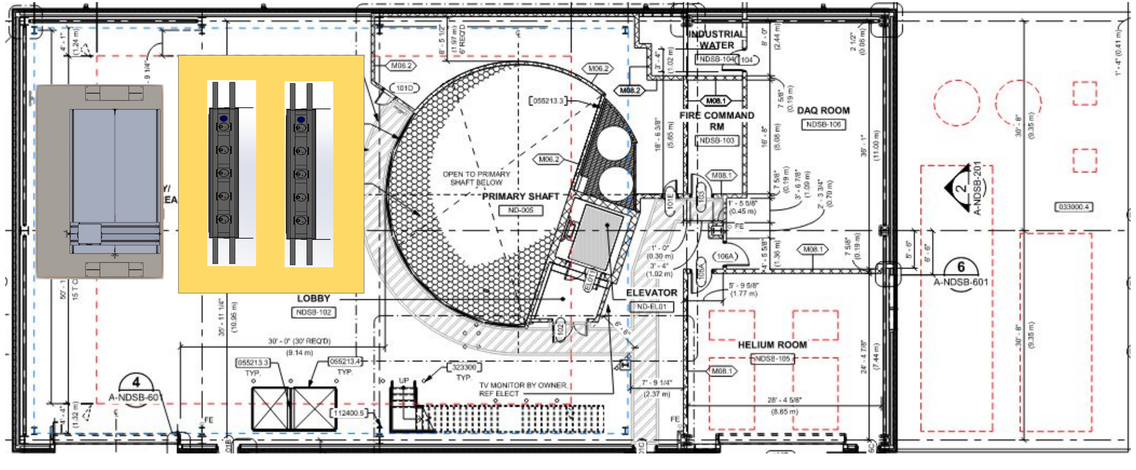
TPC Modules can be tested in parallel with TMS installation activities.

Step 43: Checkout, FNAL Signoff, Power-up Magnet

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Checkout, FNAL Signoff, Power-up Magnet	8	Off Project labor	**Critical Path**			
CRYO: LAr Proximity Cryo LArTPC: Module Row Checkouts		2 - Mech Techs Off Project Labor	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor



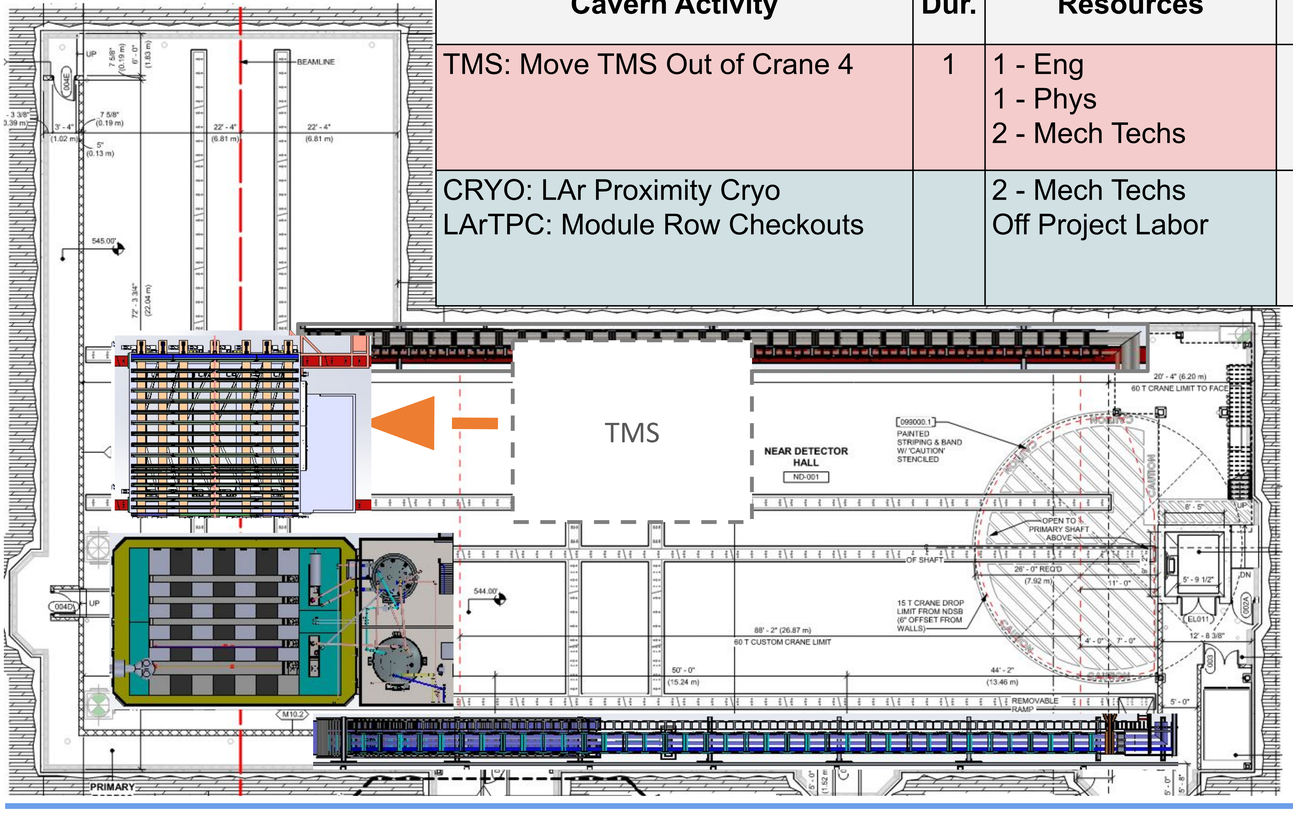


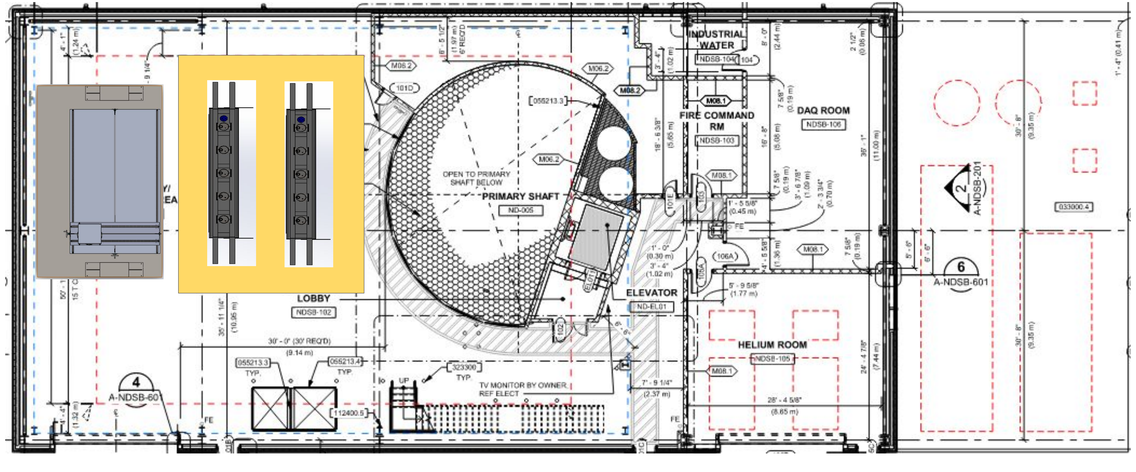
TPC Modules can be tested in parallel with TMS installation activities.

Step 44: Move TMS Out of Crane 4

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
TMS: Move TMS Out of Crane 4	1	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
CRYO: LAr Proximity Cryo LArTPC: Module Row Checkouts		2 - Mech Techs Off Project Labor	**Parallel**	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor

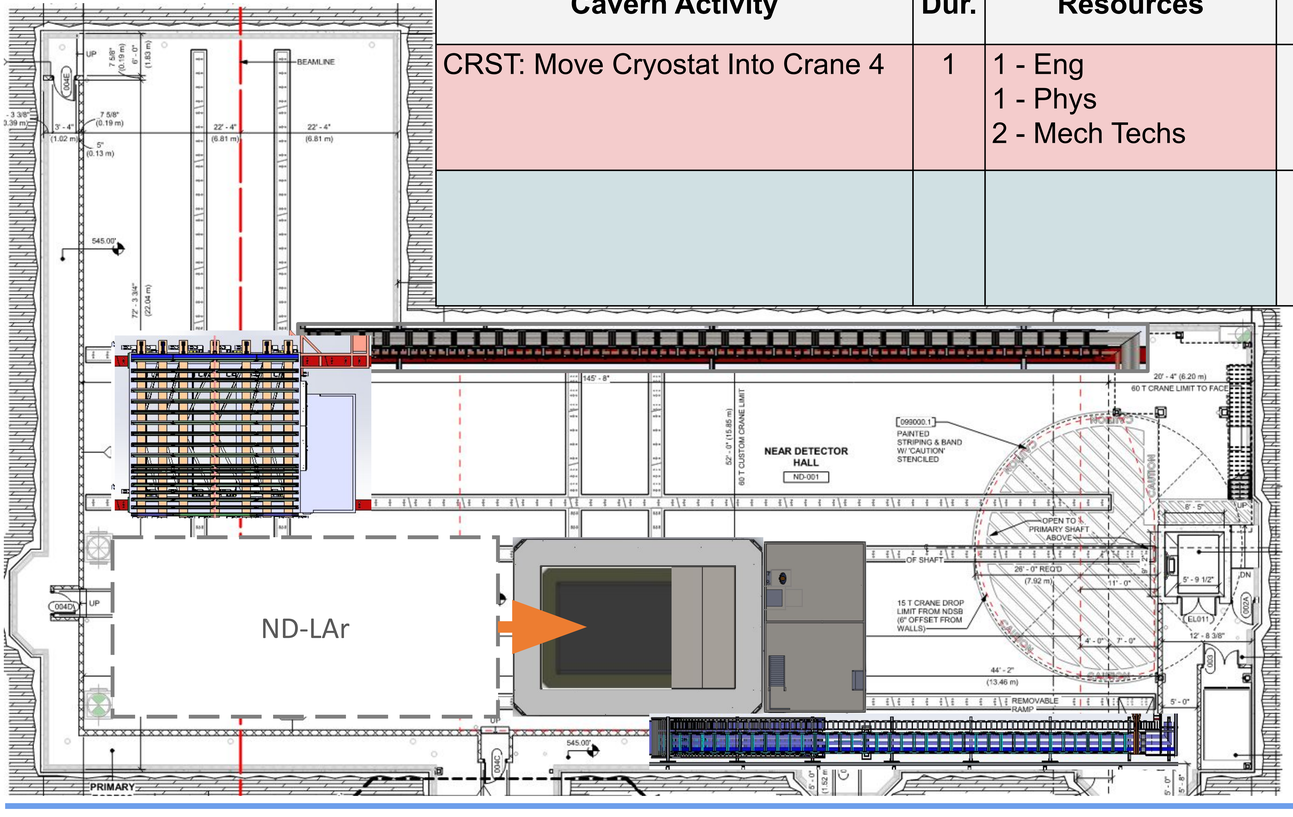


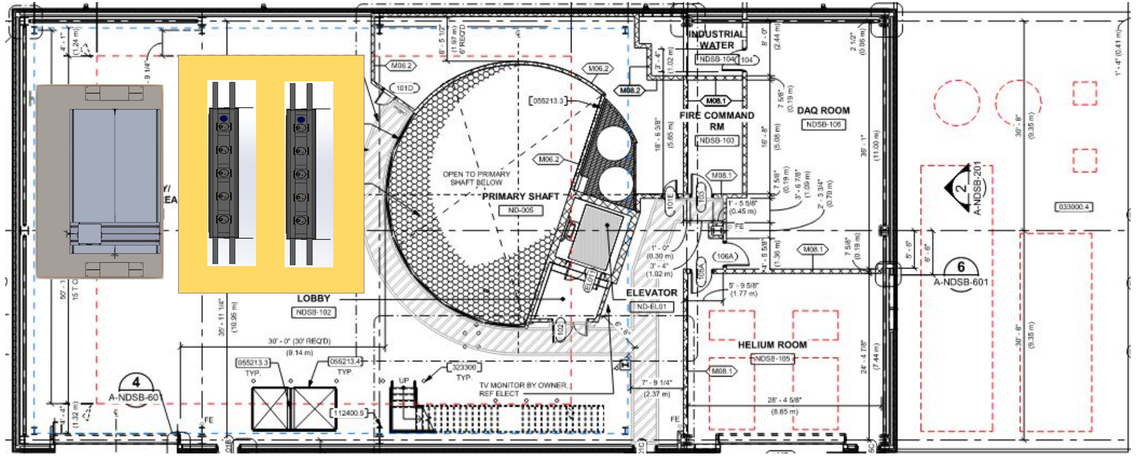


Step 45: Move Cryostat Into Crane 4

Scale 1”:2m

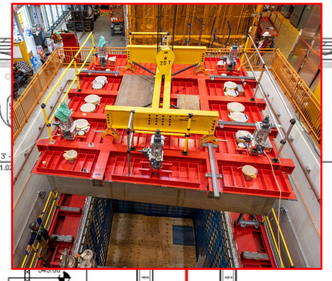
Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Move Cryostat Into Crane 4	1	1 - Eng 1 - Phys 2 - Mech Techs	**Critical Path**			
			Parallel	LArTPC: TPC Integration		2 - Riggers 2 - Mech Techs Off Project labor



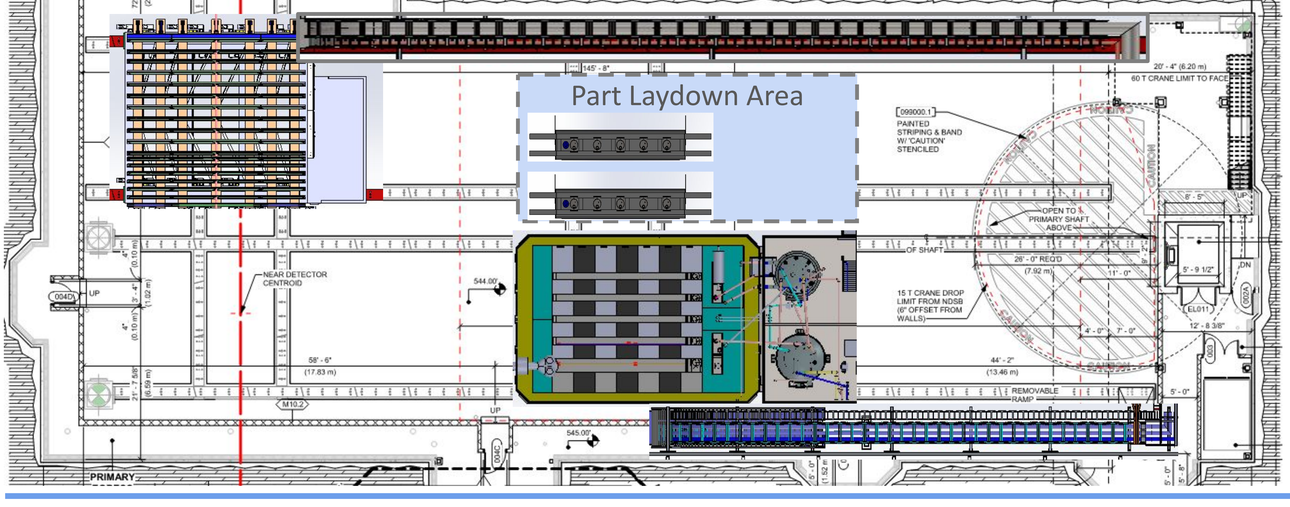


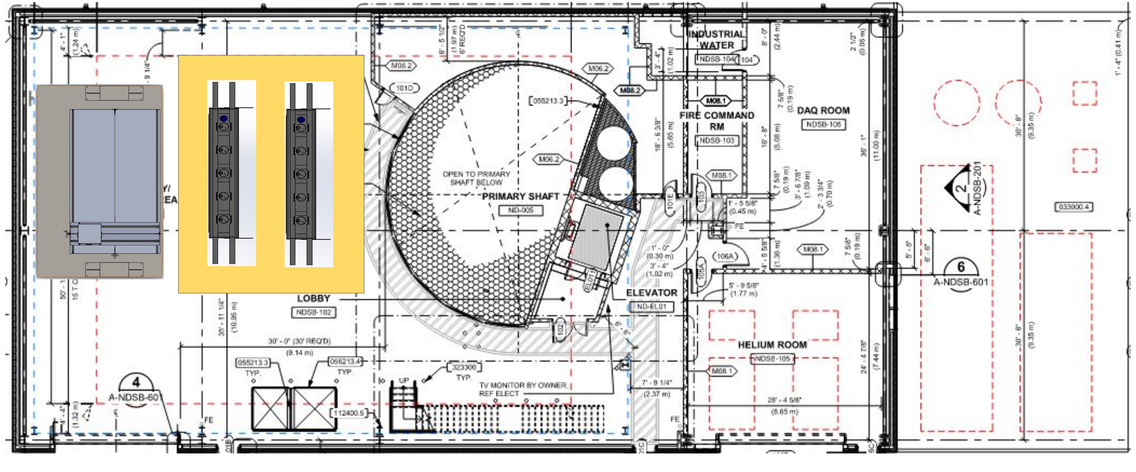
Step 46: TPC Row 5-7 Install

Scale 1”:2m



Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST+LArTPC: Row 5-7 Install, racks install, rapid test and lid weld	40	2 - Riggers 4 - Mech Techs	**Critical Path**			
			Parallel			

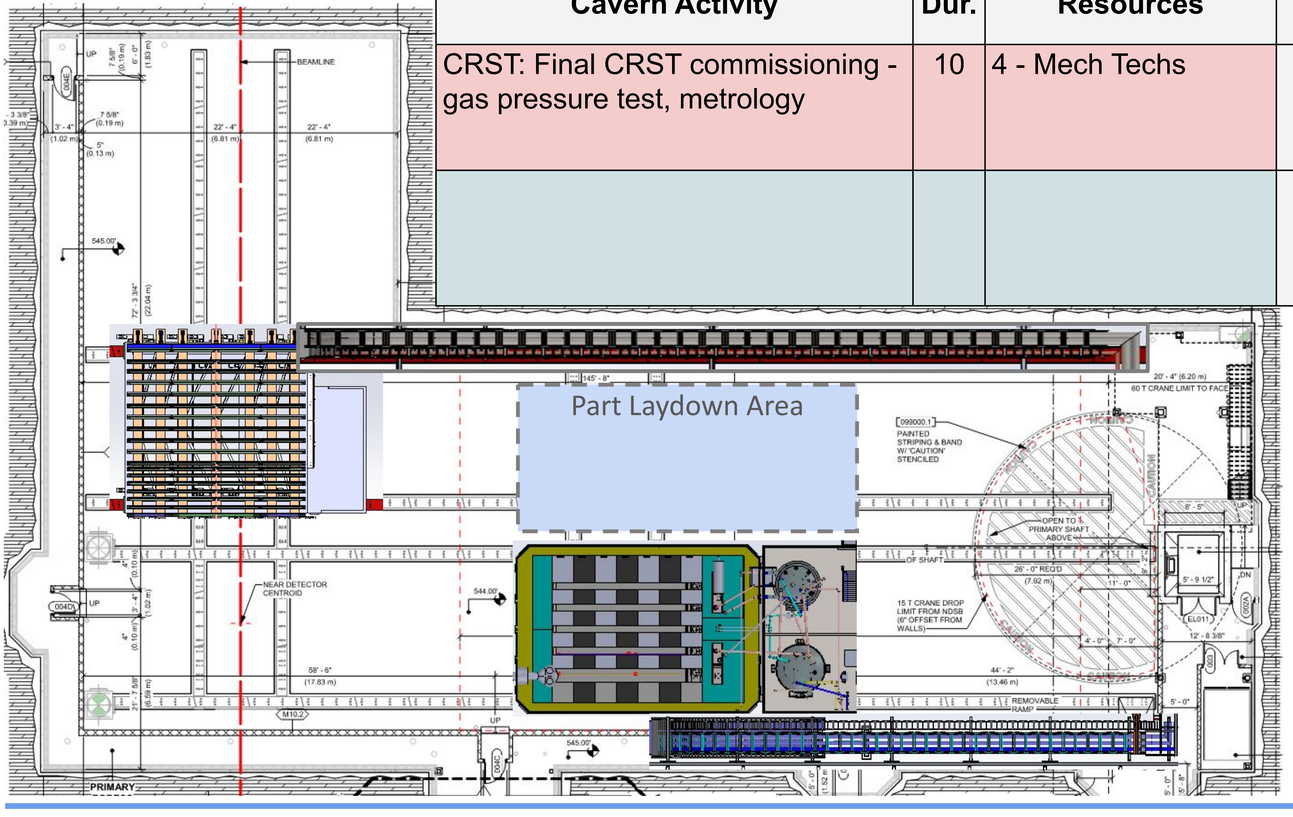


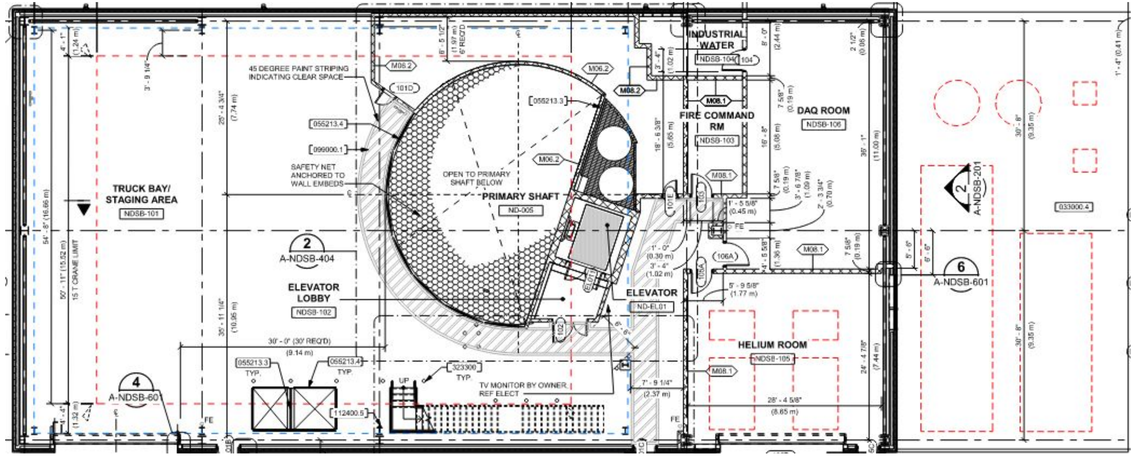


Step 47: Cryostat Comissioning

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: Final CRST commissioning - gas pressure test, metrology	10	4 - Mech Techs	**Critical Path**			
			Parallel			

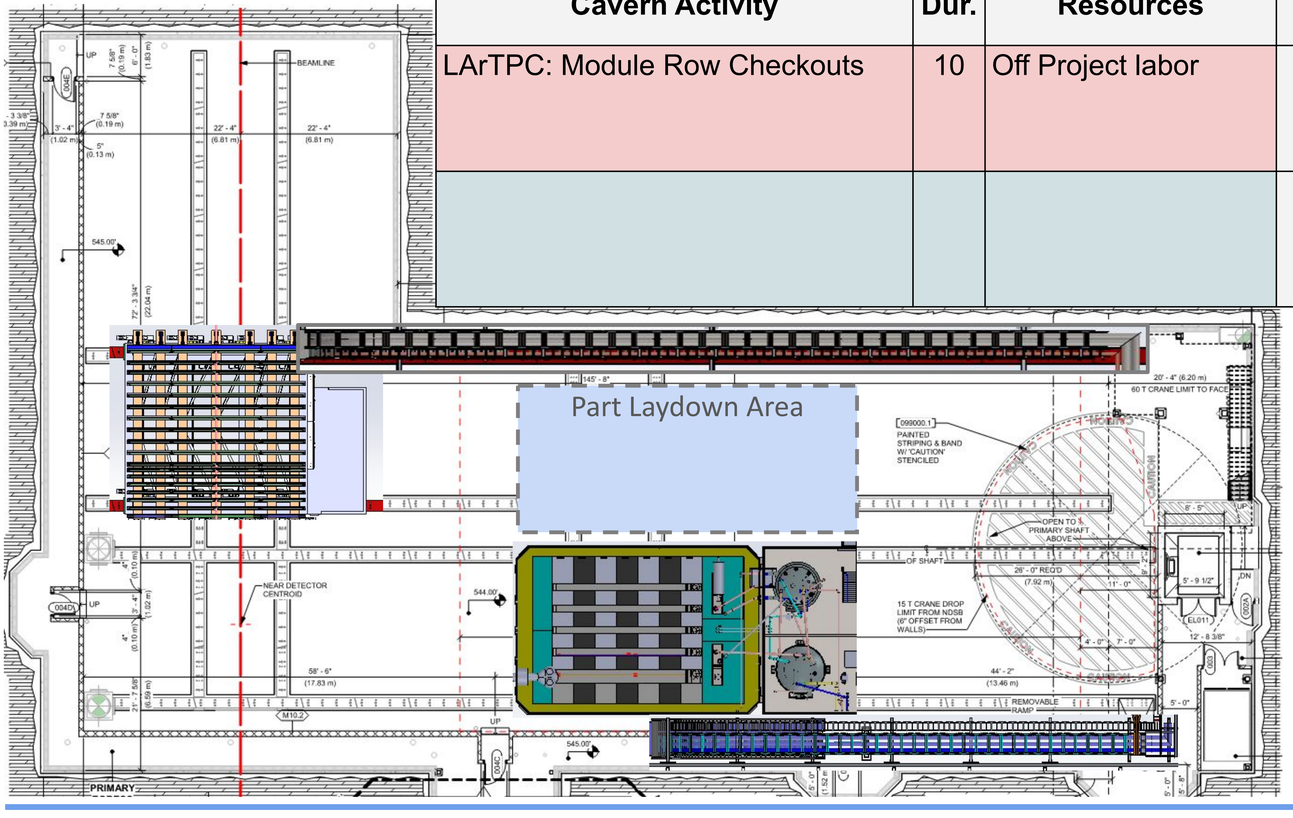


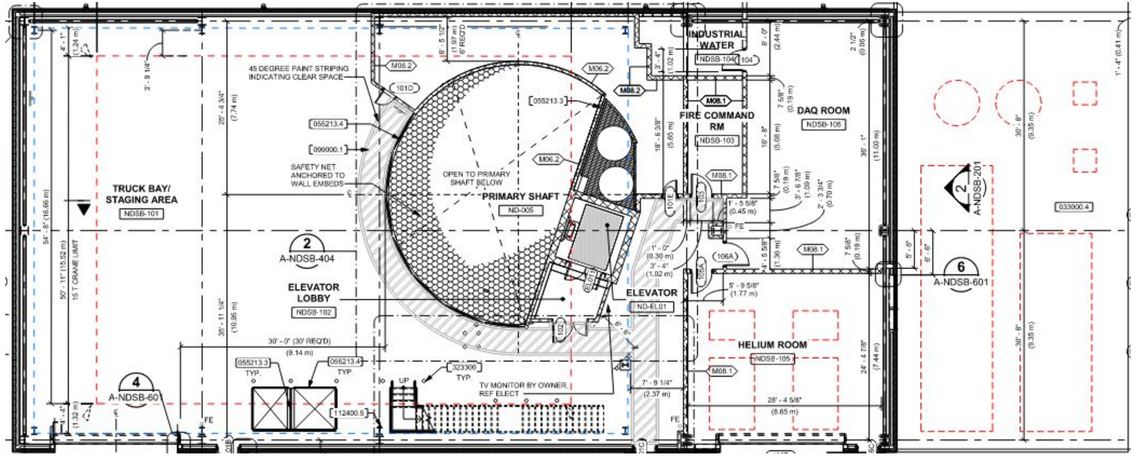


Step 48: Module Row Checkouts

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
LArTPC: Module Row Checkouts	10	Off Project labor	**Critical Path**			
			Parallel			

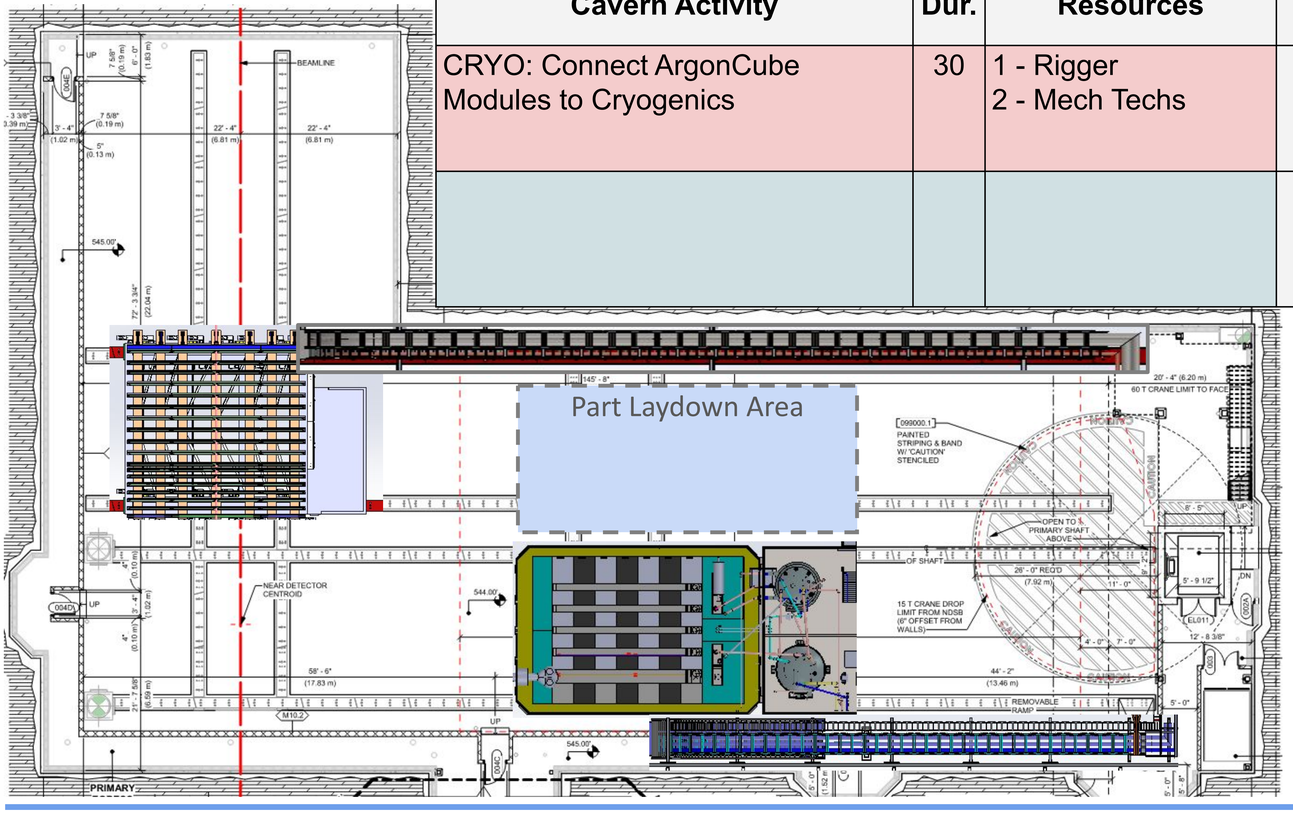


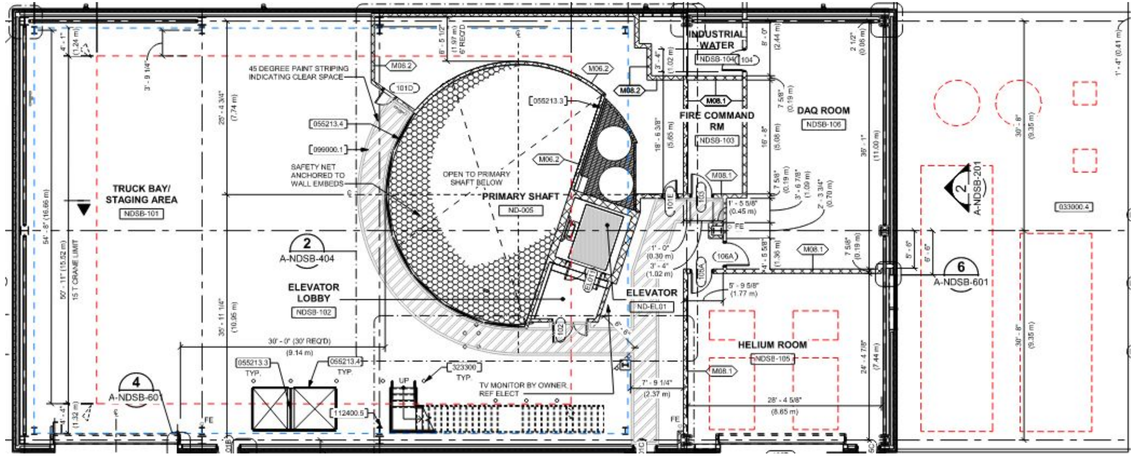


Step 49: Connect Argoncube to Cryogenics

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRYO: Connect ArgonCube Modules to Cryogenics	30	1 - Rigger 2 - Mech Techs	**Critical Path**			
			Parallel			

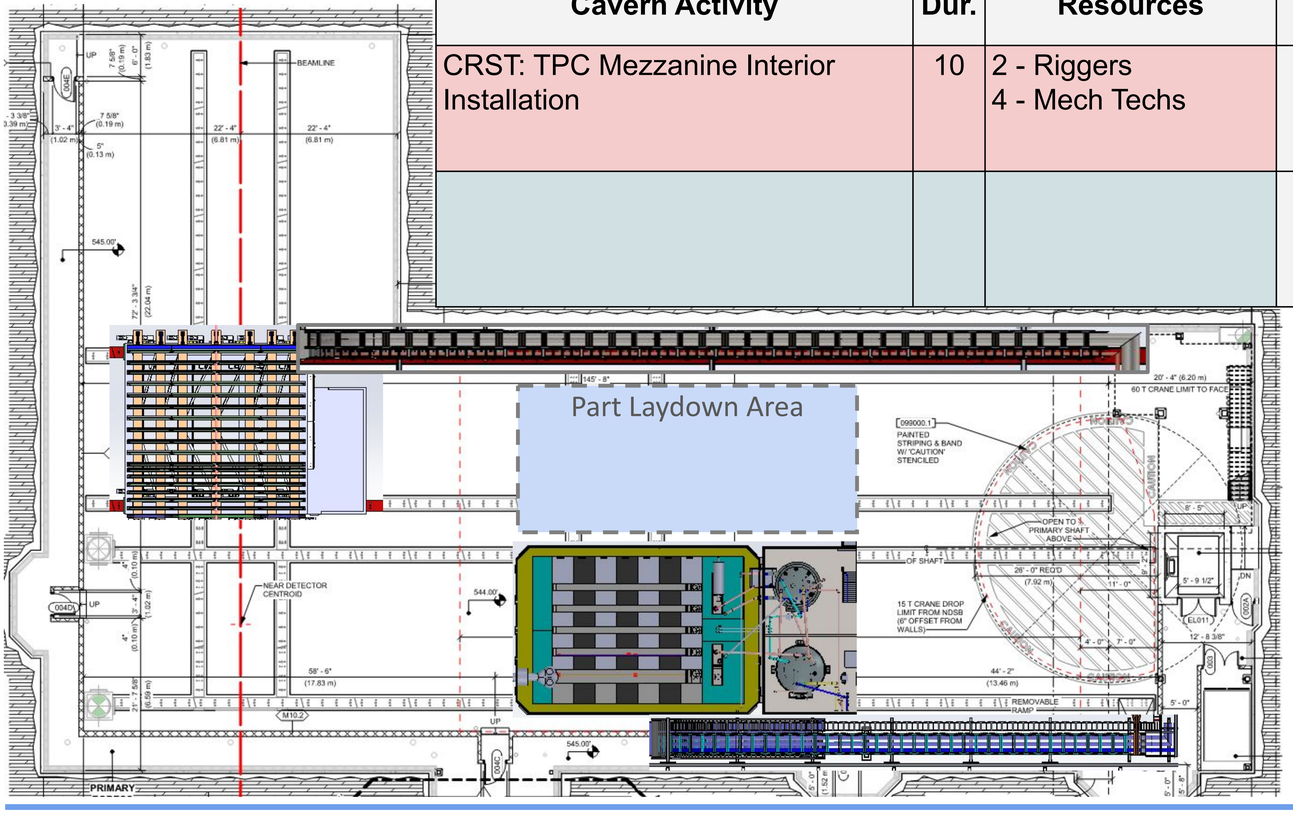


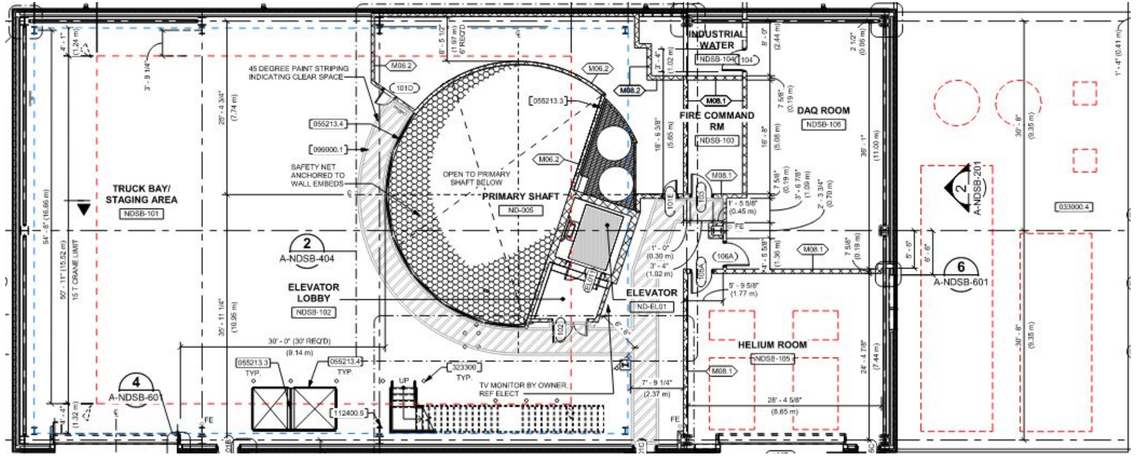


Step 50: TPC Mezzanine Interior Installation

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
CRST: TPC Mezzanine Interior Installation	10	2 - Riggers 4 - Mech Techs	**Critical Path**			
			Parallel			

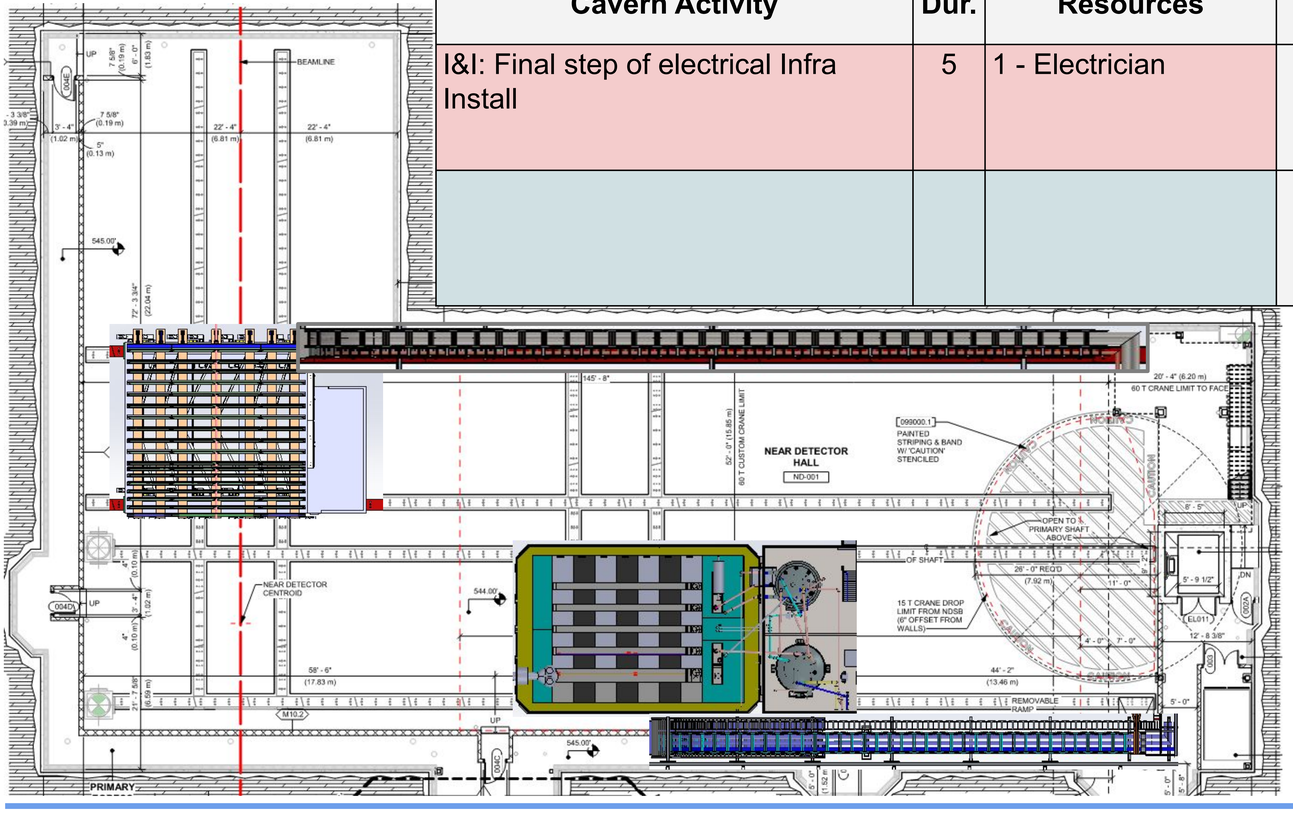


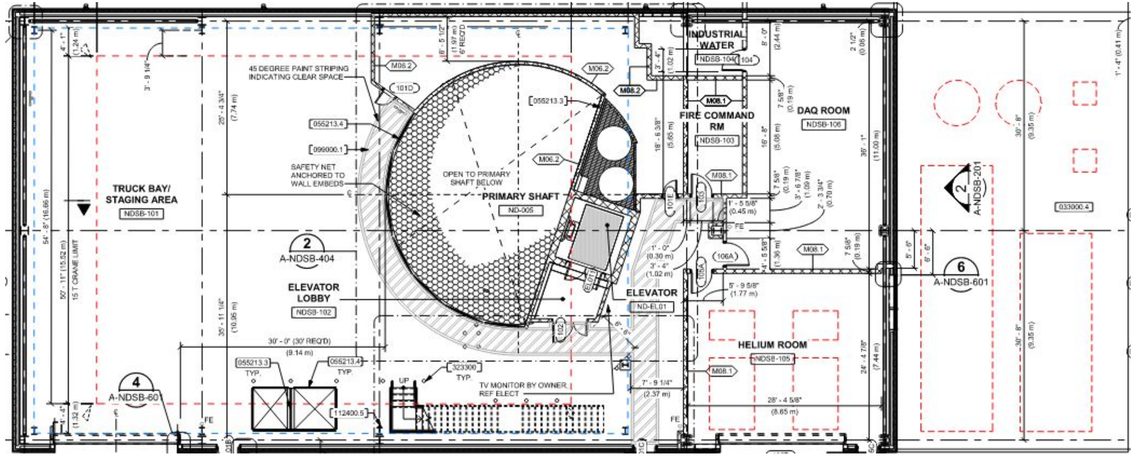


Step 51: Final Electrical Infrastructure Installation

Scale 1”:2m

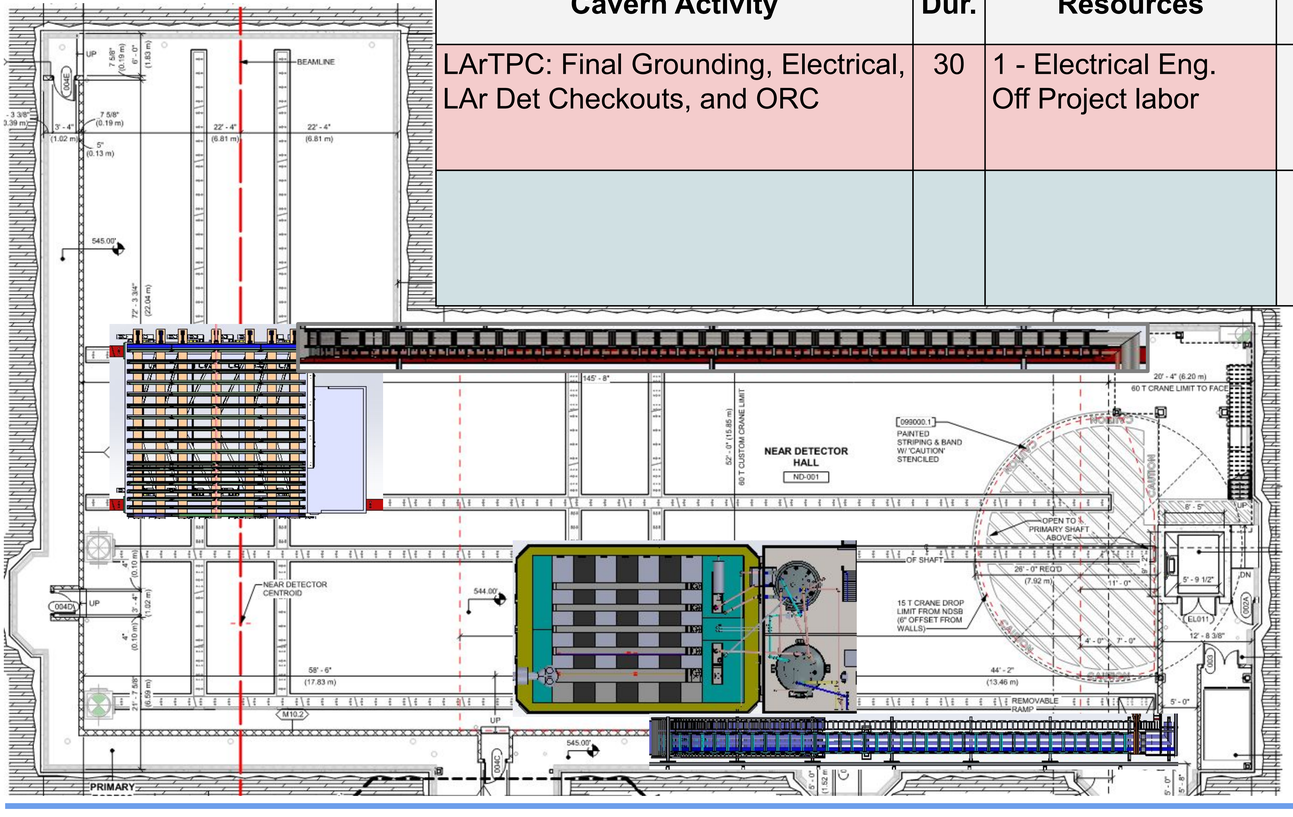
Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
I&I: Final step of electrical Infra Install	5	1 - Electrician	**Critical Path**			
			Parallel			

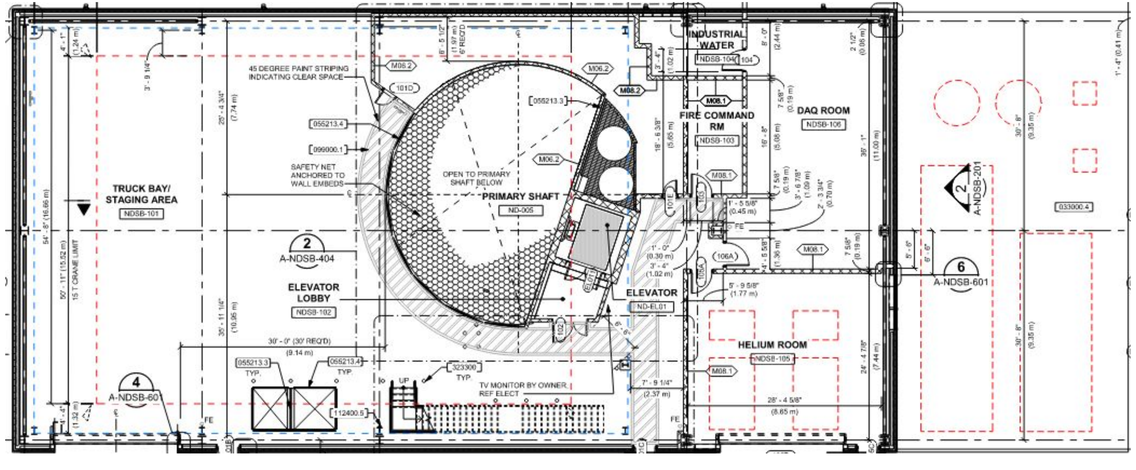




Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
LArTPC: Final Grounding, Electrical, LAr Det Checkouts, and ORC	30	1 - Electrical Eng. Off Project labor	**Critical Path**			
			Parallel			

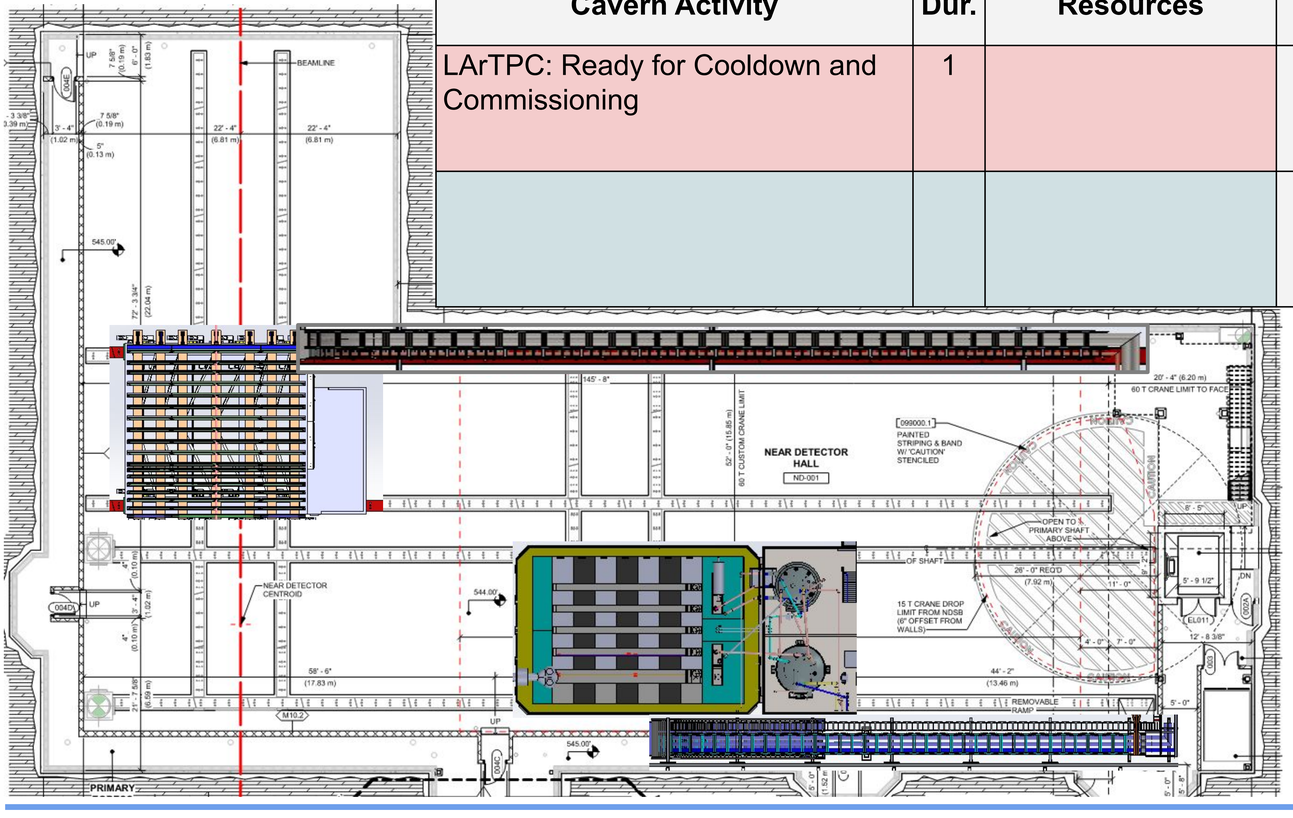


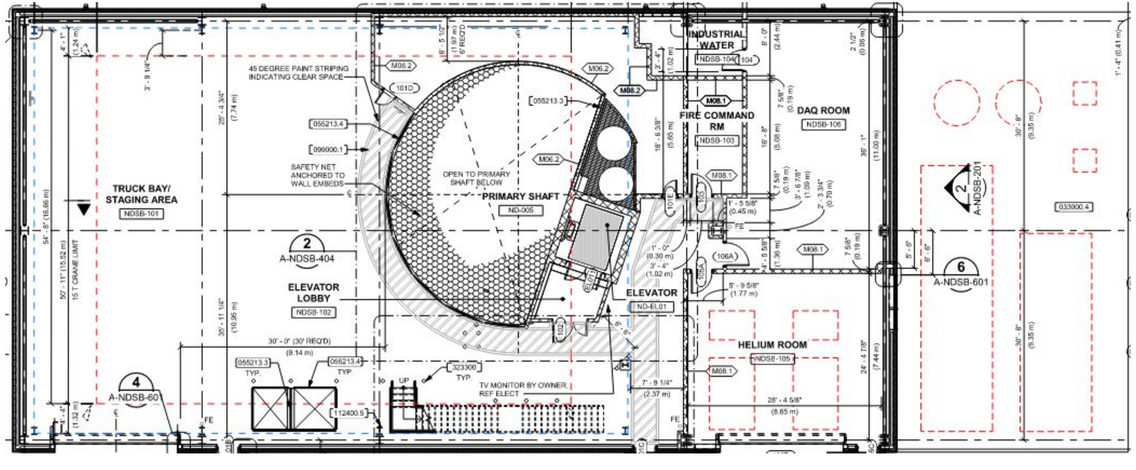


Step 53: Ready for Cooldown and Comissioning

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
LArTPC: Ready for Cooldown and Commissioning	1		Critical Path			
			Parallel			



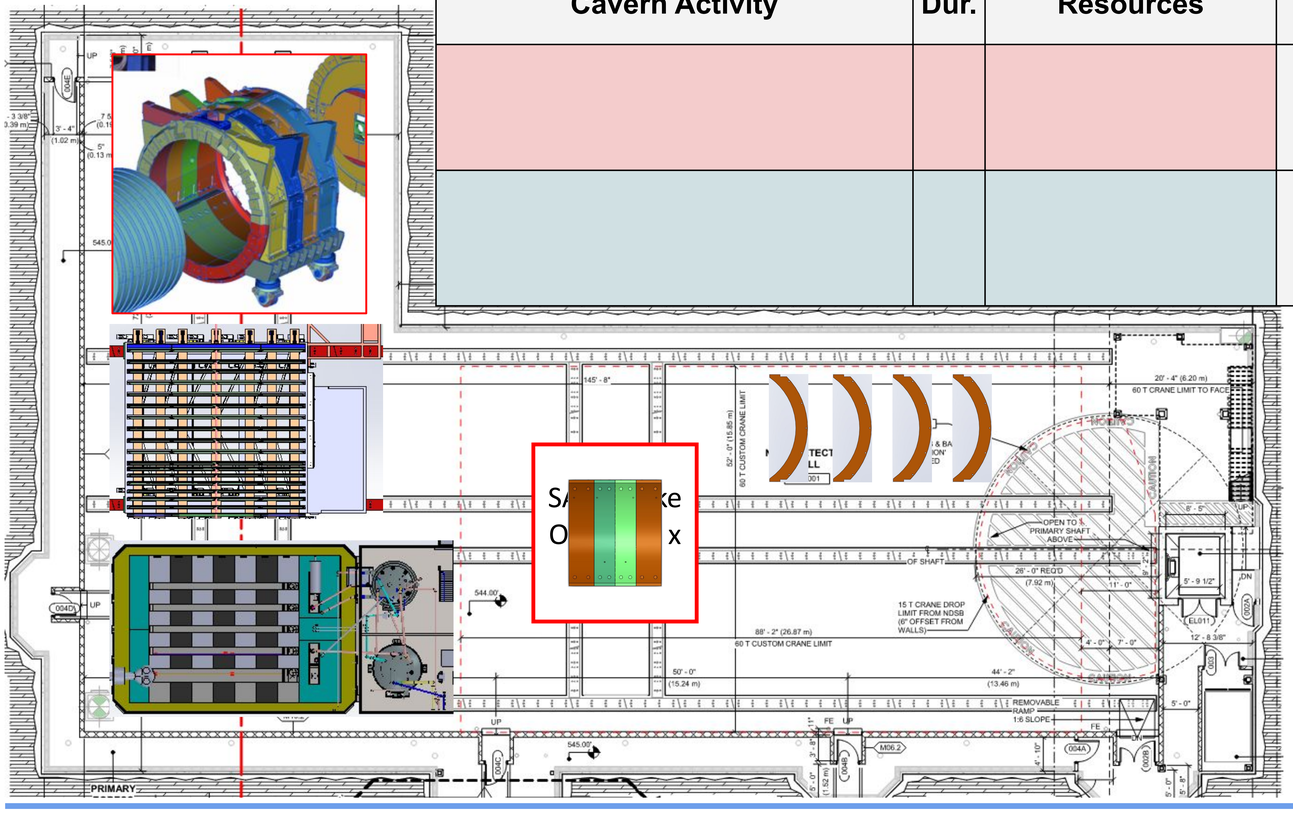


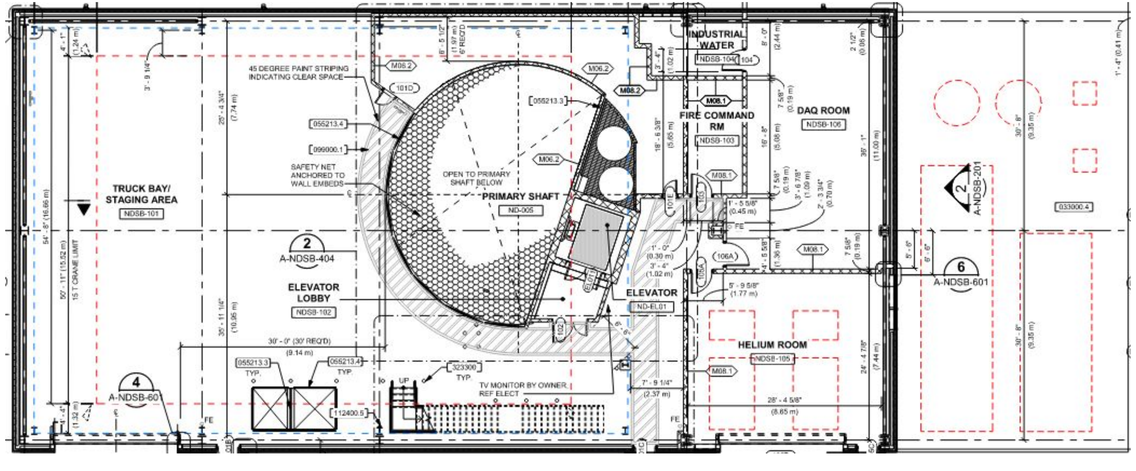
SAND Install - Off Project

Step 55: Assemble the Bottom Yoke Pieces on the middle rails

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			



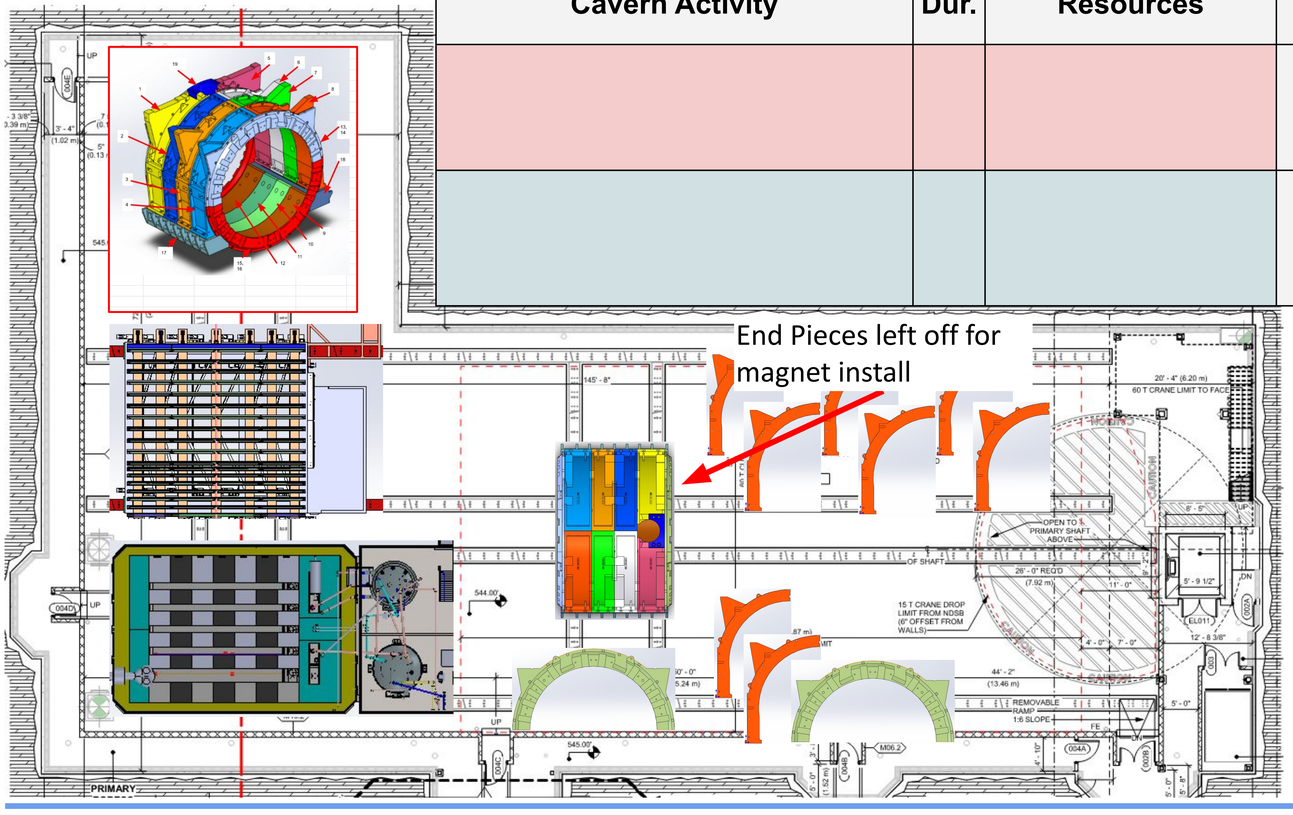


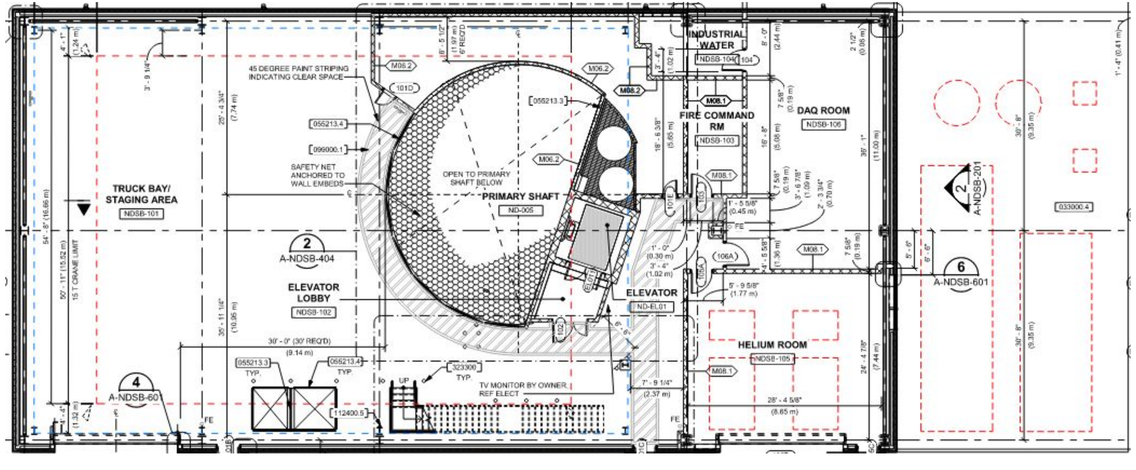
Assumptions:
Status: SAND size shown includes all yoke pieces and endcaps installed.
Open Questions:

Step 56: Stage/Assemble Top Yoke Pieces

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			





Assumptions

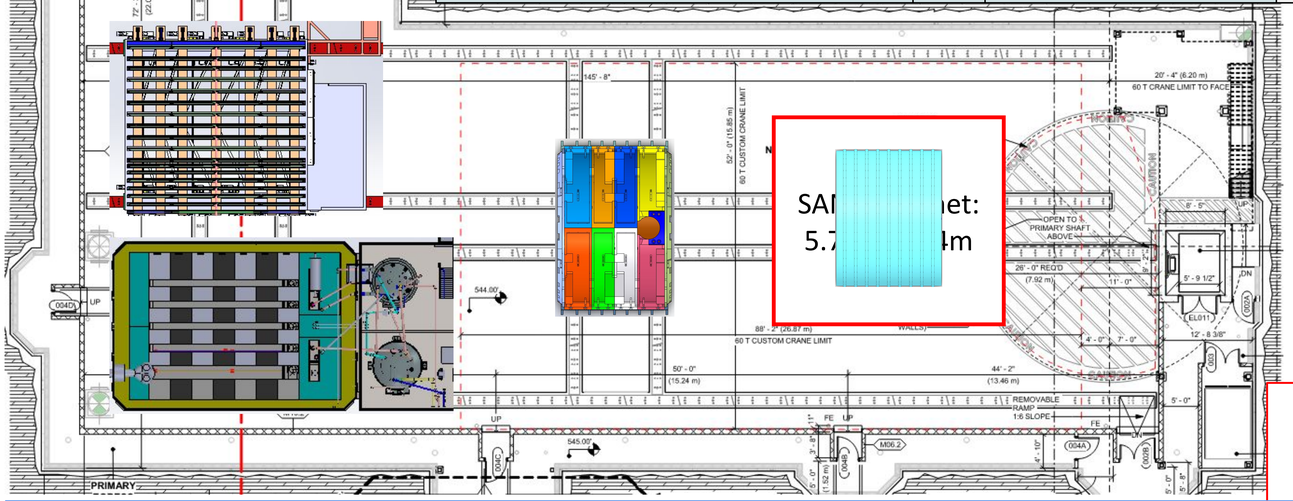
Status: Similar to previous, actual yoke piece geometries not yet captured. Rightmost top yoke pieces left off for magnet installation.

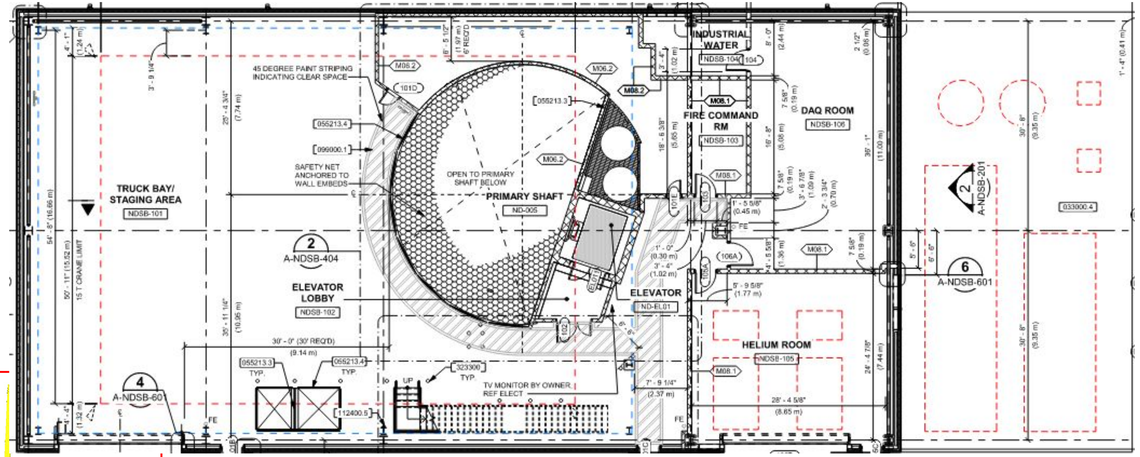
Open Question:

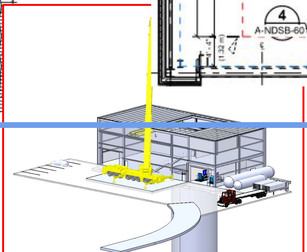
Step 57: Stage and insert Magnet

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			





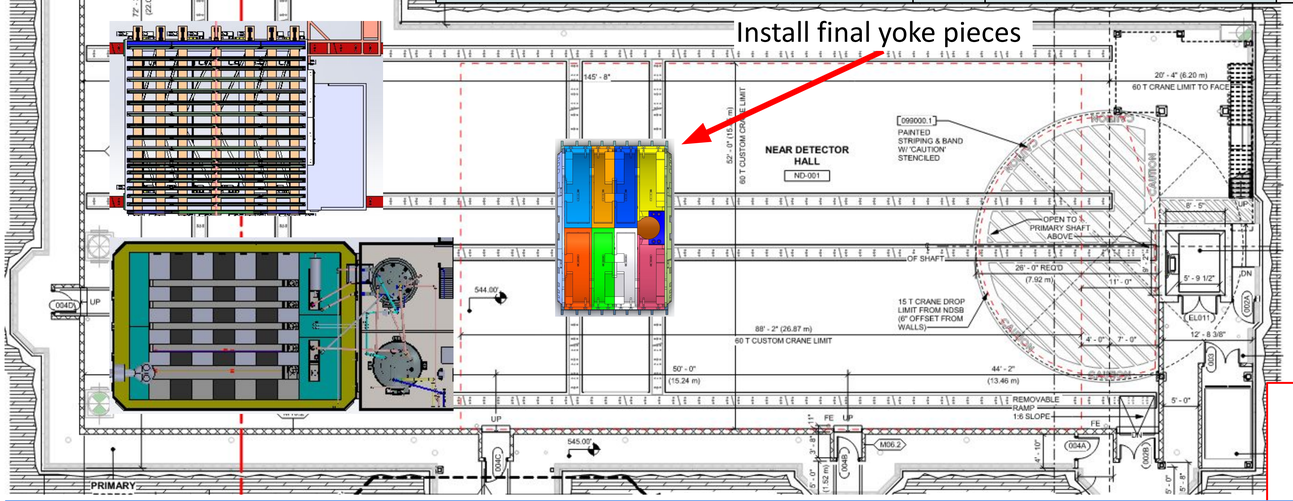


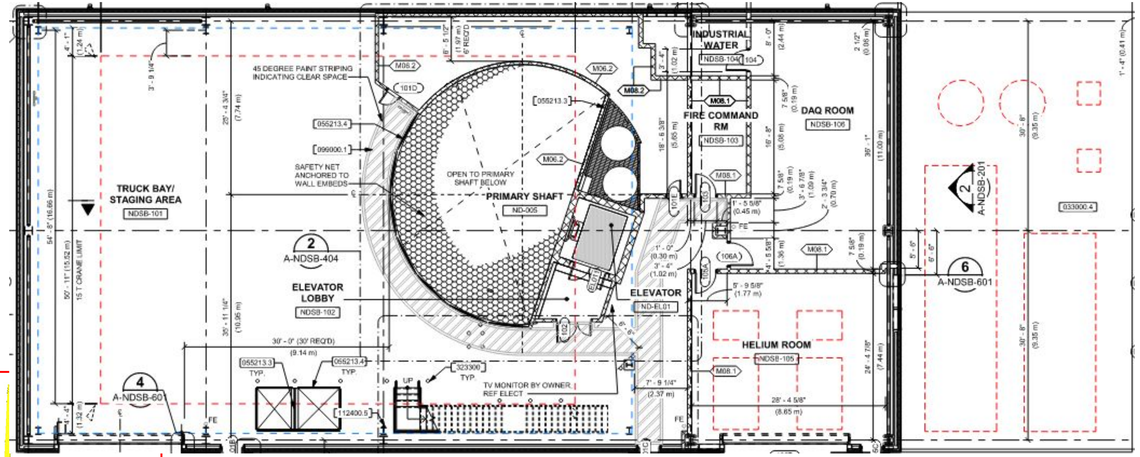
Assumptions
Status: SAND magnet size must be smaller than Yoke footprint, just needs to be measured.
Open Question: Turret on the magnet facing away from beam, towards shaft

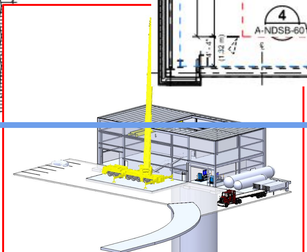
Step 58: Complete the Yoke after magnet install

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			





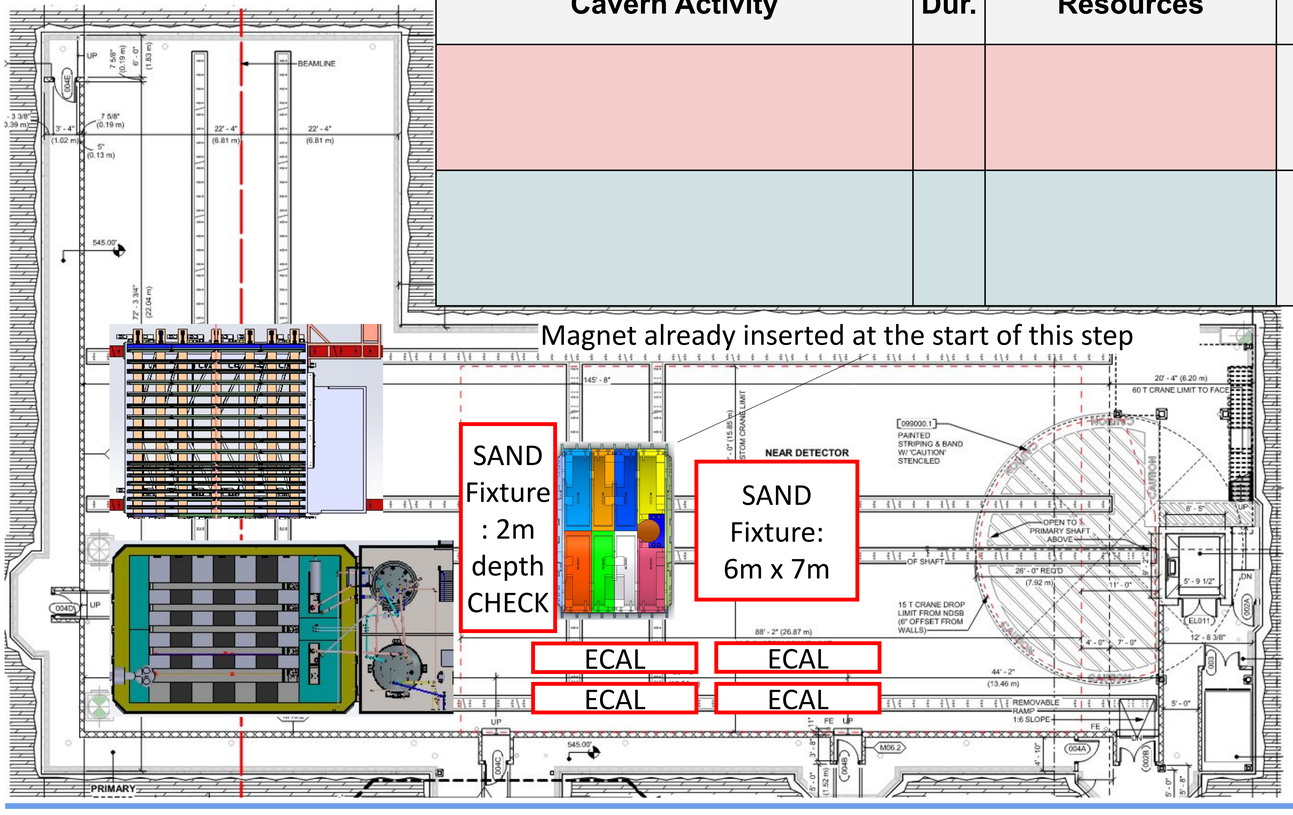


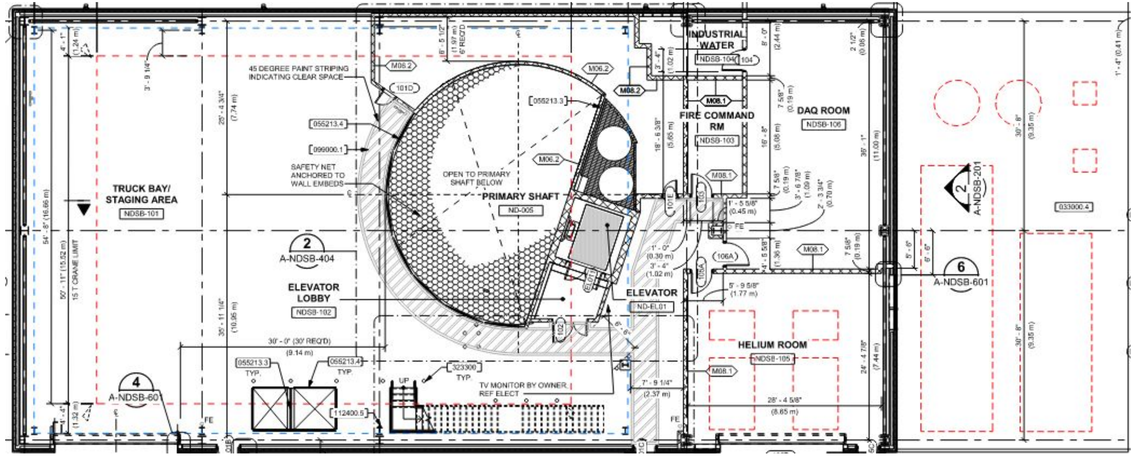
Assumptions
Status: SAND magnet size must be smaller than Yoke footprint, just needs to be measured.
Open Question: Turret on the magnet facing away from beam, towards shaft

Step 59: Stage/Assemble ECAL

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			





Assumptions: Ecal modules conveyed by SB crane

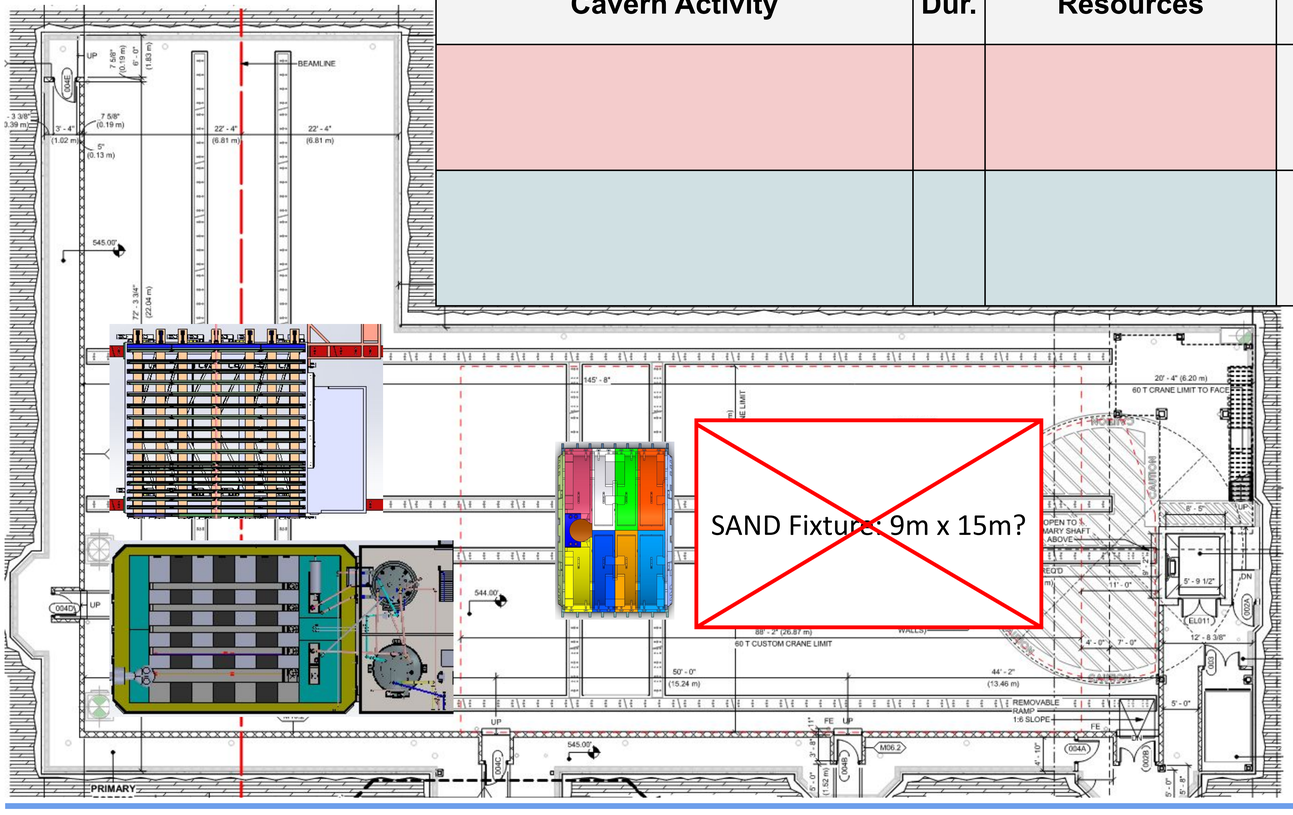
Status: SAND fixture is likely not 15m, need dimensions from INFN. Not all necessary ECAL modules likely shown. Platform needed to left of yoke to pull in ECAL modules.

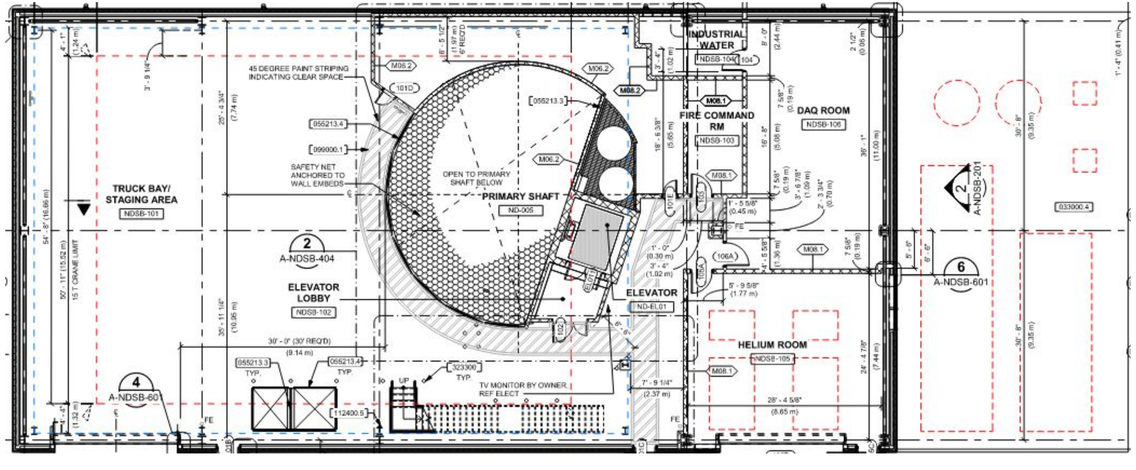
Open Question:

Step 60: Remove Installation Fixturing

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			





Assumptions

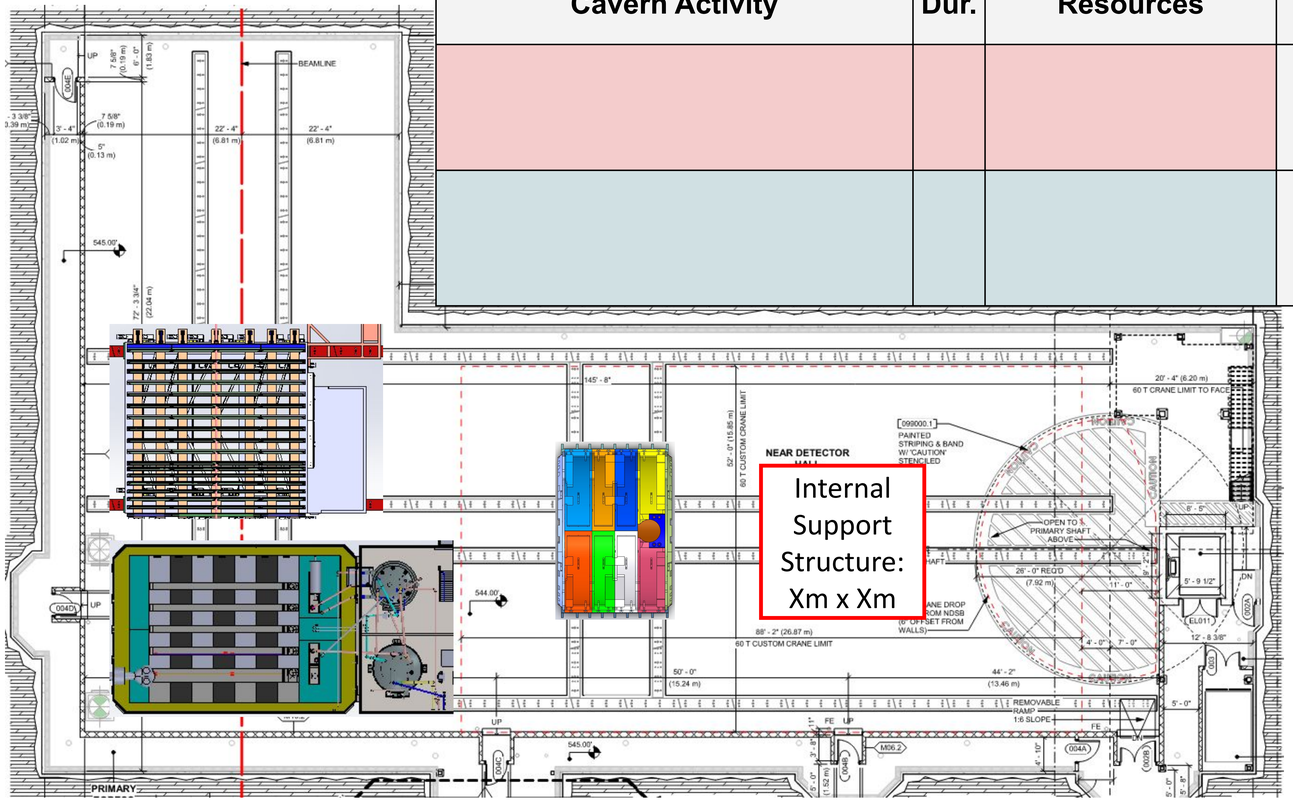
Status:

Open Question:

Step 61: Install STT/GRAIN Support Structure

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			



Assumptions: STT modules conveyed by SB crane

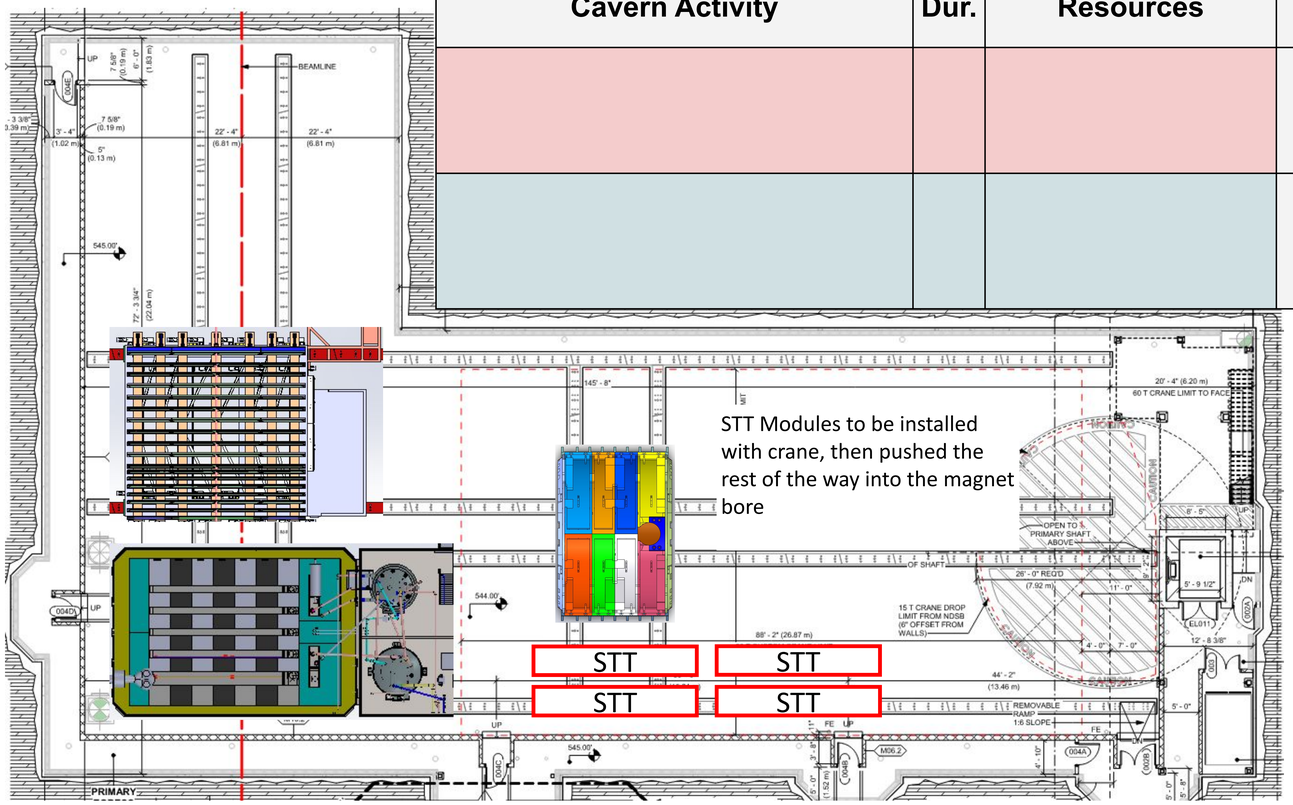
Status: STT modules mainly moved/installed by crane and mobile lift.

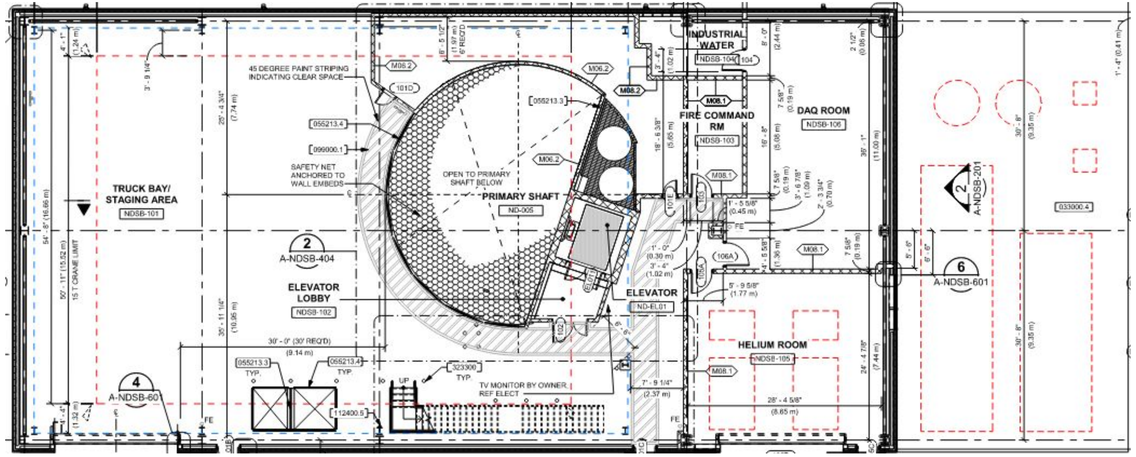
Open Question: IS the fixture really be under the shaft? If yes, does it forbid the lowering of the STT components? Does it require FNAL safety exception?

Step 62: Stage/Assemble STT

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			





Assumptions: STT modules conveyed by SB crane

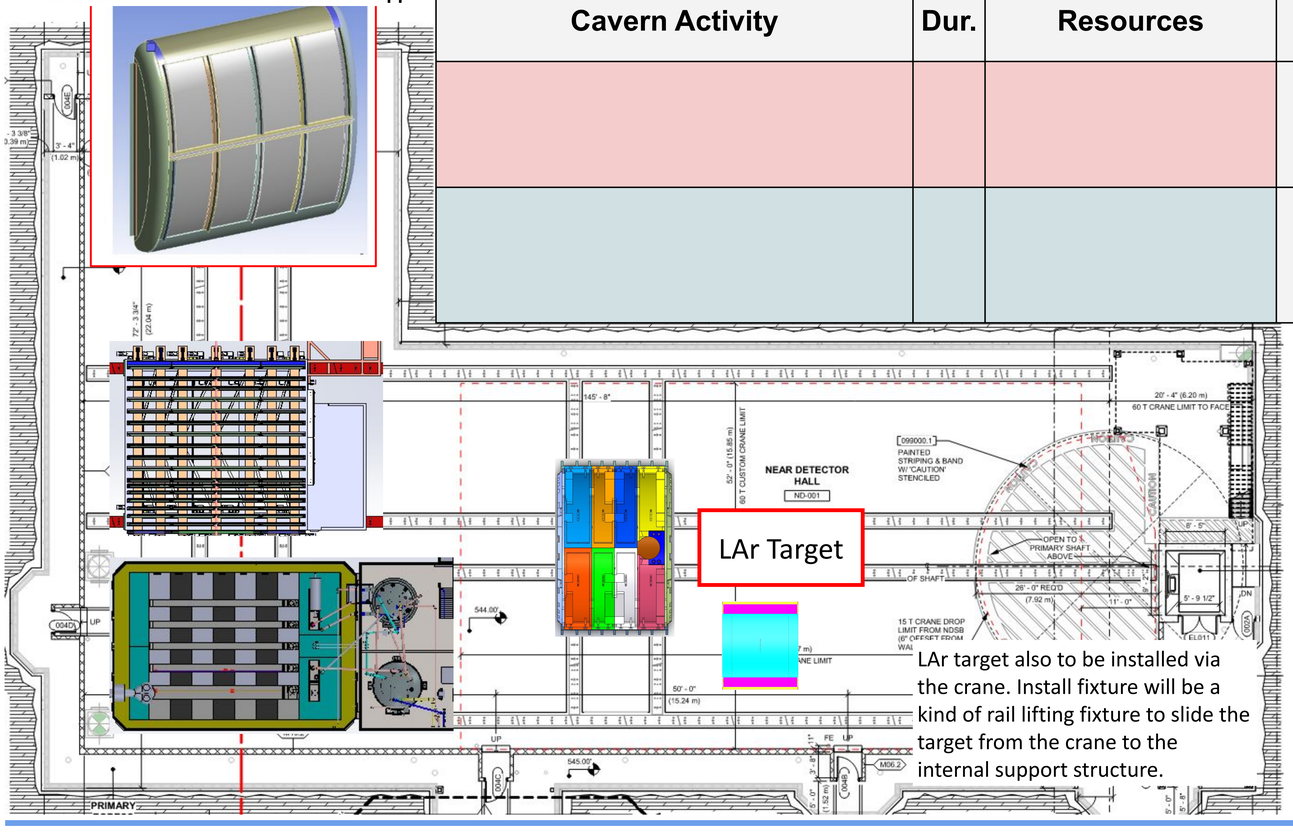
Status: STT modules mainly moved/installed by crane and mobile lift.

Open Question: IS the fixture really be under the shaft? If yes, does it forbid the lowering of the STT components? Does it require FNAL safety exception?

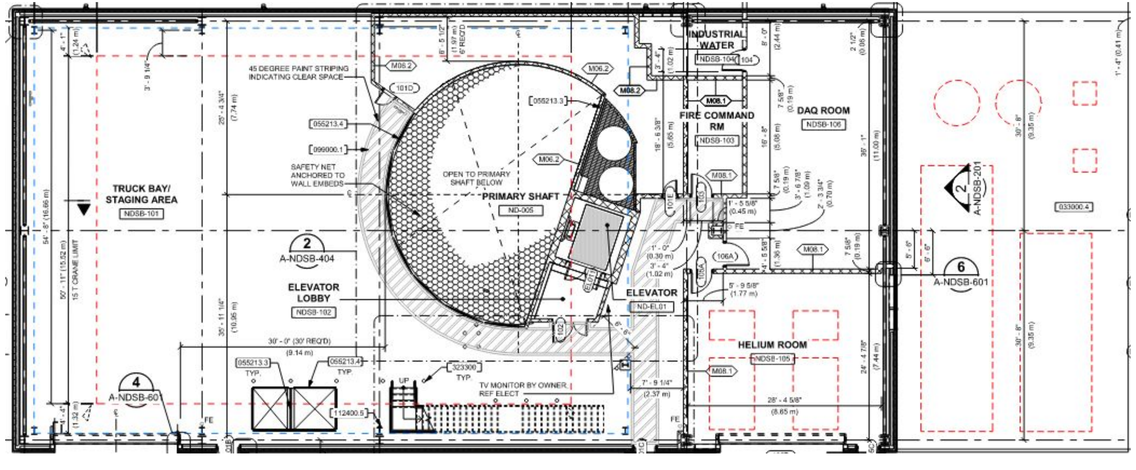
Step 63: Stage/Assemble LAr Target

Source: Stanco-ND-SAND-17dec2020-v.pptx

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			



LAr target also to be installed via the crane. Install fixture will be a kind of rail lifting fixture to slide the target from the crane to the internal support structure.



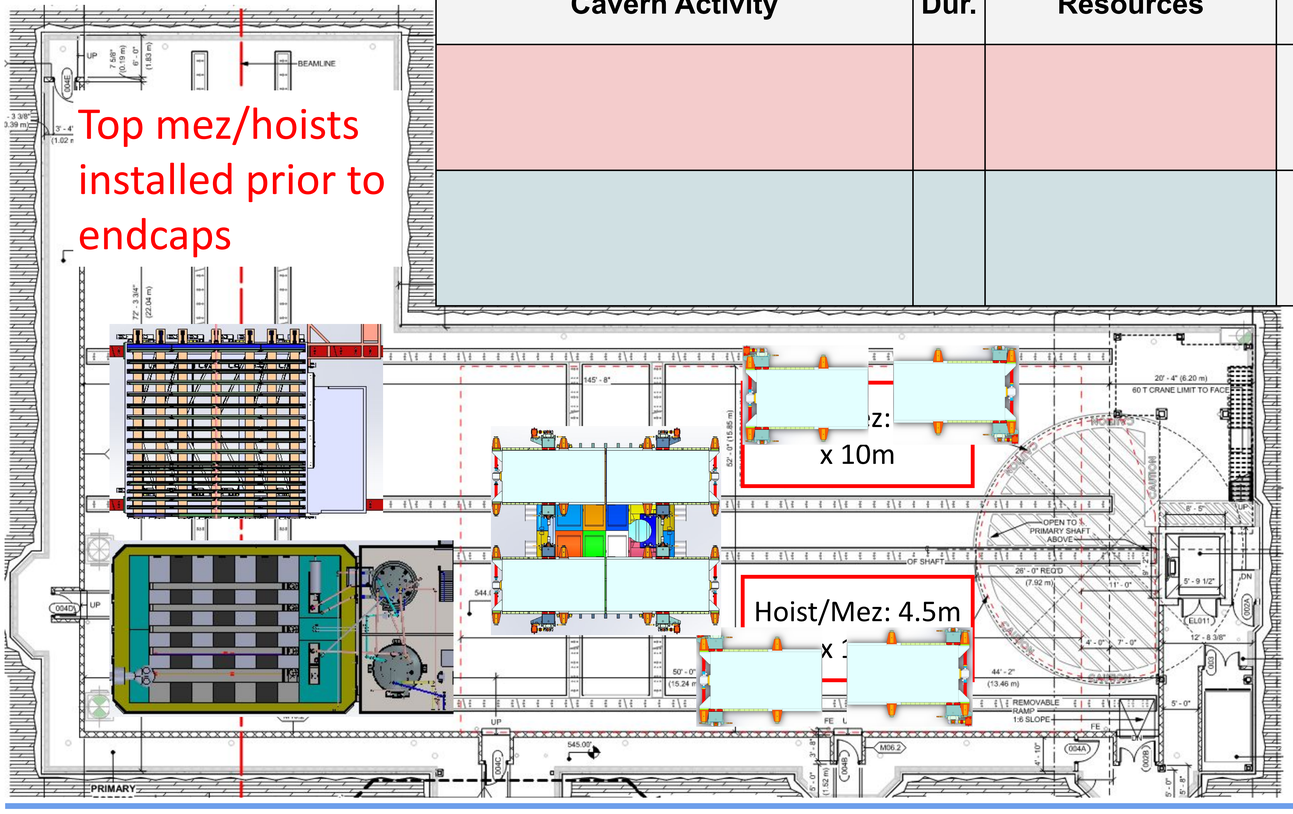
Assumptions: LAr Target conveyed by SB crane
Status:
Open Question:

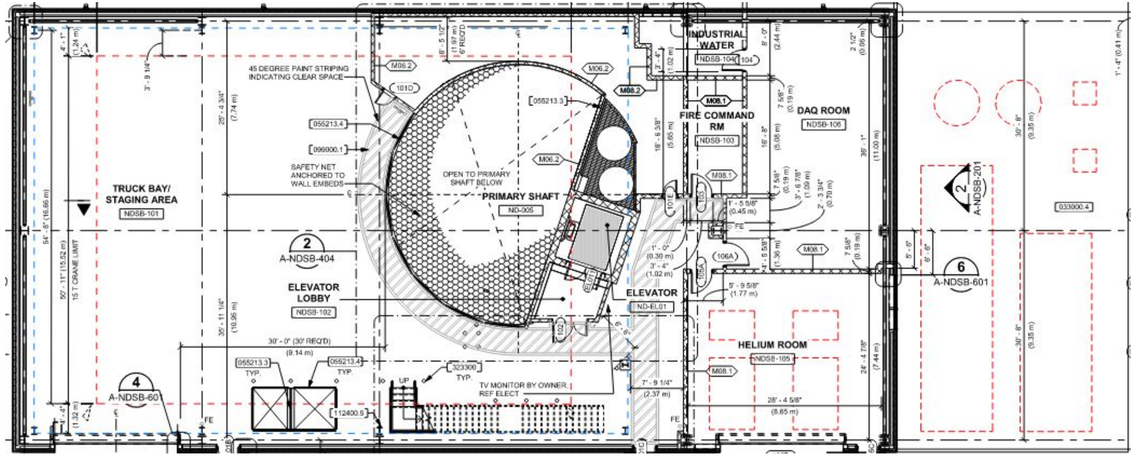
Step 10: Stage/Assemble Cap Hoist/Mezzanines

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			

Top mez/hoists installed prior to endcaps





Assumptions

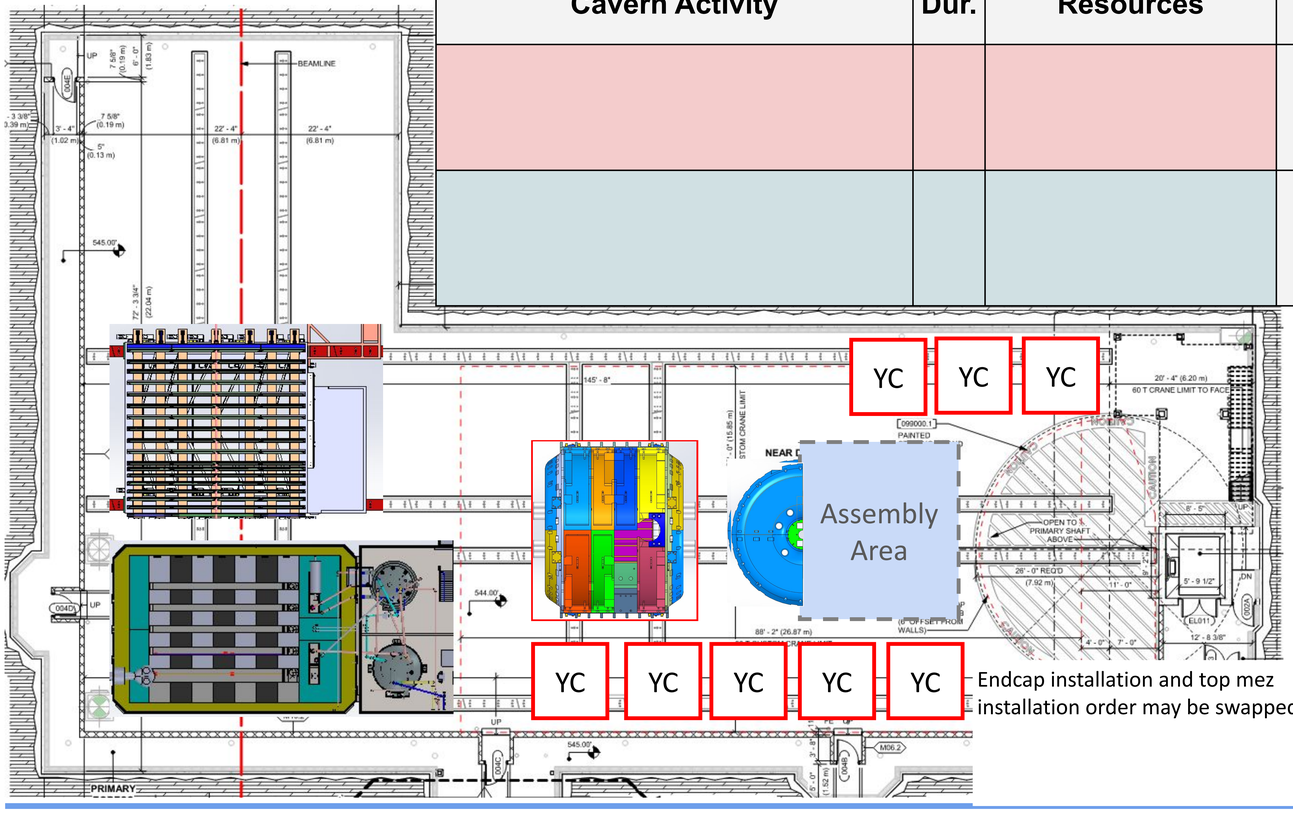
Status: Top Mez dimensions driven by motors/mechanisms attached to the edges. Can these be attached later?

Open Question:

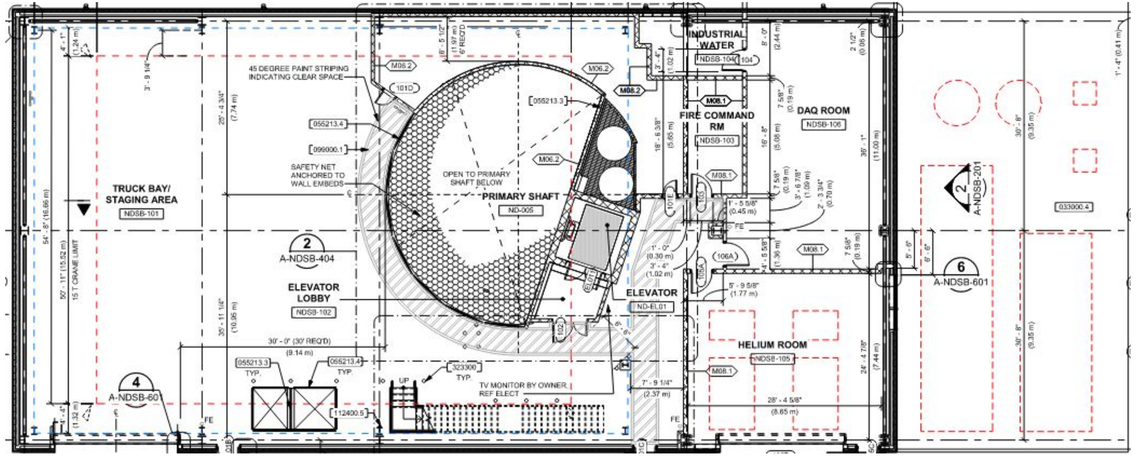
Step 65: Stage/Assemble Yoke Caps

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			



Endcap installation and top mez installation order may be swapped.



Assumptions: Yoke end cap pieces can be installed without SAND top mezzanines/Hoists in place
Status:
Open Question:

Step 66: Move SAND

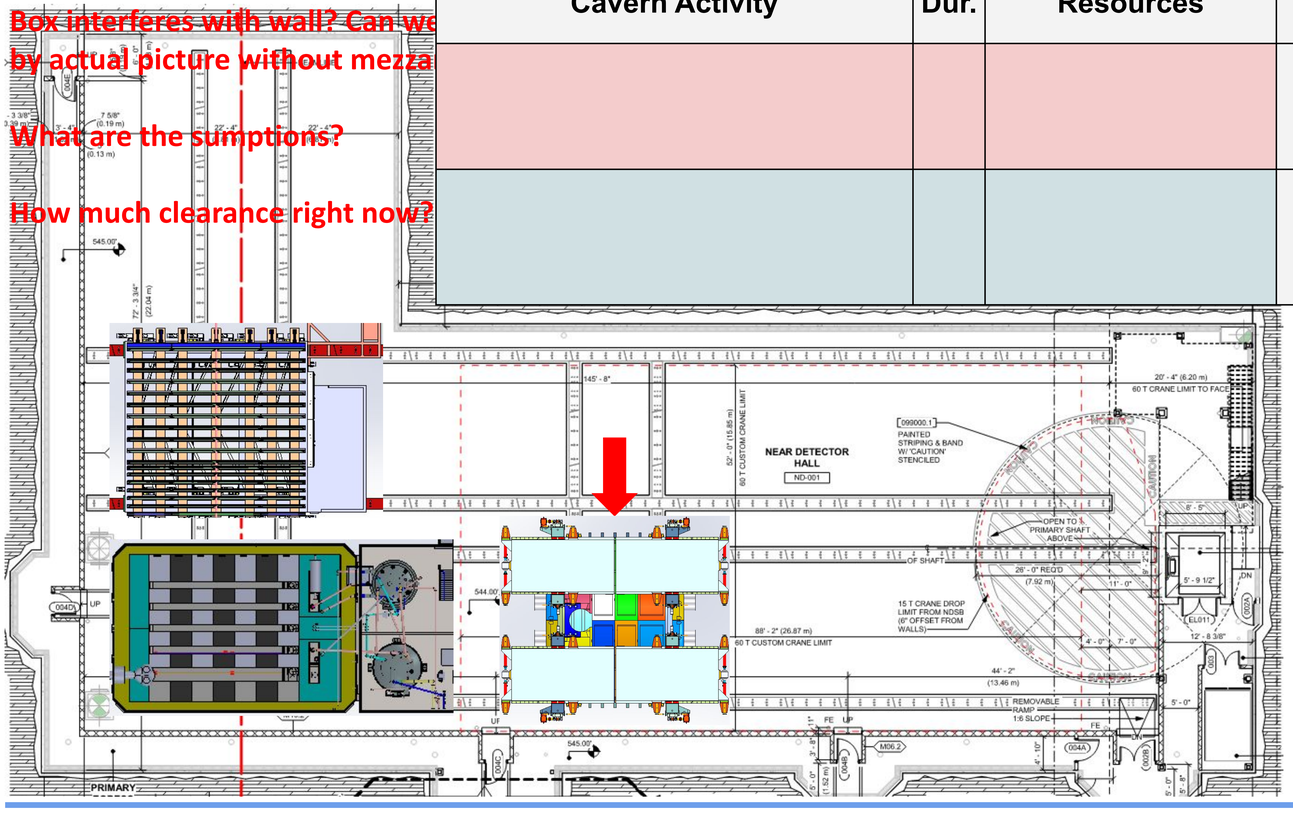
Scale 1”:2m

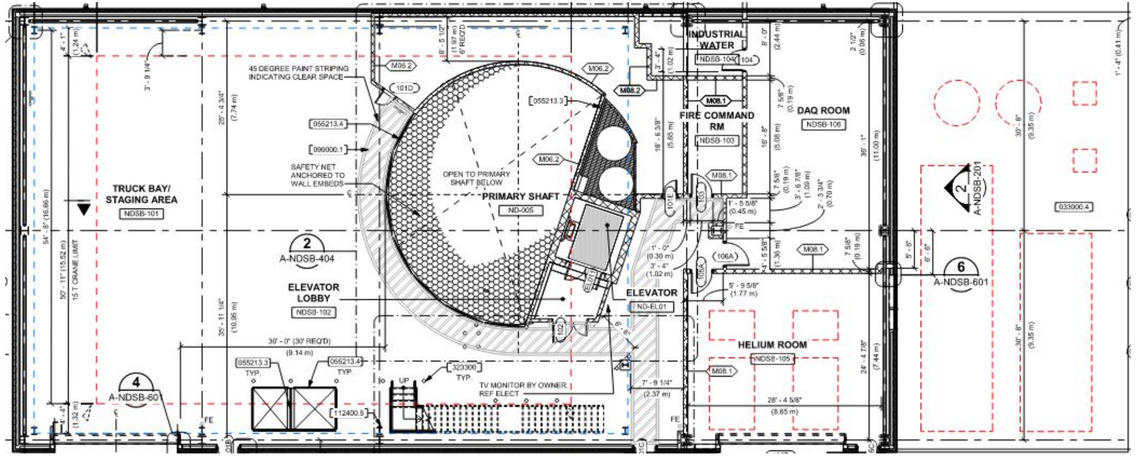
Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			

Box interferes with wall? Can we
by actual picture without mezza

What are the sumptions?

How much clearance right now?

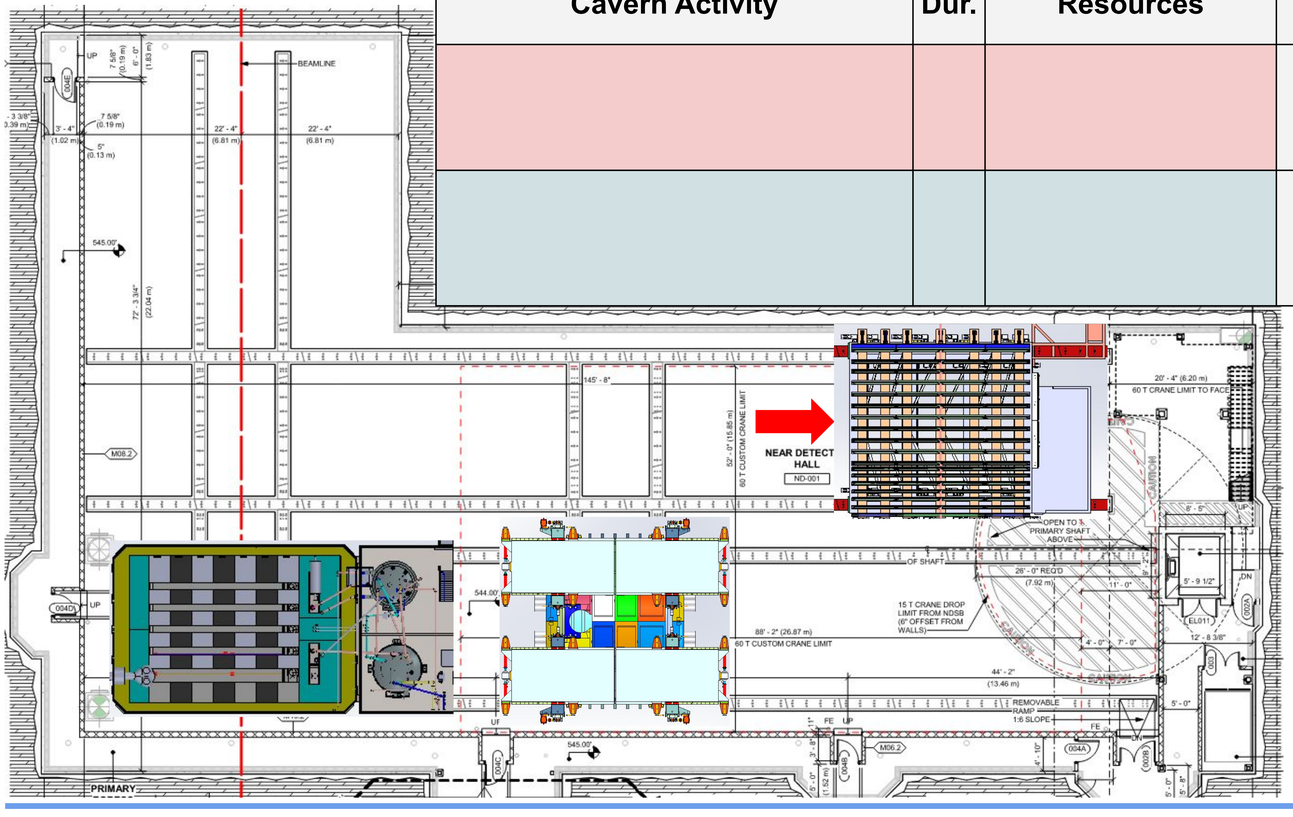


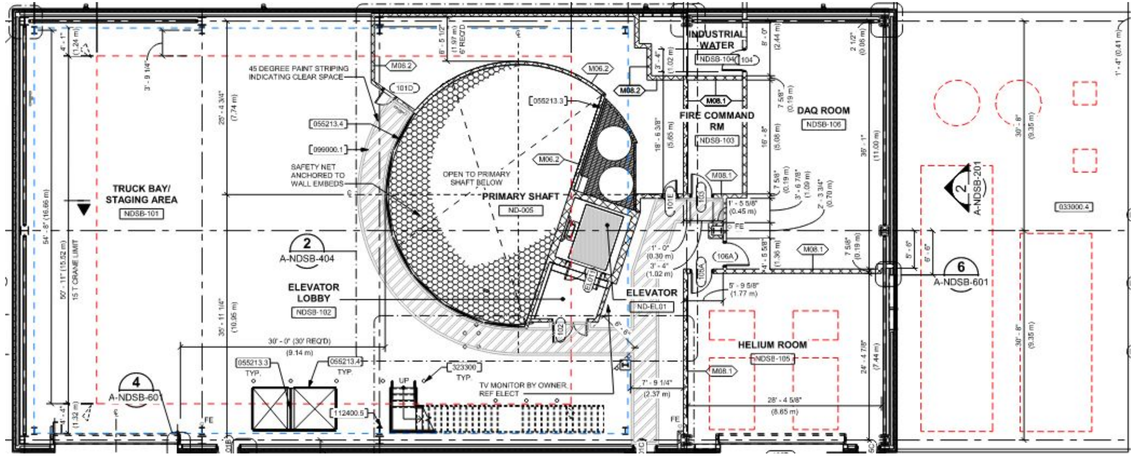


Step 67: Move TMS

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			

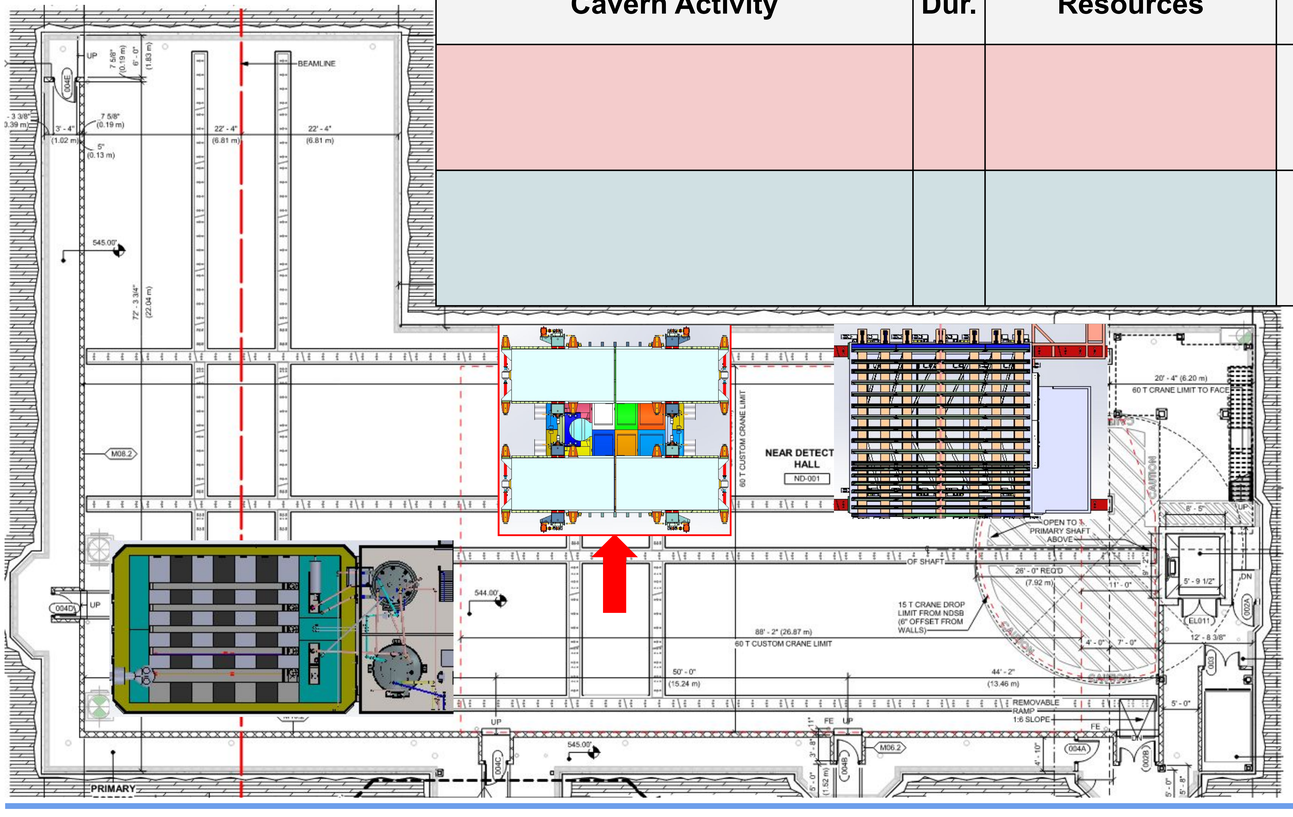


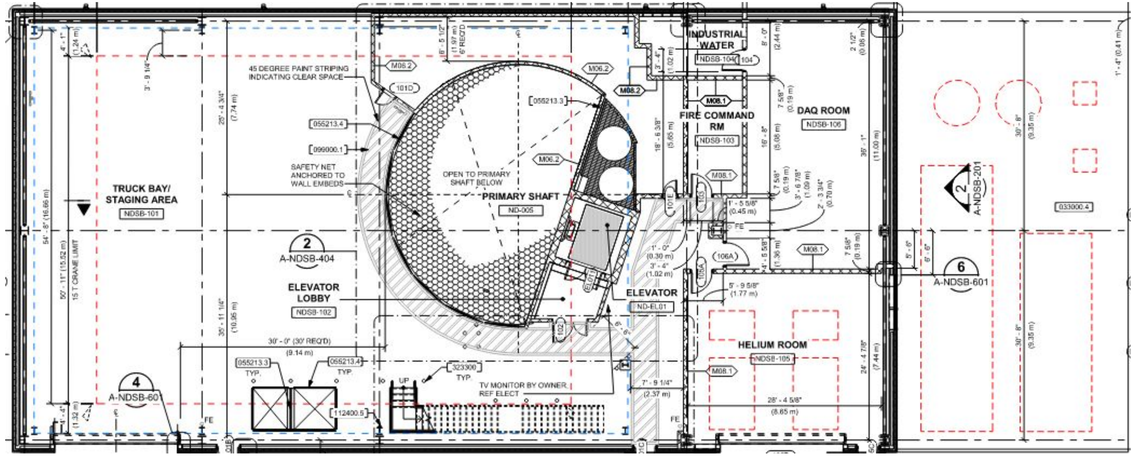


Step 68: Move SAND

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			

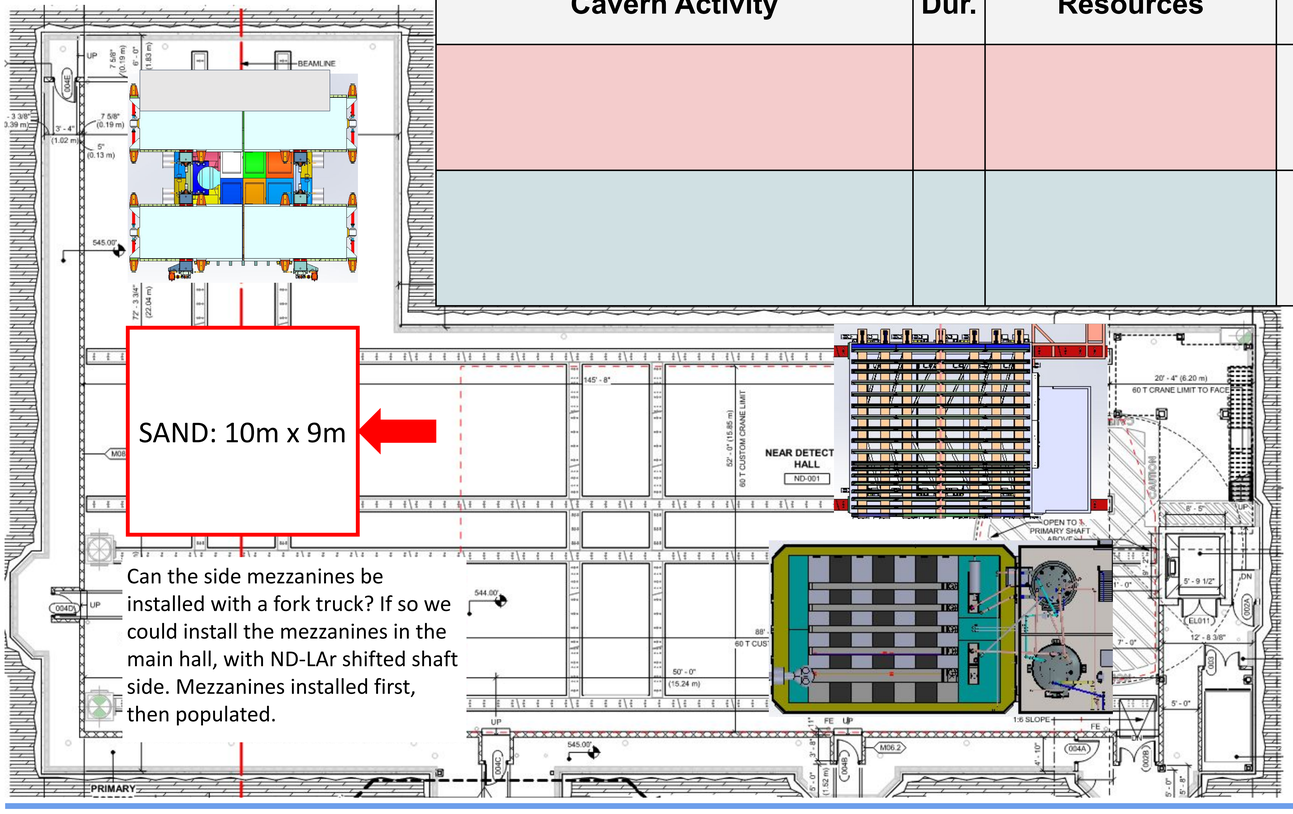


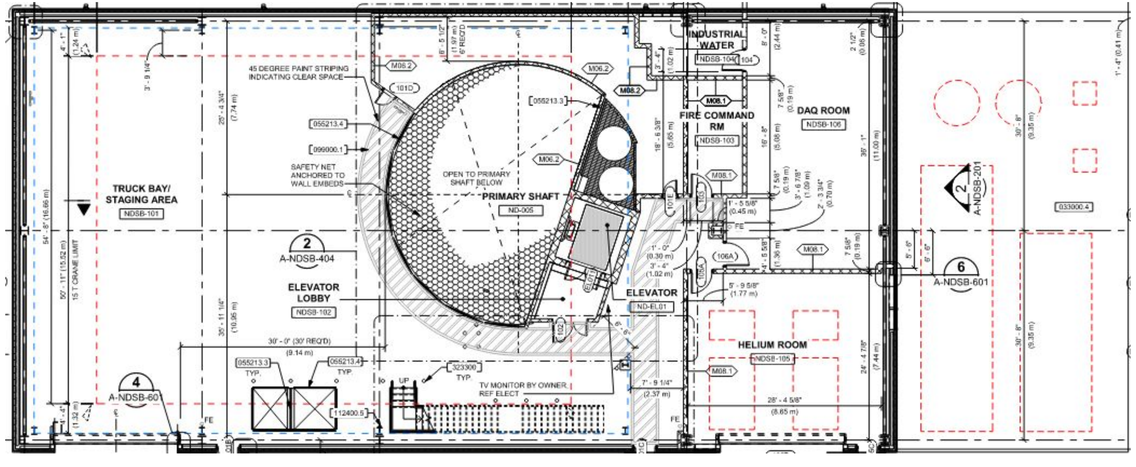


Step 69: Move SAND

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			





Assumptions
Status: Top Mez dimensions driven by motors/mechanisms attached to the edges. Can these be attached later?
Open Question: What is the coverage of the alcove crane?

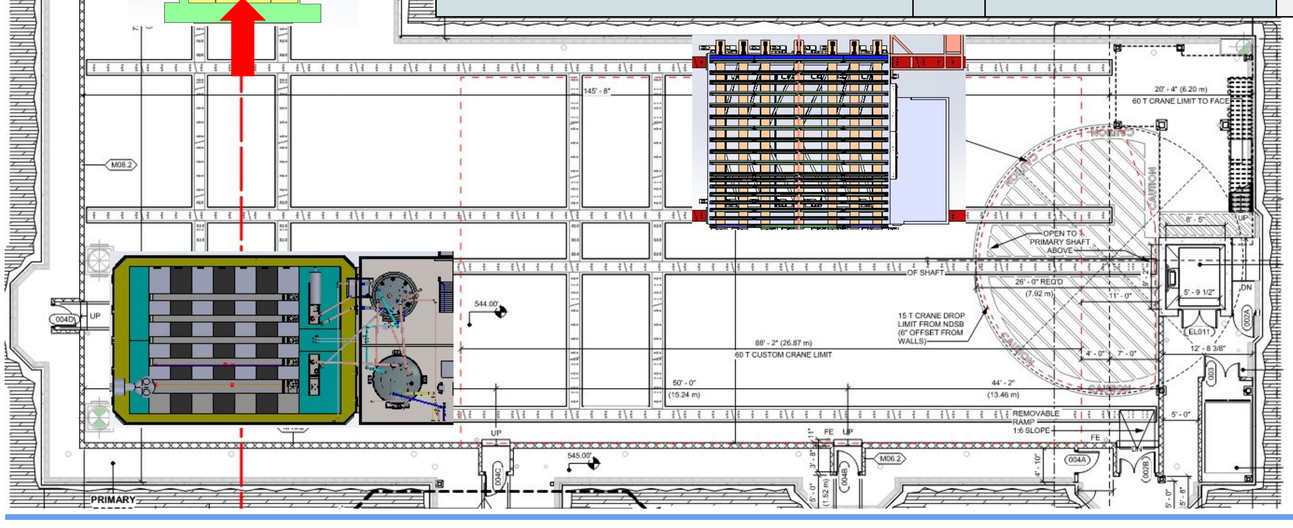
Step 70: Move SAND/Install Side Mezzanines

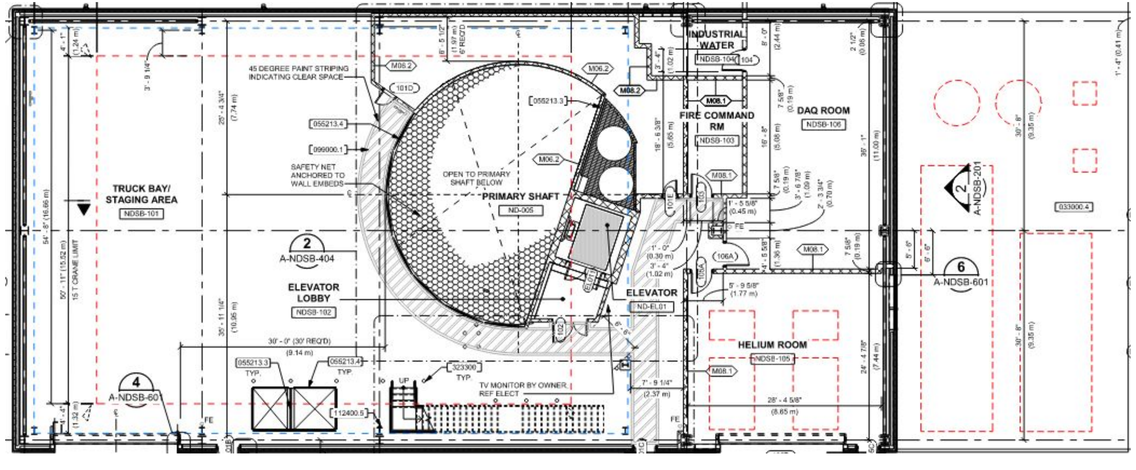
Scale 1”:2m

Work continue in the mezzanine, connections to NSCF, energizatior etc…

d,
.
, ND-LAr
a corridor
shaft to

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			

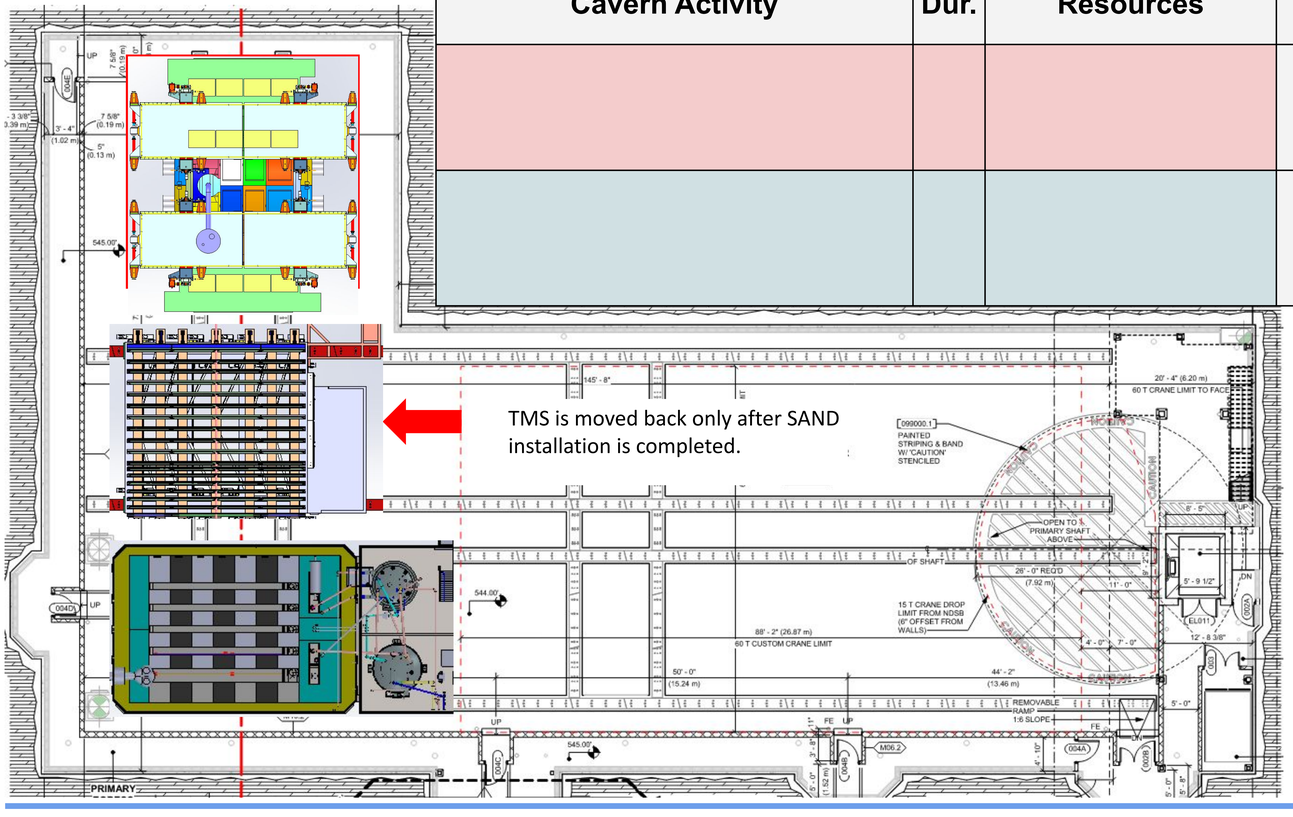


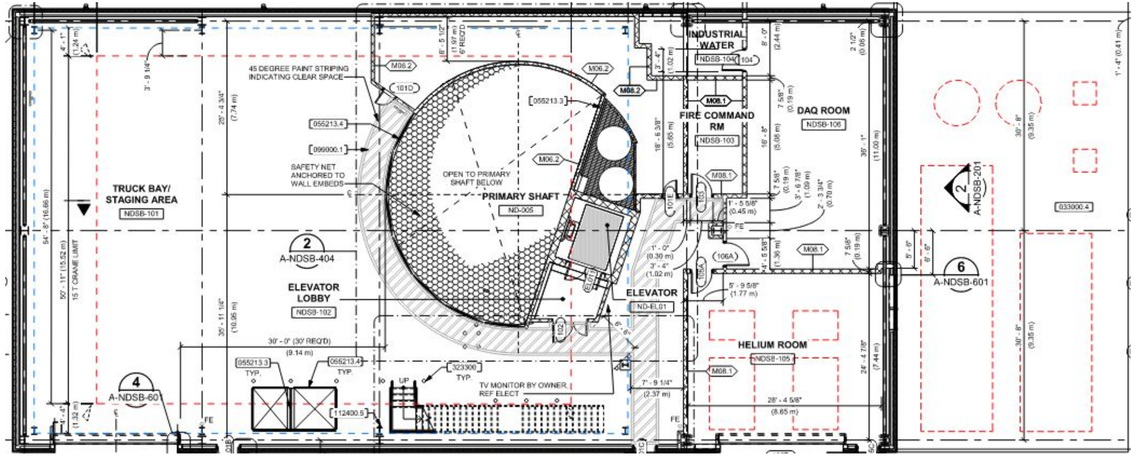


Step 71: Move TMS

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			



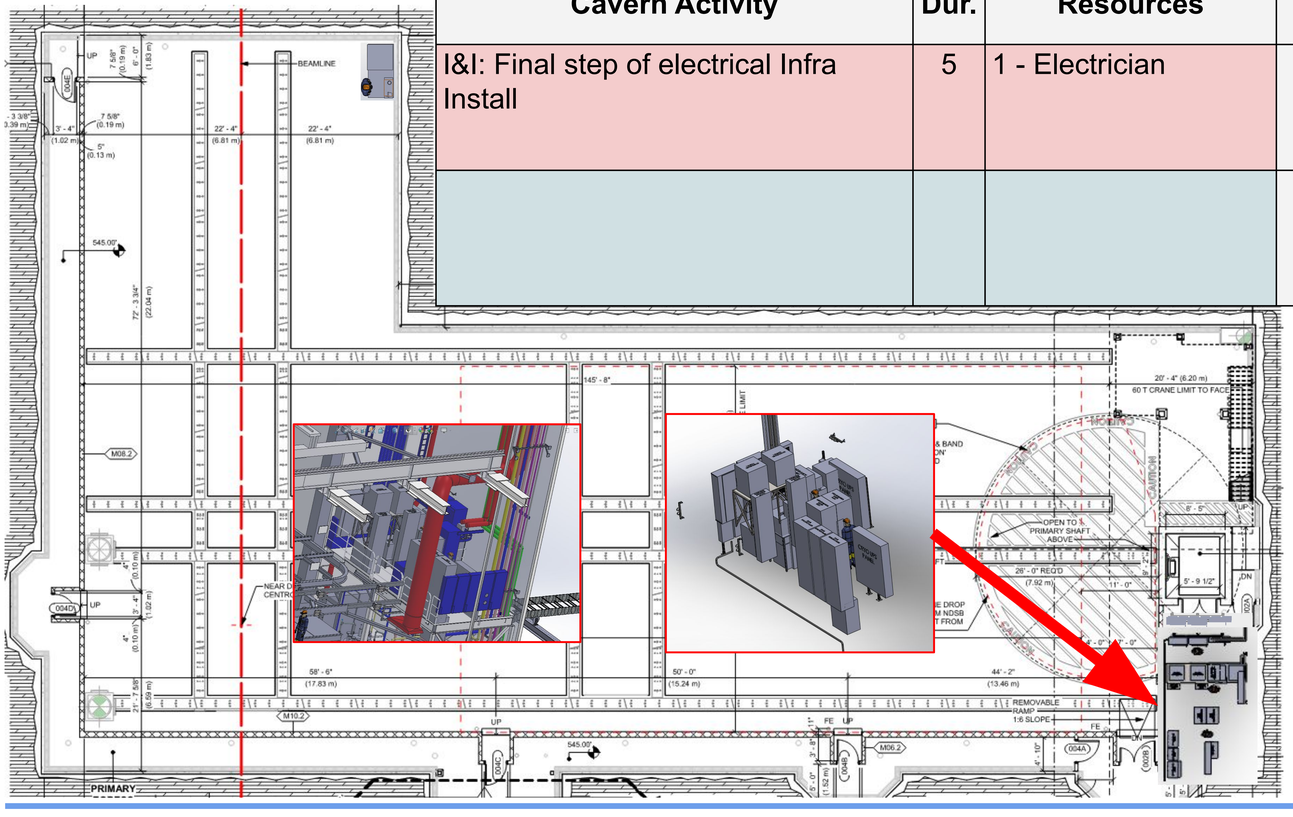


Add’l Details not in 10k View

Step 73: Final Electrical Infrastructure Installation

Scale 1":2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
I&I: Final step of electrical Infra Install	5	1 - Electrician	**Critical Path**			
			Parallel			

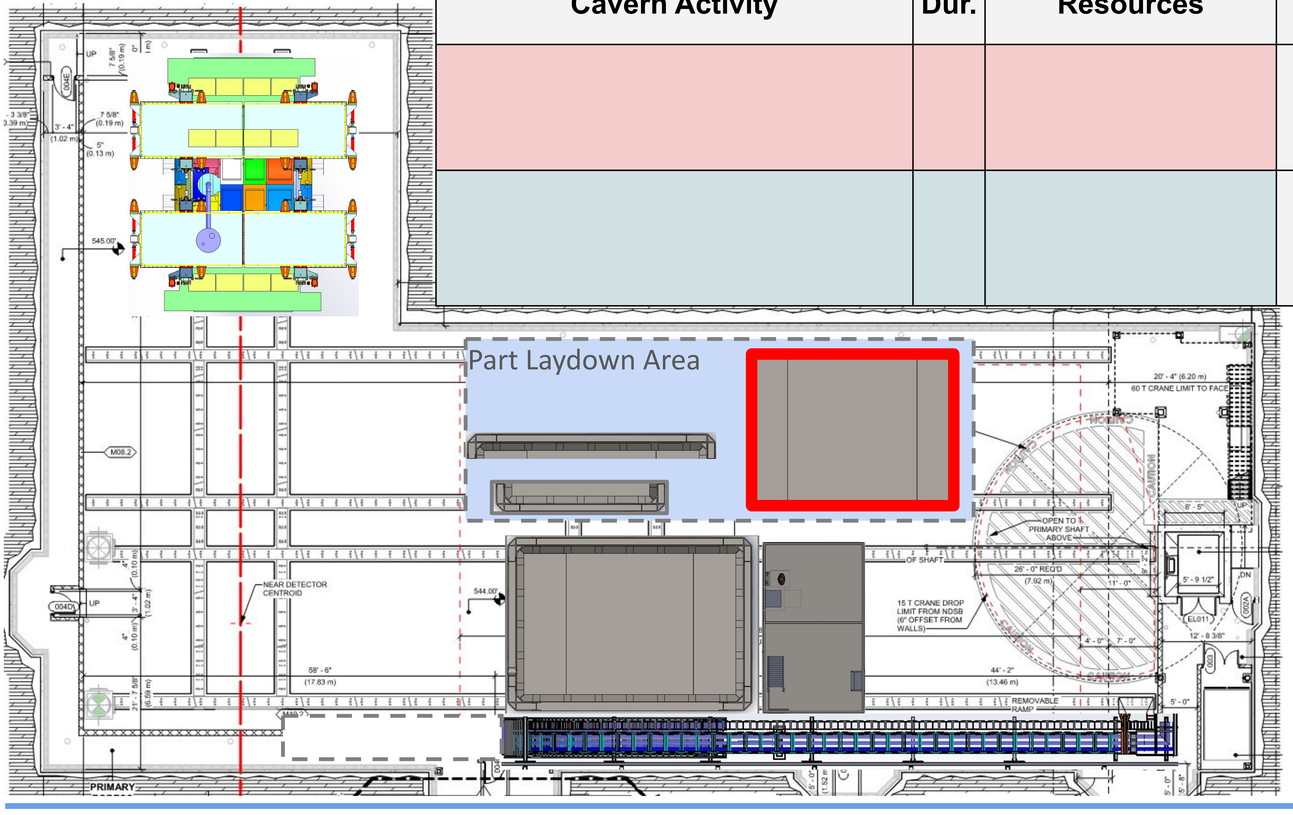


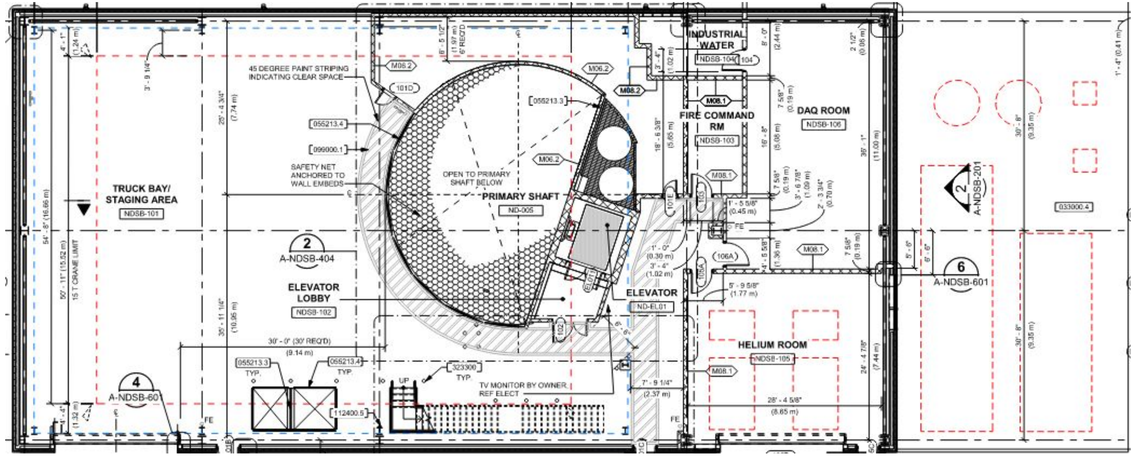
Energization?

Step 74: Install the Cryostat Warm Structure Base

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			





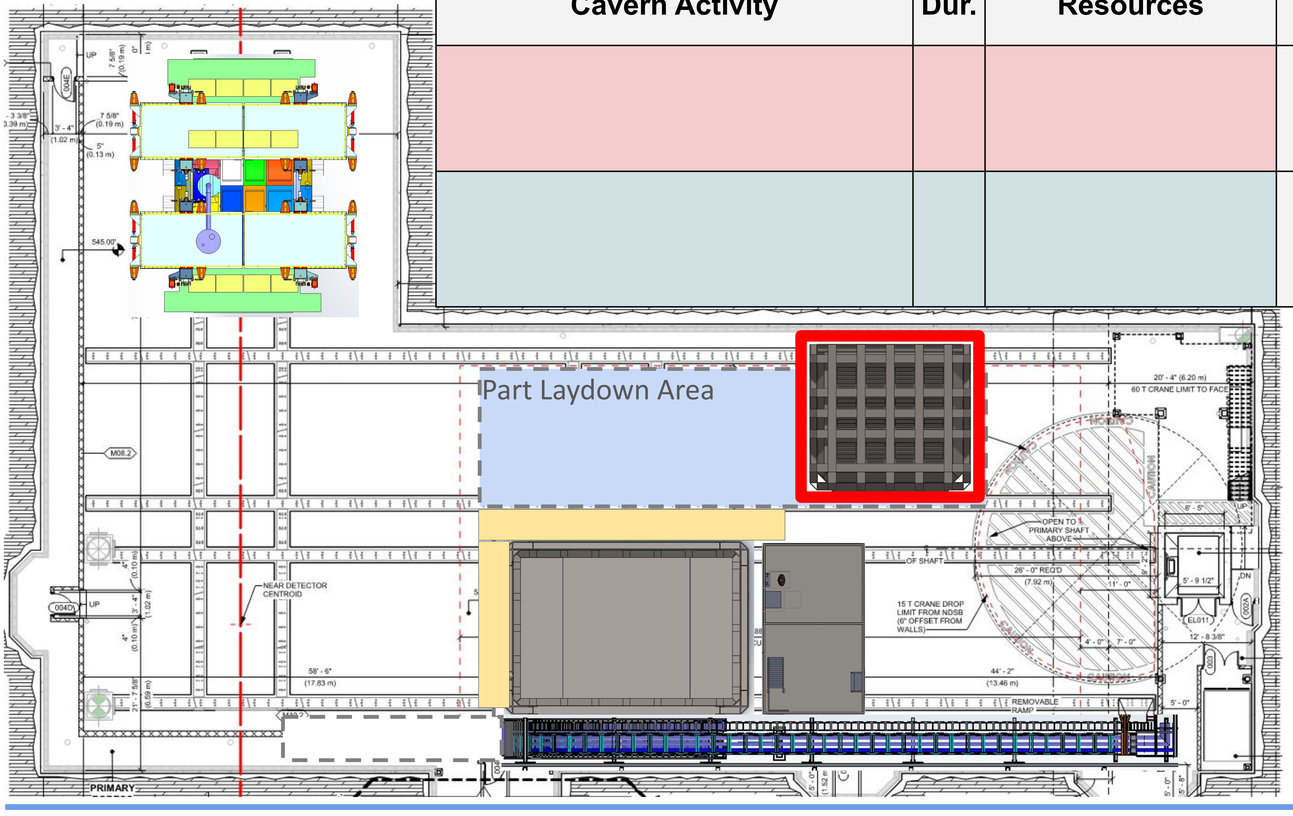
How many parts do we want in the cavern at once?

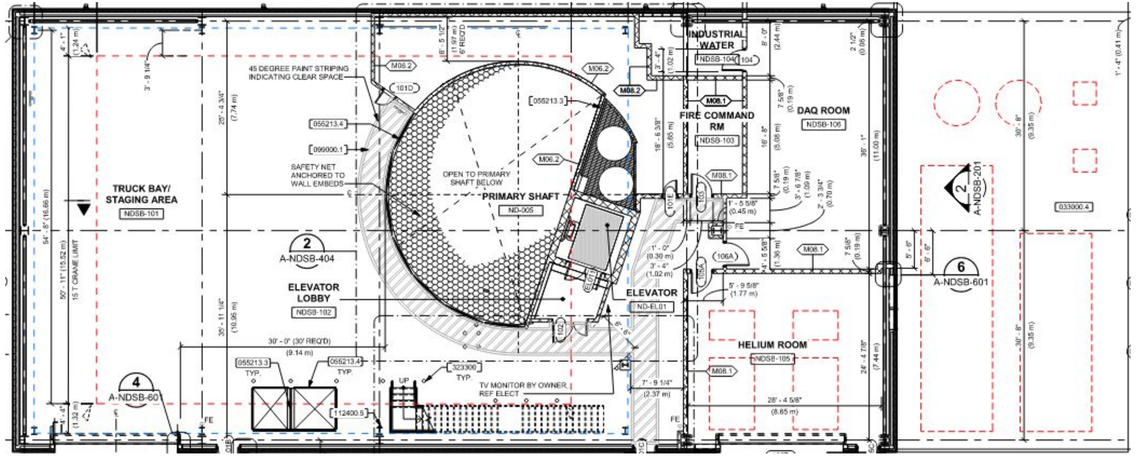
This process will require a rental crane.

Step 75: Install the Cryostat Warm Structure Walls

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			





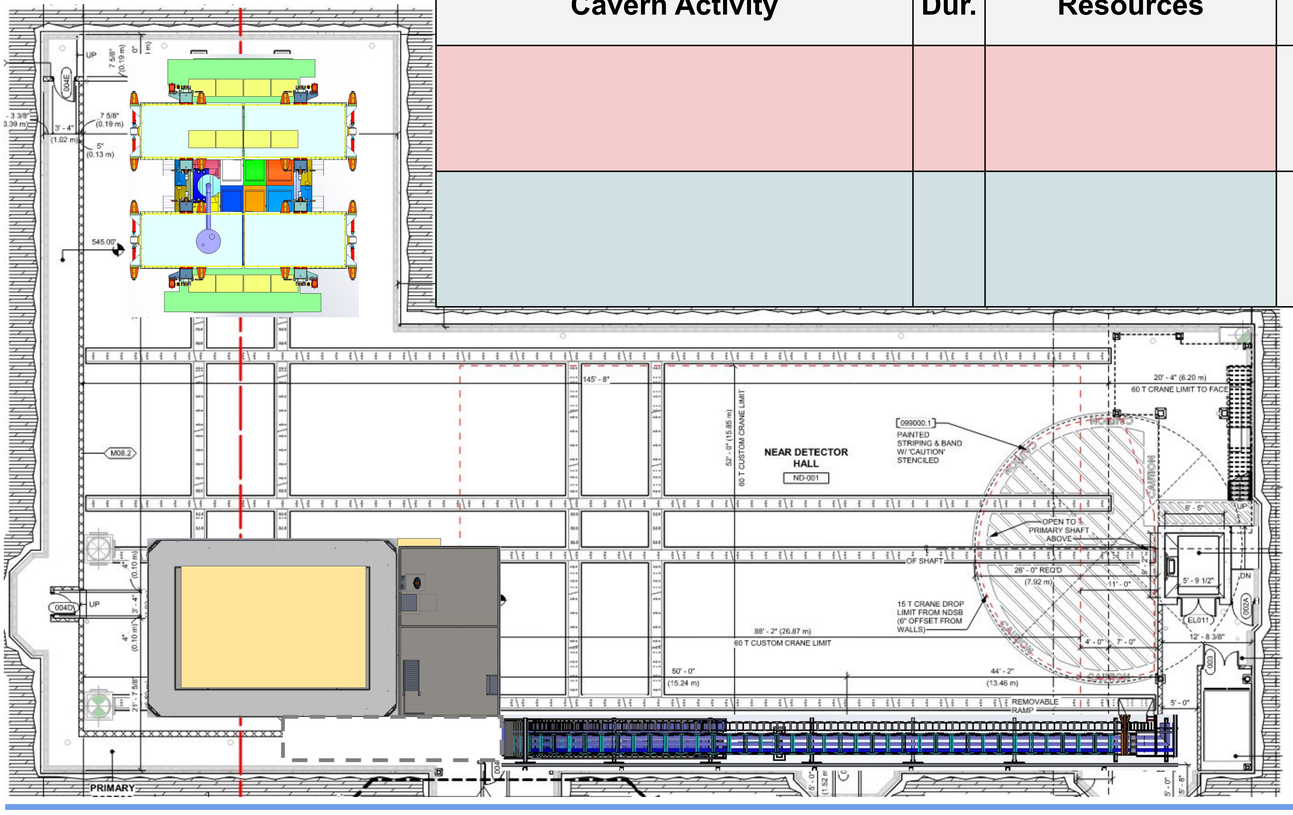
What type of scaffolding do we want?

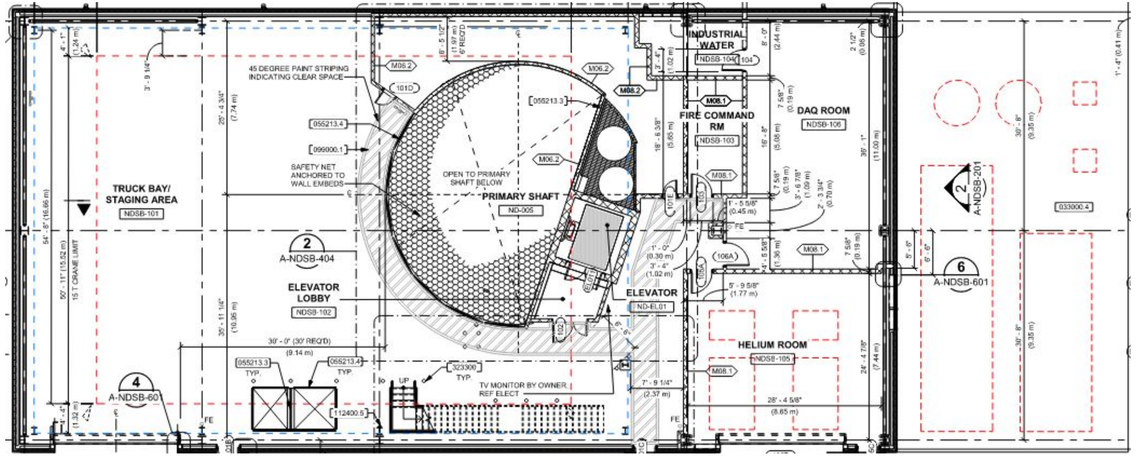
Significant fixturing is required.

Step 76: Weld and Leak Check the Vapor Barrier

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			



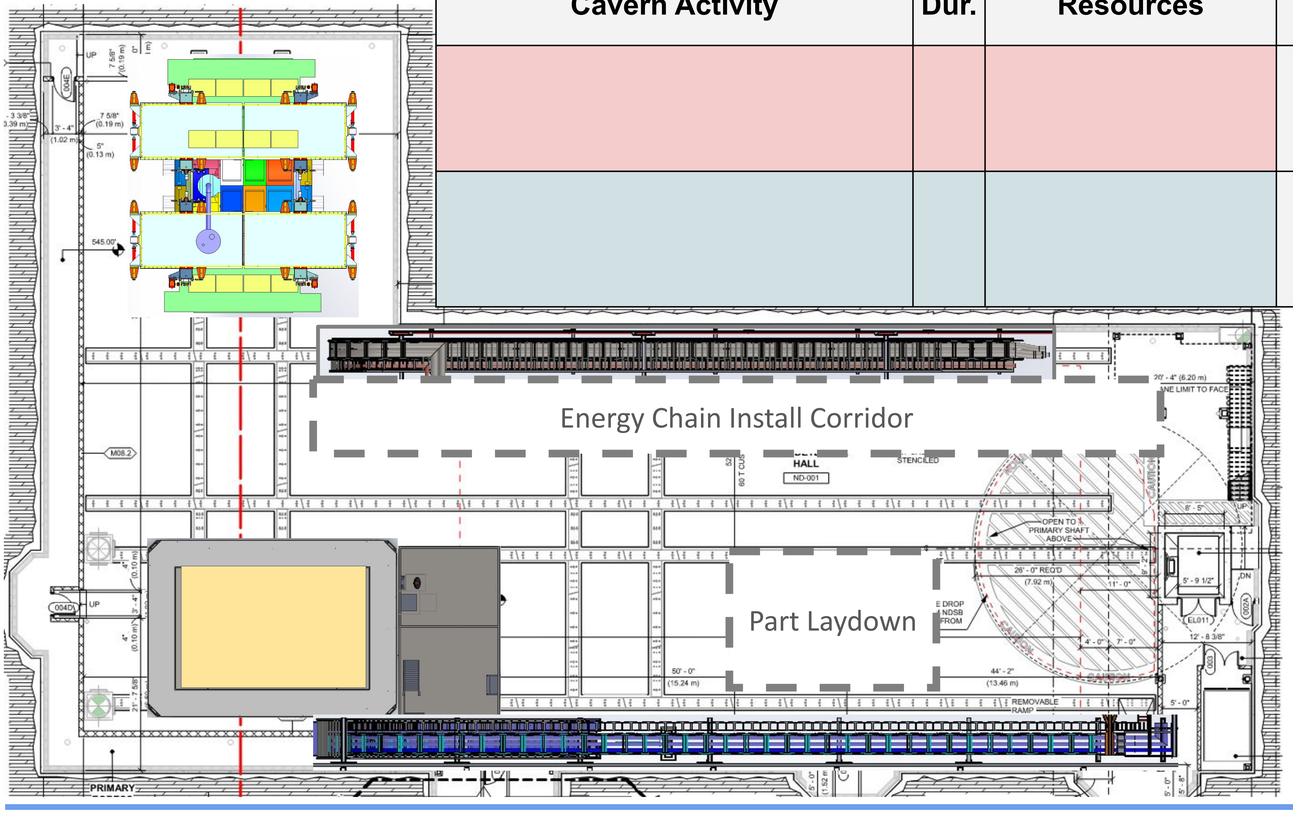


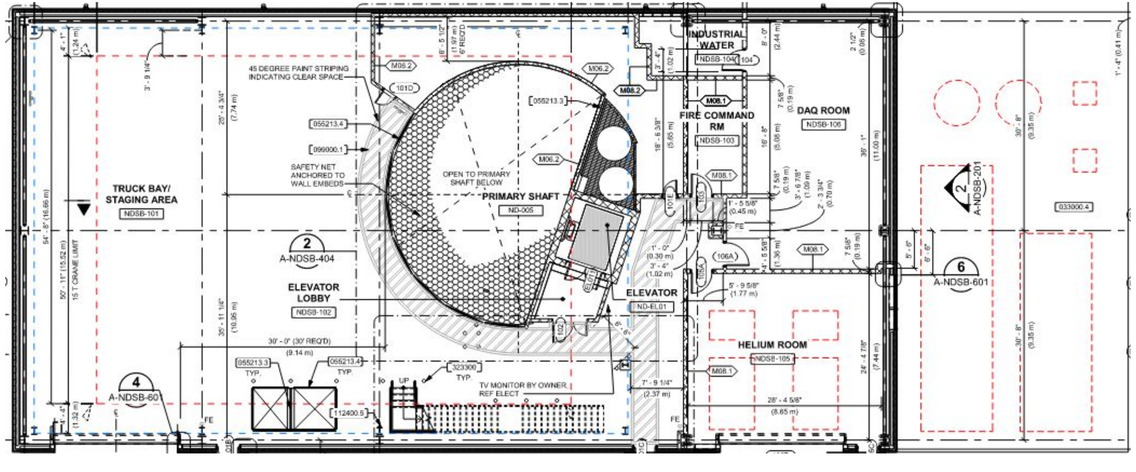
What kind of fixtures and scaffolding will be required?

Step 77: Install the TMS PRISM Energy Chain

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			

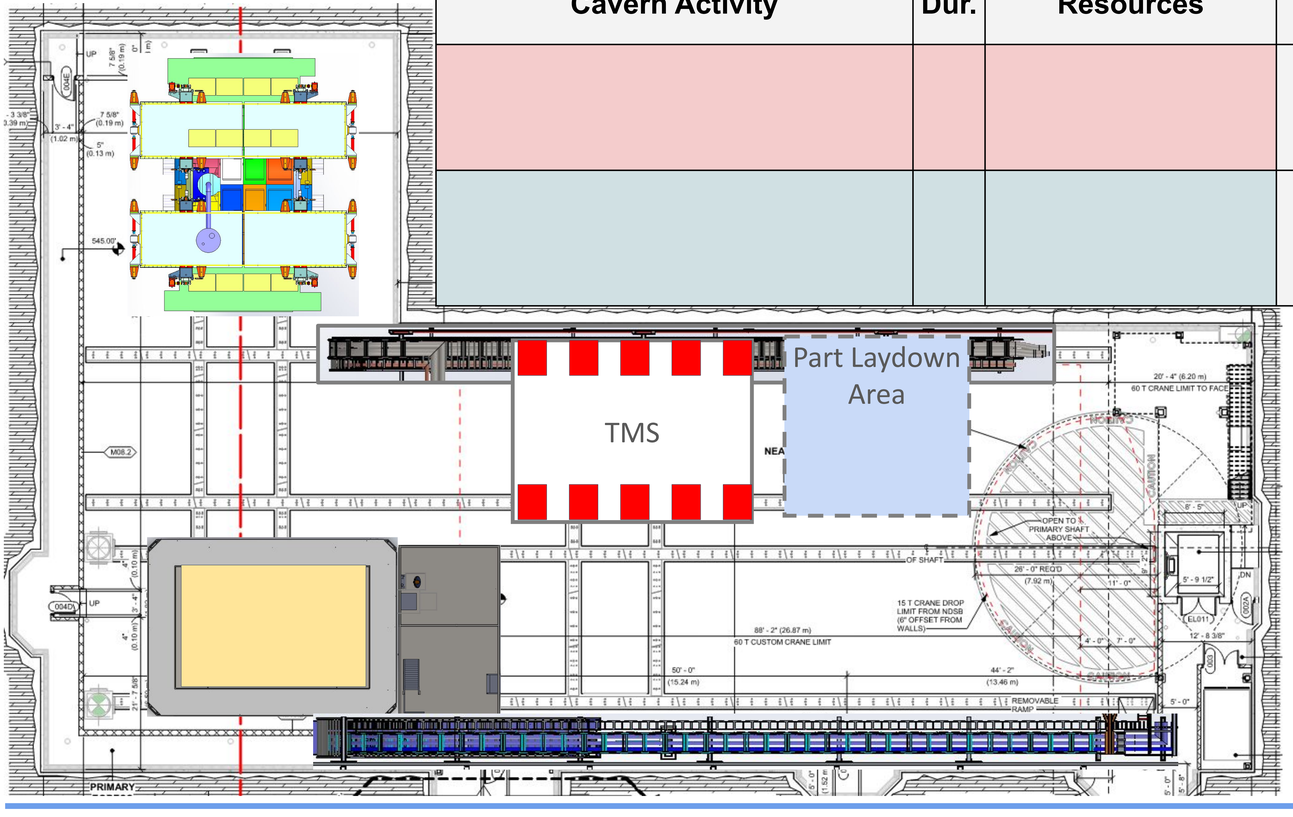


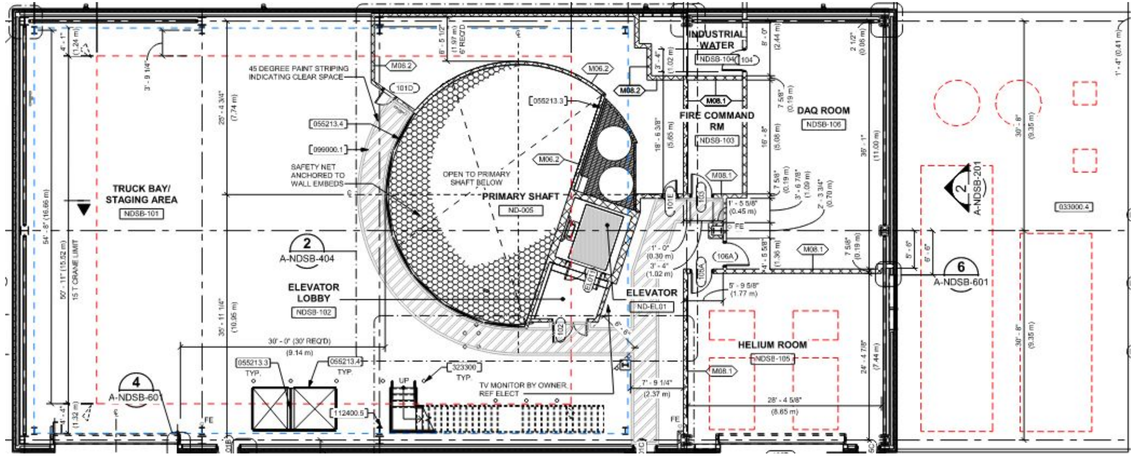


Step 78: Install the TMS PRISM Rollers

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			

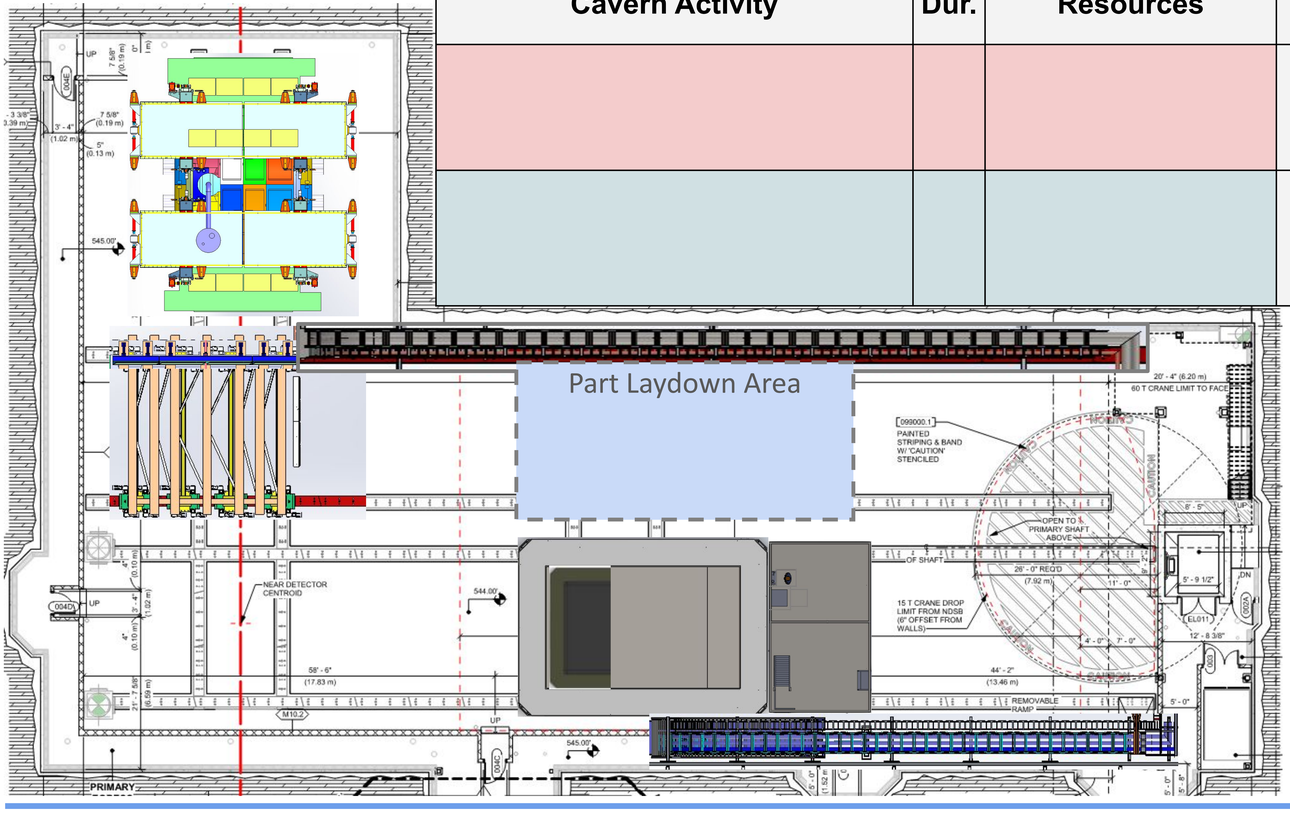


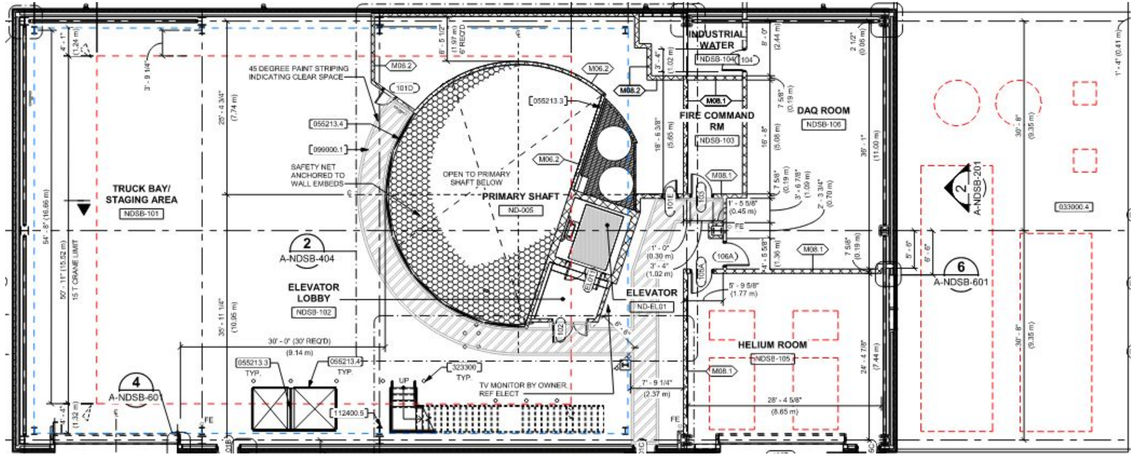


Step 79: Begin the Install of the Cryostat Cold Membrane

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			



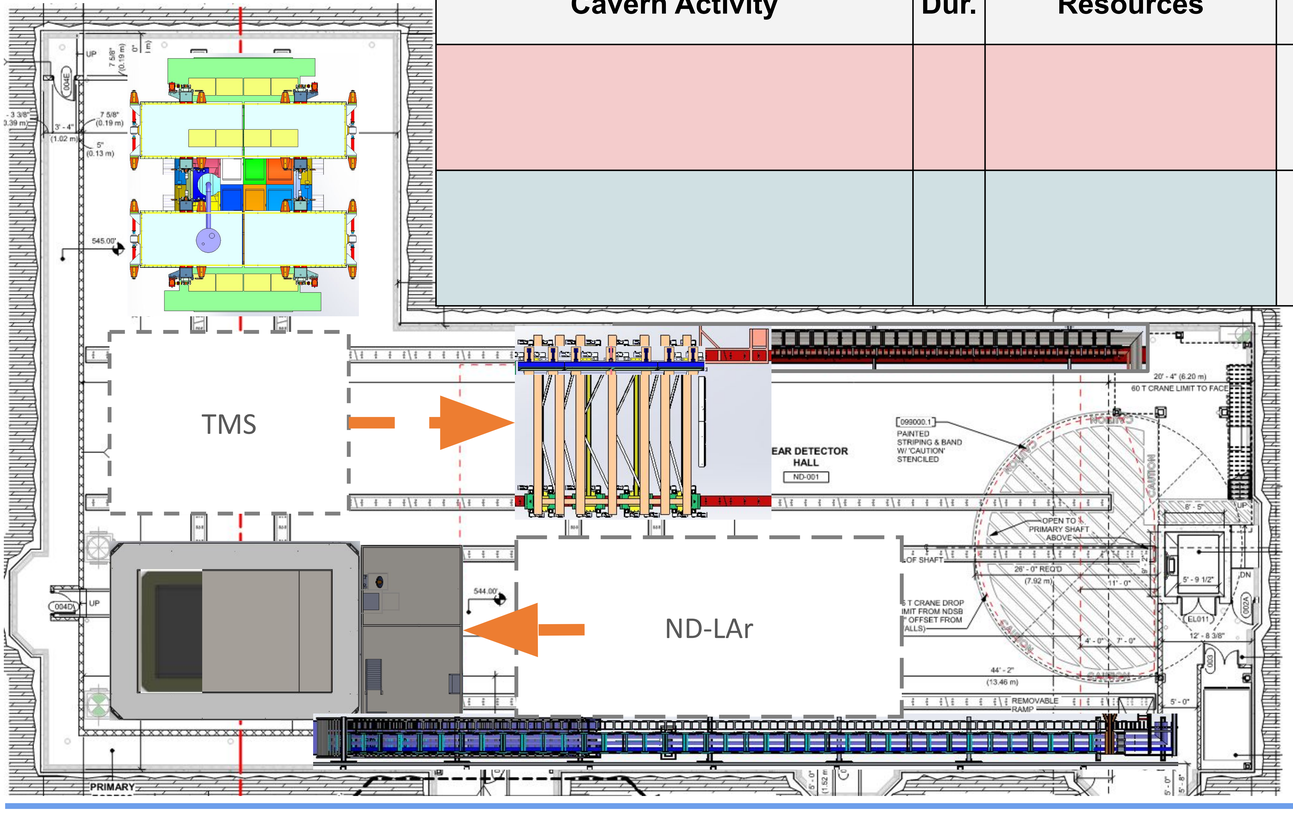


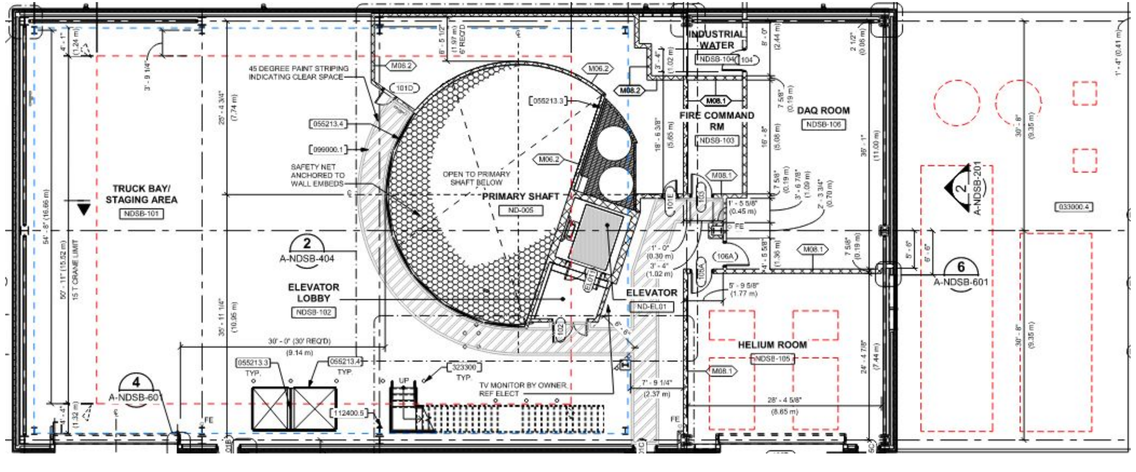
How is the cold membrane constructed?

Step 80: Switch the Detectors

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			

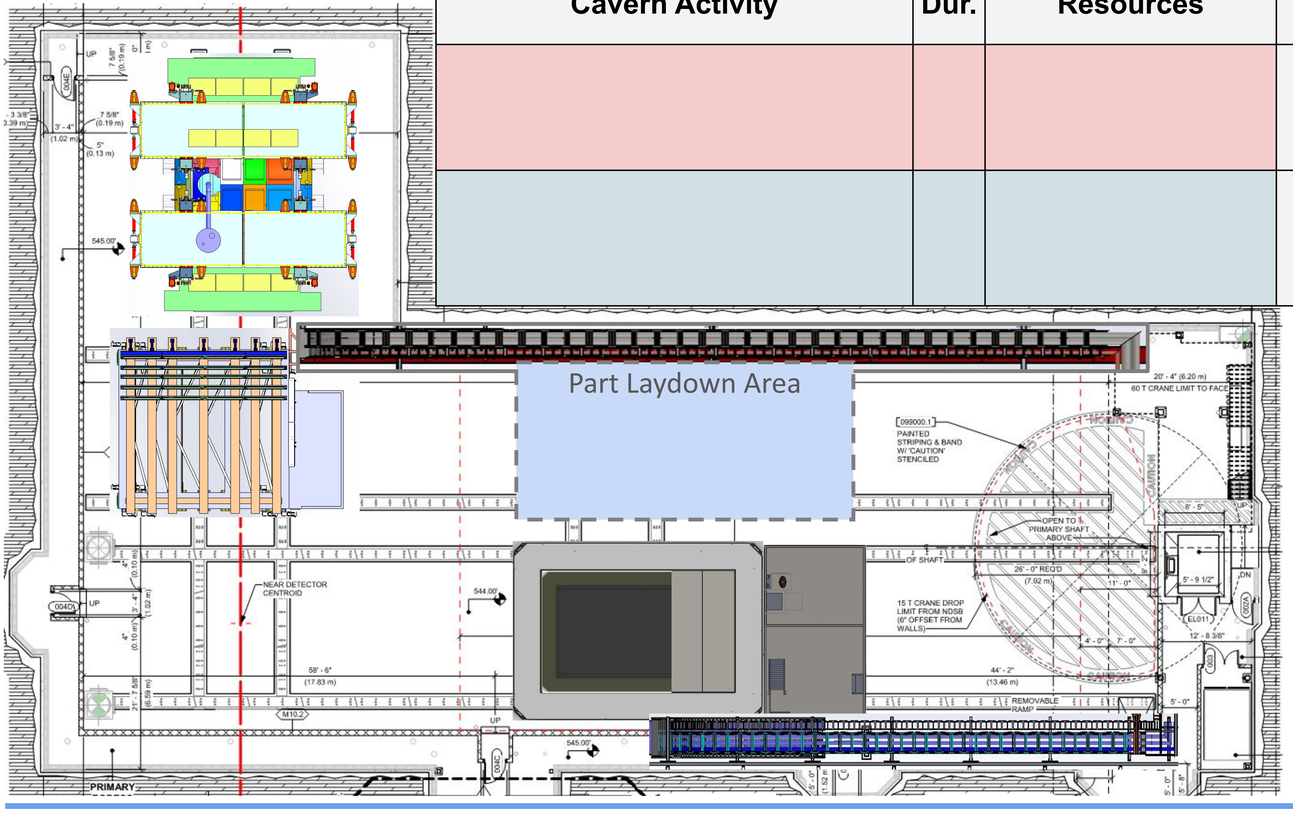


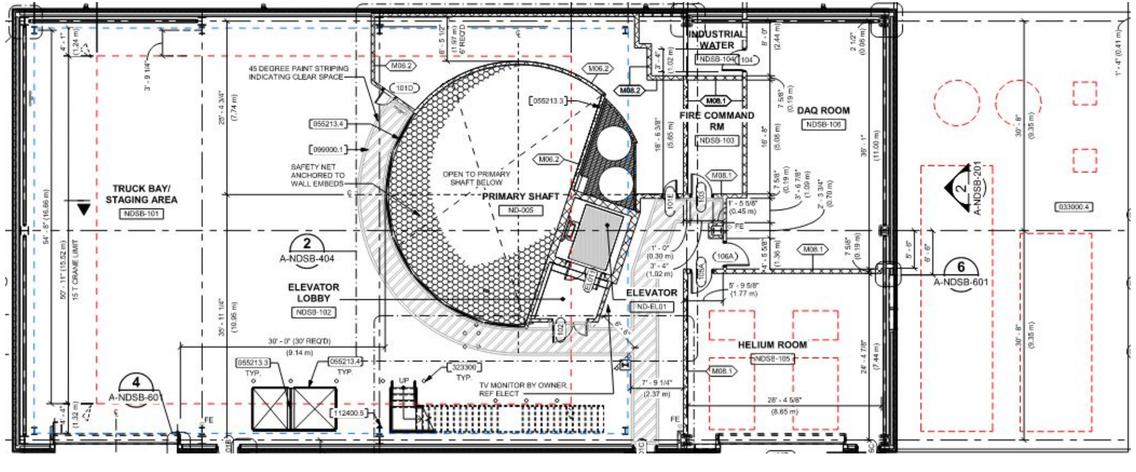


Step 81: Install more of the Cold Membrane

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel			





TMS Planes can be tested in parallel with Cryostat installation activites

Step 82: Install Power Distribution on the Cryostat Mezzanine

Scale 1”:2m

Cavern Activity	Dur.	Resources	Activity Type	Surface Activity	Dur.	Resources
			Critical Path			
			Parallel