

Far Detector Laboratories in the NuMI Beam

LBNE Reconfiguration Workshop

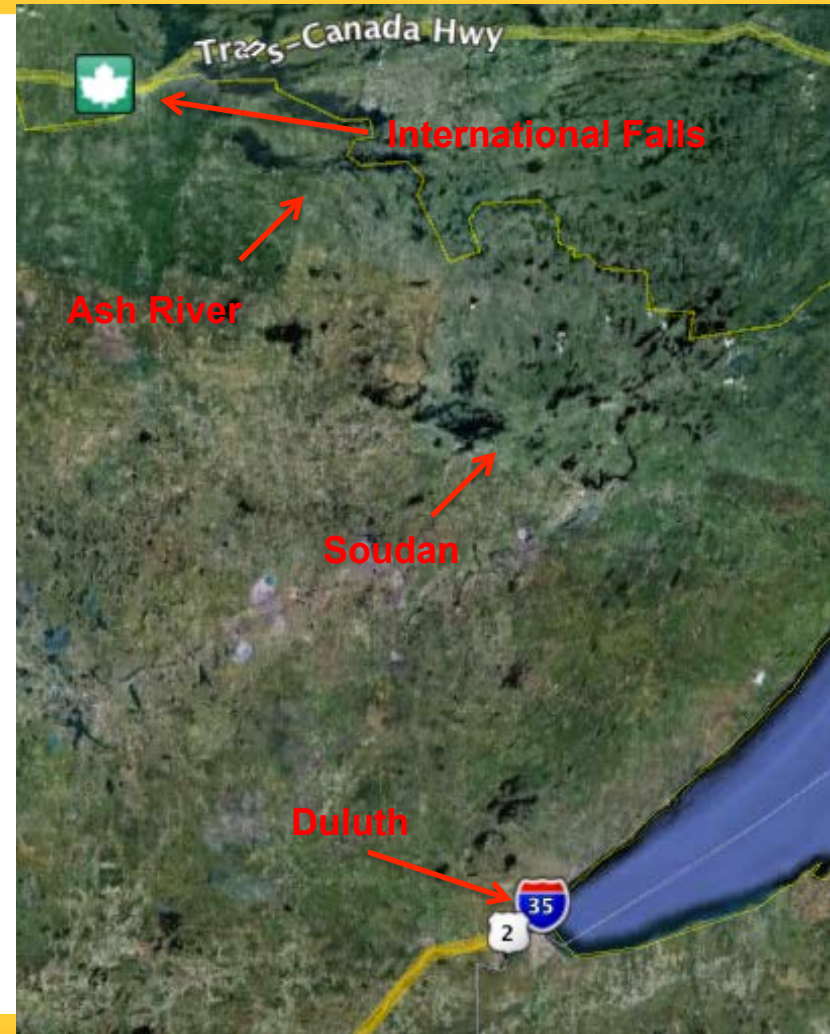
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April 25, 2012

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The NuMI Laboratories

- The NuMI Laboratories are **three** large detector cavities in the NuMI Beam.
- The Soudan 2/LBCF Hall and the MINOS Hall are located 710 m underground in Soudan MN.
- The NOvA Ash River Laboratory is located on the surface ~60 km ESE of International Falls MN



Underground Labs at Soudan



Soudan 2/LBCF Laboratory



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MINOS Laboratory



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NOvA Ash River Laboratory



<http://home.fnal.gov/~tesarek/nova/AshRiverCameras.html>

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The NuMI Laboratories

	Soudan 2/LBCF	MINOS	NOvA Ash River
Depth	710 m	710 m	3 m
Length	74 m	92 m	108 m
Width	13.3 m	13.3 m	20.4 m
Height	10.7 m	13.8 m	21.6 m
Floor Area	985 m ²	1230 m ²	2200 m ²
Volume	10,500 m ³	16,950 m ³	47,590 m ³
Cavity Cost (FY10)	\$3.6 M	\$9.3 M	\$25.8 M
Total Cost (FY10)	\$8.4 M	\$20.1 M	\$41.5 M

The NuMI Laboratories

- The NuMI Laboratories in total include 27,450 m³ of underground volume for detectors and 47,590 m³ of surface volume for detectors.
- The Ash River Laboratory also has a 1,140 m² service area.
- The total cost (excavation, outfitting, EDIA, etc.) of the NuMI Laboratories (FY10 dollars) is \$70 million.
- For context, SURF is enlarging the Davis Laboratory (2,550 m³) and constructing a Davis Transition Area (3,470 m³). Total near future experimental space at SURF is 6,020 m³.

NuMI Laboratories—Operations

- At Soudan, University staff members operate the lab and the experiments (MINOS, CDMS and several low background detectors) and State Park staff operate the mine, the site and the interpretative program.
 - Soudan Lab Staff (6.25)
 - Lab Manager
 - Assistant Manager
 - Computer/Telecom Technician
 - Senior Technicians (3)
 - Administrator (25%)
 - State Park Staff (10):
 - Manager
 - Assistant Manager
 - Lead Maintenance
 - Maintenance/Hoist (4)
 - Electrician (2)
 - Administrator
 - Interpretative Staff

Soudan Laboratory—Operations

WBS	Description	FY07		FY08		FY09		FY10		FY11	
		Actual	SOW	Actual	SOW	Actual	SOW	Actual	SOW	Actual	SOW
4.1.1	Mine Crew Labor	\$ 843,543	\$ 894,071	\$ 798,282	\$ 858,120	\$ 626,609	\$ 651,495	\$ 578,198	\$ 608,715	\$ 460,828	\$ 471,638
4.1.2	DNR Lease	\$ 335,172	\$ 350,465	\$ 283,119	\$ 247,622	\$ 202,177	\$ 249,044	\$ 186,996	\$ 253,426	\$ 213,279	\$ 253,426
4.1.3.1	Phones	\$ 36,115	\$ 48,097	\$ 18,523	\$ 42,695	\$ 17,516	\$ 17,853	\$ 13,032	\$ 17,464	\$ 24,356	\$ 17,464
4.1.3.2	Vehicles	\$ 4,275	\$ 8,442	\$ 3,198	\$ 4,921	\$ 2,145	\$ 3,772	\$ 1,902	\$ 3,772	\$ 2,824	\$ 3,772
4.1.3.3	Surface Building	\$ 51,537	\$ 66,243	\$ 57,208	\$ 56,332	\$ 56,029	\$ 56,726	\$ 50,561	\$ 56,934	\$ 49,435	\$ 56,934
4.1.3.4	HVAC	\$ 38,952	\$ 39,700	\$ 33,091	\$ 41,550	\$ 32,430	\$ 34,271	\$ 30,496	\$ 36,645	\$ 31,432	\$ 36,645
4.1.3.5	Computer Supplies	\$ 18,428	\$ 17,328	\$ 13,488	\$ 11,675	\$ 7,414	\$ 14,112	\$ 7,255	\$ 14,112	\$ 2,510	\$ 14,112
4.1.3.6	Lab Supplies/Maintenance	\$ 42,992	\$ 44,276	\$ 25,083	\$ 24,992	\$ 21,321	\$ 27,779	\$ 19,383	\$ 25,187	\$ 14,771	\$ 25,187
4.1.3.7	Safety	\$ 26,841	\$ 19,026	\$ 16,052	\$ 20,494	\$ 26,367	\$ 23,742	\$ 7,745	\$ 18,482	\$ 8,852	\$ 18,482
4.1.3.8	CDMS Cleanroom	\$ 5,894	\$ 9,450	\$ 7,046	\$ 7,745	\$ 6,565	\$ 7,347	\$ 251	\$ 7,347	\$ 631	\$ 7,347
4.1.3.9	Travel	\$ 12,700	\$ 18,270	\$ 13,771	\$ 13,694	\$ 20,929	\$ 13,730	\$ 13,334	\$ 12,135	\$ 10,363	\$ 12,135
4.1.3.10	Shipping	\$ 3,002	\$ 3,780	\$ 2,442	\$ 3,455	\$ 3,306	\$ 2,642	\$ 2,703	\$ 3,308	\$ 2,449	\$ 3,308
4.1.3.11	Outreach	\$ 106	\$ 1,890	\$ 147	\$ 1,076	\$ -	\$ 854	\$ 9	\$ 854	\$ 150	\$ 854
4.2	Improvements	\$ 18,507	\$ -	\$ 32,440	\$ -	\$ 13,328	\$ -	\$ 3,325	\$ 12,801	\$ 71	\$ -
4.3	Housing	\$ 11,794	\$ 18,519	\$ 13,246	\$ 15,019	\$ 11,138	\$ 14,208	\$ 9,389	\$ 14,302	\$ 11,842	\$ 14,302
total	Total					\$ 1,041,540	\$ 1,105,338	\$ 925,525	\$ 1,085,484	\$ 833,793	\$ 935,606
G	Overhead					\$ 215,693	\$ 212,405	\$ 182,303	\$ 202,919	\$ 158,563	\$ 163,951
Grand Total		\$ 1,449,858	\$ 1,539,557	\$ 1,317,136	\$ 1,349,390	\$ 1,262,967	\$ 1,329,980	\$ 1,107,838	\$ 1,288,403	\$ 992,356	\$ 1,099,557

FY2012: \$1.2 million + \$0.4 million reserve for capital maintenance
 “DNR Lease” includes electric power for experiments and Lab share of
 common costs

NuMI Laboratories—Operations

- The Laboratory staff at Ash River is currently 3 people
 - Lab Manager
 - Safety Officer
 - Maintenance Person
- The NOvA Detector installation staff count is dynamic; currently ~20; expect to increase to 40-50.
- The long term lab + detector staff count is expected to be 6-8 people.
- The lab operating budget is currently \$0.4 million.

NuMI Laboratories—Operations

- Total operating budget for Soudan and Ash River Laboratories (including experiment operation and capital maintenance) is \$2.0 million
- Total staff is 6.25 at Soudan Lab, 10 at Soudan State Park (paid by State of Minnesota) and 3 at Ash River. Total: ~20
- For context, budget at SURF (no operating experiments) is \$12.1 million, staff is 95 FTE (Ron Wheeler, 2011)

Details That Matter

- General
 - The DOE rules for universities seem more flexible than the DOE rules for labs (Cooperative Agreement)
 - Universities can smooth out cash flow issues
- Specific to the University of Minnesota
 - The University is a public corporation, chartered by the Territorial Legislature of 1851 and the Minnesota Constitution of 1858. The University controls its own finances independent of the State.
 - The University has the powers of a municipality. It can take property by eminent domain, issue its own building permits and certificates of occupancy, establish its own building codes and zoning, enact ordinances, act as RGU for its own environmental permits. The University also sovereign immunity and a captive insurance company.

Details That Matter

- The University of Minnesota typically manages \$300-\$500 million of construction at any given time.
- The management fee is <3% +~2% for building permits and code compliance



Re-Configuration Costing

- The limited time available for the LBNE Re-Configuration Initiative has resulted in a costing strategy with limitations.
- Our community has focused 12 years and ~\$200 million on Homestake (NSF ~\$50 million, South Dakota ~\$130 million, DOE ~\$10 million). Now we are costing NuMI beam sites in ~1 month.

Limitation #1—Cost Model

- Limitation #1: The estimated cost for surface labs (both SURF and NuMI) is based on the cost of the NoVA Ash River Lab.
- The NOvA Lab is comparable to a 17 kT LAr Lab—slightly larger in the detector pit, about half the size in the much less expensive service area.
- The total cost of the NOvA Lab in FY2010 was \$41.5 million. However, the cost of the 17 kT LBNE Surface Lab is \$84 million (FY2010).
- The cost model does not recognize the cost savings of the Cooperative Agreement model

Limitation #1—Cost Model

A	B	C
	FY10 Cost Reference Design	FY10 Cost 17 kT at Surface Ash River
Surface	\$ 20,122,493	\$ 18,692,807
UGI	\$ 116,962,023	\$ 7,053,876
Excavation	\$ 119,317,033	\$ 18,429,180
CM	\$ 46,587,301	\$ 9,276,931
Preliminary Design	\$ 9,985,594	\$ 1,767,035
Final Design	\$ 14,978,391	\$ 2,650,552
Geotech	\$ 2,499,372	\$ 500,000
Control Survey	\$ 238,892	\$ -
SDSTA or MN Indirects	\$ 286,670	\$ 94,601
Disputes Review Board	\$ 191,113	\$ 100,000
Owner Provided QC Services	\$ 410,307	\$ 250,000
A/E Services During Construction	\$ 820,613	\$ 270,802
L3 Support	\$ 8,226,509	\$ 2,056,627
Conceptual Design	\$ 487,000	\$ 1,000,000
Fermilab Indirects	\$ 960,688	\$ 480,344
Site Adapt Costs		
Land Acquisition Cost	\$ -	\$ 150,000
Road & Utility Easements	\$ -	\$ -
Allowance for Constructing Facilities on Hillside	\$ -	\$ -
Additional Surface Utility Allowance	\$ -	\$ 1,000,000
Additional 2% Sales Tax on Materials	\$ -	\$ 441,759
Contingency	\$ 106,696,000	\$ 19,708,046
TPC	\$ 448,770,000	\$ 83,922,561

Limitation #2—Soudan Underground

- The cost estimation for an underground laboratory at Soudan is based on a “green field” site with no existing infrastructure other than surface electrical power
- There are 27,450 m³ of existing lab space
 - Use this volume to reduce new excavation volume for cryo and utilities
 - Extend or deepen one or both of the existing caverns for the detector

Limitation #3—Soudan Shafts

- The costing for shafts and hoists at Soudan is not based on real engineering.
 - No evaluation of the shaft sites or the rock
 - No investigation of what must be conventionally constructed and what could be raise-bored.
 - Possible double counting of some items

Limitation #3—Soudan Shafts

TRAYLOR

Submitted By:

Traylor Mining, LLC

Carl L. Johnson, Division Manager

Date: February 27, 2012

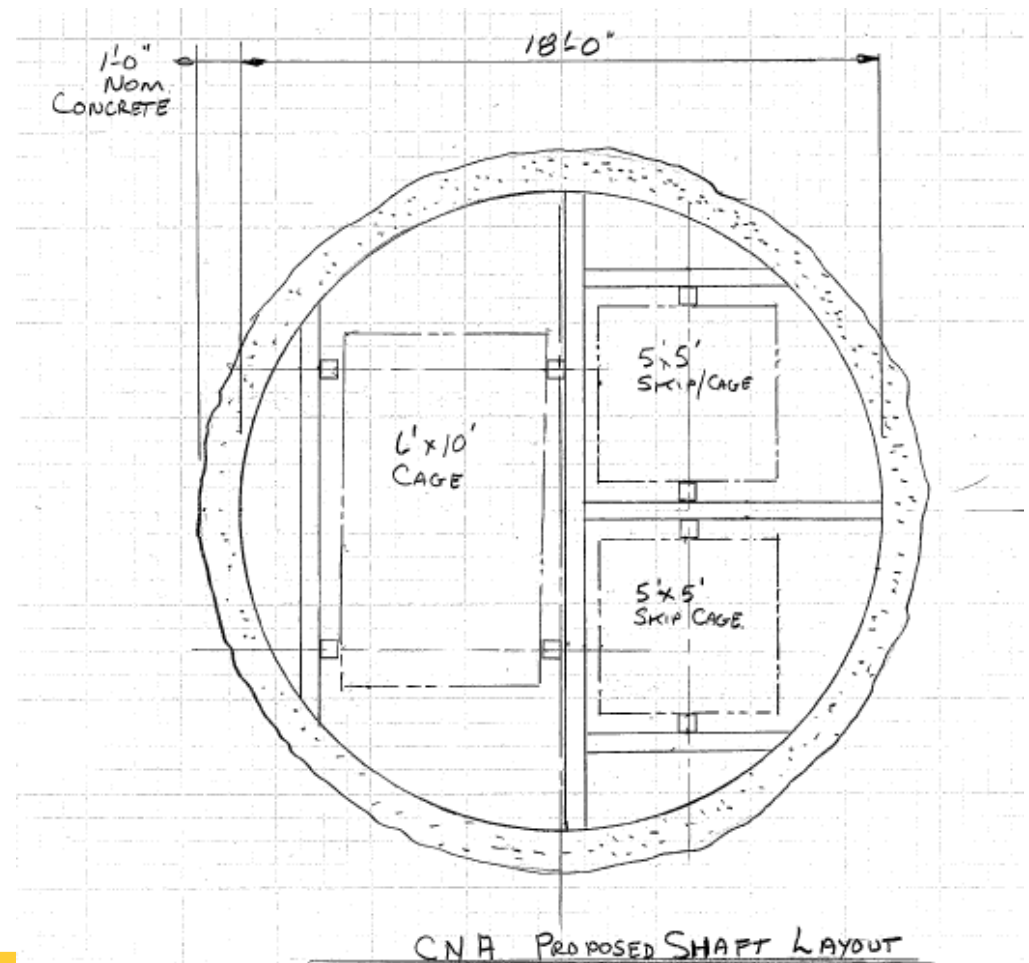
MSHA Contractor ID No. X940

405 Urban Street, Suite 210

Lakewood, CO 80228

Telephone: 303 988 8821

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Limitation #3—Soudan Shafts

18 FT DIAMETER SHAFT CONSTRUCTION COSTS					
BID ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
1000	MOBILIZATION TO SITE	1	LS	\$522,450.00	\$522,450.00
1100	SETUP TEMPORARY SURFACE FACILITIES	1	LS	\$1,650,000.00	\$1,650,000.00
1200	SETUP SINKING PLANT	1	LS	\$3,640,000.00	\$3,640,000.00
1300	CONSTRUCT HEADFRAME	1	LS	\$2,075,000.00	\$2,075,000.00
1400	CONSTRUCT HOIST & HOIST HOUSE	1	LS	\$6,090,000.00	\$6,090,000.00
1500	CONSTRUCT SHAFT COLLAR	100	VF	\$14,200.00	\$1,420,000.00
1600	SINK & LINE SHAFT	2300	VF	\$7,700.00	\$17,710,000.00
1700	EXCAVATE & SUPPORT SHAFT STATION	1	LS	\$775,000.00	\$775,000.00
1800	FURNISH & INSTALL SHAFT STEEL	2400	VF	\$2,195.00	\$5,268,000.00
2000	REMOVE TEMPORAY FACILITIES & DEMOBE	1	LS	\$810,000.00	\$810,000.00
TOTAL ESTIMATED COST					\$39,960,450.00

The NuMI Laboratories

- The NuMI Laboratories have a strong record of efficiently and effectively delivering infrastructure for physics experiments
 - Three already constructed laboratories
 - 75,000 m³ of detector volume
 - 1,140 m² support space
 - \$70 million (FY2010)
- In a decade, the NuMI Laboratories cost \$100 million less than SURF for operations
- Using the NuMI Beam saves LBNE ~\$400 million
- We can do real physics!