Review of the current underground space at completion of CF

Douglas Pelletier, CF Project Manager

22 August 2018

Outline

- High level overview of Arup 30% Final EXC Underground Design
  - Major Changes from Preliminary Design
- High level overview of Arup 30% Final BSI Underground Design
- Review remaining deliverable dates and review periods
- Preliminary Excavation Sequence animation

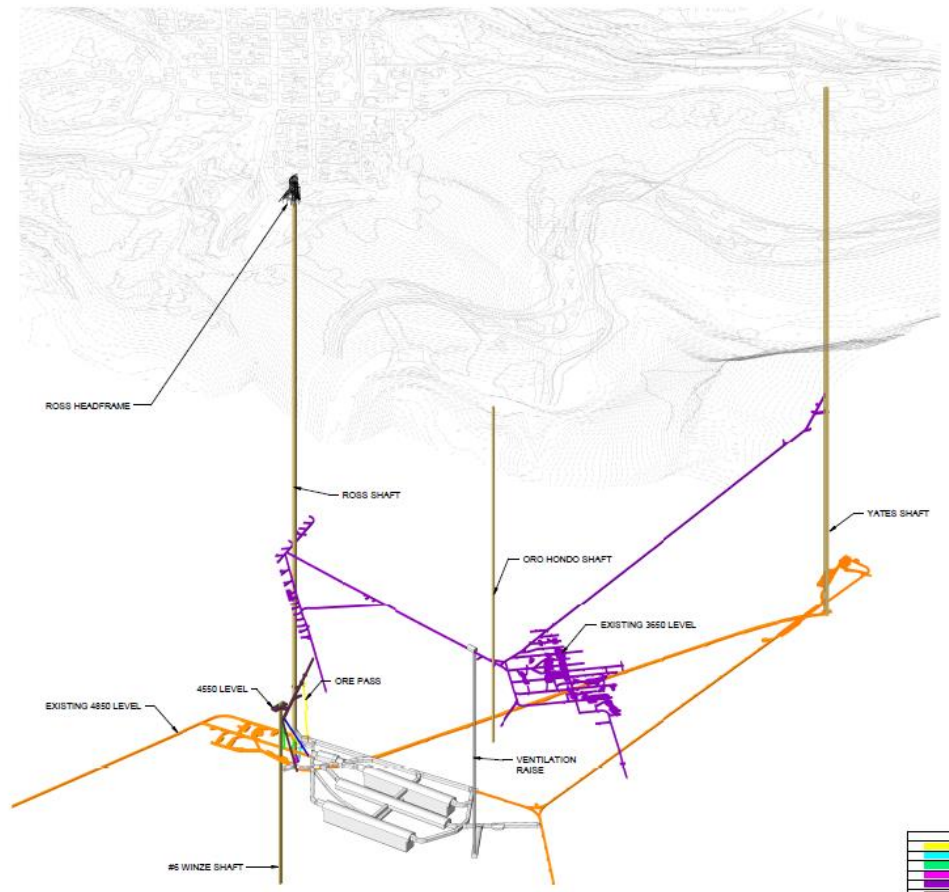
Major Changes from EXC 100% Preliminary Design

- Removal of septum in North and South Caverns and shortening of the overall caverns in line with F10043159 Rev C.
- Centered Center Access Drifts with respect to the north and south caverns, and moved the Central Utility Chamber so that the alignment with these drifts remains as in the 100% PD
- Removal of the Maintenance Shop, High Voltage Electrical Room and the LV/MV Electrical Room, and enlargement of the Trolley Drift to form the Electrical Substation, in line with the recommendations of the Underground Electrical Substation Relocation Study, 7/14/2016.
- Drift geometry has been updated in line with the Drift Optimization Study, 4/14/2016.

Major Changes from EXC 100% Preliminary Design

- Modified the location of Ventilation Raise Access Chamber, the Ventilation Raise, and the Spray Chamber location and length.
- The ‘mucking drifts’, which are provided for construction use only, have been modified to avoid impacting the waste pass in the existing trolley drift and minimize the overall excavation volume.
- Mucking drifts have been maintained to the 4910 Level at the base of the caverns, but the connection to the east has been removed as it is no longer needed with the revised construction phasing.
- Refined Ross Brow and junction geometry.
- Yates Brow removed from scope.

Arup 30% Final EXC Design DUNE-doc-9585



LBNF - SITE LAYOUT

SCALE: N.T.S.

LEGEND
ORE PASS, PLUGGED IN 1A
ORE PASS, REFURBISHED IN 1A
ORE PASS, NOT PART OF EXCAVATION
SKIP LOADING POCKET, REFURBISHED IN 1A
3650 LEVEL
4550 LEVEL
4850 LEVEL
SHAFTS

NOTES:

1. FOR GENERAL NOTES AND ABBREVIATIONS, REFER TO DRAWING UG-FD-C-001.

REV.	DATE	DESCRIPTION
1	07/13/18	30% FD SUBMISSION

REVISIONS

ARUP

McMILLEN JACOBS ASSOCIATES

consulting

SCALE:

Fermilab

Long-Baseline Neutrino Facility

DESIGNED	AV	ARUP
DRAWN	ES	ARUP
CHECKED	JH	ARUP

LBNF - FSCF - EXCAVATION

OVERALL SITE LAYOUT

DRAWING NO. 15-1-6F UG-FD-C-100 REV. 1

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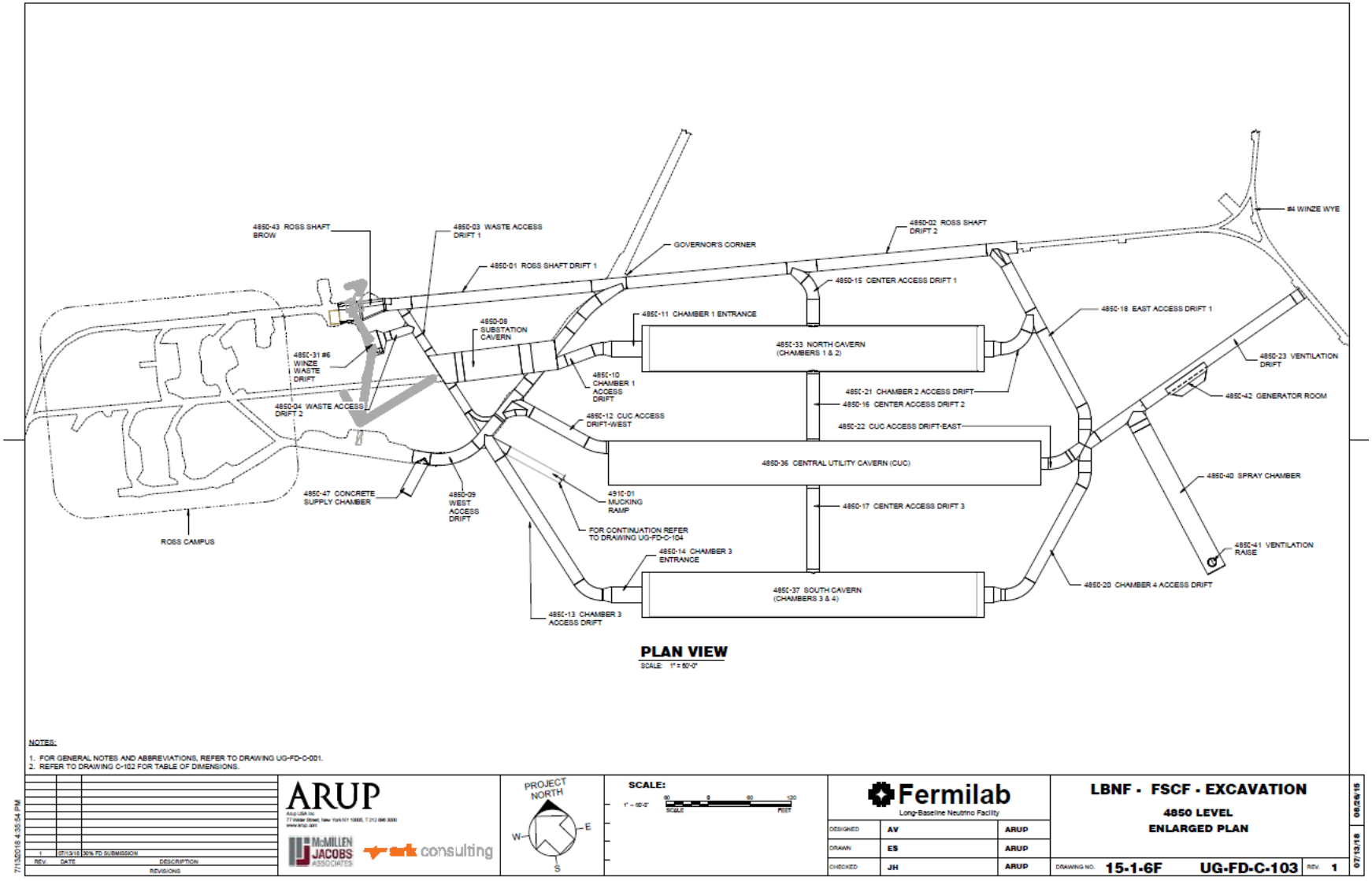
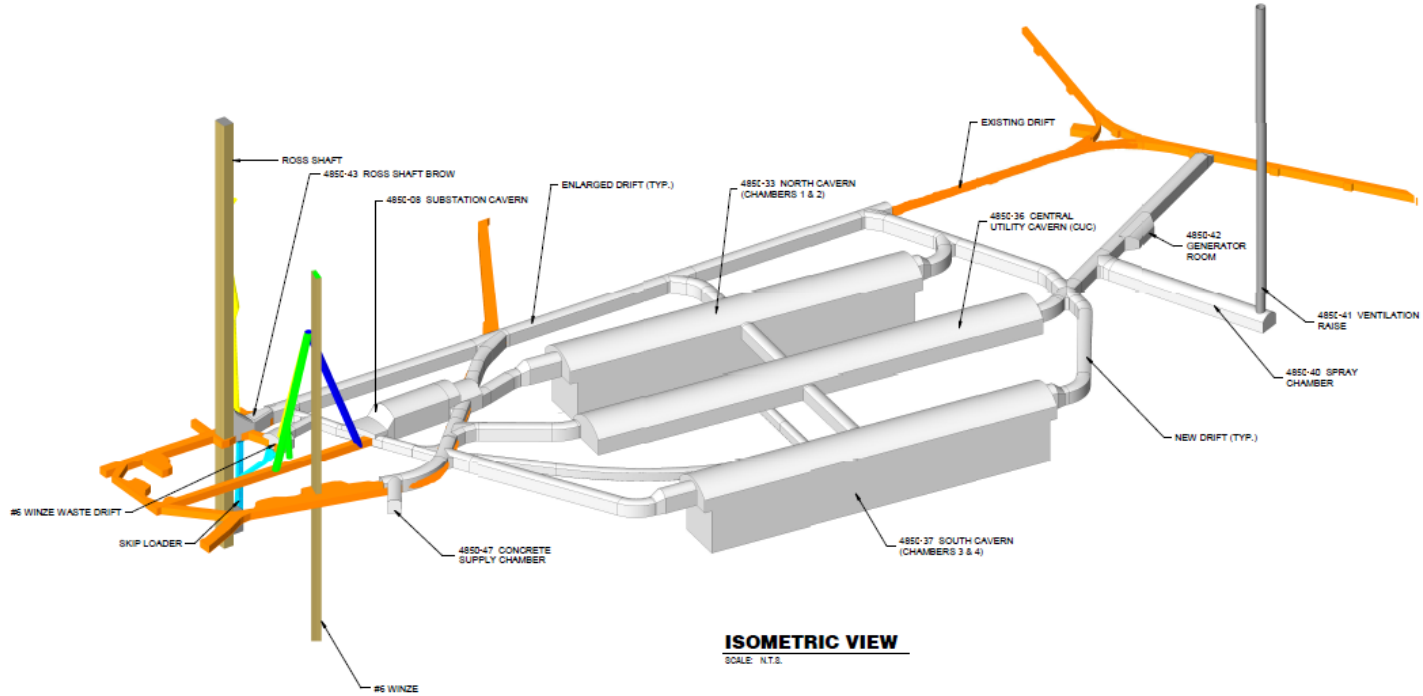
Arup 30% Final EXC Design



Arup 30% Final EXC Design



ISOMETRIC VIEW

SCALE: N.T.S.

NOTES:

1. FOR GENERAL NOTES AND ABBREVIATIONS, REFER TO DRAWING UG-FD-C-001.

REV.	DATE	DESCRIPTION
1	07/13/18	30% FD SUBMISSION

REVISIONS

ARUP

McMILLEN JACOBS ASSOCIATES

rsk consulting

SCALE:

Fermilab
Long-Baseline Neutrino Facility

DESIGNED	AV	ARUP
DRAWN	ES	ARUP
CHECKED	JH	ARUP

LBNF - FSCF - EXCAVATION

ISOMETRIC VIEW

DRAWING NO. 15-1-6F UG-FD-C-105 REV. 1

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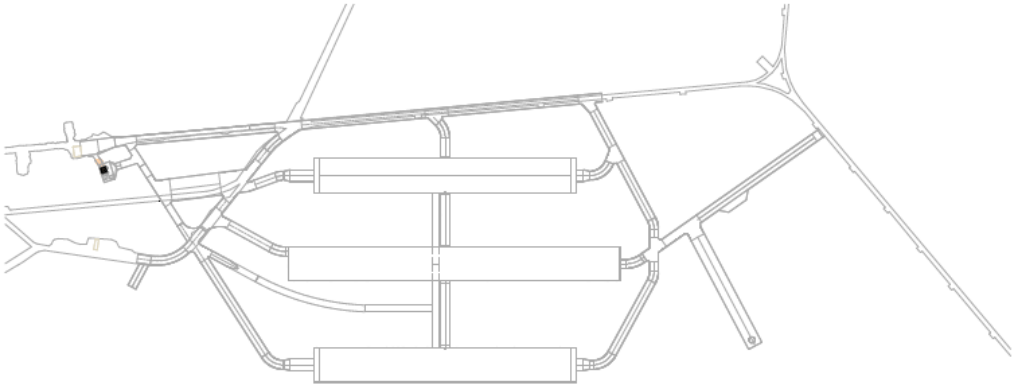
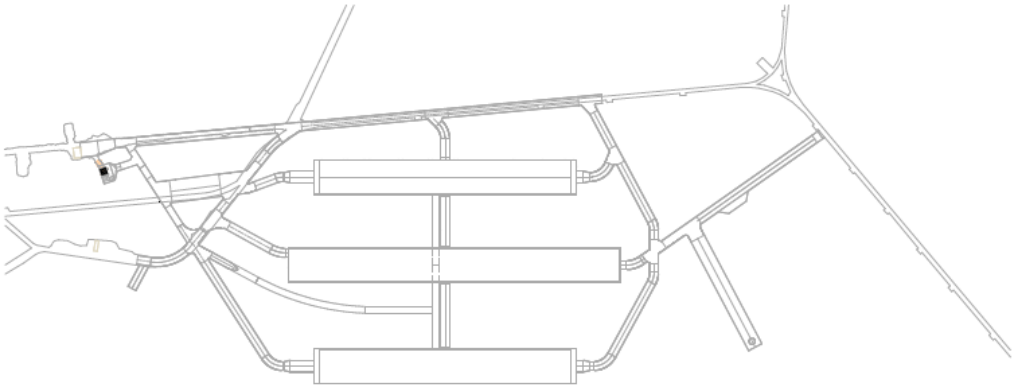
Arup 30% Final EXC Design



CLEARANCE LONG BEAMS - 48'Lx1.5'Hx3'W

SCALE: 1" = 100'-0"

CLEARANCE DIAGRAMS TO BE UPDATED DURING 60% FD.



CLEARANCE MAX CONTAINER - 26'Lx10'Hx5.5'W

SCALE: 1" = 100'-0"

LEGEND:

- DRIFT CENTERLINES
- LOAD PATH (FOLLOWING RAIL WHERE APPLICABLE)
- LOAD CLEARANCE ENVELOPE

NOTES:

1. FOR GENERAL NOTES AND ABBREVIATIONS, REFER TO DRAWING UG-FD-C-001.
2. FOR RAIL DETAILS, REFER TO DRAWING UG-FD-C-310.
3. WHERE RAIL IS USED, IT IS ASSUMED THAT THE LOADS HAVE 1'-0" (0.3m) OVERHANG ON EITHER SIDE OF THE WAGONS.

REV.	DATE	DESCRIPTION
1	07/13/18	30% FD SUBMISSION

REVISIONS

ARUP

McMILLEN JACOBS ASSOCIATES

sk consulting

PROJECT NORTH

SCALE: 1"=100'-0"

Fermilab
Long-Baseline Neutrino Facility

DESIGNED	AV	ARUP
DRAWN	ES	ARUP
CHECKED	JH	ARUP

LBNF - FSCF - EXCAVATION

4850 LEVEL

CURVATURE ENVELOPE

DRAWING NO. **15-1-6F** **UG-FD-C-311** REV. **1**

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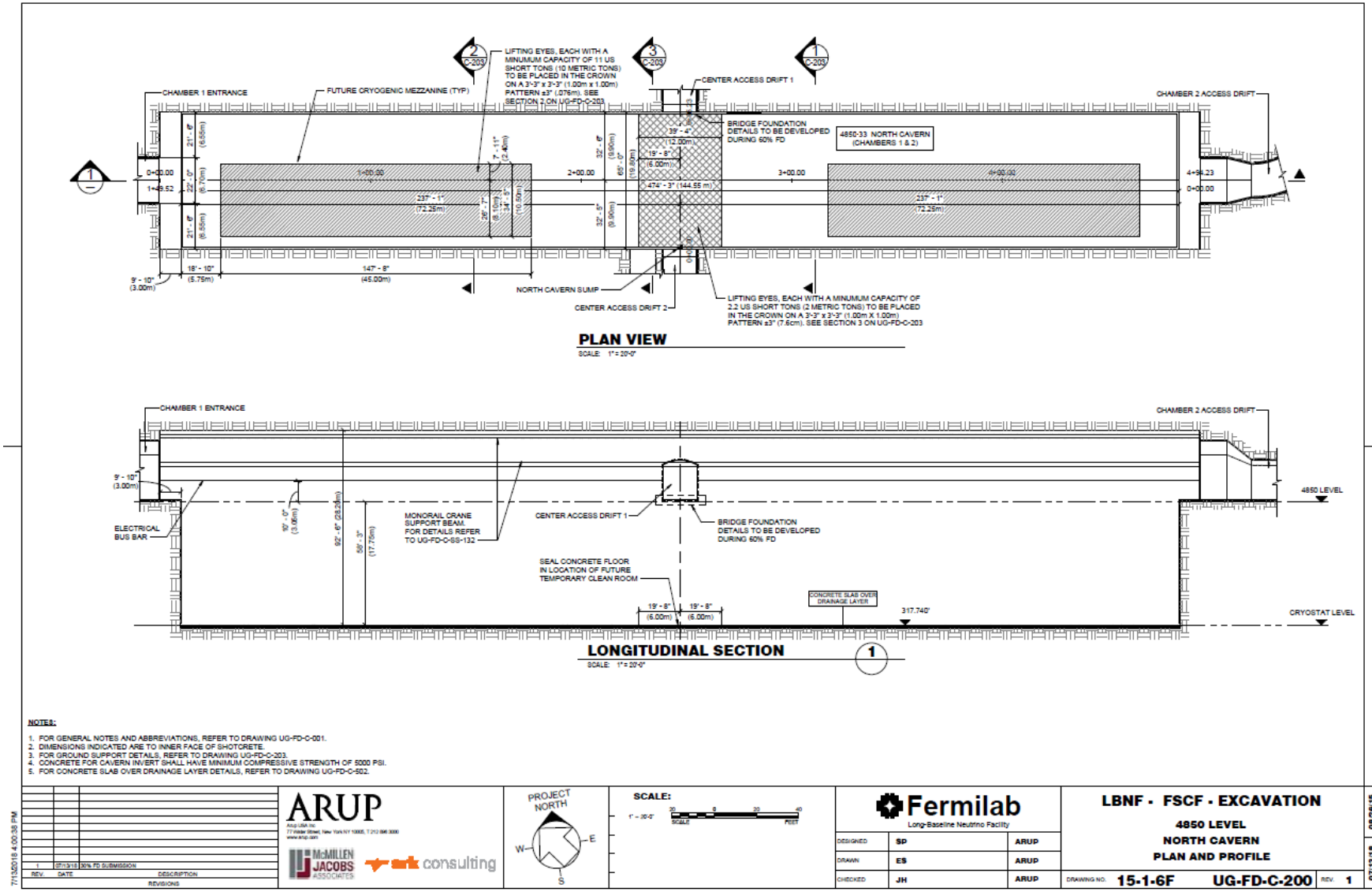
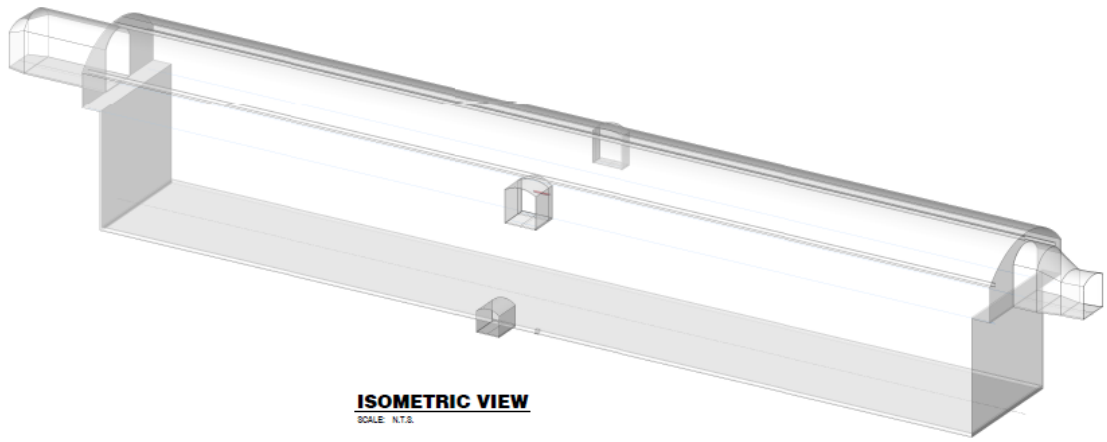
Arup 30% Final EXC Design

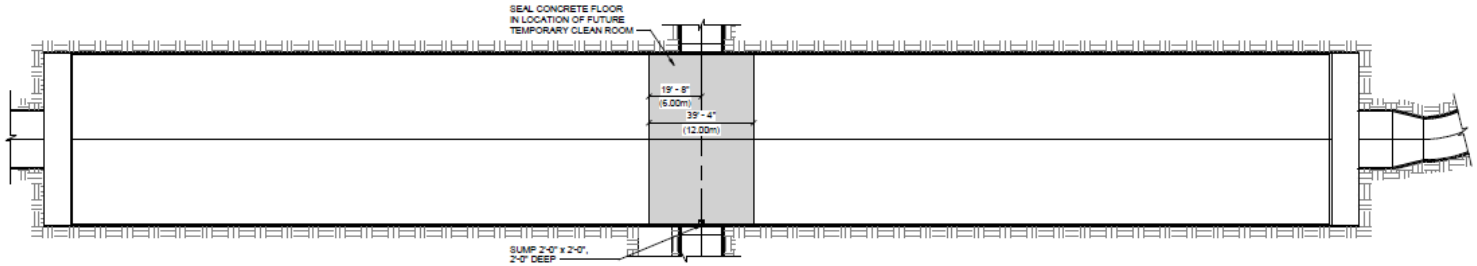


Arup 30% Final EXC Design



ISOMETRIC VIEW

SCALE: N.T.S.



INVERT PLAN VIEW

SCALE: 1" = 20'-0"

NOTES:

1. FOR GENERAL NOTES AND ABBREVIATIONS, REFER TO DRAWING UG-FD-C-001.
2. FOR CRANE BEAM DETAILS, REFER TO DRAWING UG-FD-SS-132.
3. DIMENSIONS INDICATED ARE TO INNER SURFACE OF SHOTCRETE.
4. FOR ROCK REINFORCEMENT DETAILS, REFER TO DRAWING UG-FD-C-500.
5. CONCRETE FOR CAVERN INVERT SHALL HAVE MINIMUM COMPRESSIVE STRENGTH OF 5000 PSI.
6. FOR CONCRETE SLAB OVER DRAINAGE LAYER DETAILS, REFER TO DRAWING UG-FD-C-502.

REV.	DATE	DESCRIPTION
1	07/13/18	30% FD SUBMISSION

REVISIONS

ARUP

McMILLEN JACOBS ASSOCIATES

sk consulting

SCALE: 1" = 20'-0"

Fermilab
Long-Baseline Neutrino Facility

DESIGNED	SP	ARUP
DRAWN	ES	ARUP
CHECKED	JH	ARUP

LBNF - FSCF - EXCAVATION

4850 LEVEL

DETECTOR CAVERNS

INVERT PLAN & ISOMETRIC

DRAWING NO. **15-1-6F** **UG-FD-C-202** REV. **1**

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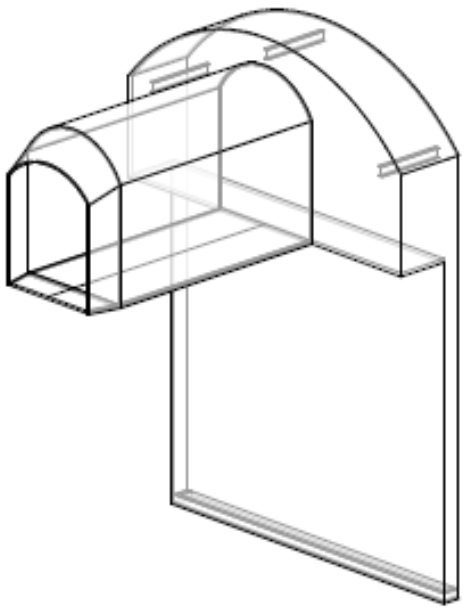
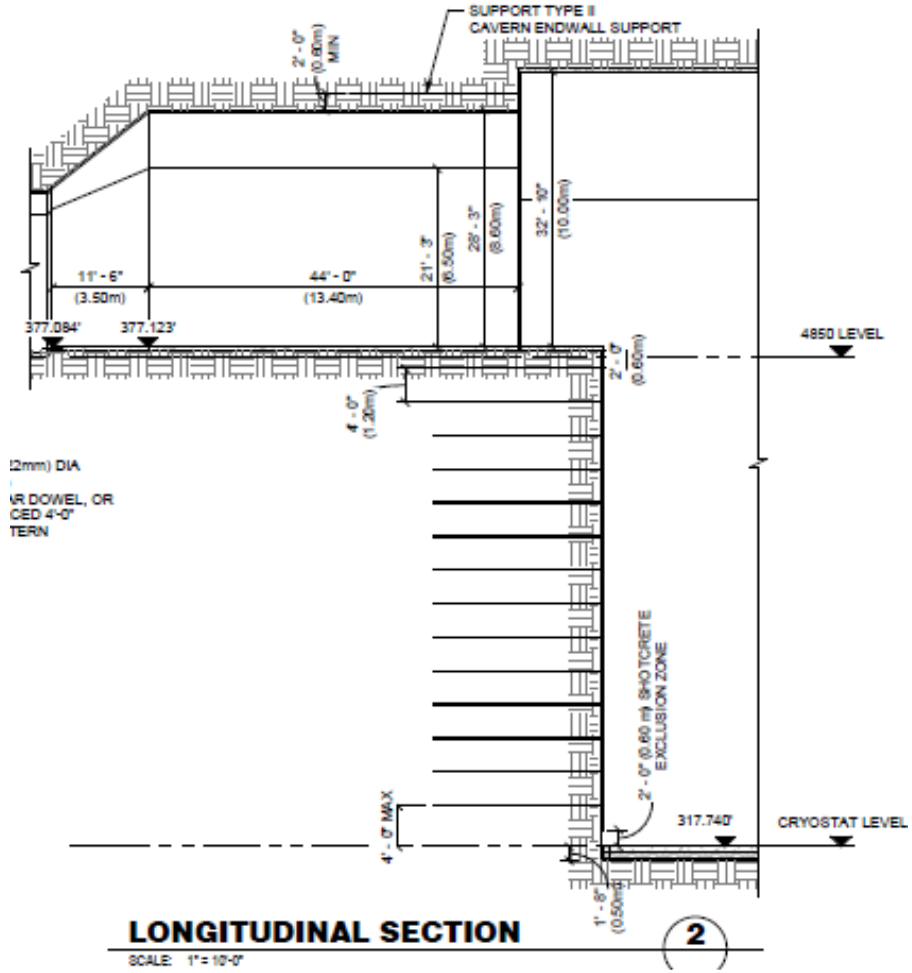
Arup 30% Final EXC Design



TYPICAL ISOMETRIC VIEW

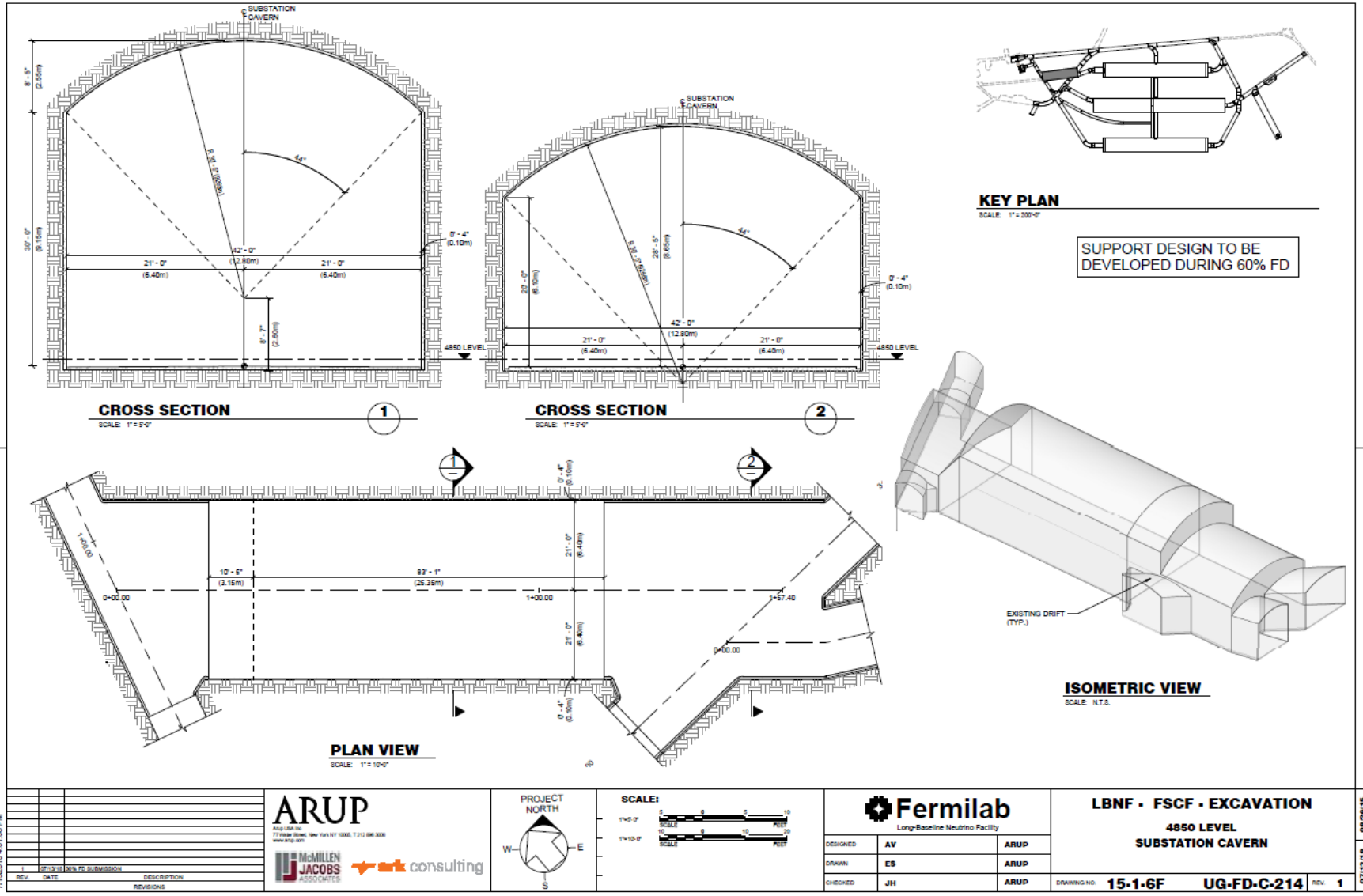
SCALE: N.T.S.



LONGITUDINAL SECTION 2

SCALE: 1" = 10'-0"

Arup 30% Final EXC Design



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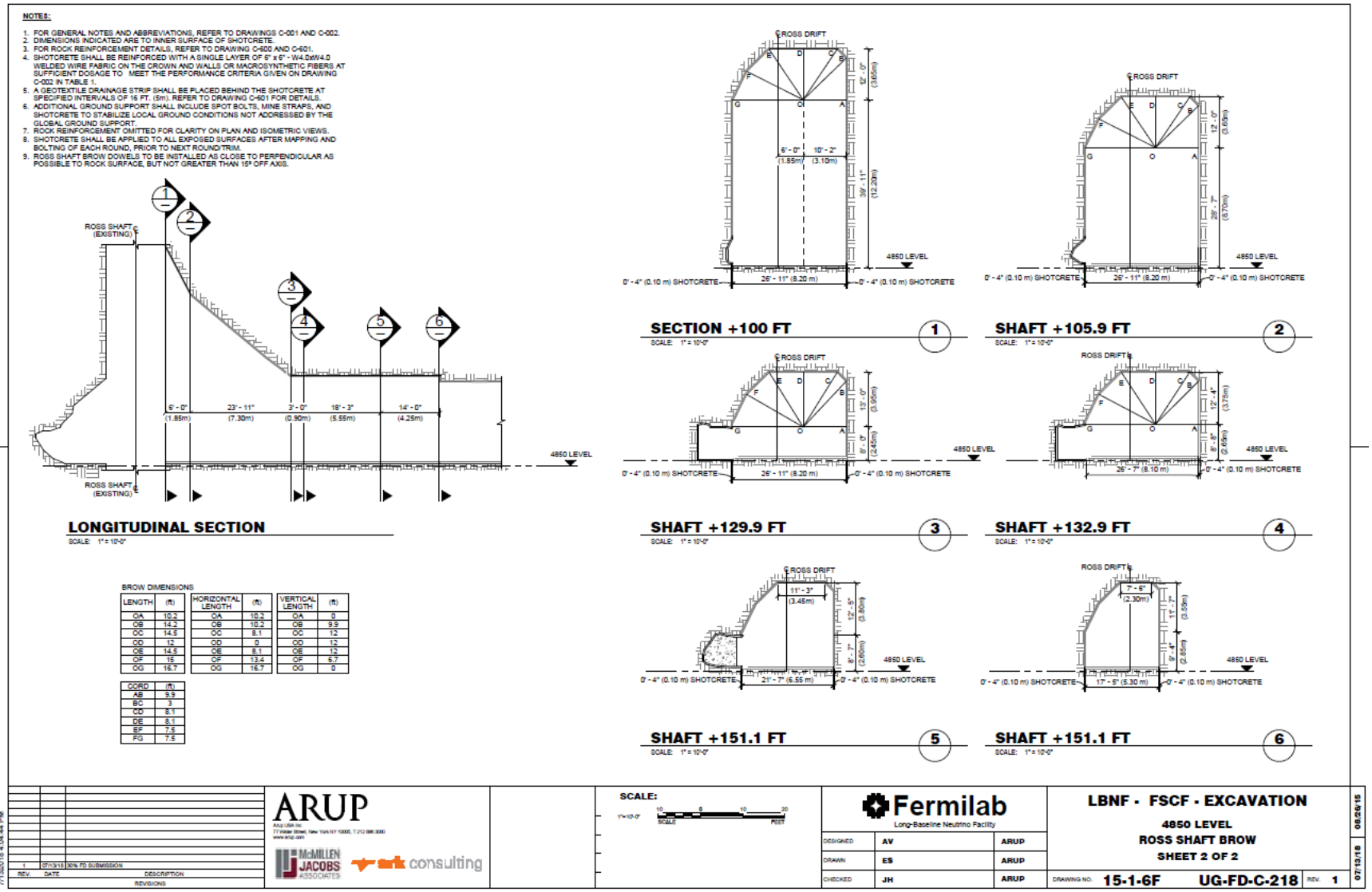

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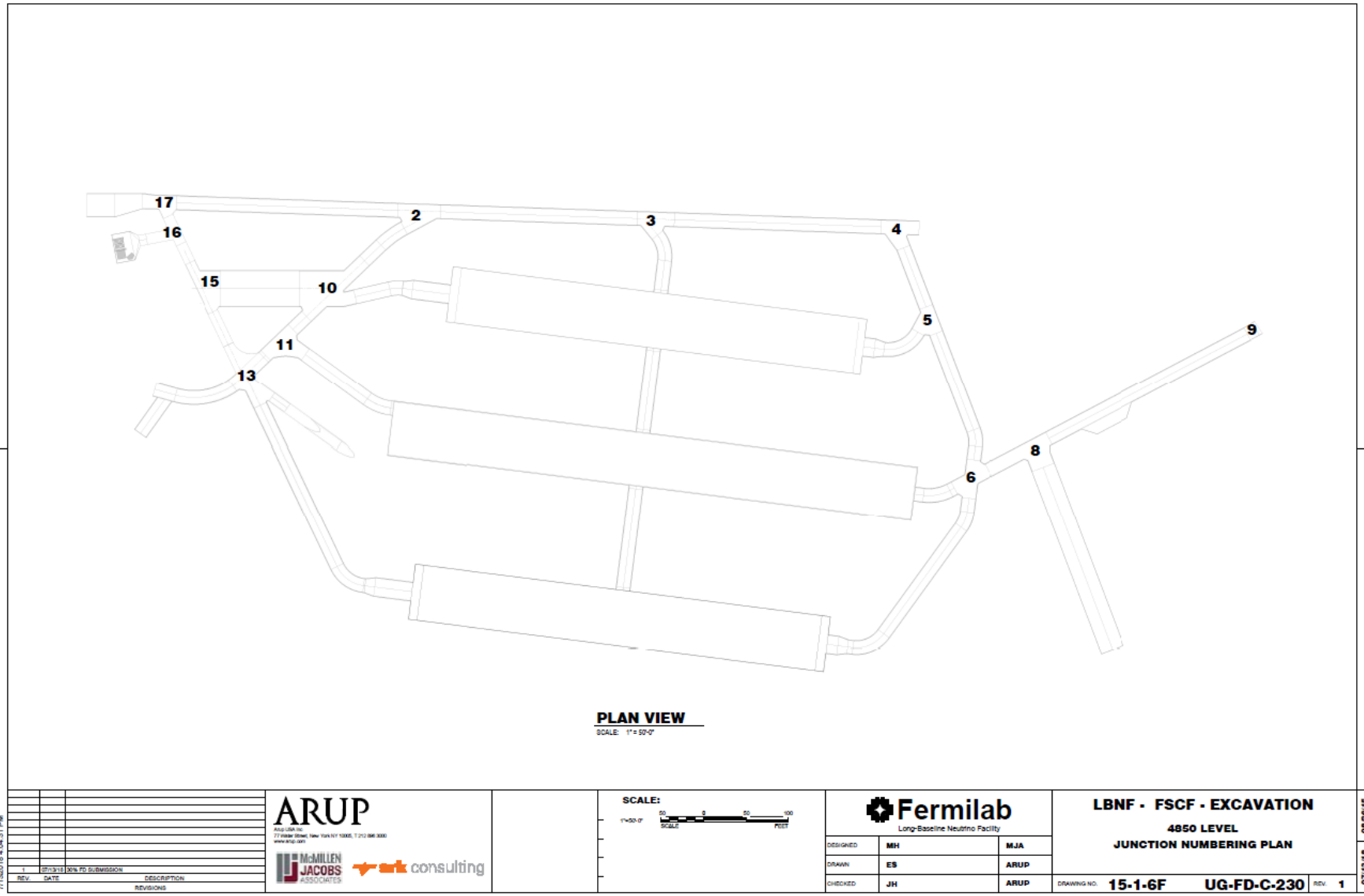
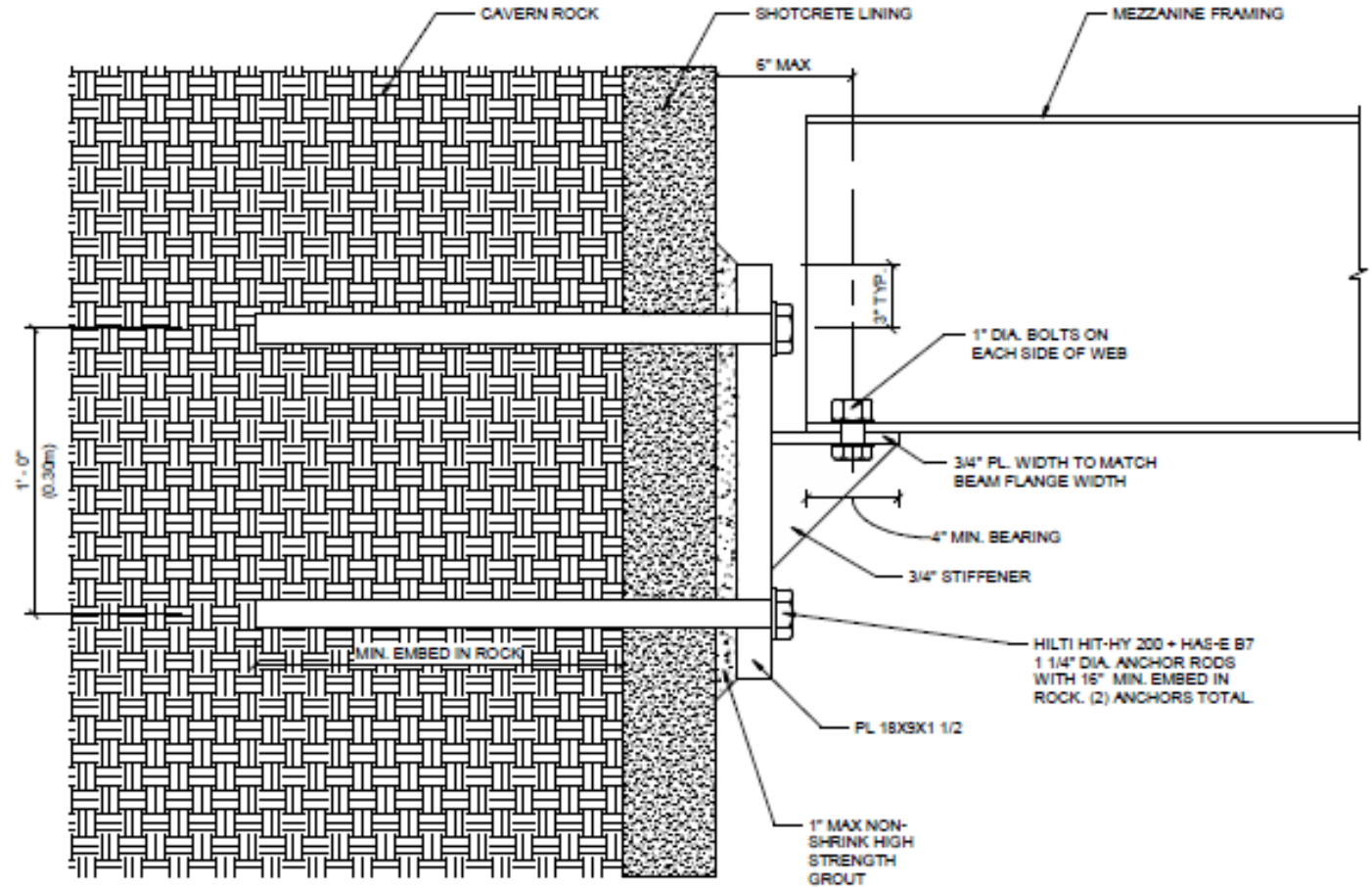


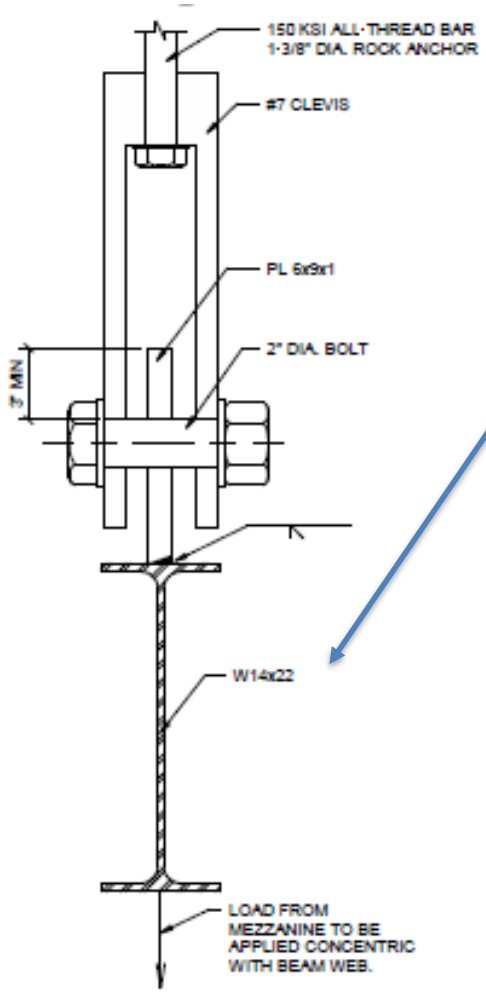
Arup 30% Final EXC Design



MEZZANINE SUPPORT CROSS SECTION 3

SCALE: 3" = 1'-0"

Arup 30% Final EXC Design



MEZZANINE HANGAR CROSS SECTION 4

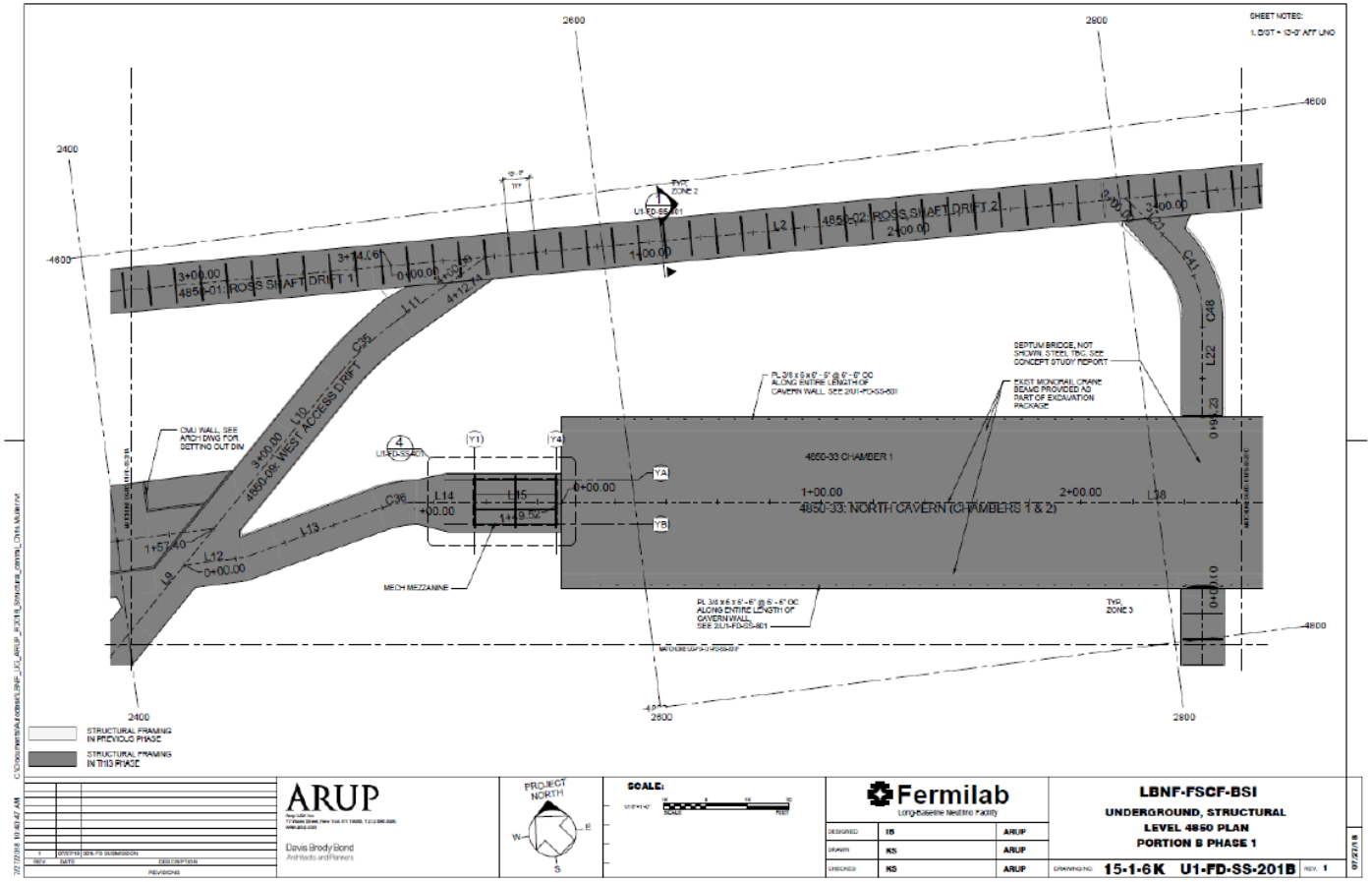
SCALE: 3" = 1'-0"

Arup added distribution beam to avoid single point failure issues, under re-evaluation.

Arup 30% Final BSI Design [DUNE-doc-9835]

Steel:

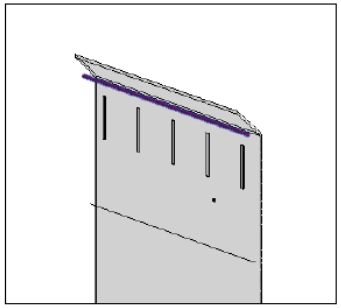
- New supports on Cavern Walls
- Rationalized Frame Geometry



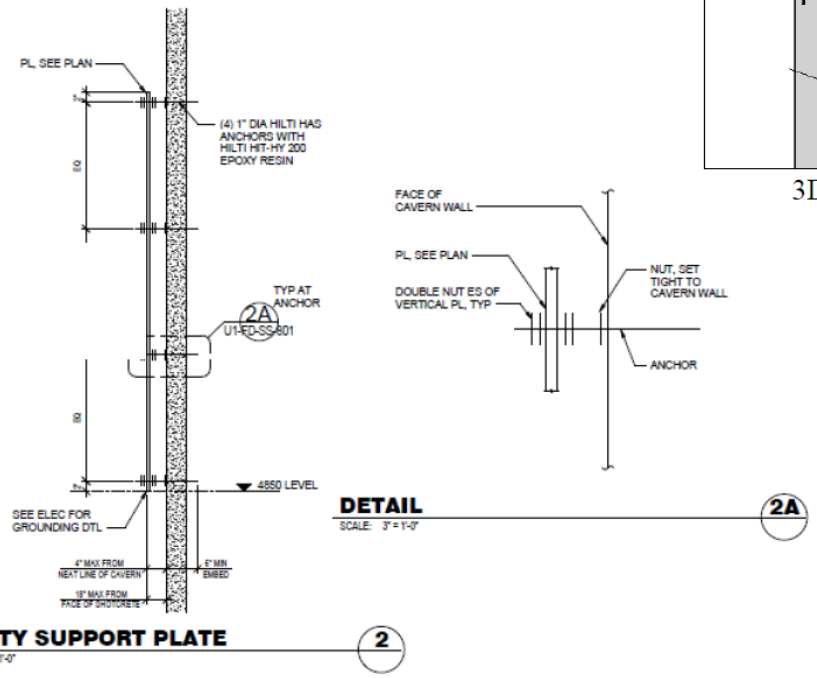
Arup 30% Final BSI Design

Experiment Cavern Utility Support:

- New supports on Cavern Walls 6’-6” OC (2m)
- Loading per frame:
  - 2800# Cryo Piping
  - 1100# Cable Tray



3D of Supports



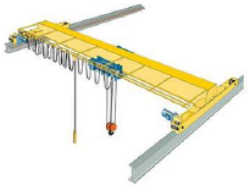
Arup 30% Final BSI Design

Septum Bridge (not in 30% but):

- Concept Study Ongoing
- Approx. Girder Depths – limited to 4ft including bridge deck due to crane constraints
- Rolled sections with splices likely to be most economic.
- If we can revisit hook clearance we can make more economic

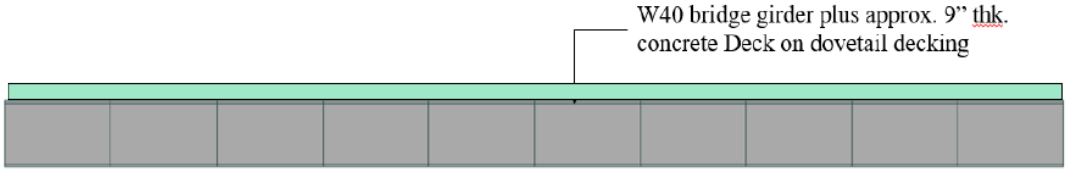
Top Running Crane

The bridge of a top running crane is designed to travel on rails that are mounted onto the runway beams. The beams can be supported by either precisely engineered free-standing columns or by the existing columns of the building.



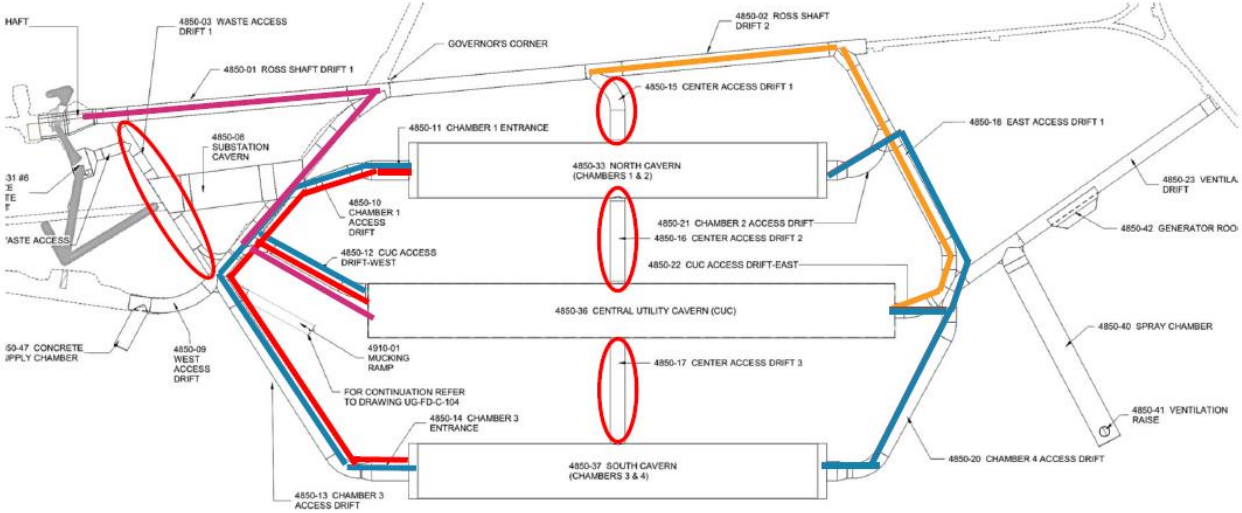
Under Running Crane

The bridge of an underhung crane is engineered to travel on the bottom flange of a runway beam. The roof structure of a building typically supports the runway beam in this type of configuration.



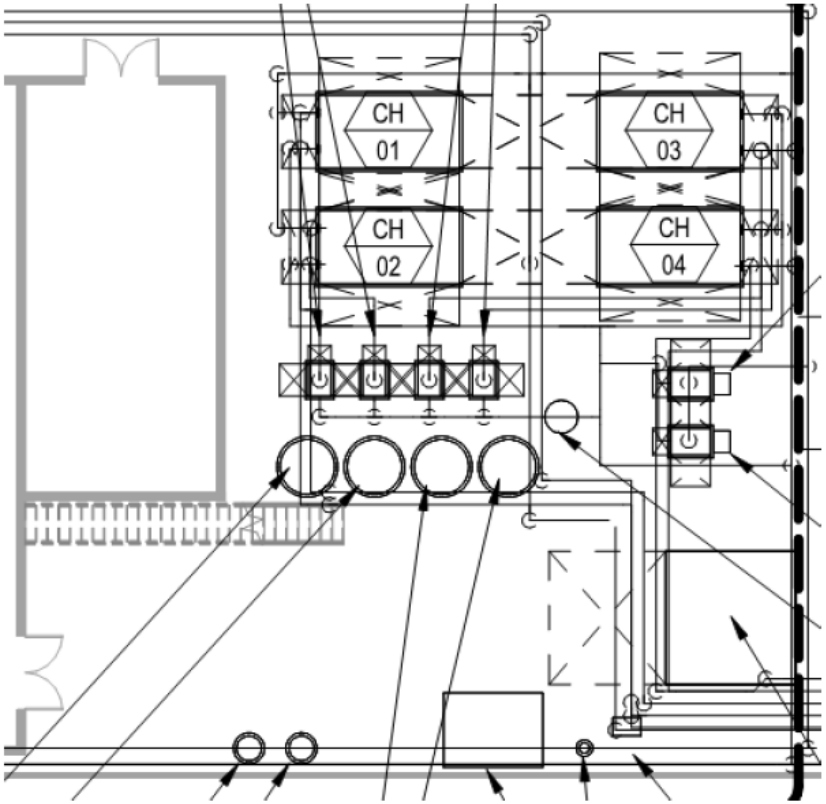
Arup 30% Final BSI Design

Rerouted Piping



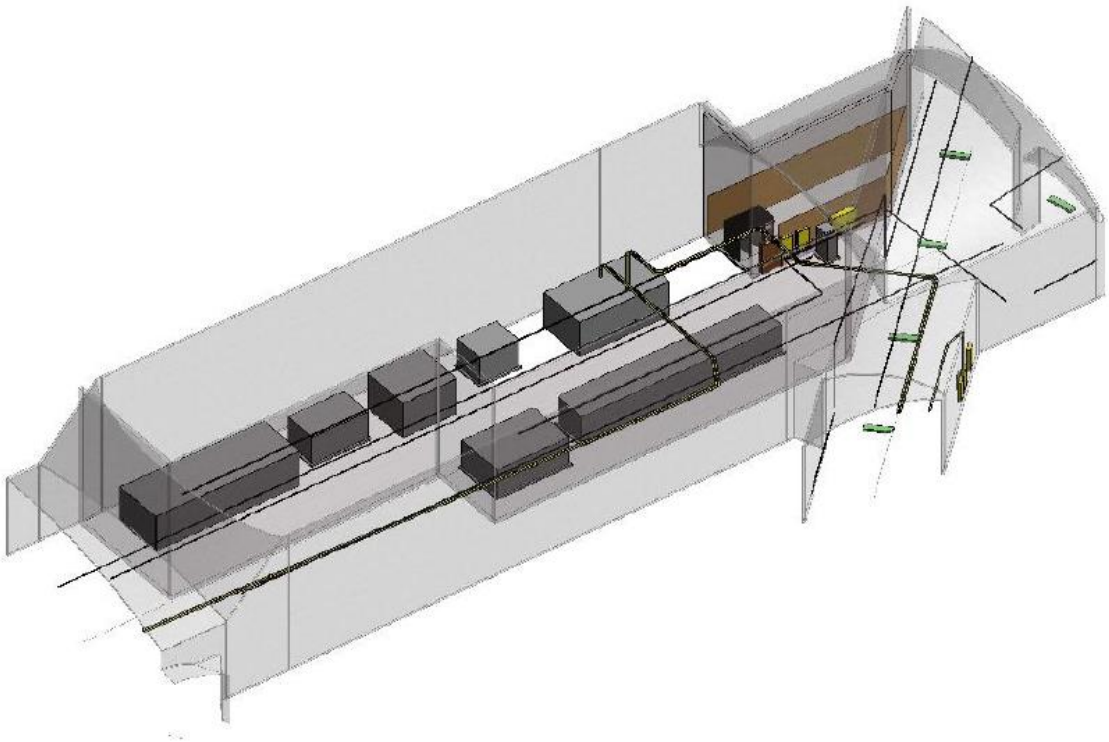
Arup 30% Final BSI Design

Additional Chiller



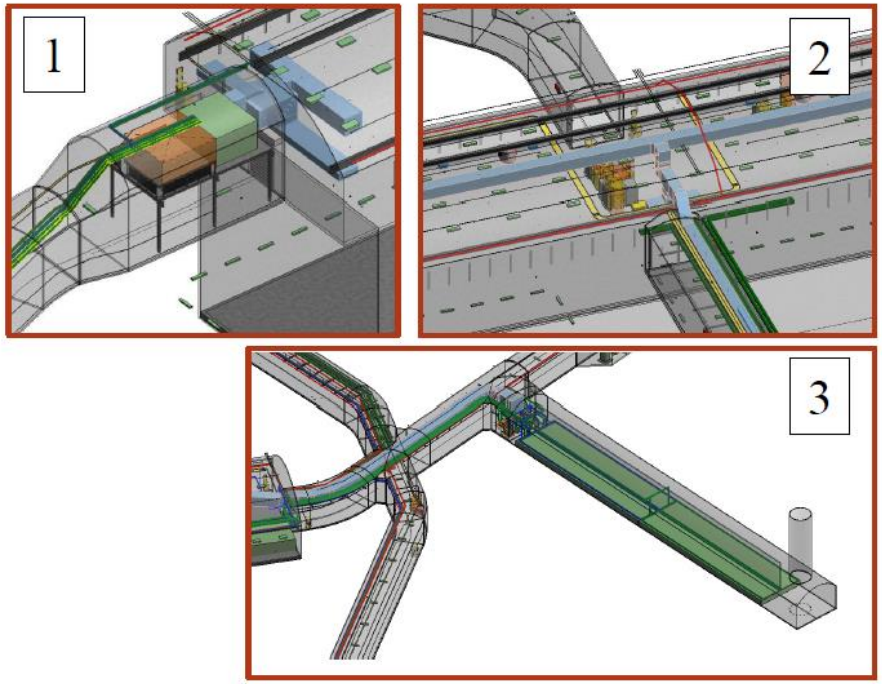
Arup 30% Final BSI Design

Substation Room 3D View



Arup 30% Final BSI Design

Coordination Challenges

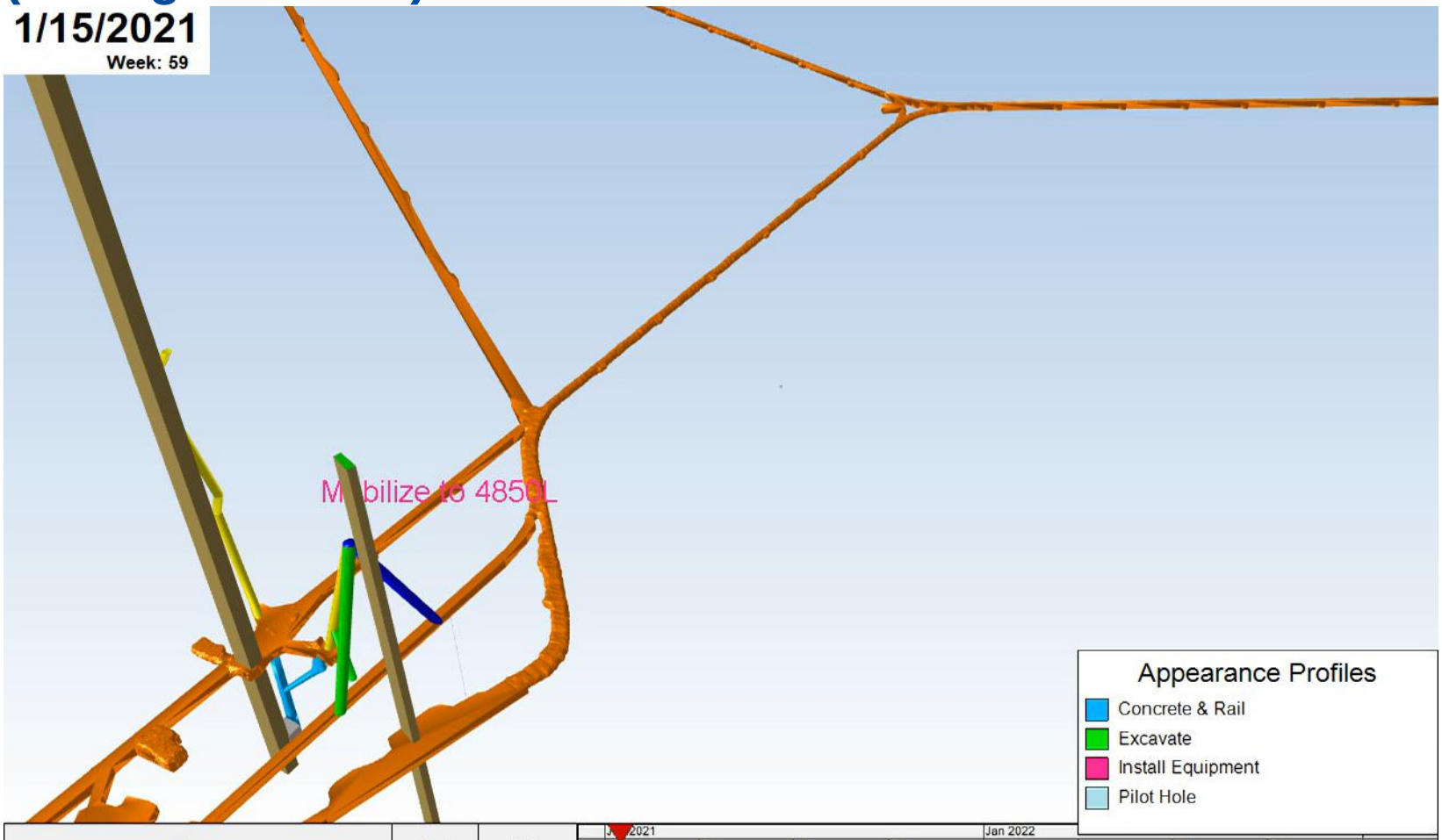


1. Space Constraints
2. Ductwork Clearances
3. Spray Chamber

Remaining Final Design Deliverables

- 60% EXC due October 5, 2018
- 60% BSI due October 19, 2018
- 60% comments due 3 weeks after delivery, Design is Frozen at this point
- 90% EXC due January 11, 2019
- 90% BSI due January 25, 2019
- 100% EXC & BSI due March 29, 2019 (Issued for Construction Procurement)

Preliminary Excavation Sequence prepared by KAJV (Disregard dates)



Name	Start	Finish
MOBILIZATION: Prep "Production" Equipment for Hoisting	12/15/2020	3/9/2021
Milestone: Option 1A Completion		1/15/2021 (*)
Milestone: Option 1B NTP for Construction	1/15/2021	
Mobilize to 4850 Level	1/15/2021	1/22/2021