Logistics and Integration Facility Overview v2

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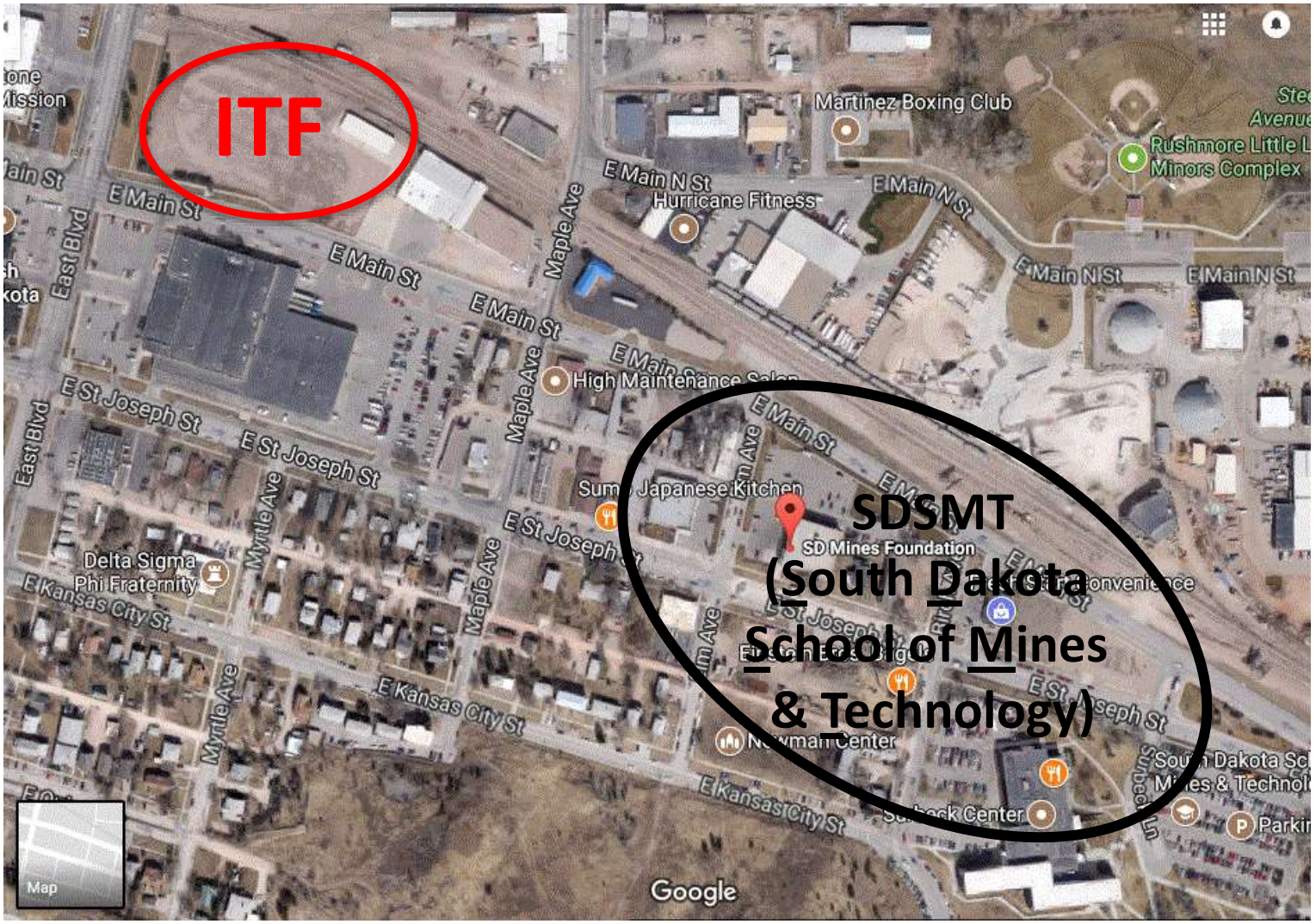
Goals of the Workshop

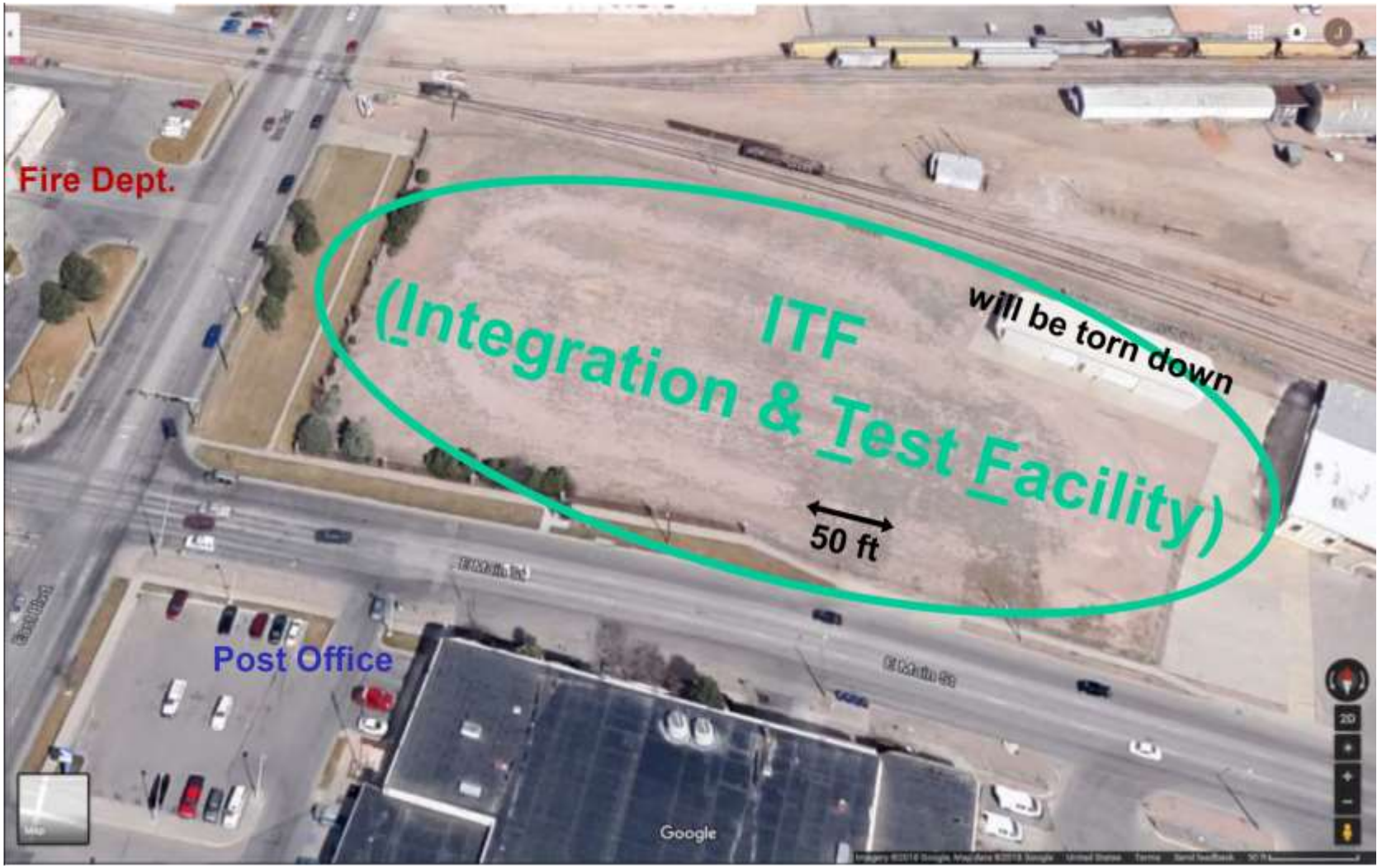
We are on an aggressive schedule to locate/build a Integration and Testing facility for commissioning by October 2020

- Help define the testing, equipment and space requirements from each of the consortia in the ITF
  - Cleanroom space: Area required for integration and testing
  - Equipment required: Overhead crane, fork lift, pallet jack
  - Electrical and environmental requirements: Clean power, heated or cold storage, lighting
  - Buffer space for storage outside the cleanroom
  - Integration and testing schedule: When is the ITF needed, how does the
  - Receiving requirements: Loading dock, ramp, overhead crane, estimated number of shipments and schedule
  - Shipping requirements: Shipping container/box that will efficiently work going underground, estimated number of shipments and schedule
  - Office Space

Possible Site for ITF in Rapid City

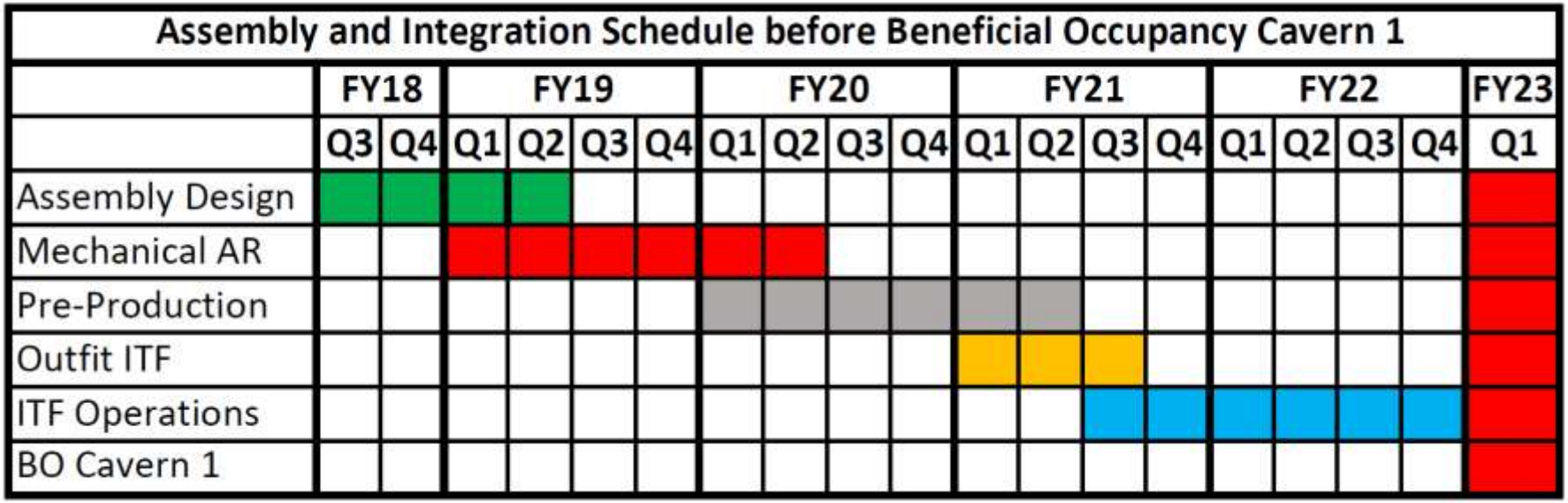


Integration and Test Facility

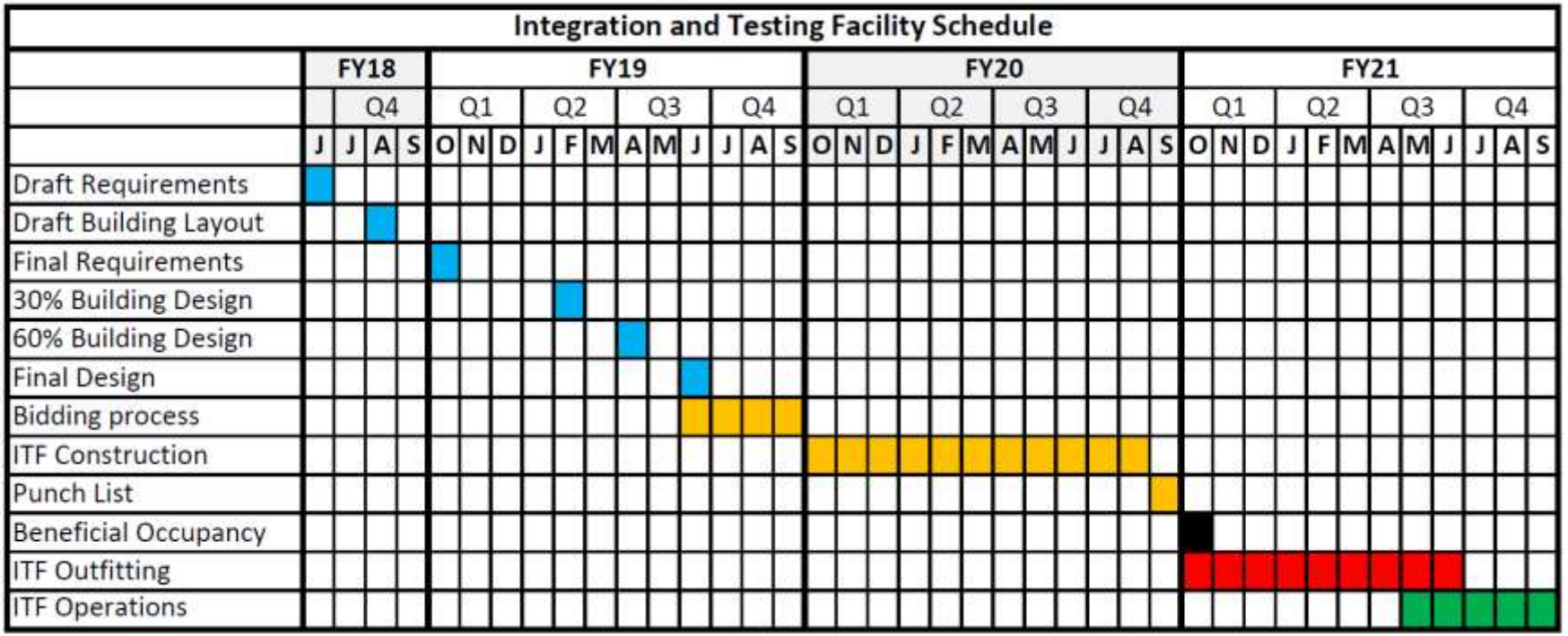


Overall Schedule Before BO

- **These are approximate time ranges and starts dates**
- Many tasks to be completed before we have an ITF in full operation
  - Testing the cable routing
  - Test modifications to APA mechanical design: Lifting fixtures, PD rails and opening, electronics access, installation fixtures…..
- Some tests are starting now, others at Ash River ~6 months



Estimated ITF Timeline

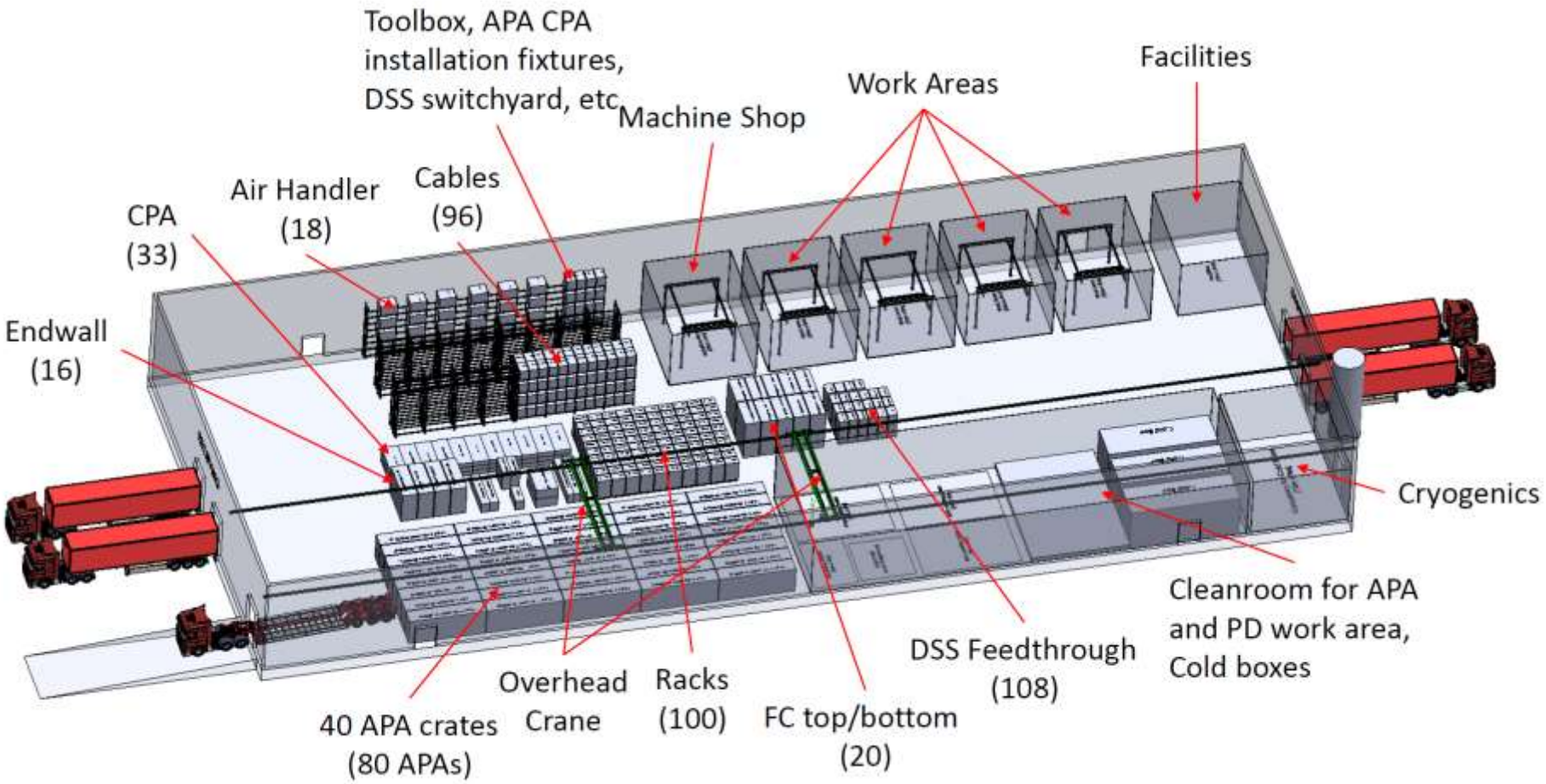


Milestone Dates:

- **Final Requirements for ITF** — **October 2018**
- **Final Design of ITF** — **June 2019**
- **Beneficial Occupancy of ITF** — **October 2020**
- **Complete ITF Outfitting** — **~ April 2021**
- **ITF Operations** — **April 2021- ~2025**

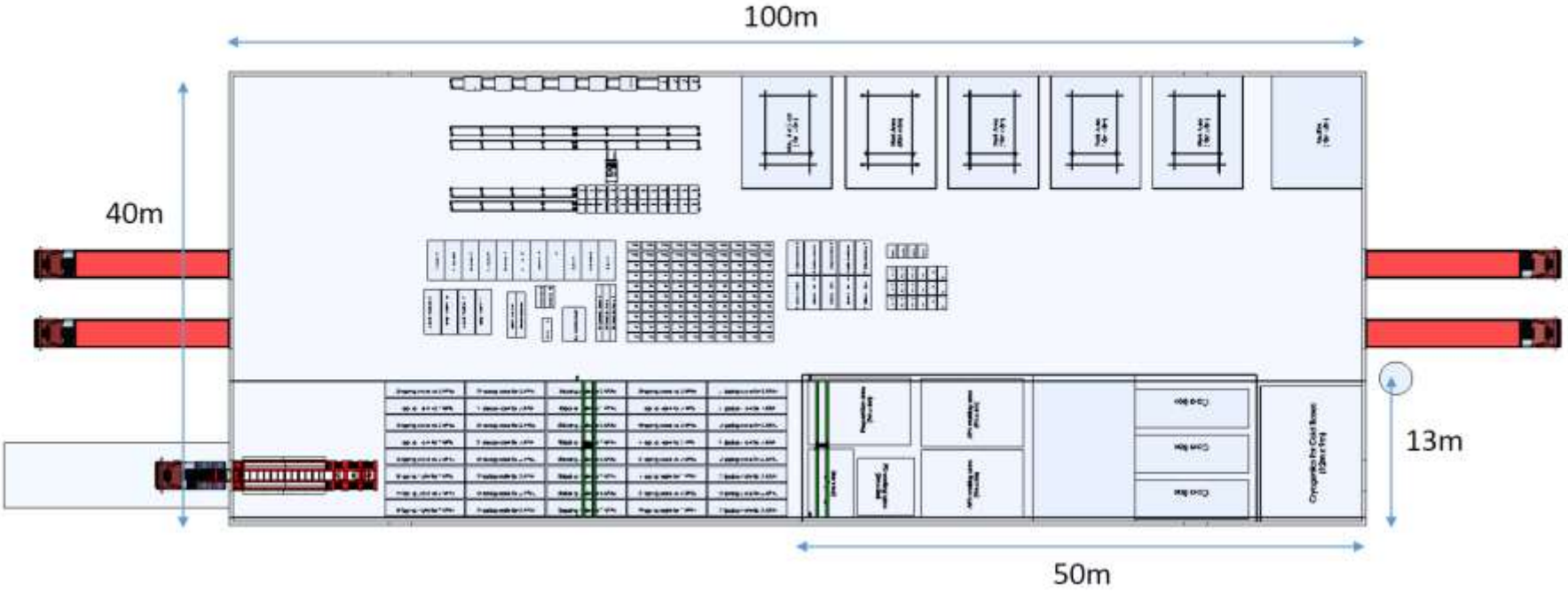
First Draft Layout ITF for discussion

Warehouse Layout for SP
(40m x 100m)

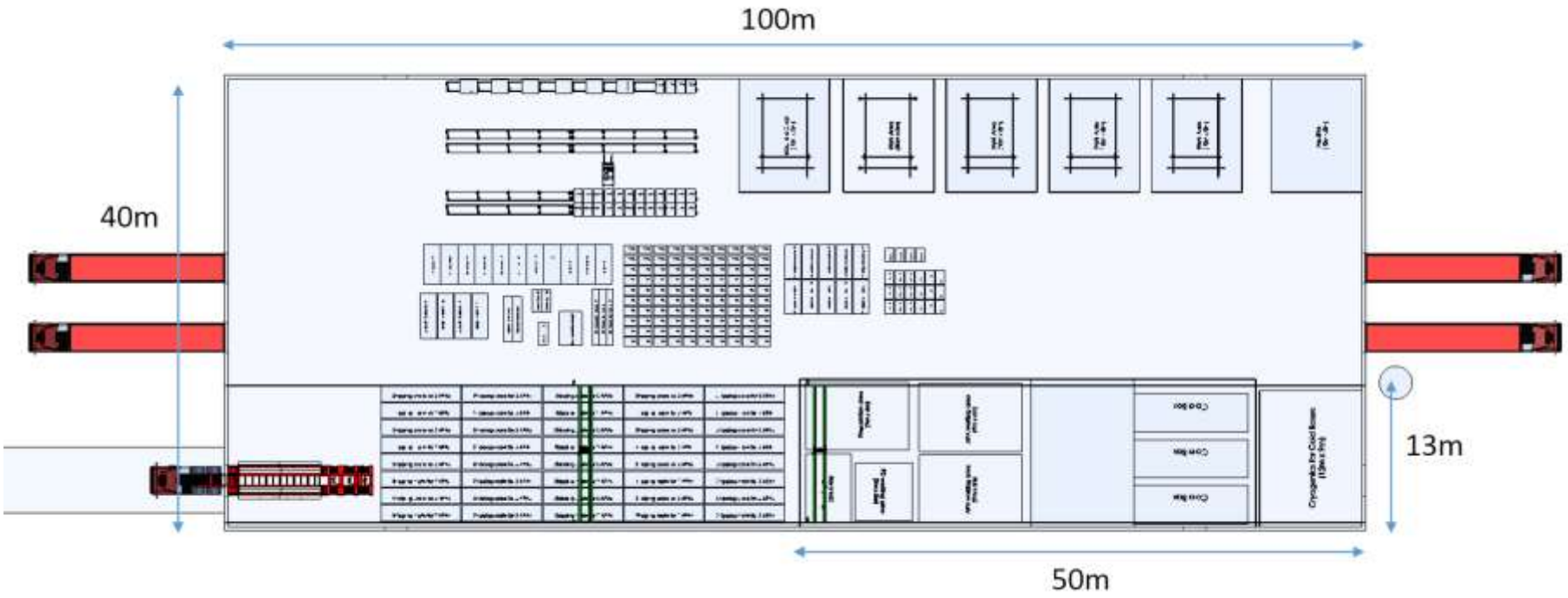


Plan view- 40m by 100m

This view only shows our estimated TPC components for the SP detector. It does not show the additional space required for the first detector infrastructure, CUC or the DP detector

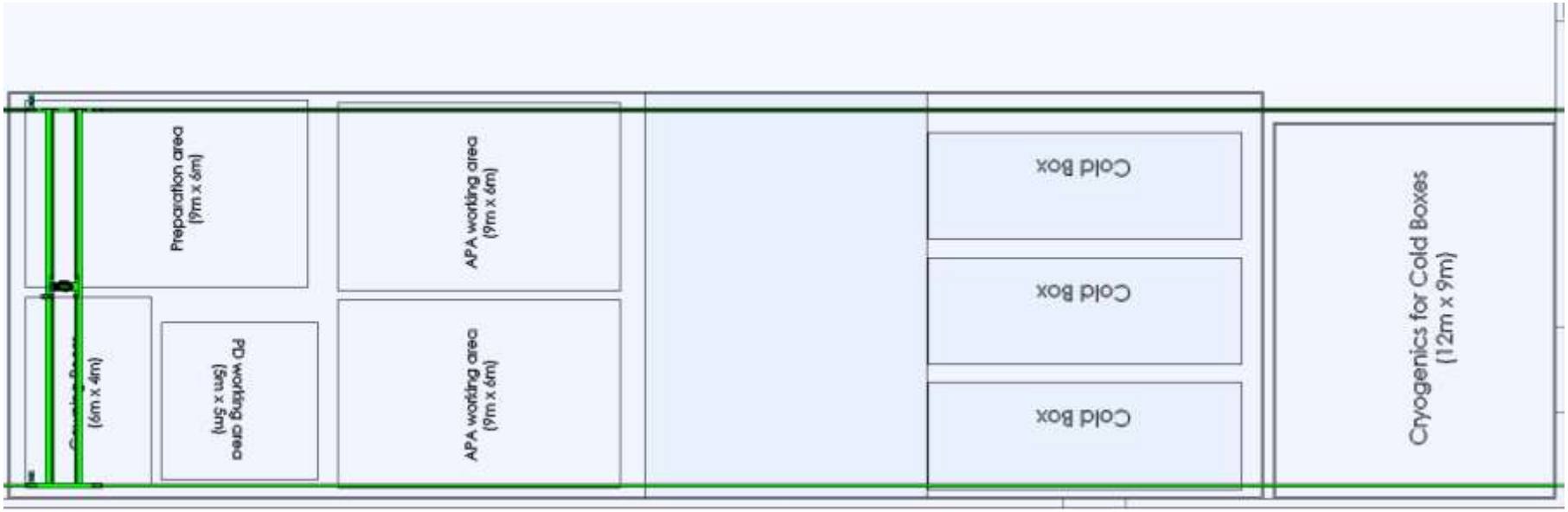


ITF Plan View- 43,000 sq. ft.



This has a small machine shop and 4 work areas with small gantry cranes. No office space has been added yet.

ITF layout-SP Cleanroom



This space has not been optimized, but it shows the amount of space to work on two APAs at one time plus have 3 testing in the cold box. It has an over head crane in the cleanroom

Consortia Survey first pass at Storage Space Requirements

- From the first survey information and estimates from ProtoDUNE it is clear we are not there yet
- **HV System-**1000 m^2 (½ dedicated & shared storage)
- **APA-** ~1000 m^2 40-80 APAs
- **Single Phase CE-** 40 m^2
- **Dual Phase CE-** 200 m^2
- **Dual Phase Photon-** 45 m^2

- A large amount of detector infrastructure items staged for Beneficial Occupancy Underground at the same time TPC components are also at their peak
  - CUC components
  - DSS
  - Installation equipment for both cryostat and cleanroom
  - Underground Cleanroom
- Is there space at cryostat warehouse available at this time?

Other ITF Requirements

- Overhead crane
- Fork lift
- Pallet jack
- Slings, clevises, chains, etc.

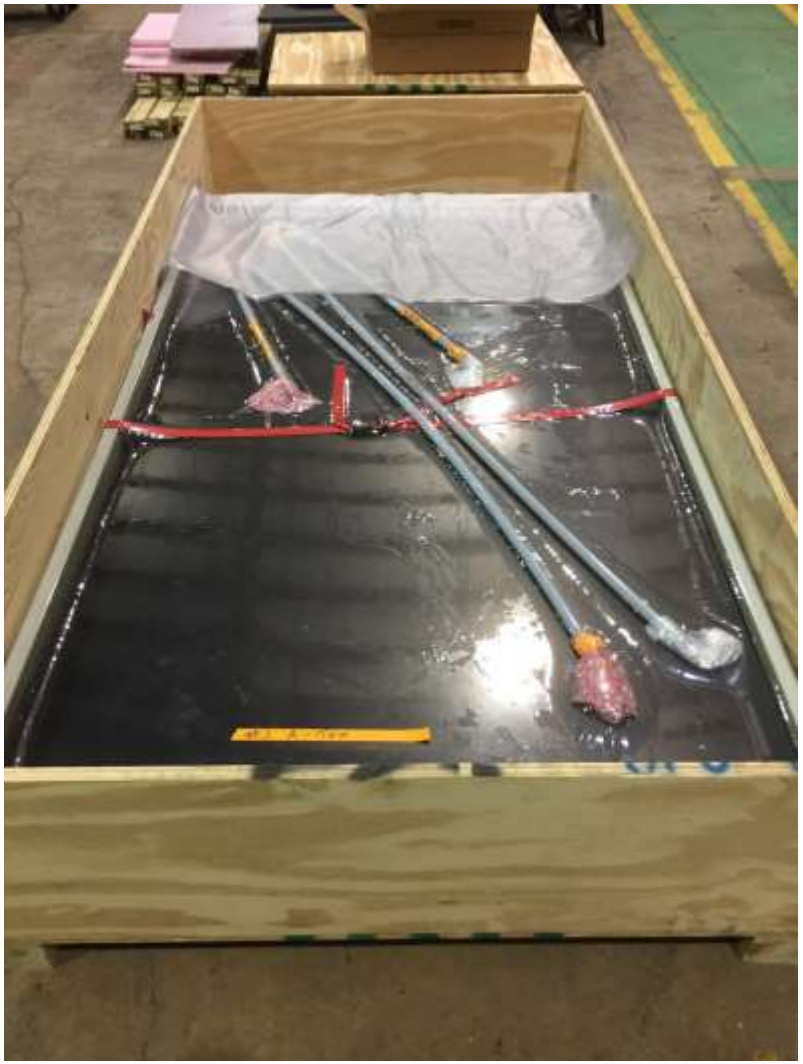
- Electrical requirements?
  - Quiet power
- Lighting requirements?
- Small shop area
  - Milling machine
  - Drill press
  - Band saw
  - Chop saw
  - Table saw
  - Small lathe
- Metal stock, fasteners

Re-Packaging Requirements

Some of the TPC and detector infrastructure will be shipped via shipping container or regular shipping means.

- These items need to be repackaged to minimize time loading and unloading on the cage
- Repackaging to protect from the environment
- Repackaging after integration with other components

- Vacuum seal equipment to bag clean parts
- Parts cleaning: Ultra sound system



Cleanroom Space

Clearly the SP APA will drive most of the size requirements

- Are they compatible with other cleanroom needs or do need several cleanroom areas
- Is the schedule compatible with the DP needs
- Cleanroom access requirements: How is your equipment moved
- **Cold testing: Number of cold boxes?**
  - A horizontal cold test saves height requirements on the building
  - Can/should the cold test be in a separate room for ODH issues?

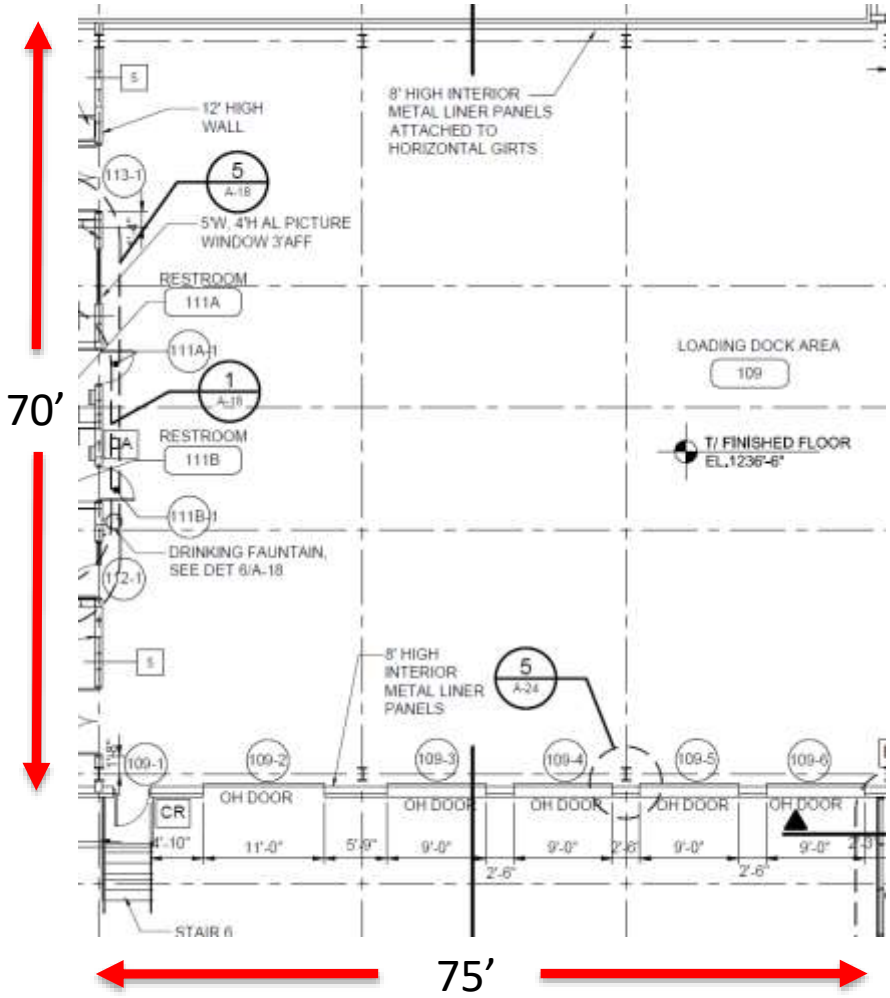
Vertical Cold Box and rail system at CERN

Loading Dock Area

The NOvA loading dock area worked well for our receiving and delivery, something of similar size is needed for DUNE.

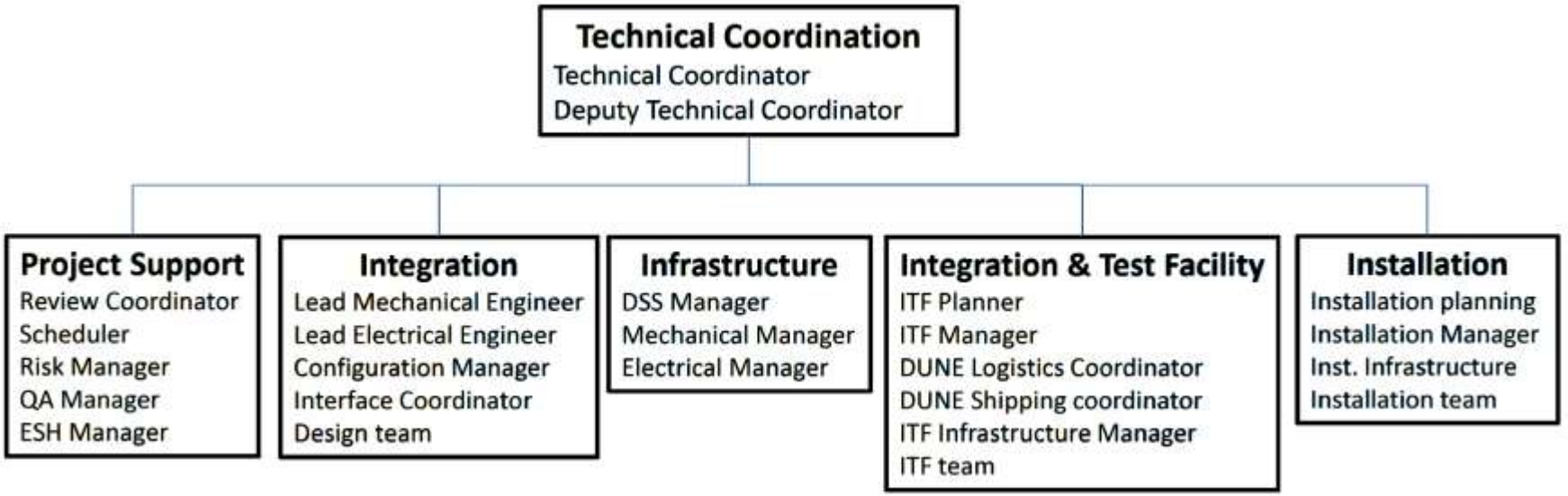
This area would only be for temporary storage of staged materials

- It includes 4 standard loading docks and 1 drive in ramp
- We would have ~1-3 trucks per day going to the headframe with a similar number of return loads



Loading Dock at Ash River

Technical Coordination Organization



Under the direction of the Technical Coordinator the Integration Test Facility Planning Team and the Underground Installation Team to work with the consortia to plan TPC installation

Integration Test Facility Team

- Integration Test Facility (ITF) team develops the logistics plan for receiving detector components in South Dakota and transporting them to SURF as needed (in coordination with LBNF Far Site Logistics Team)
- ITF team is also responsible for working with the consortia to determine any detector integration and testing activities that this facility could usefully provide
- The team also takes responsibility for the specification and procurement of any common infrastructure associated with this facility
- At a later date, this team will morph into the on-ground team in South Dakota responsible for the operation of the facility

Underground Installation Team

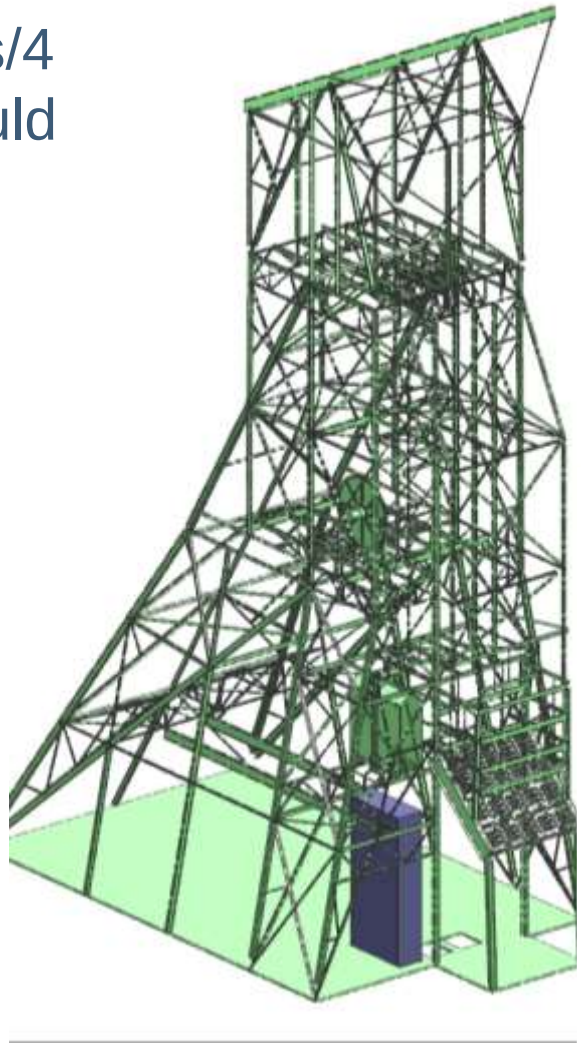
- Underground Installation Team (UIT) develops the plan for the installation of the detectors at SURF
  - Work with the consortia who maintain responsibility for the installation and commissioning of their subsystems
- This team is also responsible for the specification and procurement of common detector infrastructure
  - Common detector pieces such as the detector support structure, racks, cable trays, etc…
  - Temporary items required for the installation process such as clean rooms, cranes, scaffolding, etc…
- At a later date, this team will morph into the on-ground team at SURF responsible for the detector installation

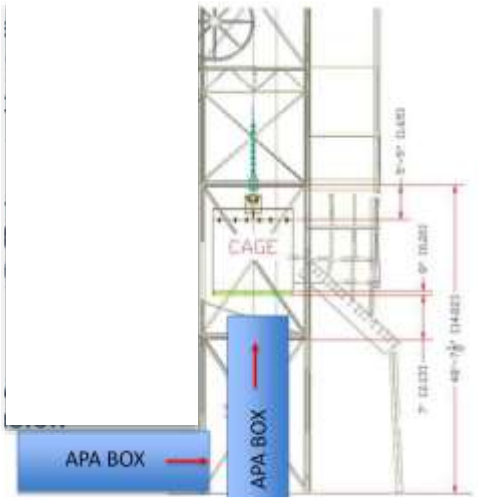
Shipping Everything Underground

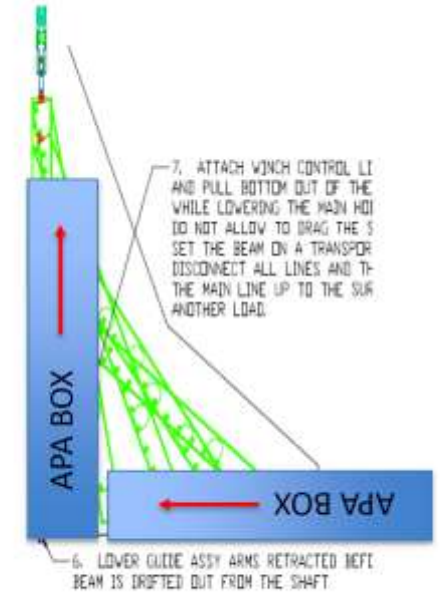
- Access underground controlled by SDSTA
  - slung loads take ~66 min
  - regular cage loads ~17 minutes.
  - Personnel trips max 30 people ~15 minutes
- Weekly planning meetings with SDSTA/SURF, Underground Installation Coordinator, and LBNF Far Site Logistics Team will be held to coordinate shipping schedules to minimize interference- **PLANNING IS CRITICAL TO OUR SUCCESS**
- Cage rides for shifts will be scheduled for a specific time, this is further complicated by limited parking for personnel. There will be a shuttle bus to the head frame
- No room at the headframe for staging
  - Truck from the ITF arrives at headframe on schedule and load taken directly from truck to head frame
  - The load goes down and a load of empty boxes comes up and gets put on the truck and it makes the trip back to the ITF

Underground Shipping Assumptions

- Working two 10 hour shifts/4 days per week. Friday would be schedule contingency
- 2 APAs install/day 3 days/week
- Shipping box design must be light weight, reusable, meet cage design criterial and able to make cage rotation
- ~ 1 week buffer of TPC components underground and ~1 month at ITF







First detailed estimate Cage Loads

- First detailed estimate of loads has us at ~1366 trips over the first year after beneficial occupancy of Cavern #1
  - 1132 of them standard Cage loads (pallet size)
  - 234 of the slung loads (loads must hang balanced to fit)

DUNE Loads

Description	Contact	Date	Total Number of Units	Weight per unit	Units per package	Type of package	Package Dimensions				Number of packages per trip	Type of trip	Number of Hoist Trips
							Width	Height	Length	Package weight			
				kg			m	m	m	kg			ea.
APA installation phase													**445**
APA		May-18	150		2	Box	1.4	7	2.5		1	Slung	75
CPA		May-18	200		1	Crate	1	0.5	3		4	Cage	50
Field cage top bottom modules		May-18	200		2	Crate	1.4	4	3		1	Slung	100
Cables		May-18	600		1	Pallet	0.8	1	1.2		3	Cage	200
Misc. pallets		May-18					0.8		1.2			Cage	20
Endwall #1 installaiton													**7**
Endwall Field Cage Panel		May-18	16		4	Crate	1.4	3	4		1	Slung	4
Misc. Beams		May-18					1	0.5	5			Cage	1

DUNE Infrastructure Bottleneck

- There is a large bottle neck of equipment right before beneficial occupancy for ~4 months when the DSS, Cryo-piping, CUC setup, cable trays, Cryostat Racks equipment is all at the ITF
- This is also be the same time period of maximum TPC components

				2023												
	Start	Dur	D	J	F	M	A	M	J	J	A	S	O	N	D	J
Benificail Occupancy Cryostat #1	12/29/2022	0	◆													
Install Cryostat Racks, Cabletrays, Power		3		■	■	■										
Install CUC-Cryostat fiberoptic cables		1					■									
DAQ comissioning with detector		12						■	■	■	■	■	■	■	■	■
Prepare Installation Detector #1		4		■	■	■	■									
Install DSS		2		■	■											
Install Cryopiping Det#1		2		■	■											
Clean Cryostat and install floor		1				■										
Install early cryo instrumentation		2					■									
Install FC Endwall #1		1						■								
Install APA-CPA-FC		8							■	■	■	■	■	■	■	■

Inventory Management

- Having a good inventory management system is critical to our success. This caused numerous delays and changes of schedule on ProtoDUNE. **A Logistics Manager will be hired soon to work on-site. Having a strong team here is important**
- In January, 2018 Hajime Muramatsu (UMN) and Elizabeth Higart (FNAL) toured with Rapid City Economic Development folks looking at warehouse availability. The largest one Dakota Warehouse (200k ft^2) used a **cloud based Warehouse Management system**
- It was simple to check on items but they were all hand entered. It was not clear if it could be made to be RF scan-able
- It is clear that work on some commercial software system needs to be started now to have it in time for ITF
- In a perfect world this information including test results, would be entered into the hardware data base as well.
- The University of Minnesota is interested in working on solving these problems

ITF Manpower

The manpower level of the ITF team at this early design stage is still in flux as we develop the details of the scope.

There are many factors will contribute to the size of the staff

- ITF Schedule required to meet the Underground Installation needs
  - 1 or 2 shifts per day
- Technicians required by consortia

This work would be supported by the Technical Coordination Team

- In our first manpower estimate for FY21 we would have a staff with some of the management shared with Underground Installation Team.

ITF Team Management

- Assembly Supervisor-50%
- Assistant Assembly Supervisor
- Administrative Assistant-50%
- Safety Officer-50%

Manpower for ITF: Pre-B.O.

		2021									2022									
Resource	Resource Description	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
						Single 10 hr shift/day 4 days/week														
		IT Facility				WBS-2.1.3 Design									WBS-2.1.4 Production Setup W					
Integration and Testing Facility																				
Management		Commission ITF				Startup of Operation of the Integration and Testing Facility														
FD.MNG.AS	Assembly Supervisor	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FD.MNG.AAS	Asst. Assembly Supervisor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FD.MNG.AS-M	Administrative Support	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FD.MNG.ESH	ESH Officer	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Engineering																				
FD.ENG.MEC-S	Mechanical Engineer - Senior																			
FD.ENG.MEC	Mechanical Engineer																			
FD.ENG.DES	Designer																			
Assembly Tech																				
FD.TECH.LDR	Tech Forman	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FD.TECH.EO	Equipment Operator	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FD.TECH.MT	Mechanical Tech	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
APA Consortium																				
APA.AS	Physicst Supervisor	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
APA.TECH	Mechanical Tech	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
CPA Consortium																				
CPA.AS	Physicst Supervisor																			
CPA.TECH	Mechanical Tech																			
CE Consortium																				
CE.AS	Physicst Supervisor	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
CE.TECH	Electronics Tech	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
DAQ Consortium																				
DAQ.AS	Physicst Supervisor	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
DAQ.TECH	Software Tech	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Total FTEs	10	10	10	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12

ES&H

- Fermilab is the host lab so at a minimum all of their rules and standards will apply.
  - If there are additional rules associated with working underground these will be added
- The DUNE Project ES&H will review the design process as we move forward to insure a safe working environment for both the ITF team and any consortia members
- The ITF safety officer will work directly with Fermilab and SURF to insure all procedures are approved and followed
- Readiness reviews will be held prior start-up of any major equipment
- The consortia will work with the ITF safety officer in collecting all procedure documentation, SDS documentation, technical and structural information needed for their tasks
- The ITF safety officer will be responsible for writing and updating the Building Safety Document and monitoring the site activities to adhere to the safety policies

Summary

- These assumptions listed in this talk are essentially the same if a new building is designed for our needs or we modify an existing warehouse space.
  - Typical warehouse rental space in Rapid City is $10-15/ft^2
- If designing a new building for our use works it can be designed for our specific needs.
- Before we can start to get realistic cost estimates we need to clearly define the scope and requirements needed to do the job.
- A full time staff associated with the Integration Testing Facility is required, staff estimates will depend on the ITF scope

Discussion

Consortium	Transport Buffer	Re-Packaging	Component Fabrication	Component Integration	Inspection, Testing	Visitor Support
High Voltage	Yes	Yes	No	Yes?	Yes	Yes
APA	Yes	Yes	Yes	Yes	Yes	Yes
DAQ	Yes	Yes	Yes	Yes	Yes	Yes
SPCE	Yes	Yes	No	No	Yes	Yes
DPCE	Yes	No	No	No	Yes	Yes
SPPD						
DPPD	Yes	Yes	Yes	No	Yes	Yes
CISC						
CRP						