



The Soudan Underground Laboratory

History/Management/Organization

Soudan Operations Review

Fermilab

May 14-15, 2003



Early History



- It all started with nucleon decay and grand unification.
- After several splits, Minnesota/Argonne built Soudan 1
- 23rd level of Soudan mine
- No lease, found space.





Intermediate History



- In 1983, UM/ANL/Tufts + Oxford/RAL proposed Soudan 2
- Space on 27th level (bottom) leased from DNR
- Excavated/outfitted from 1984-86.
- 1kt Soudan 2 installed SLOWLY, '86-'92.
- Ran until 7/'01.



OVERVIEW OF THE FIRST AND SECOND HALF WALLS. CABLE TRAYS ALONG THE LEFT SIDE OF THE DETECTOR CARRY SIGNALS FROM THE WIRES AND STRIPS TO ADC ELECTRONICS. THE CEILING AND WALL VETO SHIELD MODULES CAN BE SEEN ABOVE THE DETECTOR, IN THE LOWER BACKGROUND AGAINST THE CAVITY WALL, AND ON THE UPPER LEFT.



Installation of Soudan 2



- During installation ('86-'92):
 - 8 Physicists/Post Docs/Grad students
 - 8 Mine crew: laboratory + technical tasks
 - Materials handling
 - Wire-plane stringing/final assembly
 - Installation of modules/cabling/gas system
 - Noise fighting: diagnostics/electronics swaps
 - Veto shield final assembly/installation



Operation of Soudan 2



- Pure Operation: '93-'98 (before MINOS)
 - Physicists etc.: 0-3, often zero
 - Mine crew: down to 6
 - Maintained laboratory, gas system, electronics and computers/DAQ system
 - Fought noise (new sources monthly)
 - Ran the detector diagnostic programs
 - Did 1st-pass scan of S2 data (later years)
 - Crew augmented to 8 – last year (or so)
 - Designed the MINOS FD installation scheme
 - Did many pre-excavation laboratory modifications



New Experiment Develops



- During 1992, IMB/Kamioka/Soudan 2 began to have indications of a lack of atmospheric muon neutrinos.
- Long-baseline oscillation experiments began to be formulated.
- Fermilab won LB competition.
- Soudan won far site selection competition.
- The NuMI/MINOS project was the result.

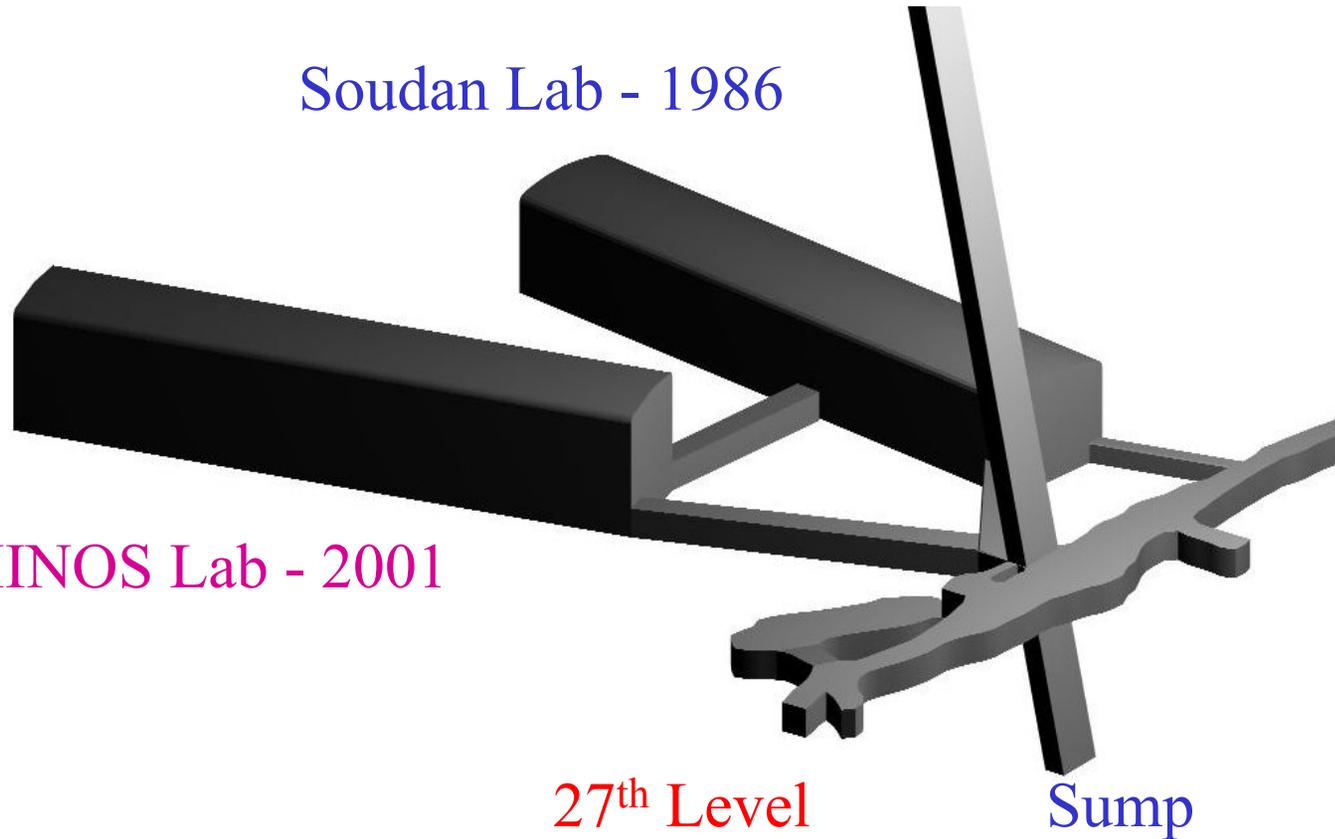


Laboratory Expansion



Soudan Lab - 1986

MINOS Lab - 2001



DNR
Soudan
Mine
tours



Soudan Laboratory



South



Behind
the wall



North



South
under
deck





MINOS Laboratory



South



Far South



North



THE Mural





Other Facilities



Machine Shop in S2 Lab



Elec. Work area



MINOS Surface Building (down the hill): receiving/steel sorting-bundling



Management Organization



- Operational Responsibility is with U of MN
 - Was funded by DOE U Program grant **for Sudan 2**
 - Now funded for NuMI/MINOS by:
 - UM/State/FNAL for pre-construction
 - DOE grant from FNAL funds (+UM \$3M) for construction
 - PO's from FNAL for installation/operation
- Home is School of Physics and Astronomy
 - All budgets in the School
 - Supervised by: Institute of Technology (College), Sponsored Projects Administration, and the Vice President for Research.
- Off-campus indirect cost rate (space is leased – but no utilities furnished by UM).



Laboratory Management



- Laboratory Director (EAP)
 - Appointed by VP for Research with consent of Director of FNAL
 - Advised by Soudan Program Management Group
 - VP for Research
 - Dean of Institute (usually Assoc. Dean for finance)
 - Head of School (Allen Goldman)
 - Another Physics Dept. member (Prisca Cushman - CDMS)
 - Soudan Operations Manager from Fermilab (Gina)
 - Others by invitation (MINOS install-Jeff Nelson, Physics administrator-Dave Holets, Bill Miller are always present)



U of MN Liabilities



- Leases: all guarantee “no costs” to owners
 - With the Department of Natural Resources
 - Soudan 2 Laboratory (**expired, renewal in process**) (+8K\$/yr ?)
 - CDMS II is a sublease of S2 lab area (+12K\$/yr)
 - MINOS Laboratory (+20K\$/yr) – expires end of '08...
 - With Breitung Township
 - “MINOS Surface Building” (43.2K\$ - 7 years/end of '07)
 - With the Hill's: for a 3br house in Soudan (\$600+/mo.)
- Capital Equipment Insurance (\$2M on facility)
- 6-12 months of cash-flow easement



DNR Leases



- “No additional costs to DNR” is guide, so:
 - Cage/hoist maintenance – cage trip fee (~\$31.50, inflates)
 - Labor costs for hoistmen “not on duty”
 - Pay DNR back for (our part of the) electric bill
 - Administration fees (part-time secretary)
 - Miscellaneous: pagers/cage repair/office supplies/...
 - Any odd jobs by electrician, DNR crew
 - Safety equipment (shared 50/50)
 - (All checked by Bill Miller/EAP before payment)
- Soudan 2, CDMS and MINOS detectors to be removed at lease termination.



Memoranda of Understanding



- MOU's are the basic instrument between FNAL and UM
 - Exist for Facility Construction/Outfitting
 - Installation of the MINOS Far Detector
 - Operation of the Laboratory (this review)
 - Construction of CDMS Facilities (needs work)
 - Operation of CDMS
- SOW's set funding, MOU's responsibilities



MINOS Lab Construction



- Designed by CNA Engineers – Input by:
 - Bill Miller/Dave Ayres re installation + crew
 - NuMI management (THF/DB/GB)
 - MINOS management (GR/ABW/DP/JK/JN...)
 - MINOS collaboration (lots of people)
- Initial Funding by UM/State/some from FNAL
 - \$650K (State/UM)/\$100K (FNAL) for pre-construction
 - Design/Hoist Refurbishment/Facilities moves/etc.
 - \$3M “internal loan” from UM
 - Paid back by allocation of 50% of lab-related overhead
 - After installation about 2/3 remains to be amortized...
- CDMS construction folded in (see below)



UM During Construction



- Managed by UM Facilities Management Dept.
 - Paid the monthly invoices from contractors
 - Interface with UM Building Code group
 - Attended construction meetings, supervised (Title 3)
 - (Detailed supervision actually done by Bill Miller/crew/EAP)
 - Signed off on contract issues resolved by the Title 3 engineers (CNA again)
 - Useful in the “end game” – i.e. currently, for outfitting closeout; formerly, for transferring floor to outfitters.
 - Kept FNAL current with earned value numbers



CDMS Construction



- Simultaneous with MINOS Outfitting
- Initial code/FNAL interface problems
 - Code: no flammable construction, but detector RF-free enclosure was ‘manufactured’, and many delays in getting fire rating
 - Plans had to be signed by MN-registered engineer (solved when Stan Orr received MN registration)
- Change orders to outfitting (schedule help)
 - Redo deck to support electronics/AC equipment
 - Two rooms, electrical/fire systems
 - Not well controlled w.r.t. change orders



CDMS Buildings



Air
handling



Electronics
Room
(early photo)

Ar/He
plumbing



Clean
[entry]
room
(early
photo)



UM during MINOS installation



- Hired the installation crew
 - Topped out at 31 total, some small amount of turnover
 - Interviews by EAP/Bill/Jerry, later +Jeff
 - Helped by LTV closure that winter...
 - (and we are about to lay off most of them)
- Developed safety documents
 - Modeled after FNAL readiness reviews
 - Much help from FNAL/MINOS
 - Periodically reviewed, rewritten (esp. Materials Handling)
- Purchased some supplies (except detector components)
- Provided housing for visiting physicists



Housing for MINOS/CDMS



- Big influx of physicists/students: limited hotel/motel resources
- (Soudan 2 had rented 2 apartments + 2 houses for installation: set the model). Took over 2 apartments, and:
- High-water mark: 4 houses and 5 apartments – 21 bedrooms total. (CDMS rents 3br house in Ely as well.)
- Managed by EAP/Eileen – WEB reservation system. Paid for by users – check/credit-card/direct charges to FNAL...
- Almost all were unfurnished: bought kitchen equipment, TV/VCR, beds, linens, 2Mb wireless LAN, a little furniture. Weekly cleaning.
- Much furniture from UM surplus property, some donated by Bill Miller/Eileen/others.
- Will be a HUGE garage sale in August! (Need the money!!)



Installation (continued)



- Accounting efforts during installation (Eileen!)
 - Detailed WBS structure for all expenditures
 - MINOS installation
 - Laboratory-related expenses
 - CDMS expenses
 - Housing expenses – ALL SEPARATE UM ACCOUNTS
 - Provided raw material for this review
 - Veto shield installation – funded separately
 - Budgets from Stanford (the bulk of the \$\$) and dribbles from
 - Argonne
 - Cal Tech
 - Texas A&M
 - ...



Operation responsibilities



- Maintain the facility
 - Some materials handling equipment
 - Lights/Electrical
 - Air Conditioning (loop to surface, big chiller system there)
 - Computers/Network
 - Janitorial and Sanitary
 - Surface building facilities – shipping/receiving too
- Maintain the experiments (see Jeff's talk, later)
 - MINOS:
 - Light leaks if any
 - Failed components (currently tube bases @ ~2/week)
 - Electronics and DAQ
 - CDMS:
 - Mostly liquid Argon/Helium systems
 - **Soudan 2**: run it or dismantle/remove it (a lease requirement)



Operational Plan



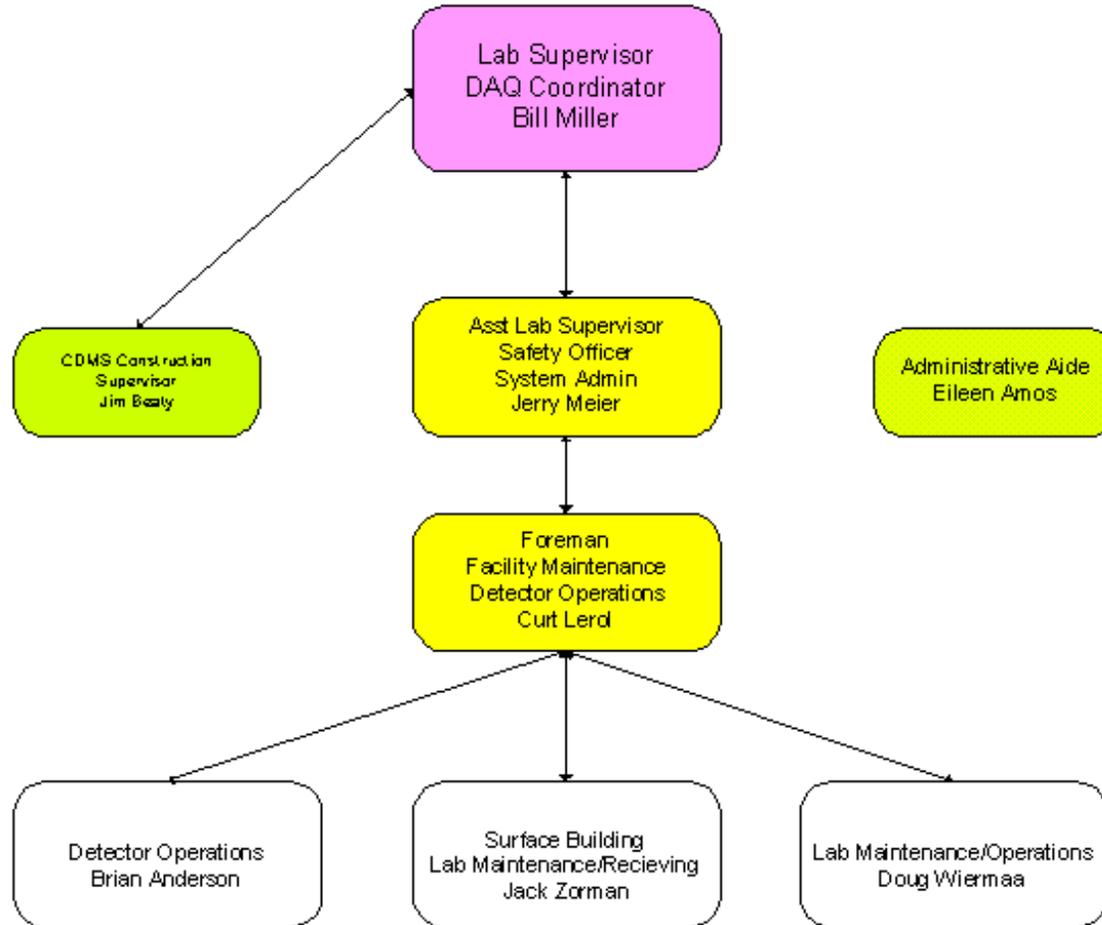
- Crew Organization: (see Jeff's talk, later)
 - Lab Supervision: Bill Miller
 - Lab Safety/electronics/computers/network: Jerry Meier
 - Administrative aide: (part-time) Eileen Amos
 - CDMS specialist: Jim Beaty
 - Laboratory maintenance: Curt Lerol
 - MINOS technicians: Brian Anderson/Jack Zorman/Doug Wiermaa
- Complications: 24-hour/7-day on-call access



Laboratory Operations



Crew Organization Chart





Discussion



- Probable crew work schedule: 10 hrs/day, 4 days/week (operations crew).
- Two people (minimum) required to be underground
- Physicist availability: probably M-Th only (?)
- Installation frenzy implies much crew vacation time has accumulated
- Some occupation of surface building necessary
- MUCH more discussion of these issues later in the review.



One try at a Crew Schedule



	Eileen	Bill	Jerry	Curt	Jim	Brian	Jack	Doug	Min
Mon	8	8	8	10			10	10	2
Tues	8	8	8	10	10	10	6+4	10	3
Wed	8	8	8		10	10	10	10	3
Thurs	8	8	8	10	10	10	6+4	10	3
Fri		8	8	10	10	10			2
Sat			 on call					
Sun			 on call					
Mon	8	8	8	10	10	10			2
Tues	8	8	8	10	10	10	6+4	10	3
Wed	8	8	8		10	10	10	10	3
Thurs	8	8	8	10	10	10	6+4	10	3
Fri		8	8	10			10	10	2
Sat			 on call					
Sun			 on call					

“Min”
column
assumes
one crew
member
sick or on
vacation