



Detector Operations Deep Underground 25 years at Soudan

SOUDAN UNDERGROUND LABORATORY

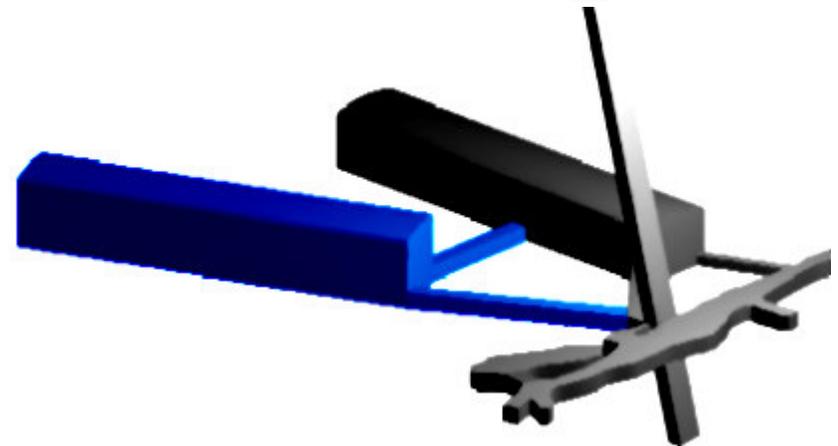
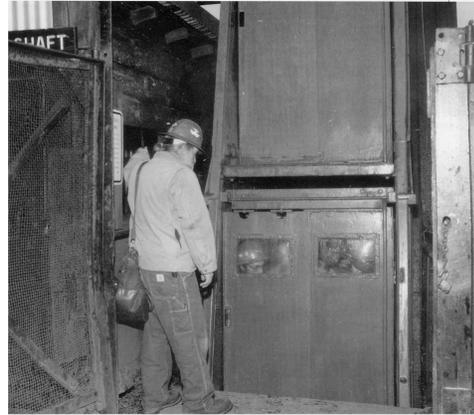
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Over 25 years of large neutrino and particle physics studies in Northeastern Minnesota



Soudan 2-1Kt
1985-2001



MINOS-5.6Kt
1999-??



CDMS
2000-??

Soudan 1-35t
1981-89



Operation Cost Overview

- Yearly Lab budget including overhead ~\$1.3M
- Manpower-9 FTE's: \$820k
- DNR-\$330k
 - Hoist trips(\$60k), electricity(\$110k), On-call, OT, Hoist operators (\$90k), Lease & administration (\$70k)
- Surface Building-\$60k
- Phones, network-\$40k
- DNR overall budget to operate the Soudan Underground Mine is ~\$1.1M (\$300k tours)
- Total ~\$2.1M



Lab Infrastructure Operations

- Lab Operations-~5 FTE
 - Administration: Lab manager, assistant lab manager, Office Specialist
 - Network specialist
 - ½ FTE safety officer
 - ½ FTE janitorial staff
- Park Operations-~8 FTE
 - Administration-Park Manager, Assistant park manager, office specialist- All ~50% operations/50% historical interpretation
 - 4 hoist operators/mine maintenance
 - 1 grounds keeper/janitorial
 - 2 electricians (one master) 75% at Soudan



Detector Operation

- MINOS:2 FTE to maintain 136,000 channel “simple” detector
 - 96% overall on-time, 99.3% during beam
- CDMS:1-2 FTE PLUS 1-2 FTE Physicists
 - Much more labor intensive
- Lab runs 5 ten hour shifts, 24/7 on-call for emergencies. Biggest problem used to be power outage issues those have mostly been cured with system of UPS’s and a generator



Detector Operation

- Both detector's were designed for remote operation for almost all operations
- MINOS is watched 24/7 by shifters at Fermilab that call experts (or the minecrew) depending on the problem
- CDMS uses an auto dialer system that monitors everything and calls if there is a problem. Plus has remote control capabilities in the surface building.



Super-K & XMASS Operations

- Rough manpower estimates 16 FTE's
- Onsite Physicists: 21 ~30% operations
70% physics
- Onsite technicians: 5
- Onsite secretaries: 5



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Important Operations \$ Issues

- 24/7 Access?
- Safety constraints
 - Many different area's in DUSEL, always maintain minimum 2 person crew, at least one should have a defined level of on-site training
 - Elevator (non-hoist operator) access
- Large Technical staff or run mainly by physicists?
- Detector design can have a major impact on operation costs, difficult to make a general “rule” of thumb



Cost estimates-Manpower

- Manpower-Operation
 - Using Super-K as a model for manpower of ~20 FTE
* \$20(average hourly wage)*40%(fringe benefits)*26%(overhead rate at U of M)-~\$1.5M per year
- Manpower-Installation
 - Using MINOS as a model we had ~5 times the work force during installation. DUSEL Water Cherenkov installation period was 2 years
 - Running 3 shifts/day-Crew of ~30 FTE/shift *\$16*40%*26%-~\$5.5M/year
- Manpower contingency
 - Early stages of labor estimates a minimum 50%



Estimating Costs-Utilities

- Electrical
 - At Homestake they are pay ~\$.06/Kwh including the demand charge
 - Estimate for DUSEL Water Cherenkov 50,000 channels of electronics @10w= ~4 megawatts of power Cost is ~\$500,000/year per megawatt
 - Plus HVAC-Detectors need to pay for their lab HVAC (~30% of the power usage for NOvA). It may be much higher at 4850 level so I have used 40%. PLUS filtration, control room etc. ~20%



Safety Costs

- Safety costs are based on ~double Soudan yearly costs. Liquid Argon and Water Cherenkov detectors may have additional costs like ventilation which are not included in this estimate.
 - Full time Safety Officer-\$100K
 - Training-\$20k/year
 - Equipment and supplies-\$20k/year
 - Inspections-Fire equipment, etc.-\$10k/year



Facility Costs

- These costs are based on ~ double the occupancy of the Soudan Lab
- Office Supplies-Computers, printers, office supplies, etc. :~\$30k
- Facility Maintenance-Ventilation filters, equipment repair, maintenance contracts~\$80K
- Supplies-Nuts, bolts, cleaning, lunch facilities,etc.-\$40



Other Costs

- VERY Rough estimate there are several of them shown below. At Soudan these costs are ~10% of the total operation budget minus the electrical costs
- Travel-Key local staff -?
- Surface Facilities-?
- Vehicles-?
- Facility Improvements-?
- Outreach-\$50k plus 1 FTE-\$125k total



Operations Cost Estimate

Rough Operation Cost 100kt Detector			
		Unit Cost	Total Yearly Cost
Manpower	20 FTE	\$75k/FTE	\$1,500k
Electrical			\$3,300k
	Detector-4 Megaw	\$500k/Mw	\$2,000k
	HVAC -40%	\$500k/Mw	\$800k
	Other-20%	\$500k/Mw	\$400k
Phones,Network	T-3 connection	\$50k	\$100k
	Phone	\$50k	
Facility Costs			\$150k
	Office/Computers	\$30K	
	Maintenance	\$80k	
	Supplies	\$40k	
Safety	1 FTE,equipment	\$150k	\$150k
Other costs			\$300k
	Misc. -10%	\$175k	
	Outreach-1 FTE plus	\$125k	
Total			\$5,410k