

LBNF / DUNE Update

Community Advisory Board Elaine McCluskey, LBNF Project Manager 25 July 2019









Overview of LBNF / DUNE project elements



"The LBNF/DUNE project will be the first internationally conceived, constructed, and operated mega-science project hosted by the Department of Energy in the United States" - DOE SC-2

Overview – "Far Site" – LBNF / DUNE at Sanford Lab, Lead, SD

Conventional Facilities:

- Surface and shaft Infrastructure including utilities
- Drifts and two caverns for detectors
- Central utility cavern for conventional and cryogenic equipment
- Cryostats:
 - Four membrane cryostats supported by external steel frames

Cryogenic Systems:

- LN2 refrigeration system for cooling and re-condensing gaseous Argon
- Systems for purification and recirculation of LAr
- Argon:
 - 70kt LAr
- DUNE Detectors
 - Four LAr TPC detectors





Construction at Far Site



EXCAVATION AND BUILDING/SITE INFRASTRUCTURE

- Final design completed in May 2019.
- Working to issue request for proposals for excavation in fall 2019.

PRE-EXCAVATION

- Construct the systems to transport ~800,000 tons of rock from underground blast area to "Open Cut" in downtown Lead, SD.
- All work is fully under contract and started early 2019.
- Planned completion of this phase of work is November 2020.





The Team in South Dakota

- Kiewit/Alberici Joint Venture Construction Manager/General Contractor
- Arup Architect/Engineer Design
- Fermilab LBNF Team + CERN Team



ARUP

		Global Tunnelling Proj	ect of ti	he Year	(over \$	500M)							
	global-tunnelling-project-of-the-year-over-500m_400.png													
	Winner: Vegas Tunnel Contractors - Arup, Lake Mead Intake No. 3 Shaft and Tunnel													
ENR THE TOP 400 CONTRACTORS THE TOP 400 List														
201	RANK 8 2017	FIRM	2017 REVE	NUE (\$ MIL)	2017 NEW CONTRACTS	GENERAL	MANUFACTUR	POWER	Water Ser	NDUS. / PETE	TRANSPORT	HaZaRDOUS	TELECOM	% CM-AT-HISK
	1	BECHTEL, San Francisco, Calif. [†]	18.267.0	10.018.0	7.198.0	0	0	11	1	54	26	5	1	32
	2 2	FLUOR CORP., Irving, Texas [†]	15,777.6	7,384.9	12,566.0	7	3	16	0	56	6	10	1	19
	3 3	THE TURNER CORP., New York, N.Y.	11,766.1	620.4	15,385.9	83	1	0	0	3	5	0	7	100
	1 5	AECOM, Los Angeles, Calif. [†]	10,574.3	1,196.7	7,412.6	64	1	9	2	9	11	0	2	74
	5 6	KIEWIT CORP., Omaha, Neb.†	7,988.0	1,048.5	11,001.3	9	1	20	9	27	33	0	0	9
	6 7	SKANSKA, New York, N.Y. [†]	7,254.1	39.2	7,567.3	45	8	3	1	7	33	0	1	51
36	38	CLAYCO INC., Chicago, III. [†]	2,021.8	0.0	2,200.0	50	12	0	0	0	0	0	0	0
37	34	ALBERIGI-FLINICO, St. Louis, Mo.	1,984.4	554.5	2,395.4	47	8	5	10	28	3	0	0	50
38	30	THE VATES COS INC. Deliadalabia Mica	1,935.0	93.1	2,220.0	2	0	24	/	50	14	0	2	0
40	41	BLACK & VEATCH, Overland Park, Kan. [†]	1,775.3	452.6	143.1	0	44 0	61	11	5	0	0	22	15

Fermilab at Sanford Underground Research Facility (SURF)

- Fermilab operations at SURF continue to mature. In June 2018, Fermilab created the South Dakota Services Division (SDSD). New personnel are being stationed at SURF to support LBNF/DUNE activities and closely coordinate work with the South Dakota Science & Technology Authority (owner of the site).
- SURF, at direction of DOE, submitted a proposal to enter into "Cooperative Agreement" to fund future operations starting FY20. Represents significant commitment by DOE and will provide robust operational platform for LBNF/DUNE construction and DUNE operations.



Overview - "Near Site" – LBNF / DUNE at Fermilab, Batavia, IL



- Primary proton beam @ 60-120GeV extracted from Main Injector
- Initial 1.2 MW beam power, upgradable to 2.4 MW
- Embankment allows target complex to be at grade and neutrino beam to be aimed to SURF
- Decay region followed by absorber
- Four surface support buildings
- Near Detector facility
- DUNE Near Detector

Integration of Beamline & Conventional Facilities



Beamline Preliminary design underway

International partners working with us today on Beamline include UK for targets and India for magnets

Near Site Conventional Facilities efforts are ramping up

- Planning early "Site Preparation" contract to clear site of conflicting utilities and other existing features
- Construction proposals to be received in August
- Construction planned for to start at end of CY2019



Site Preparation



10 07.25.19 E McCluskey I LBNF Status

Cooling Tower Model

The DUNE Collaboration

As of today: 60 % non-US 1108 collaborators from 183 institutions in 32 nations

Armenia, Brazil, Canada, CERN, Chile, China, Colombia, Czech Republic, Finland, France, Georgia, Greece, India, Iran, Italy, Japan, Madagascar, Mexico, Netherlands, Paraguay, Peru, Poland, Portugal, Romania, Russia, South Korea, Spain, Sweden, Switzerland, Turkey, UK, Ukraine, USA





ProtoDUNEs at CERN

Dual-phase technology prototype (filling on next slide)





Dual-phase ProtoDUNE detector – filling cryostat with LAr

Filling cryostat with liquid argon this month



Video courtesy of Dominique Duchesneau

Near-term Milestones

- The project has enjoyed very strong support from Congress, DOE, and international partners.
- Project plans to baseline the full scope (DOE "Critical Decision 2") in the next year.
- This will provide full demonstration of the U.S. commitment to the project and assure DOE funding continues at high levels to enable project to proceed apace.
- Construction will be underway at both sites in the next six months!

Questions?



DUNE Science Objectives

Neutrinos – most ubiquitous matter particle in the universe, yet the least understood. Opportunities for game changing physics discoveries:



Origin of matter

Investigate leptonic CP violation, mass hierarchy, and precision oscillation physics

Discover what happened after the big bang: Are neutrinos the reason the universe is made of matter?



Neutron Star and Black hole formation

Ability to observe supernovae events

Use neutrinos to look into the cosmos and watch the formation of neutron stars and black holes in real time



Unification of forces

Investigate nucleon decay targeting SUSY-favored modes

Move closer to realizing Einstein's dream of a unified theory of matter and energy