BSI / EXC discussion and cavern handoff

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19-AUG-2019, SURF FS Installation Workshop

Minimum conditions from EXC

- Cavern excavated
- 3 crane rails and supports
- Concrete floor slab
- Adequate blast door protection from ongoing south cavern excavation (CMU wall is needed in 4910 alcove)

Minimum services to begin warm structure

- Temporary lighting
- Temporary ventilation
- Temporary power
- Compressed air
- Communications (WiFi)
- Access from 4850 to 4910 level
- These could be the same temporary services used by the CMGC for excavation. We need to understand what these will look like in reality.

Additional items

- Installation of the hoists (2 on each rail) along with power and controls
- Installation of bridge crane along with power and controls (would the CMGC benefit from the use of the crane for pouring the slab or other work?)
- Permanent stairs installed at mid cavern (these are currently planned for install during BSI)
- Alimak at west end of cavern from 4850 to 4910
- Is it possible to lower the steel for the floor of the cryostat in or under the cage compartment? Currently being investigated.

Const handof	ruction Cavern P ff NC (TO) for Con	reparation Cryosto struction Structu	at Warm Cryost re Install Membro	at Cold De Ine Install Inst	tector Cryog allation and Op	enic Fill erations
 FSCF completes EXC scope of work in NC and CUC North Cavern 	Preparatory work for WS construction• Crane• Temp power• Temp lighting• Permanent stairs• Temp access to 4910• Temp Ventilation	 Cryostat warm structure construction Cavern Bridge Permanent power to alcove Temp fire suppression in west half of cavern for cryostat material 	 Cryostat cold membrane installation JPO/SDSD completes permanent BSI on top of warm cryostat 	Detector installation	Prepare for operations	
South Cavern	 FSCF completes EXC scope of work in SC and begins BSI work 	 Preparatory work for WS construction Crane Temp power Temp lighting Perm stairs Access to 4910 Perm Ventilation FSCF completes BSI work 	Cryostat warm structure construction • FSCF completes BSI work (permanent)	Cryostat cold membrane installation • FSCF completes BSI work on top of warm cryostat	Detector installation	Prepare for operation
CUC	FSCF begins BSI work	 FSCF completes BSI work 	Cryogenics installation			
Surface and Logistics	 Surface infrastructure for rigging materials at Ross Shaft Infrastructure at 4850 needed for material removal from shaft 		• Surface cryoge nics building	• Shaft piping for N2 and Ar		

Final ventilation is needed before cold membrane installation to control humidity
 Fire suppression is needed in West end of cavern to being storing cold membrane materials

Underground facility



North cavern



North cavern looking east



North cavern looking west



Crane and electrical alcove



Ventilation



Ventilation

- It is assumed that the CMGC will have fans installed during the excavation in the east end of the cavern. We would like to utilize these during the cryostat construction
- Once the warm structure is nearing completion, we could duct directly to the manholes in the warm structure and pull the air through the cryostat to help the air movement

North cavern West side ventilation

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UNDERGROUND, MECHANICAL LEVEL 4850L DUCTWORK PLAN PORTION B

15-1-6K U1-FD-M-401B REV. 4



We need to have a side discussion on the sizing of the AHU and the chilled water being supplied to the caverns and the CUC DAQ room.



Note: When ducting that connected the above to the 4910 level was removed from FSCF scope, no funds for adding this to JPO/SDSD was added. This needs to be reviewed.

Electrical



Electrical details

- Lighting we expect there to be a minimal amount of lighting. This would be augmented with addition task lighting at the 4910 level for the construction and lighting in the west end of the cavern where material will be handled and stored. Permanent lighting at 4850 is primarily directed at 4850.
- Construction power It is unclear how much power will be needed for the CMGC work. At a minimum, the cryostat warm structure construction will need 200 A of 3 phase power available for 10 welders, additional single-phase circuits for task lighting and power tools, local ventilation and smoke eaters for the welding operations. Compressed air is also required to operate some of the tools in the construction process. An air compressor will be temporarily located at the 4910 level. The amount of air required will be evaluated and then we will size the compressor and power requirements for this. The total is estimated at 400 to 500 A. This power will come from a central point near the alcove in the mucking drift where the permanent power will be located. This will ease the transition from temporary power with the permanent power becomes available.
- Operation power The current design has the permanent power for the hoists and overhead crane being distributed from distribution panels located at the East end of the cavern at 4850. The temporary power to these items should also be distributed from the East end. This is also where we expect the exhaust fans for ventilation to be located and powered. The temporary fans should be located and powered from here to minimize the changeover to the permanent system.

North cavern West side electrical

UNDERGROUND, ELECTRICAL LEVEL 4850 UPPER POWER PLAN PORTION B

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North cavern 4910 electrical

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UNDERGROUND, ELECTRICAL ENLARGED PLANS SHEET 16 OF 18

15-1-6K U1-FD-E-716 REV. 2



North cavern electrical details West

- DP4-48DT-B (at 4850 W) and DP4-48DT-A (mucking drift 4910) panels
- It is preferred to have welding feeds originate from 4910 panel. Need to increase amperage of panel to 400 or 800 A. TBC (Could likely reduce amperage of 4850 W panel based on this)

	PANEL: DP4-48DT-B															
	LOC, SUPPLY MOU ENCLO	VOLTS: 480/277 Wye PHASE: 3 WIRE: 4							A.I.C. RATING: 35KA BUS RATING: 800 MAIN CB: 800							
скт	CIRCUIT DESCRIP	PTION	TRIP	POLES	/	4		в	c	•	POLES	TRIP	CIRCUIT DESCRIP	тіом скт		
1	AHU-01		125	3	18650 VA	3833 VA					3	20	WELDING OUTLET	2		
3							18650 VA	3833 VA						4		
5			-						18650 VA	3833 VA				6		
7	AHU-01 RECOIL HEAT		500	3	103911	3833 VA					3	20	WELDING OUTLET	8		
9							103911	3833 VA						10		
1									103911	3833 VA				12		
1	WELDING OUTLET		20	3	3833 VA	3833 VA					3	20	WELDING OUTLET	14		
1			-				3833 VA	3833 VA						16		
1									3833 VA	3833 VA				18		
1	WELDING OUTLET		20	3	3833 VA	0 VA					1	20	SPARE	20		
2			-				3833 VA	0 VA			1	20	SPARE	22		
23									3833 VA	0 VA	1	20	SPARE	24		
25	SPARE		20	1	0 VA	0 VA					1	20	SPARE	26		
27	SPARE		20	1			0 VA	0 VA			1	20	SPARE	28		
29	SPARE		20	1					0 VA	0 VA	1	20	SPARE	30		
31	SPARE		20	1	0 VA	0 VA					1	20	SPARE	32		
33	SPARE		20	1			0 VA	0 VA			1	20	SPARE	34		
35	SPARE		20	1					0 VA	0 VA	1	20	SPARE			
37	SPARE		20	1	0 VA	0 VA					1	20	SPARE	38		
39	SPARE		20	1			0 VA	0 VA			1	1 20 SPARE				
41	SPARE 20 1 0 VA 0									0 VA	1	20	SPARE	42		
	TOTAL LOAD: 138371 VA 138371 VA 138371 VA										-					
			TOTAL	L AMPS:	5	00	5	00	50	00						
NOT	ES:															

	PANEL: D)P4-4	8DT-	A													
	Location: M Supply From: S Mounting: S Enclosure: T	UCKING R NBD4-48C JRFACE (PE 3R	amp (49 C-a	10L) VOLTS: 480/277 Wye PHASE: 3 WRE: 4							ALC. RATING: 35kA BUS RATING: 125 MAIN CB: 100						
CKT		TDID									TRID		CKT				
1	LIQUID ARGON PLIMP 1	15	3	1733 VA	1733 VA		,		<u> </u>	3	15	LIQUID ARGON PLIMP 5	2				
3		-	-	1100 111	1100 111	1733 VA	1733 VA			_			4				
5		-				1100 111		1733 VA	1733 VA	-			6				
7	LIQUID ARGON PUMP 2	15	3	1733 VA	1733 VA					3	15	LIQUID ARGON PUMP 6	8				
9	-	-	-			1733 VA	1733 VA			-		-	10				
11								1733 VA	1733 VA			-	12				
13	LIQUID ARGON PUMP 3	15	3	1733 VA	1733 VA					3	15	LIQUID ARGON PUMP 7	14				
15						1733 VA	1733 VA						16				
17		-	-					1733 VA	1733 VA	-			18				
19	LIQUID ARGON PUMP 4	15	3	1733 VA	1733 VA					3	15	LIQUID ARGON PUMP 8	20				
21		-	-			1733 VA	1733 VA						22				
23		-						1733 VA	1733 VA			-	24				
25	SPARE	20	1	0 VA	0 VA					1	20	SPARE	26				
27	SPARE	20	1			0 VA	0 VA			1	20	SPARE	28				
29	SPARE	20	1					0 VA	0 VA	1	20	SPARE	30				
31	SPARE	20	1	0 VA	0 VA					1	20	SPARE	32				
33	SPARE	20	1			0 VA	0 VA			1	20	SPARE	34				
35	SPARE	20	1					0 VA	0 VA	1	20	SPARE	36				
37	SPARE	20	1	0 VA	0 VA					1	20	SPARE	38				
39	SPARE	20	1			0 VA	0 VA			1	20	SPARE	40				
41	SPARE	20	1					0 VA	0 VA	1	20	SPARE	42				
		TOTAL	LOAD:	1386	i4 VA	1386	4 VA	1386	4 VA								
		TOTAL	AMPS:	5	i0	5	0	5	0								
NOT	ES:												1				



REFERENCE NOTES

INTEGRATED POWER SYSTEM (IPS) WITH 480Y/277V PANEL FOR DRIFT LIGHTING, STEPDOWN TRANSFORMER AND 208Y/120V PANEL FOR GENERAL PURPOSE EQUIPMENT - 42"W X 24"D X 92"H. FURNISH AND INSTALL 20A, 125V, WEATHERPROOF, GFCI RECEPTACLE WITH "WHILE IN USE" COVER ADJACENT TO IPS FOR CONVENIENCE POWER USE.

North cavern East side electrical

2 NOT USED.

3 SECURITY ACCESS CONTROL PANEL

4 POWER FOR TELECOM ENCLOSURE.

5 POWER FOR FIRE ALARM ASDP.

6 POWER FOR BMS PANEL AND BTU ENERGY METER.

7 POWER FOR 2-WAY PAGE SYSTEM COMMUNICATOR.

 CONFIRM FINAL JUNCTION BOX LOCATION WITH FRA CONSTRUCTION COORDINATOR PRIOR TO CONSTRUCTION.

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UNDERGROUND, ELECTRICAL LEVEL 4850 UPPER POWER PLAN

North cavern electrical details West

- DP4-48DT-C (at 4850 E) (Note: Could likely reduce amperage of panel due to moving welding outlets to 4910 power panel)
- Need to investigate power required for hoists and crane.

PANEL: D	P4-4	8DT	-C									Γ		PANEL: PF	P-48DT-A											
LOCATION: CHAMBER 2 ENTRANCE VOLTS: 480/277 Wye AL.C. RATING: 35KA SUPPLY FROM: SWBD4-48CC-A PHASE: 3 BUS RATING: 400 MOUNTING: SURFACE WIRE: 4 MAIN CB: 400 ENCLOSURE: TYPE 3R				-		LOCATION: MUCKING RAMP (4910L) VOLTS: 1 SUPPLY FROM: TX-CE-A PHASE: 3 MOUNTING: SURFACE WIRE: 4 ENCLOSURE: TYPE 3R						120/208 W 3 4	205 Wye A.I.C. RATING: 225A BUS RATING: 225 MAIN CB: 225													
	TRIP	POLES		A		В		c	POLES	TRIP	CIRCUIT DESCR PTION O	ľ														
1 WELDING OUTLET	20	3	3833 VA	3833 VA	2022 \/A	2022 \/A			3	20	WELDING OUTLET	2	KT	CIRCUIT DESCRIPTION	TRIP	POLES		A	1	8	(5	POLES	TRIP	CIRCUIT DESCRIPTION	CKT
5		-			3033 VA	3033 VA	3833 VA	3833 VA		-			1	SP-01	20	1	0 VA	0 VA					1	20	SP-02	2
7 WELDING OUTLET	20	3	3833 VA	3833 VA			0000 111		3	20	WELDING OUTLET	L	3	-		-			0 VA	OVA			-	-	-	4
9					3833 VA	3833 VA						ī 📑	5	-		-					0 VA	0 VA	-	-		6
11 -							3833 VA	3833 VA	-		-		7	SP-03	20	1	0 VA	0 VA					1	20	SP-04	8
13 WELDING OLITLET	20	3	3833 VA	3833 VA					3	20	WELDING OUTLET	14	9	-		-			O VA	OVA				-	-	10
15					3833 VA	3833 VA			-	-	-	1 1	11	-		-					O'VA	0 VA		-	-	12
			40.405.144	470701/4			3833 VA	3833 VA					13	SP-05	20	1	O VA	0 VA					1	20	SP-06	14
19 MONORAIL CRANE POWER	/0	3	18435 VA	1/2/2 VA	10425 \/A	17070 \/A			3	/0	MONORAIL CRANE POWER		15	SP-07	20	1			AV 0	OVA			1	20	SP-08	16
21		-			10430 VA	11212 VA	18/35 \/A	17272 \/A		-	-		17	FOR GEOTECH INSTRUMENTATION	20	1					600 VA	720 VA	1	20	NORTH LOW, CAVERN CONV. REC.	18
25 MONORAIL CRANE POWER	100	3	27071 VA	0 VA			10400 171	11212 11	1	20	SPARE		19	8MS PANEL	20	1	500 VA	1080 VA					1	20	CONV. RECEPTACLES	20
27		-			27071 VA	0 VA			1	20	SPARE	2	21	CONV. RECEPTACLES	20	1			1080 VA	1080 VA			1	20	CONV. RECEPTACLES	22
29							27071 VA	0 VA	1	20	SPARE	31 1	23	SPARE	20	1					0 VA	0 VA	1	20	SPARE	24
31 SPARE	20	1	0 VA	0 VA					1	20	SPARE	3: [25	SPARE	20	1	0 VA	0 VA					1	20	SPARE	26
33 SPARE	20	1			0 VA	0 VA			1	20	SPARE	3 1	27	SPARE	20	1			0 VA	0 VA			1	20	SPARE	28
35 SPARE	20	1					0 VA	0 VA	1	20	SPARE	3 1	29	SPARE	20	1					0 VA	0 VA	1	20	SPARE	30
37 SPARE	20	1	0 VA	0 VA	_				1	20	SPARE	3 1	31	SPARE	20	1	0 VA	OVA					1	20	SPARE	32
39 SPARE	20	1			0 VA	0 VA			1	20	SPARE	4 3	33	SPARE	20	1			0 VA	OVA			1	20	SPARE	34
41 SPARE	20	1	0007		0.57	76.14	0 VA	0 VA	1	20	SPARE	1	35	SPARE	20	1					0 VA	0 VA	1	20	SPARE	38
		L LOAD:	857	10 VA	857	70 VA	85//	10 VA	-			1	37 SPARE				0 VA	0 VA					1	20	SPARE	38
NOTES	IUIA	L AIMPS.	· °	10	• ۱	510	3	10	I			- 3	30 SPARE			1			0 VA	OVA			1	20	SPARE	40
												E	41	SPARE	20	1					0 VA	OVA	1	20	RPARE	42
												F	TOTAL LOAD: 150						214	1 VA	1320.1/4					
													TOTAL AMPS: 14						18 15				1			
													NOTES: 14													
												1														

North cavern West side cyberinfrastructure

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UNDERGROUND, CYBERINFRASTRUCTURE

LEVEL 4850L PLAN

PORTION B

VING NO. 15-1-6K U1-FD-T-401B REV. 4



North cavern East side cyberinfrastructure



Electrical with cryostat floor members



Cryostat full floor



Complete cryostat warm structure



Addition of the N/S bridge



Addition of cryogenics mezzanine structure



Addition of the detector mezzanine



Current layout of cryostat mezzanine with barracks and cryogenic support structures



Additional questions

- Do we want to outfit the west end of the cavern?
 - Mezzanine supports
 - Pipe and cable tray supports on the wall
 - Slab design locks in the position of the cryostat beams



North cavern West side structural

LBNF-FSCF-BSI UNDERGROUND, STRUCTURAL

LEVEL 4850 CEILING PLAN



Seal concrete and shotcrete surfaces



Working document



Shared BSI/EXC Scope Shift for LBNF

Abstract

Implement a change of possession to allow for cryostat installation to begin at the earliest possible time after completion of Excavation (EXC) work in the north cavern.

Highest level schedule protected by the EFIG (proposal in P6)



BSI activities proposal

	1			12 1		12 1		12
Cavern CUC Handover to FNAL	x T0							
Cavern N Handover to FNAL	х то							
Cavern S Handover to FNAL		X T0+	5m					
131 04-4 1 2 CUC cavern Infrastructure Outfitting								
permanent power								
permanent ventilation								
final lighting								
safety systems (fire, ODH,)								
infrastructure (cable trays, supports,)							 	
121 04 4 1 3 N-Cavorn Infrastructure Outfitting								
151.04-4.1.5 N-Cavern innastructure Outlitting								
temporary power								
temporary ventilation								
temporary lighting								
temporary access to 4910 west								
Install main crane + hoists								
permanent stairs to 4910 center								
Install survey network								
permanent power								
permanent ventilation								
permanent lighting								
safety systems (fire, ODH,)								
131.04-4.1.4 S-Cavern Infrastructure Outfitting								
temporary lighting								
temporary access to 4910 west								
Install main crane + hoists								
permanent stairs to 4910 center								
Install survey network								
permanent power								
permanent ventilation								
permanent lighting								
safety systems (fire, ODH,)								

Cryostats activities (1/2)

	1				12	1			12	1			12
							_						
Cavern N Ready for Cryostat installation		X	T0+	·3m	 	_	_				 		
Cavern S Ready for Cryostat installation							X	T0+15m			 		
131.04-4.1.5 Cryostat #1 Installation Preparation													
prepare material storage													
prepare mechanical workshop in cavern													
lower floor beams													
131.04-4.1.6 Warm Cryostat #1													
							_				 		
continue lowering Floor material first							_				 		
install floor structure						_	_				 		
level floor, grout underneath beams, install plates						_	_				 		
assembly of the remaining walls & top											 		
final plates welding and leak tests											 		
start lowering insulation material + tools							_				 		
install bridge											 		
install mezanines											 		
131.04-4.1.7 Cold Cryostat #1													
continue lowering, floor insulation first					_	_				_	 	_	_
install insulation and cryo barriers													
leaks tests													
cleaning										\square			
cryostat top material installation													
cryostat top cabling													
internal DSS													
internal cryogenics start installation													
install internal remporary floor													
131.04-4.1.8 Detector 1 clean room prep													
metallic structure installation													
position cold boxes													
prepare clean room													
lower N2 to start cold boxes													

Cryostats activities (2/2)

19.08.19

131.04-4.1.9 Cryostat #2 Installation Preparation	
· · · · · · · · · · · · · · · · · · ·	
prepare material storage	
prepare mechanical workshop in cavern	
lower floor beams	
121 04 4 1 10 Warm Crucetat #1	
151.04-4.1.10 Wallin Cryostat #1	
continue lowering floor material first	
install floor structure	
level floor, grout underneath beams, install plates	
assembly of the remaining walls & top	
final plates welding and leak tests	
start lowering insulation material + tools	
install mezanines	
131.04-4.1.11 Cold Cryostat #2	
continue lowering, floor insulation first	
install insulation and cryo barriers	
leaks tests	
cleaning	
cryostat top material installation	
cryostat top cabling	
internal cryogenics start installation	
internal DSS	
install internal temporary floor	
131 04-4 1 12 Detector 2 clean room pren	
151.04-4.1.12 Detector 2 clean room prep	
metallic structure installation	
move cold boxes to det 2	
prepare clean room	
lower N2 to start cold boxes	