Long Baseline Neutrino Experiment : LBNE

Gina Rameika
Strategic Engineering Planning
September 17,2009

Outline

- Brief Technical Description of the Project
- Current Status
  - What stage the project is in
  - What the current plan/date for achieving CD-0, 1, 2, 3, 4 status is
  - What has been accomplished
    - Who is currently working on it ?
    - Enough Scientists assigned to guide the work ?
    - Commitments for adding people ?
- FY10 Scope of Work
  - Detailed list of what needs to be accomplished
  - Major Milestones
  - Resource Needs
  - What could be accomplished with additional resources
- FY11 Scope of Work
  - What needs to be accomplished???
  - Major Milestones???
  - Resource Needs ???
- A look at the “out-years”
- OHAP (Tables from 2008 exercise in backup)

What is LBNE?

- The LBNE project scope includes
  - Technical Components and Conventional Facilities for :
    - A high energy extracted primary proton beam
    - A conventional neutrino beam
    - A near detector
    - A far detector (L>=1000 km)
  - Scale : $700 M < TPC < $900 M
  - Time frame to CD-4 : ~10 years from now

Science Goals

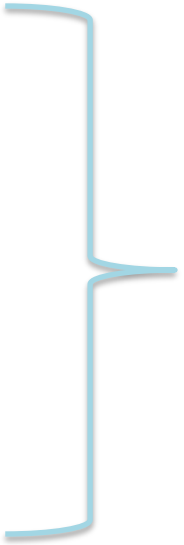
- The primary science goals to be achieved by the eventual project are to measure **neutrino mass and mixing parameters** accessible by accelerator generated neutrino oscillations
- These include
  - θ_{13}
  - The neutrino mass hierarchy
  - The CP phase δ
- The experimental discovery potential will depend on the parameters themselves, the experimental configuration (baseline and neutrino energy) and the "exposure" which is a function of the detector mass and efficiency, the proton intensity and the running time
- Detector configurations can be considered which will also have significant **scientific reach in non-accelerator areas** such as proton decay, supernova and solar neutrino detection

General Requirements for the accelerator science

- Proton Beam
  - Energy : 60 – 120 GeV
  - Beam Power : initial - 700 kW ; goal : Project X
- Neutrino beam
  - Wide band beam (0.6 – 6 GeV)
  - Significant flux over the 1st and 2nd oscillation maximum (2.8 GeV and 0.8 GeV for L = 1300 km)
- Near detector(s)
  - high event rate ➔ small mass, should match far detector target material
- Far detector
  - Need to set a goal for a desired sensitivity to a physics measurement
  - Specifications will depend on many input parameters

On-going Alternatives Analysis

- High Level :
  - Accelerator (FNAL, BNL : described in 2007 Long Baseline Study)
  - Baseline
    - L < 1000 km is not desirable for mass hierarchy
    - L > 2000 km is not desirable for flux considerations
    - **1000 < L < 2000 km is desirable**
  - Evaluation of sites
- Moderate Level :
  - **Far detector technology**
  - Far detector depth requirement
  - Cavern geometries
  - Near detector technology
- Detail Level :
  - Approaches to electronics
  - Cavity liners

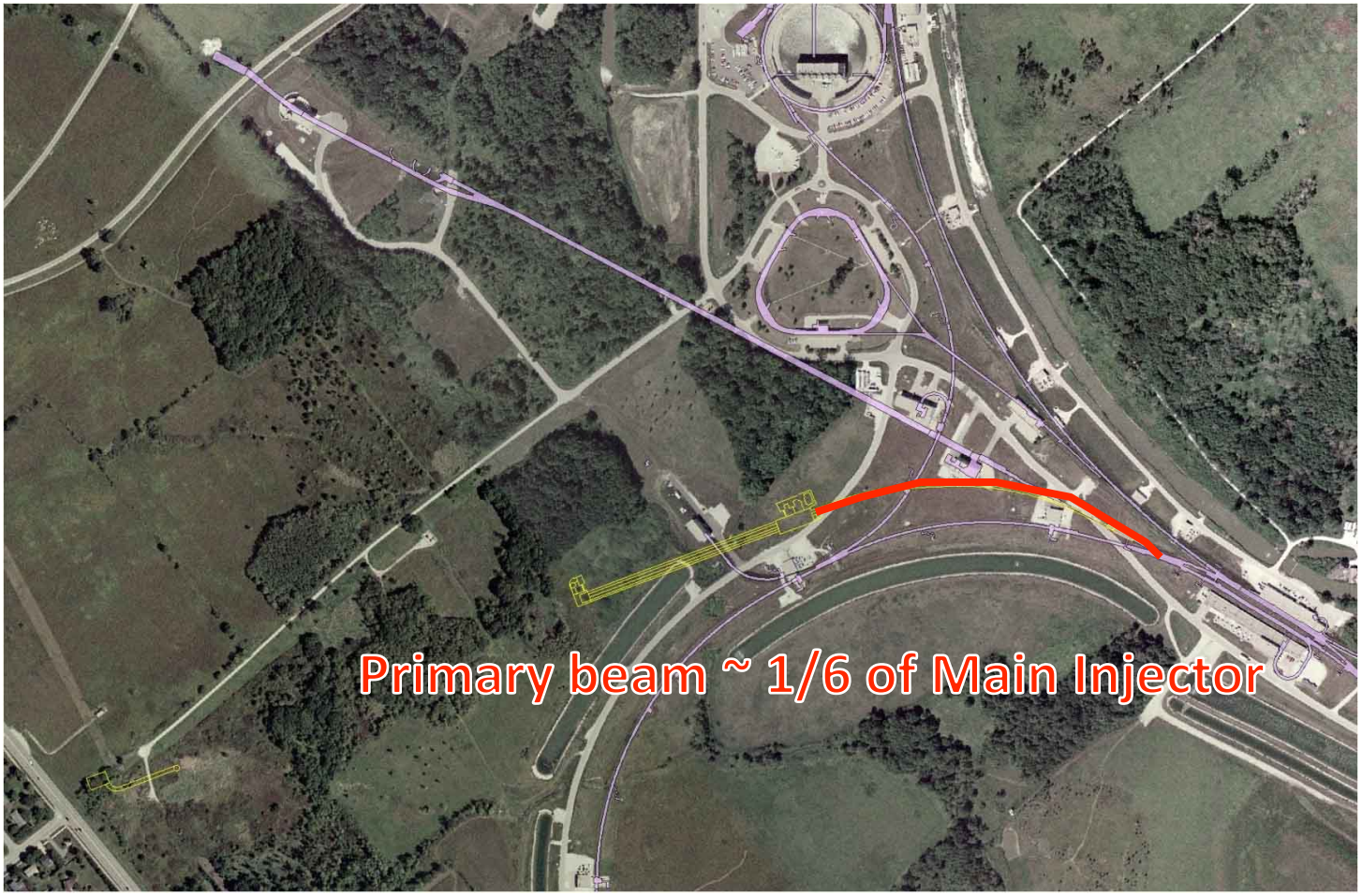


Evaluate cost, schedule and risks

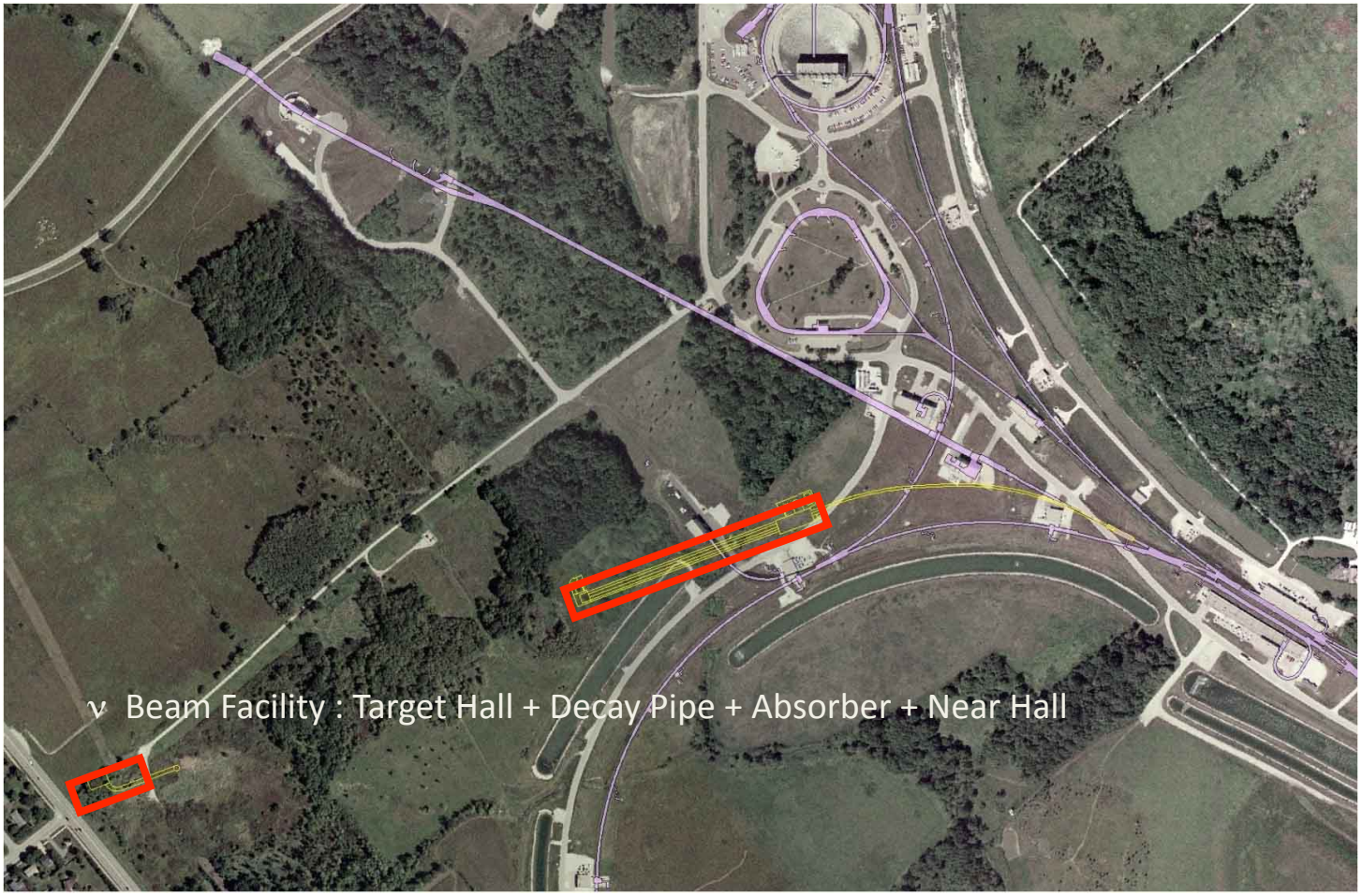
A Working "Model"

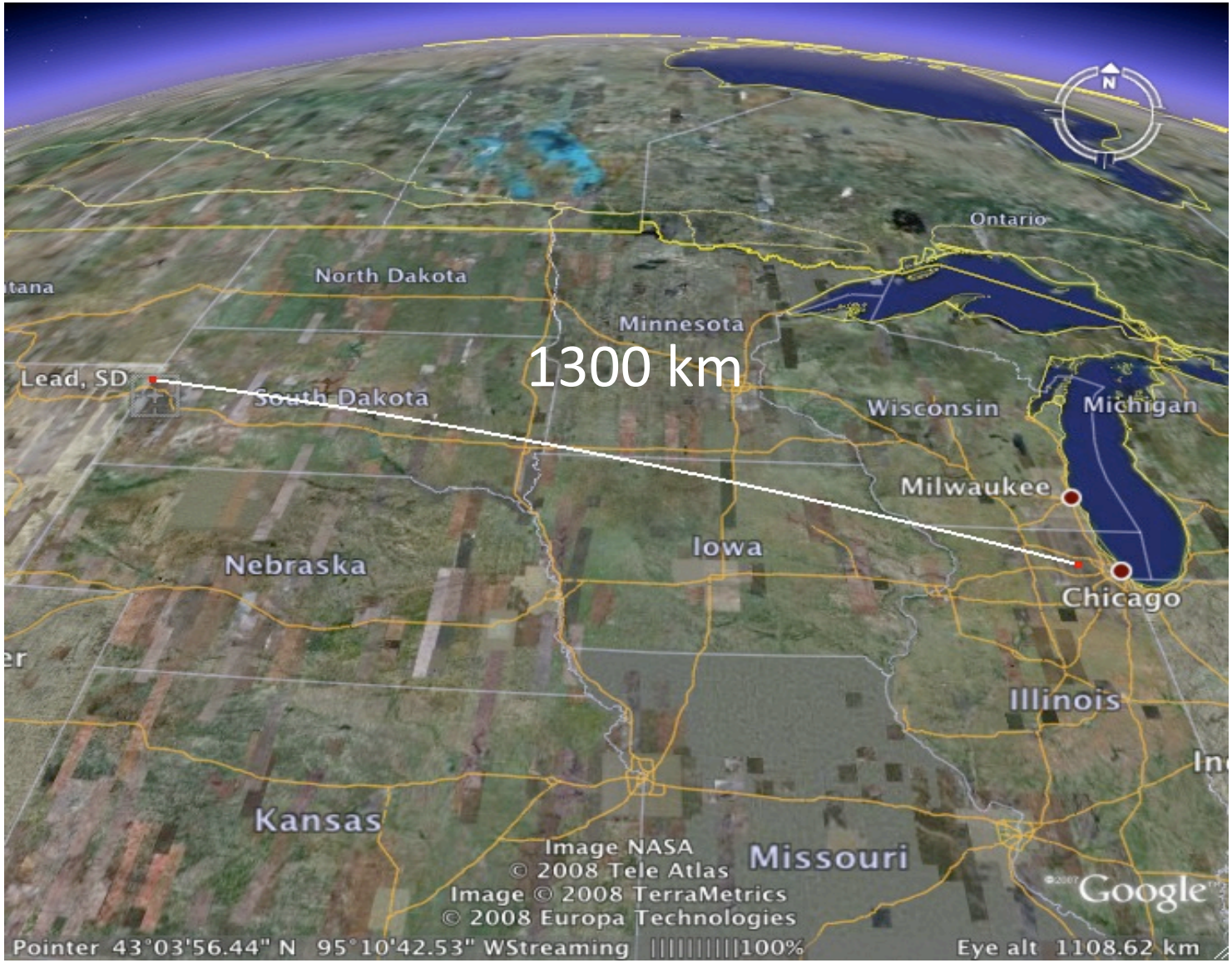
- The Main Injector starts at 700 kW but is upgraded to 2 MW
- The Neutrino Beam points to Homestake Mine in Lead, South Dakota
- Near Detector(s) are built at FNAL
- Large detectors – Water Cerenkov and/or Liquid Argon, are most likely located on the 4850 level of the Homestake Mine

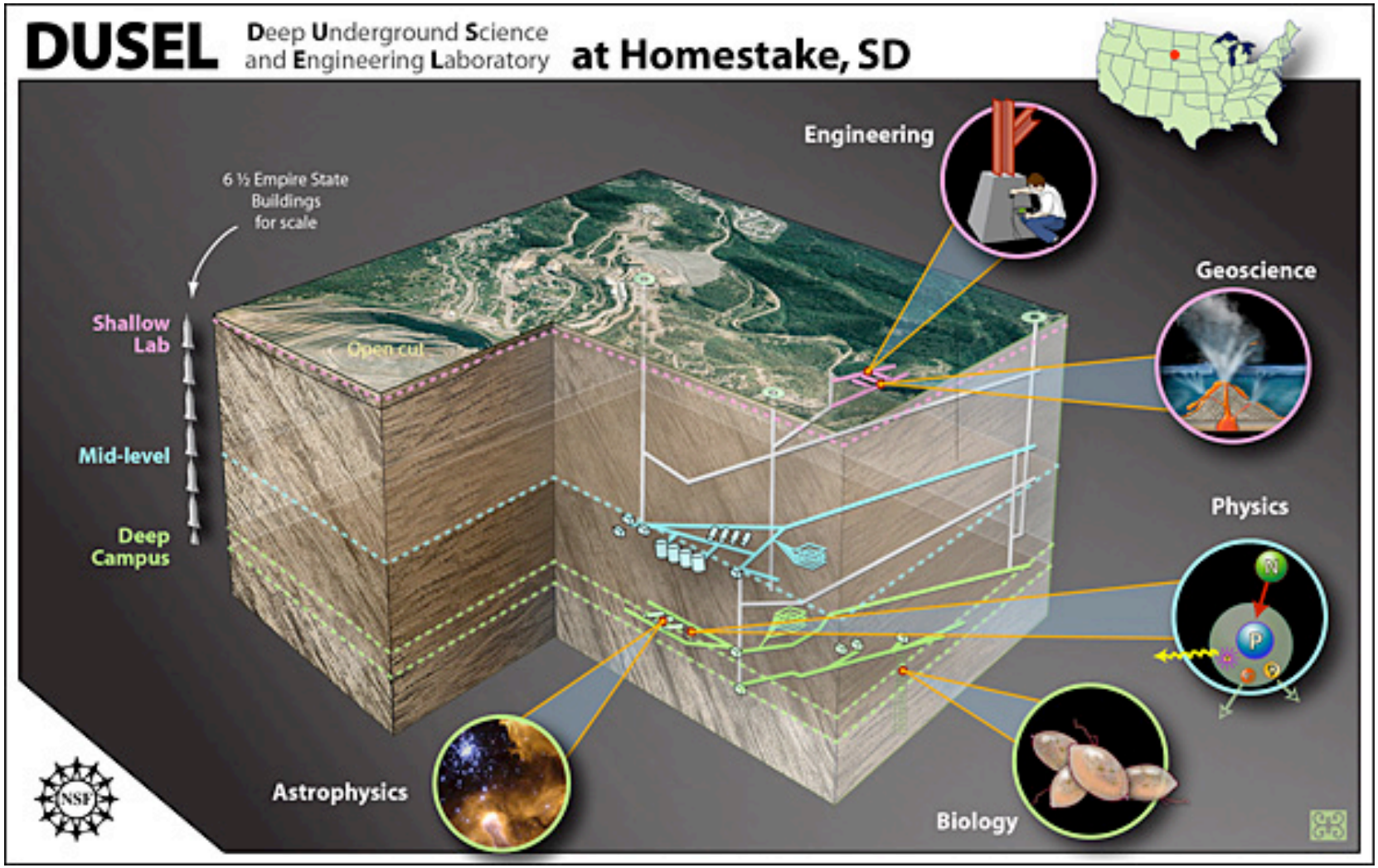
The Proton Beam



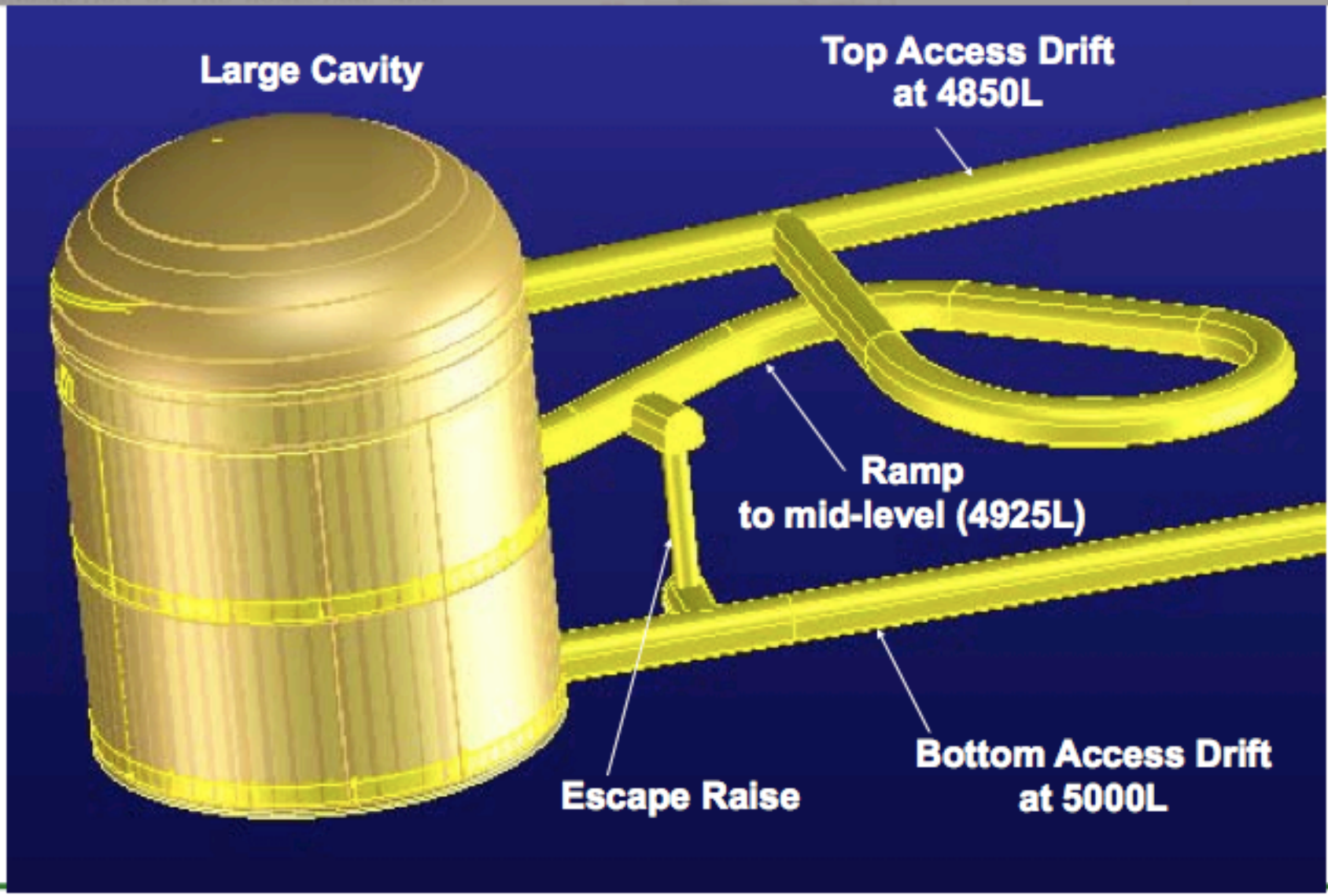
Neutrino Beam and Near Detector



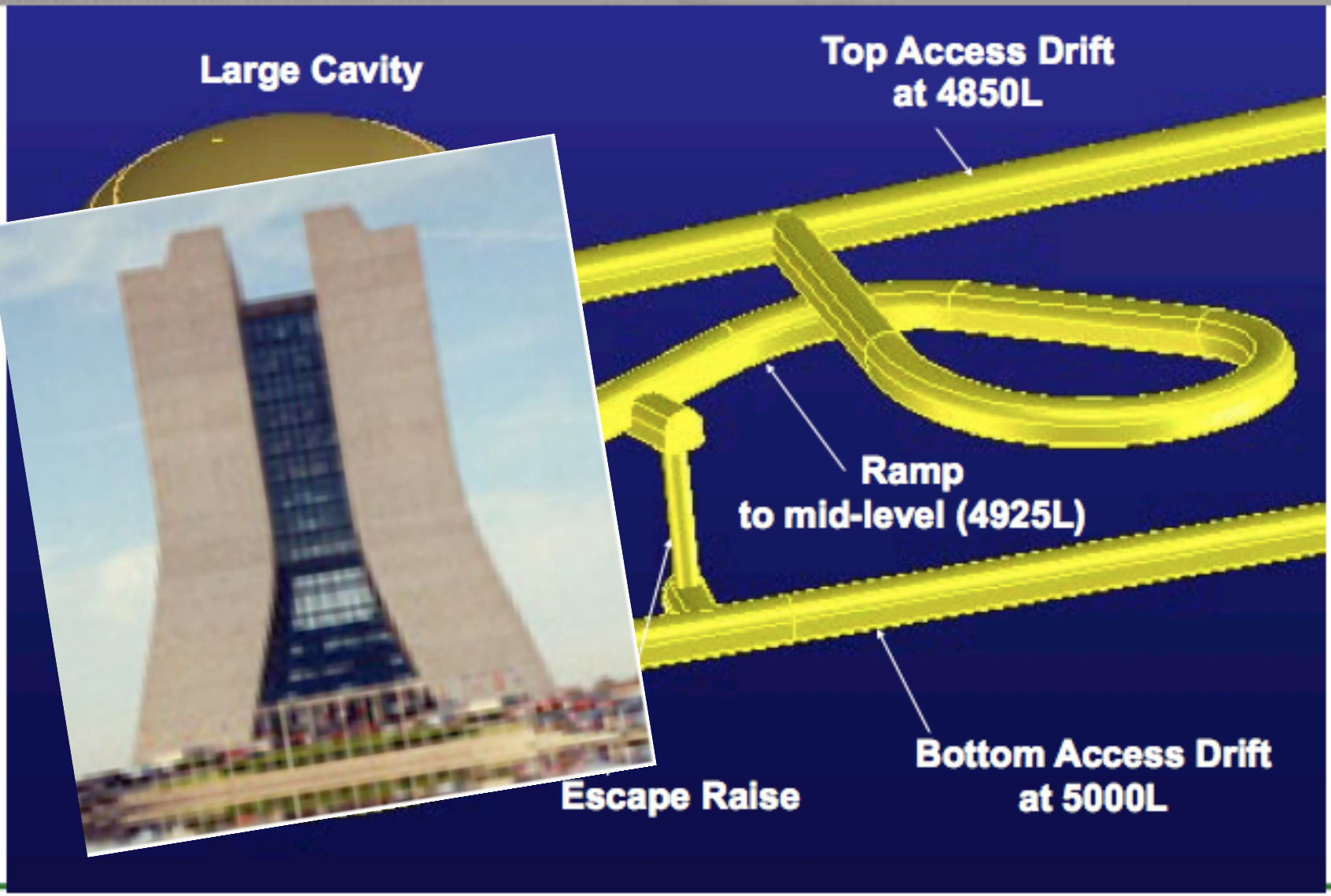

1300 km
Lead, SD
North Dakota
Minnesota
South Dakota
Ontario
Wisconsin
Michigan
Milwaukee
Chicago
Iowa
Nebraska
Illinois
Kansas
Missouri
Image NASA
© 2008 Tele Atlas
Image © 2008 TerraMetrics
© 2008 Europa Technologies
Google
Pointer 43°03'56.44" N 95°10'42.53" WStreaming 100%
Eye alt 1108.62 km


DUSEL
Deep Underground Science and Engineering Laboratory
at Homestake, SD
Engineering
6 ½ Empire State Buildings for scale
Shallow Lab
Mid-level
Deep Campus
Open cut
Geoscience
Physics
Astrophysics
Biology
NSF

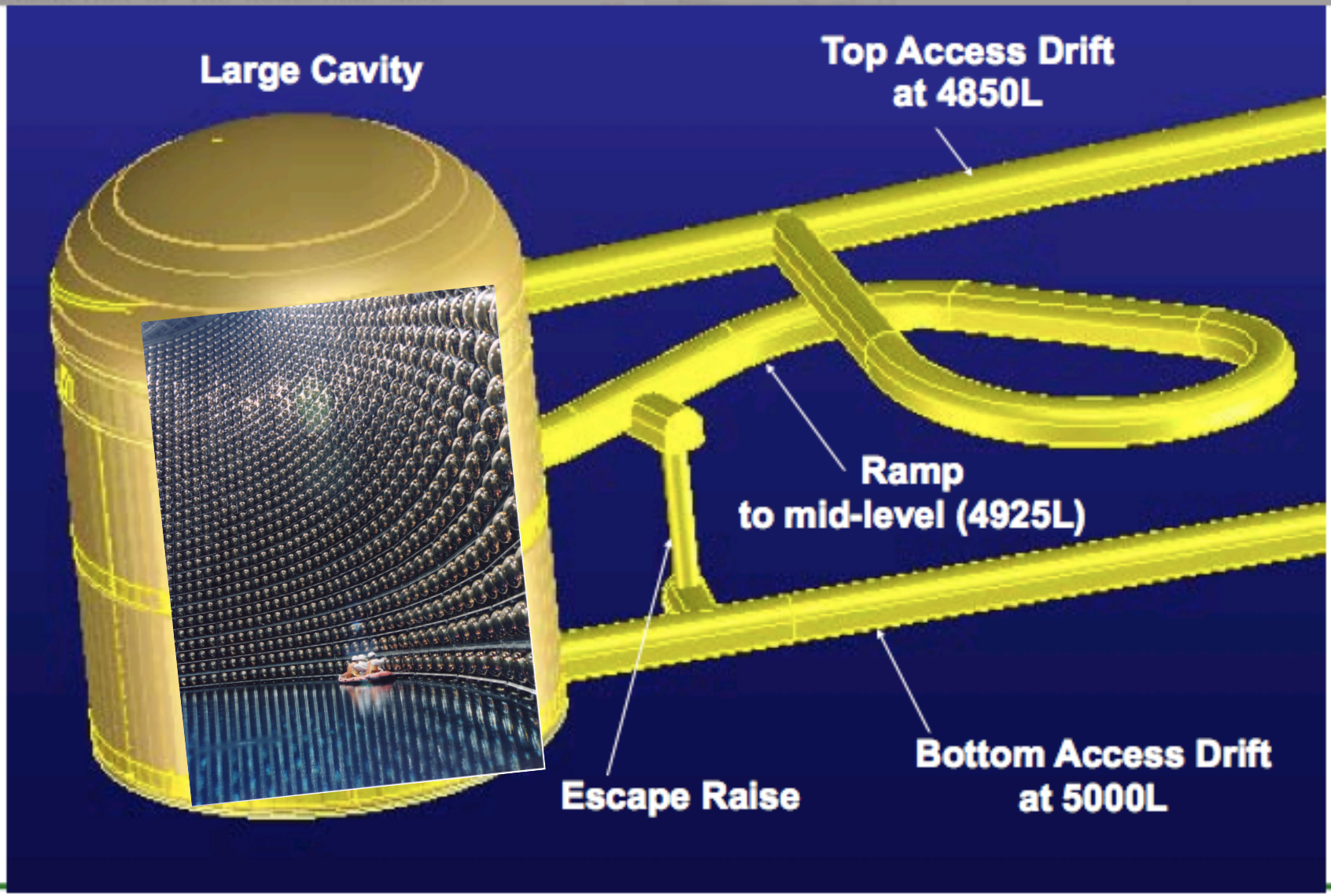
Large Cavity, Bulk Excavation Method

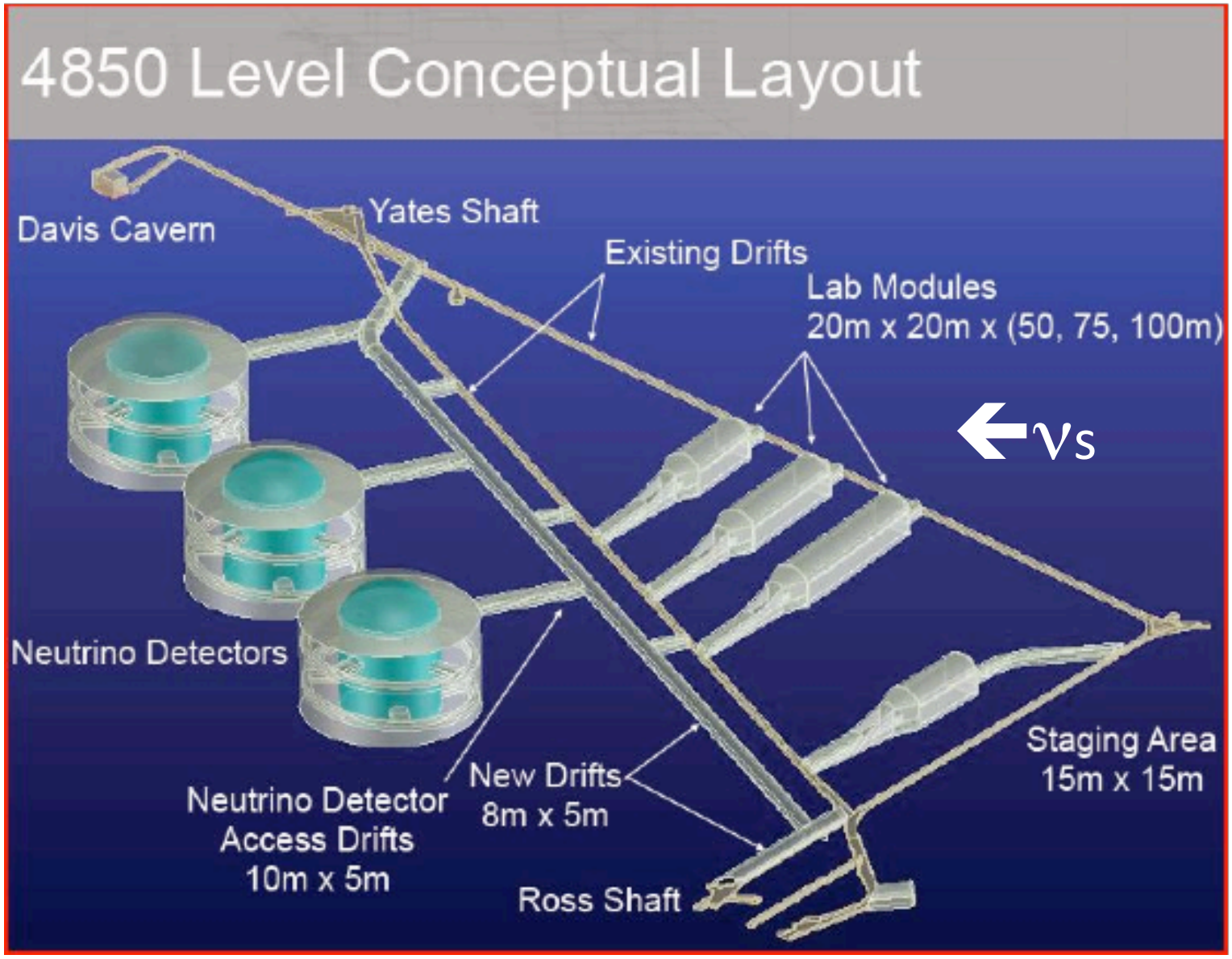


Large Cavity, Bulk Excavation Method



Large Cavity, Bulk Excavation Method

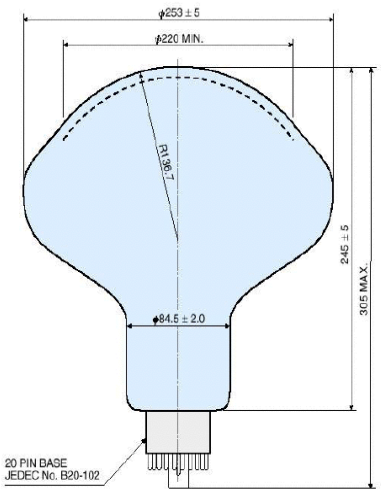



4850 Level Conceptual Layout
Davis Cavern
Yates Shaft
Existing Drifts
Lab Modules
20m x 20m x (50, 75, 100m)
νs
Neutrino Detectors
Neutrino Detector
Access Drifts
10m x 5m
New Drifts
8m x 5m
Ross Shaft
Staging Area
15m x 15m

PMT's

- 300 kT detector ➔ ~ 180 K 10" tubes for 25% coverage
- There is only one manufacturer
  - Production capacity
  - Delivery schedule
  - Unit cost + shipping
- *IF* the per channel cost is
  - $2000 (no contingency) ➔
    - $120M per module
- Need to reduce this
  - Electronics
  - Cable
  - ? Where can you get the most bang?

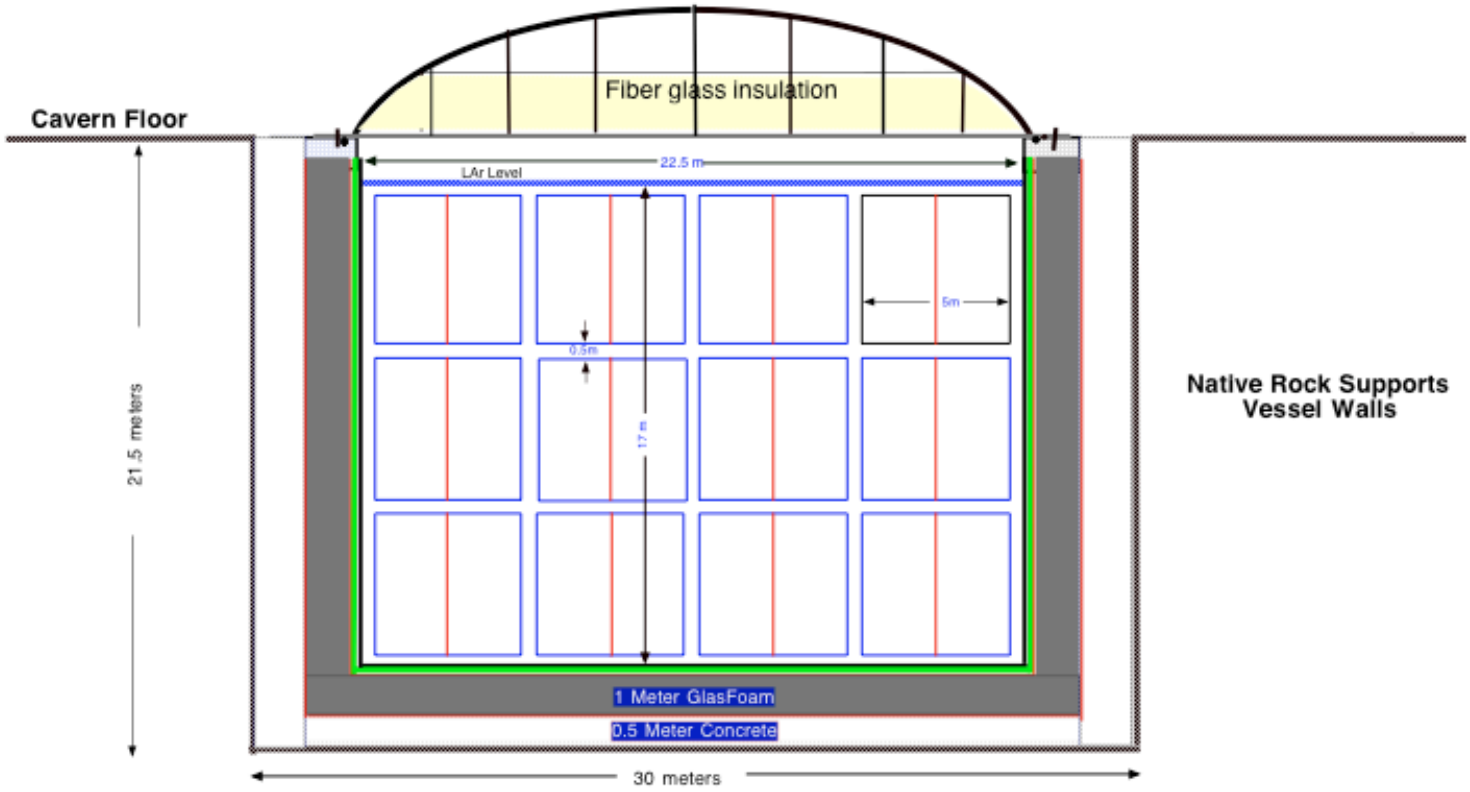
R7081 (10 inch)
R7081-20 (14-ST)
Fits for 13 inch
Glass Sphere



Liquid Argon ?

20 KT DUSEL LAr Detector, Model B - Preliminary Layout John Sondericker 8/05/09

Shown - 48 dual TPC detector basic units
5m x 5m x 40m = 12,000 m^3, 16.8 kt active volume LAr
22.5m x 17m x 42.5m = 16,256m^3, 22.76 kt Total LAr volume
Active / Total Volumes = 74%

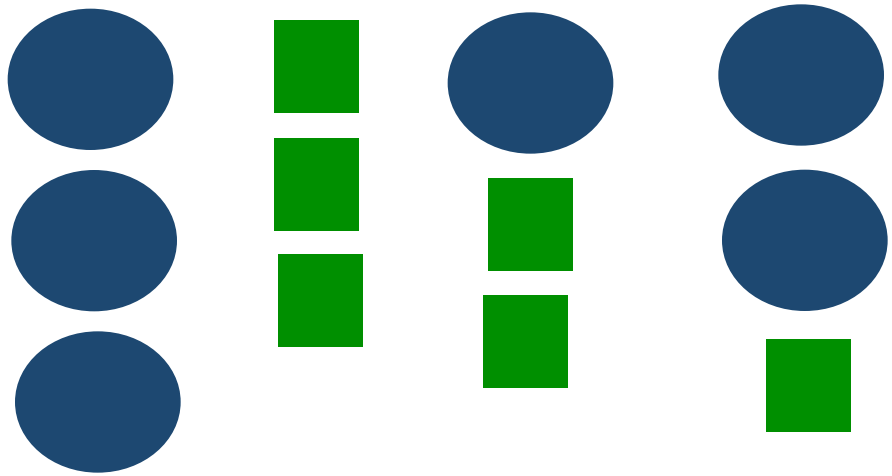


Inner containment vessel corrugated Stainless Steel or Invar, Inner wall dimensions are fixed.
Green is 3/4 inch plywood backing. Red is capping material for foamglas insulation.
Dark gray is 1 meter thickness of foam glass insulation which is also used as secondary containment of LAr.
Outer blue is reinforced concrete, 0.5 meter at base to support hydroststic head and vessel pressure loads...
Vertical concrete fills gaps so that vessel walls are supported by native rtock.

Configurations

	kilotons	
	WC	LAr
Physics Equality	300	50
Physics Module	100	17
Total Module	120	20
Dimensions	~55m diameter, ~60m height	16x16x60 m3 module;20x20x 80cavern

One can imagine 4 potential configurations



How can we optimize?

Major Challenges and Risks

- Mechanical designs of neutrino beam components (target) capable of handling 2 MW beam
- Mitigation of radiological concerns of high powered beams
- Unprecedented scale of underground construction for large detectors
- Optimization of the PMT plan for a WC detector (size, Q.E., coverage…)
- Demonstration of scalability in LAr detectors

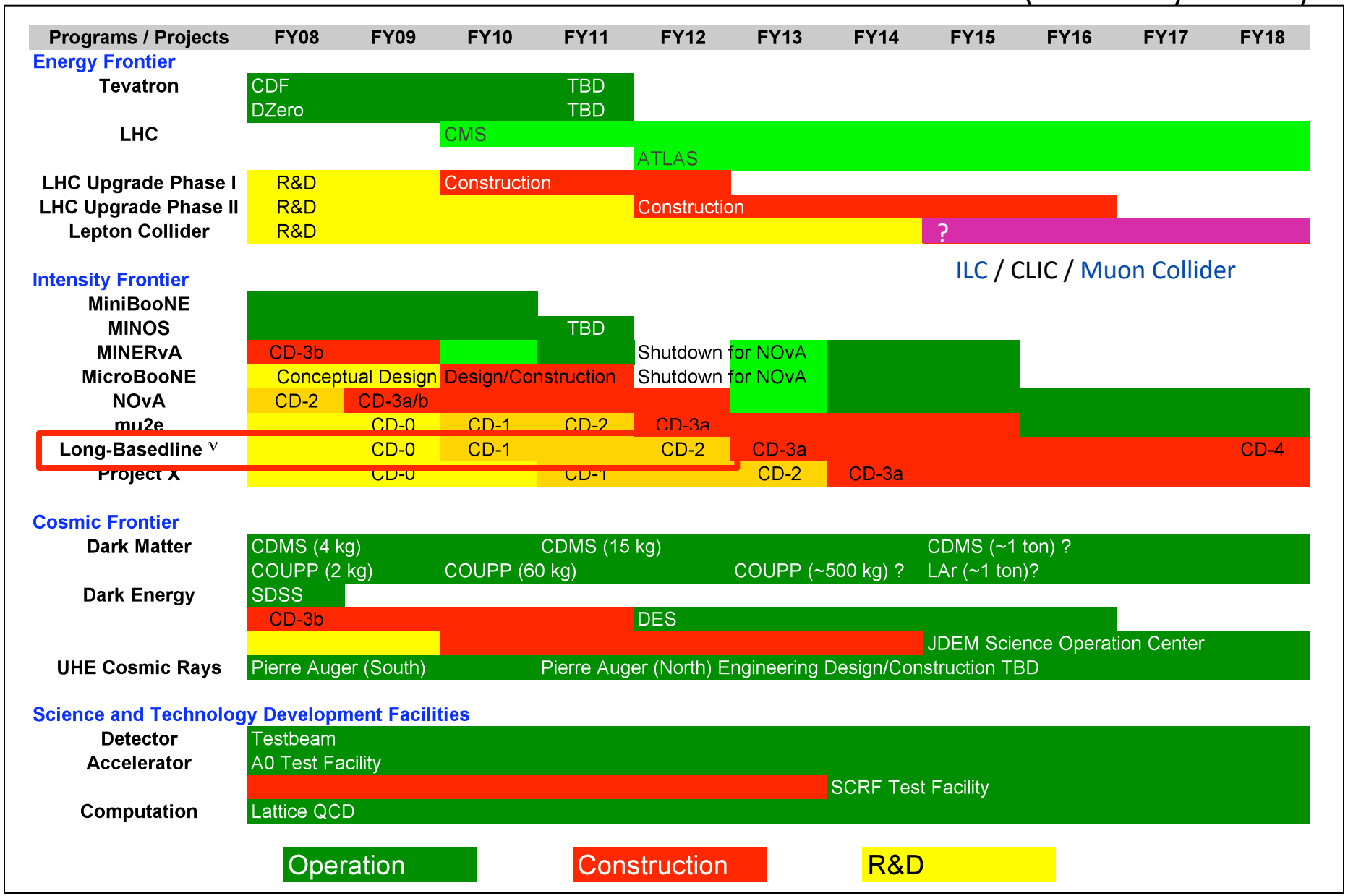
What stage is the project in?

- Documentation for CD-0 has been prepared by DOE
  - Needs to be approved by the Deputy Secretary
  - Goal : October 31, 2009
- Current Plan is to be ready for CD-1 by end of December 2010
  - Driven by DOE desire to use PED funds in FY11
  - To support the DUSEL Case to the NSF* NSB* in February 2011

* National Science Foundation – National Science Board

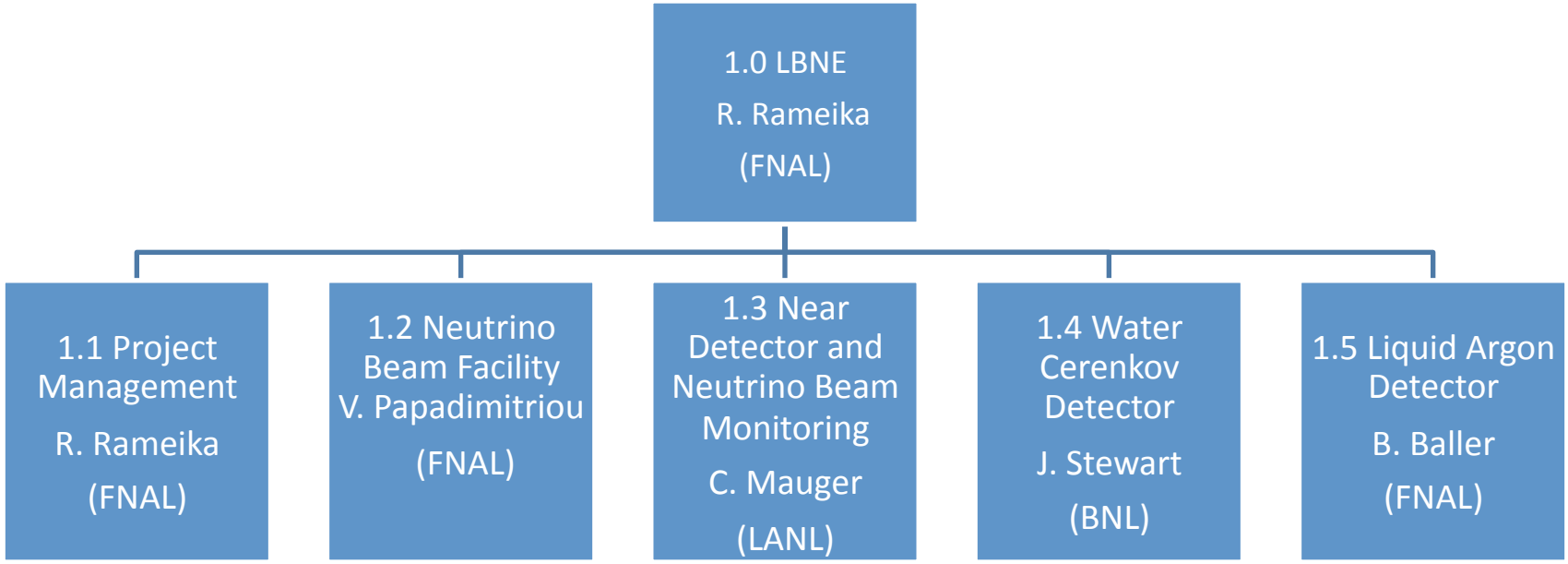
Fermilab Ten-Year Plan at The Three Frontiers

(Technically Limited)



Division of Labor

- Initially, FNAL was “assigned” responsibility for Project Management, Beam and Near Detector; BNL responsible for “far detector”
- Between November 2008 and Spring 2009 the project organization evolved ….


1.0 LBNE
R. Rameika
(FNAL)
1.1 Project Management
R. Rameika
(FNAL)
1.2 Neutrino Beam Facility
V. Papadimitriou
(FNAL)
1.3 Near Detector and Neutrino Beam Monitoring
C. Mauger
(LANL)
1.4 Water Cerenkov Detector
J. Stewart
(BNL)
1.5 Liquid Argon Detector
B. Baller
(FNAL)

What has been accomplished?

LBNE : Scope of Work to Reach CD-1

June 7, 2009

This document presents the Scope of Work required for the Project Definition Phase of the Long Baseline Neutrino Experiment (LBNE) project. This phase will cover the work period beginning with CD-0 through a CD-1 readiness review.

http://lbne-docdb.fnal.gov

User name : lbne
PW : ask Vaia

An update of this document and the budget workbook is in progress; Could not complete it in time for this presentation.

LBNE CD-1 Work Plan

- The LBNE work plan that we have developed covers the scope of work to prepare the project for the CD-1 review
  - Scale : $23 M
  - Time frame : 12 – 18 months

This is a respectable project in itself, and needs to be organized as such; CD-1 documentation is the clear deliverable. This concept takes some getting used to for many scientists and engineers.

CD-1 Deliverables : Documentation

1. Prepare a Conceptual Design Report (proposed outline is below) - Project Team
2. Prepare an Acquisition Strategy - Project Team in consultation with DOE
3. Comply with the One-for-One Replacement legislation - Project Team in consultation with DOE
4. Prepare a Preliminary Project Execution Plan - Project Team in consultation with DOE
5. Approve appointment of the Federal Project Director -DOE
6. Establish and charter an Integrated Project Team -DOE
7. Conduct a design review of the conceptual design - Project Team , DOE
8. Prepare a Project Data Sheet - DOE
9. Approve long lead procurements (if necessary) - DOE
10. Implement Integrated Safety Management into management and work process planning - Project Team
11. Prepare environmental documents - Project Team
12. Prepare a Preliminary Security Vulnerability Assessment Report - Project Team
13. Determine that the Quality Assurance Program (institutional) is acceptable and continues to apply - Project Team and FNAL staff

Project Organization

- High Level WBS and WBS dictionary being developed
- Relationships to Science Collaboration and DUSEL being defined
- Organizational Breakdown Structure and Responsibility Assignment Matrix under development
  - These are two extremely important concepts to be developed for this project
  - To do them correctly will require agreement on where the far detector will be located and who is responsible for what
- For our current design effort we are assuming the site is Homestake

- Project Management progress since February
  - 3 iterations on a CD-1 Plan of Tasks and Deliverables
  - Budget plan for CD0 ➔ CD1
  - Assembled a *well integrated, effective team*
- Short term goals (August-September)
  - Project Offices staffed with managers; administrative support, budget and schedule manpower assigned
  - MOU's and SOW's in place
  - Coordination with Science Collaboration and S4 goals
  - Budgets for ARRA funds established and P.O.s being placed as appropriate
- FY10 Plan
  - Support the project teams to develop and cost their conceptual designs
  - Coordinate preparation of the CD-1 documents

Technical Progress

- Neutrino Beam
  - Target Hall Concept
  - Underground and conventional layout of facility
  - Cost estimate in progress
  - Making a plan for High Power target R&D (Vaia)
- LAr Detector
  - Cryostat concepts
  - Plans for contract engineering
  - Electronics development plan
  - Progress on LAPD

Who is currently working on it?

Are there enough Scientists to guide the work?

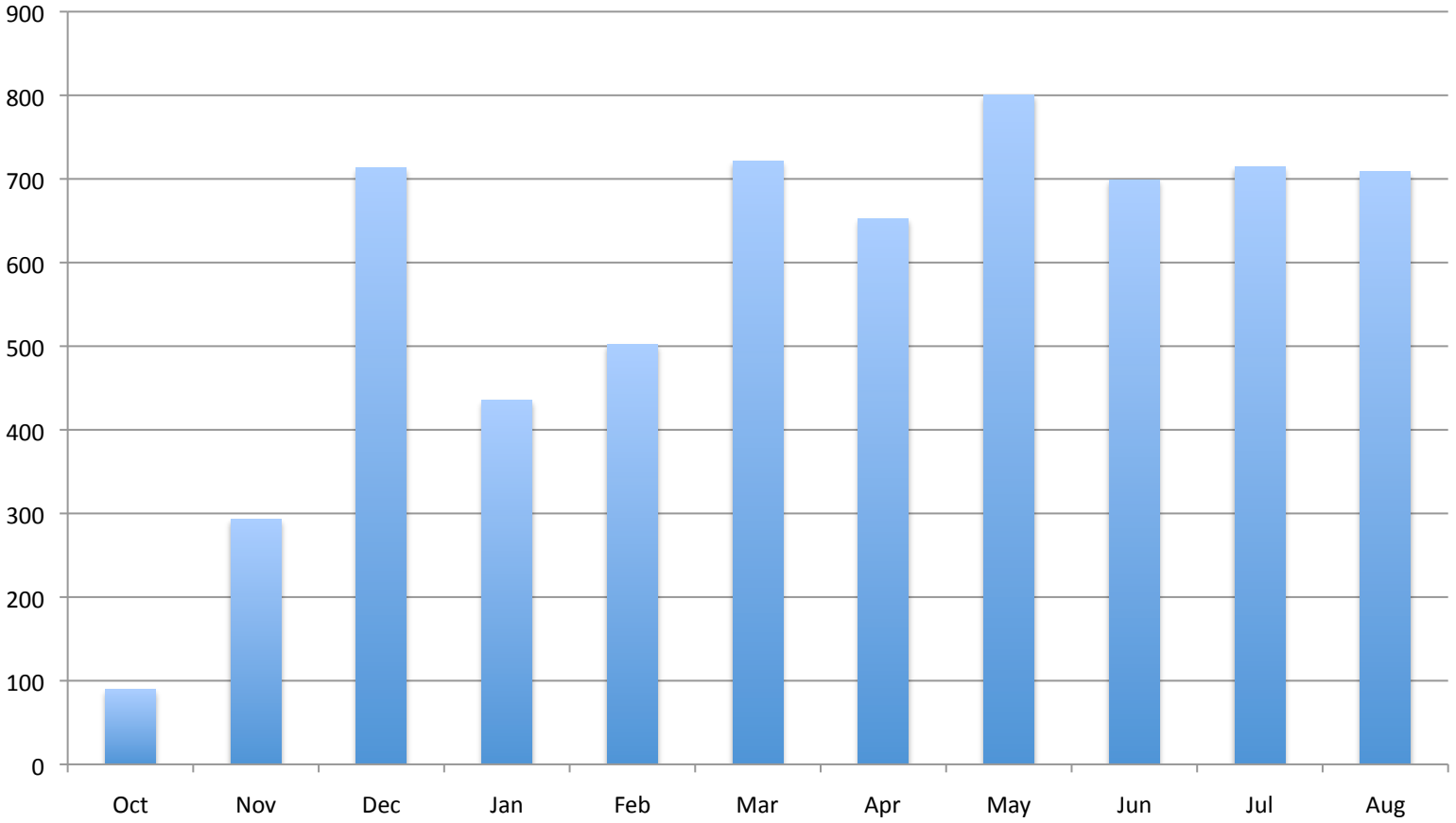
Are there any commitments for adding people?

FY09 Effort Reporting (through August)

	Name	Type	YTD	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1.1.1	Rameika, R.	Scientist	1551		144	168	144	132	176	208	160	176	176	67	
1.1.1	Wright, S.		11											11	
1.1.2	Papadimitriou, V	Scientist	8											8	
1.1.5	Baller, B.	Scientist	30											30	
1.2.1	Lucas, P.	Ap. Scientist	919			109	87	57	148	136	61	79	110	131	
1.2.1	Koizumi, G.	Eng. Physicist	374			88	43	32	35	36	33	37	35	34	
1.2.1 & 1.2.4	Childress, S.	Scientist	482			56	42	40	34	42	64	58	68	77	
1.2.2	Hurh, P.	Engineer	173						46	18	33	27	20	29	
1.2.2	Hurd, D.	Designer	92								75	17			
1.2.2	Hylen, J.	Scientist	546			103	27	62	90	67	50	34	64	49	
1.2	Lundberg, B.	Scientist	367					48	70		96	74		78	
1.2.2	Martens, M.	Scientist	92			45		26						22	
1.2	Zwaska, B.	Scientist	94			26	4	10	16	16	8	3	9	2	
1.2.4	Hammond, L.	FESS Engineer	98					2	3	0	25	30	28	10	
1.2.4	Lackowski, T.	FESS Engineer	183			9	20	23	8	29	22	33	21	18	
1.2.4	Federowicz, C.	FESS Engineer	39										7	32	
1.2.4	Vanzandbergen, G	FESS Engineer	5								1	2	2		
1.2.4	Wyman, T.	FESS Engineer	15											15	
1.2.4	Laughton, C.	Ap. Scientist	232								64	88		80	
1.4 & 1.5	Laughton, C.	Ap. Scientist	812	90	150	109	68	70	88	68	64		106		
1.4.1 & 1.4.3	Allspach, D.	Engineer	71						8	16	14	16	17		
1.5	Schmitt, R.	Engineer	47									10	26	10	
?	Krempetz, K.	Engineer	92							16	30	13	26	6	

These are hours of effort…..

Hours of Effort



Current Level of Effort : ~ 700 hrs/month

1 FTE = 160 hrs/month ➔ 4.4 FTE

(mostly scientists)

Determining Manpower Resource Requirements

From our CD-1 planning Exercise for DOE

- Methodology
  - Location independent analysis
  - Initial analysis independent of funding source (pre-ARRA)
  - Used common, average rates for three categories:
    - Engineering/Technical
    - Administrative
    - Scientific
    - Research Associate
  - Categorized into :
    - Available and working
    - Identified within the collaborating institutions (but not "assigned" or supported
    - New Hires
- Status of the analysis
  - Several iterations since February
  - "scrubbing" exercise in May
  - **Sub-project managers now "in control" – estimates are evolving and improving**
  - Today's numbers may be different from previous spreadsheets, but (hopefully more accurate)
  - So close to the end of FY09, that I would like to have just one set of tables to reflect the plan starting with the current budgets independent of FY
  - It's difficult to make good SWF budget estimates without knowing when the manpower is actually coming on board (the M&S is much easier)
    - This tends to work in favor of spending less money – at the expense of not getting the work done

FY10 Scope of Work

- Please see the schedule handout
  - It includes CD-1 preparation tasks and milestones

Major Milestones in the official ARRA Work Authorization

- Establish project offices at FNAL and BNL – August 09
- First Review of CD-1 progress - Feb 10
- Complete first draft of Alternatives Analysis document - April 10
- Complete Phase I site investigation for Neutrino Beam – May 10
- Complete preliminary cost estimate – Oct 10
- Complete Risk Analysis – Nov 10
- Conduct Review of Complete Conceptual Design Report for CD-1 – Dec 10

FY10 (+ Q1FY11) Resource Needs

					CD0 - CD1											
WBS	Task name				Labor (FTE)											
		Total	non-Sci	Sci	Technical			Administrative			Scientists			RA/Post-doc		
					W	A	N	W	A	N	W	A	N	W	A	N
1.1	**Project Management**															
SWF																
1.1.1	Project Coordination	7.2	4.4	2.8	0.40		1.00	0.50	1.50	1.00	1.00	1.75				
1.1.2	Neutrino Beam	3.4	2.4	1.0	0.40	0.50	1.00		0.50		1.00					
1.1.4	Water Cerenkov Detector	3.0	2.0	1.0			1.00			1.00	0.50	0.50				
1.1.5	Liquid Argon Detector	1.0	0.2	0.8	0.10				0.10		0.80					
	FNAL FTE Totals	**14.6**	9.0	5.6	0.9	0.5	3	0.5	2.1	2	3.3	2.25	0			
	SWF ($K)	**3905**	2240	1665	270	150	900	100	420	400	990	675	0			

W = working

A = “available” -> identified but not assigned

N = new hire

We can make these spreadsheets available

					CD0 - CD1											
WBS	Task name				Labor (FTE)											
		Total	non-Sci	Sci	Technical			Administrative			Scientists			RA/Post-doc		
					W	A	N	W	A	N	W	A	N	W	A	N
1.1	**Project Management**															
SWF																
1.1.1	Project Coordination	7.2	4.4	2.8	0.40		1.00	0.50	1.50	1.00	1.00	1.75				
1.1.2	Neutrino Beam	3.4	2.4	1.0	0.40	0.50	1.00		0.50		1.00					
1.1.4	Water Cerenkov Detector	3.0	2.0	1.0			1.00			1.00	0.50	0.50				
1.1.5	Liquid Argon Detector	1.0	0.2	0.8	0.10				0.10		0.80					
	FNAL FTE Totals	**14.6**	9.0	5.6	0.9	0.5	3	0.5	2.1	2	3.3	2.25	0			
	SWF ($K)	**3905**	2240	1665	270	150	900	100	420	400	990	675	0			

Regina Rameika: Rameika

Regina Rameika: new PM, FNAL scientists to help with documentation

Regina Rameika: Papadimitriou + Lundberg

Regina Rameika: Baller

Regina Rameika: Integration - Laughton

Regina Rameika: Laughton - civil coordination

Regina Rameika: Rich Schmitt

Regina Rameika: ES&H coordination

Regina Rameika: Project Engineer or Manager

Regina Rameika: Project Engineer

Regina Rameika: Admin, DO Budget, DO schedule

Regina Rameika: Budget, project controls

Regina Rameika: AD budget and schedule support

Regina Rameika: Add more support in 2nd half of year for CD-1 preparation

Regina Rameika: additional half admin Project controls and budget person half time each

Regina Rameika: P. Mantsch - PM for PMTs

Regina Rameika: Project Controls Specialist for PMTs

Regina Rameika: Project Engineer for PMTs

Regina Rameika: Deputy PM for PMTs

		CD0 - CD1														
WBS	Task name	Labor (FTE)														
		Total	non-Sc	Sci	Technical			Administrative			Scientists			RA/Post-doc		
					W	A	N	W	A	N	W	A	N	W	A	N
1.2	**Neutrino Beam**															
SWF																
1.2.1	Primary Beam	2.40	1.10	1.30	0.40	0.70					0.75	0.30				0.25
1.2.2	Target Hall Devices	4.85	2.70	2.15	0.10	0.10	2.50				0.40	0.50	1.00			0.25
1.2.3	Integration	0.45	0.25	0.20		0.25					0.05	0.15				
1.2.4	Civil Construction	0.35	0.00	0.35	0.00						0.35					
	1.2 FTE Totals	**8.05**	4.05	4.00	0.50	1.05	2.50				1.55	0.95	1.00			0.50
	1.2 SWF ($K)	**2340**	1215	1,125	150	315	750				465	285	300	0	0	75

		CD0 - CD1														
WBS	Task name	Labor (FTE)														
		Total	non-Sc	Sci	Technical			Administrative			Scientists			RA/Post-doc		
					W	A	N	W	A	N	W	A	N	W	A	N
1.2	**Neutrino Beam**															
SWF																
1.2.1	Primary Beam	2.40	1.10	1.30	0.40	0.70					0.75	0.30				0.25
1.2.2	Target Hall Devices	4.85	2.70	2.15	0.10	0.10	2.50				0.40	0.50	1.00			0.25
1.2.3	Integration	0.45	0.25	0.20		0.25					0.05	0.15				
1.2.4	Civil Construction	0.35	0.00	0.35	0.00						0.35					
	1.2 FTE Totals	**8.05**	4.05	4.00	0.50	1.05	2.50				1.55	0.95	1.00			0.50
	1.2 SWF ($K)	**2340**	1215	1,125	150	315	750				465	285	300	0	0	75

Regina Rameika: new RA to work with Bob Zwaska

Regina Rameika: New RA to work on Beam Fluxes for MC studies

Regina Rameika: Childress - .25 Lucas - .5

Regina Rameika: Redirected Scientific Effort to assist in cost and schedule prep - person like Baller or Grossmann

Regina Rameika: G. Velev or TD equivalent

Regina Rameika: New AS assignment ES&H Rad Safety Physicist

Regina Rameika: Hylen - 0.3 Martens - 0.1

Regina Rameika: Koizumi

Regina Rameika: P. Hurh

Regina Rameika: AD Engineering Support for System Leader

Regina Rameika: 0.1 addional of P.Hurh;

Regina Rameika: Childress

Regina Rameika: person like Bob Zwaska

Regina Rameika: FESS effort in M&S

Regina Rameika: AD New Hires if not available from existing staff - ME to become part of project team to be ready for next phase of design; at least 1.0 on target; rest on other

Regina Rameika: Engineering, Designing, Estimating from TD for new magnets (.4); AD Power Supplies, systems (.3)

		FY10											FY11
WBS	Task name	Labor (FTE)											
		Total	non-Sc	Sci	Technical		Administrative		Scientists		Post-docs		Technical
					A	N	A	N	A	N	A	N	A
1.5	**LAr Detector**												
Labor													
FNAL													
1.5.1	Project Management												
1.5.2	Cryogenics System				0.5								1
1.5.3	Cryostat				1								2
1.5.4	TPC				0.5								2
1.5.4	Readout and DAQ												
1.5.5	Cavern and Infrastructure												
1.5.7	Installation				0.5								1
1.5.8	Photon Detectors												
	1.5 FNAL FTE Totals	0	0	0	2.5	0	0		0	0		0	6
	1.5 FNAL SWF ($K)				750	0	0	0	0	0	0	0	1800

		FY10												FY11
WBS	Task name	Labor (FTE)												
		Total	non-Sc	Sci	Technical		Administrative		Scientists		Post-docs			Technical
					A	N	A	N	A	N	A	N		A
1.5	**LAr Detector**													
Labor														
FNAL														
1.5.1	Project Management													
1.5.2	Cryogenics System				0.5									1
1.5.3	Cryostat				1									2
1.5.4	TPC				0.5									2
1.5.4	Readout and DAQ													
1.5.5	Cavern and Infrastructure													
1.5.7	Installation				0.5									1
1.5.8	Photon Detectors													
	1.5 FNAL FTE Totals	0	0	0	2.5	0						0		6
	1.5 FNAL SWF ($K)				750	0	0	0	0	0	0	0		1800

Bruce Baller:
Schmitt - monitor engineering consultants

Bruce Baller:
Schmitt,Tope - cryostat, LAPD & ArgoNeut support, ODH analysis
+ designer support

Bruce Baller:
ASIC eng + support tech Cold Electronics

Bruce Baller:
Kilmer - installation planning
+ designer support

Bruce Baller:
Start final design using outside services (eg Air Liquide). FNAL eng writes specs, monitors contracts

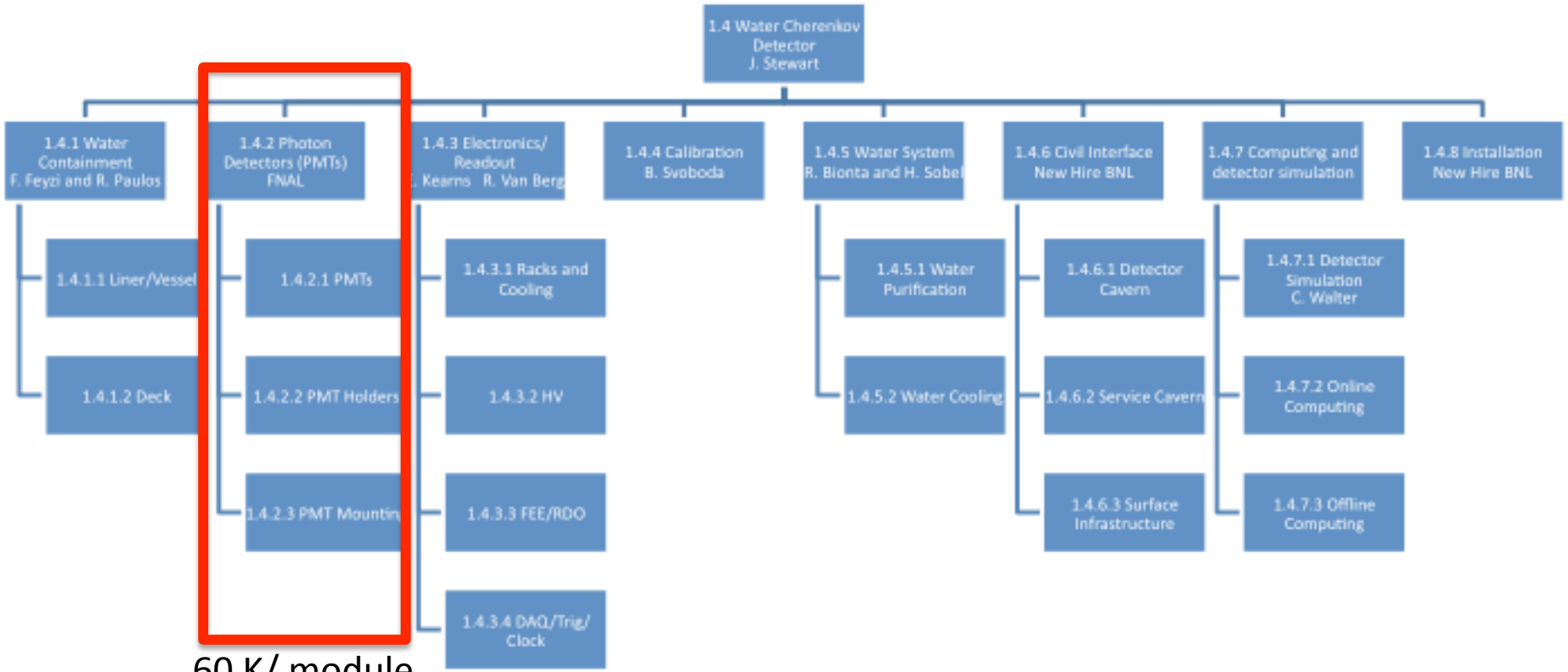
Bruce Baller:
Final design: 1 eng, 0.2 designer
1kt prototype design: 0.5 eng, 0.2 designer

Bruce Baller:
Cold electronics: 1 ASIC eng + tech
Feedthrough?: 0.5 cryo eng, designer

Bruce Baller:
Installation planning
1kt prototype planning

PMT System

- Project Management/Procurement
  - Project Engineer (FT)
  - Project Controls Specialist (FT)
  - Deputy manager (scientist) (PT)



60 K/ module

FY11 Scope of Work

- FY11Q1
  - Level of effort on CD-1 preparation continues as in FY10
  - Additional technical effort to do advanced design for CD-1 to CD-2 needs to be identified and ready to begin work
- FY11Q2-Q4
  - Work will be to produce designs, cost and schedule for the CD-2 Baseline
  - Engineering plus project support will need significant increase

A look to the “out years”

- FY12-14
  - “Final” designs
  - Preparations for CD-3
  - Major prototyping (LAr, targets, remote handling..)
  - Possible test-beam program(s)
- Level of effort needs to be in the dozens
  - Engineering for beam systems
  - Cryogenics (if building LAr)
  - Project Controls (post-CD-2 : EVMS reporting)

OHAP data

- 2008 exercise for beam was based on NuMI "extrapolation" and increased PM and ES&H support
- Detector concepts and responsibilities were undefined at the time
  - Assumed responsible for cavern and detector design
  - All institutions – not just FNAL

	2008	2009	2010	2011	2012	2013	2014
Beam - CD-2?							
2012	1.2	22	26	38	72		
2014	1.2	8	14	24	34	36	37
Detector - WC100							
Civil		37	41	45	54		
Technical		37	41	43	53		

Realistic?

- Detector project will get defined after CD-1
- Responsibilities depend on participation of collaboration and division of labor with the funding agencies
- Fermilab role may range from very large to quite modest
  - Anticipate significant contributions from collaborating institutions (M&S)
  - Fermilab role will depend on "interest" and areas of expertise
- I just don't see the numbers in this (2008) exercise being realized, even if they are needed
  - The current CD-1 plan seems more realistic and achievable

Who is currently working on it?
At the end of FY09 we have ~4 FTEs, mostly scientists

Are there enough Scientists to guide the work?
NO. Need more to help with documentation; need more to play a major role in the detector design choices and eventual construction. ← Can't count on "volunteers" ; Directorate needs to assign people!

Are there any commitments for adding people?
We have an Associate Scientist position, and will likely have one more; we have RA positions to be filled; **Need Project Specialists (budget, scheduling and controls); Need Mechanical and Cryo engineers.**

Backup

2008 OHAP

Beam
2012 CD-2

	DUSEL Beam Design					
Discipline	Functional Group	2008	2009	2010	2011	2012
Administration	Accounting					
	Administrative Support	0.01	0.15	0.15	0.20	1.50
	Audit					
	Budget		0.10	0.10	0.10	0.75
	General Administrative					
	Legal				0.05	0.10
	Library					
	Procurement		0.20	0.15	0.25	0.80
	Project Controls		0.25	0.25	0.50	2.00
	Project Management	0.05	0.70	0.50	2.00	4.00
	Public Relations		0.02	0.03	0.05	0.15
	Temporary					
	Training					
	Travel					
	Totals	1.32	5.25	11.78	14.50	15.60

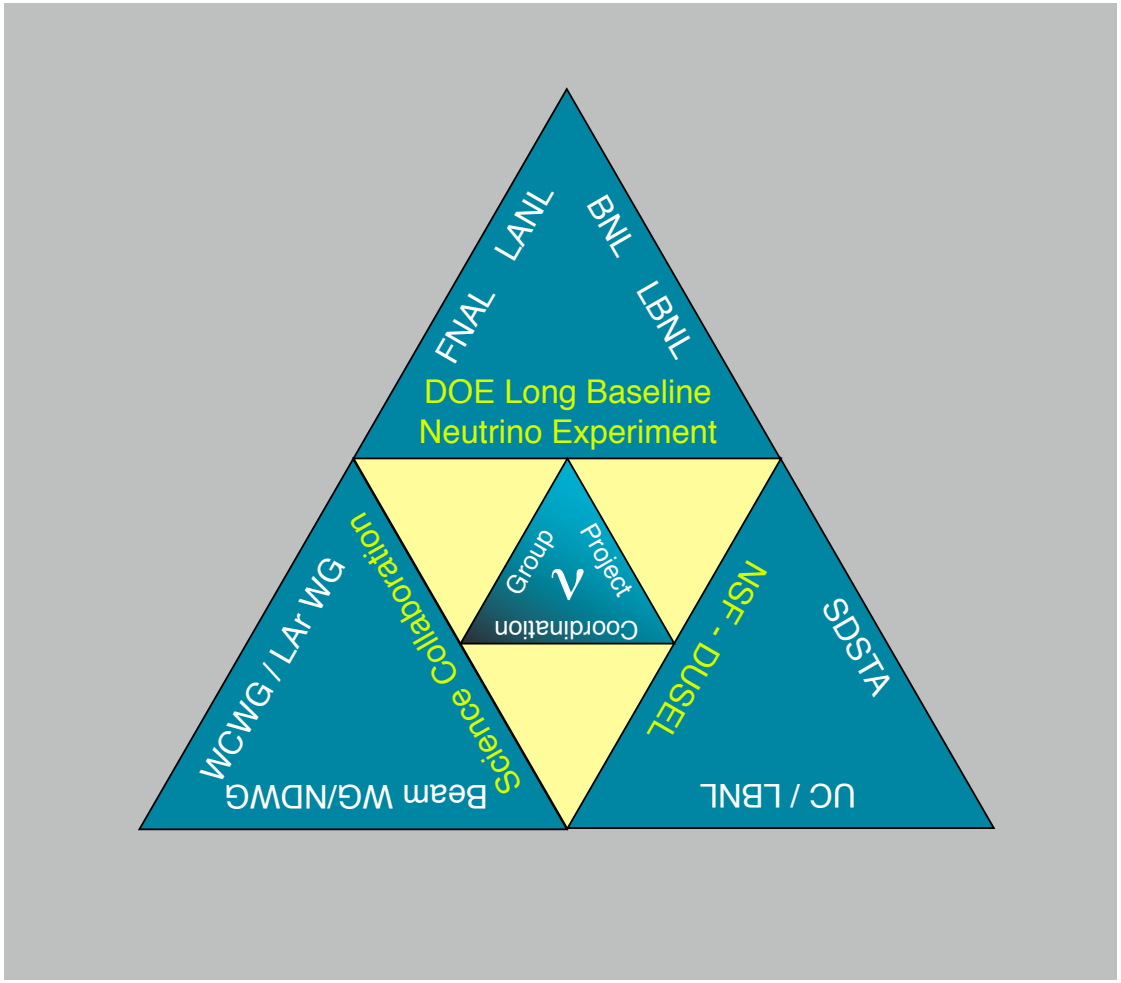
Discipline	Functional Group	2008	2009	2010	2011	2012
Engineer	AC Power Engineer		0.15	0.15	0.20	0.40
	Accelerator Technology Engineer					
	Architect		0.50	0.40	0.50	1.00
	ASIC Engineer					
	Chemical Engineer					
	Civil Engineer	0.20	4.00	4.00	6.00	6.00
	Controls Engineer		0.10	0.10	0.10	0.45
	Co-Op Student					
	Cryogenic Engineer					
	Electrical Engineer		0.15	0.15	0.25	1.50
	Electronics Engineer					
	Engineering Physicist	0.20	2.50	2.00	2.50	6.00
	Fire Protection Engineer		0.10	0.05	0.05	0.10
	Instrumentation Engineer			0.50	0.50	1.00
	Interlock Engineer				0.50	1.00
	Mechanical Engineer	0.20	1.50	2.00	3.00	6.00
	Metrologist					
	Power Systems Engineer		0.15	0.25	0.50	1.00
	Pulsed Power Engineer					
	RF Engineer					
	RF Power Engineer					
	Structural Engineer		0.55	0.40	0.50	1.00
	Switch Mode and General Power Supply Engineer					
	Totals	0.60	9.70	10.00	14.60	25.45

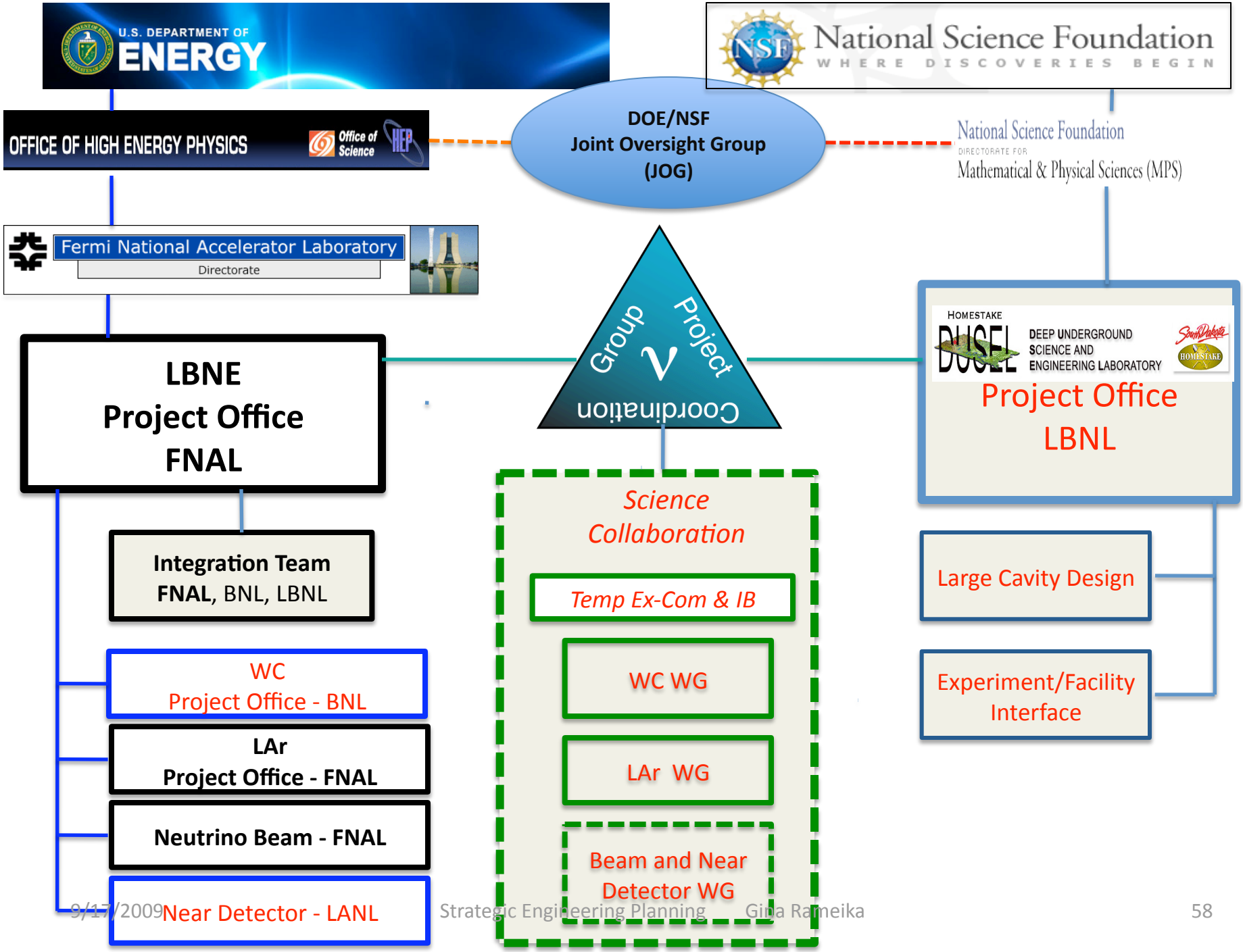
Discipline	Functional Group	2008	2009	2010	2011	2012
ES&H	Construction Safety	0.05	0.30	0.25	0.25	0.50
	Electrical Safety	0.05	0.10	0.05	0.05	0.10
	Emergency Planner					
	Environmental		0.50	0.50	0.50	1.00
	General ES&H		0.40	0.20	0.20	0.40
	Industrial Hygienist					
	Laboratory Analysis					
	Occupational Medicine Nurse					
	Occupational Medicine Physician					
	Radiation Protection	0.05	0.75	0.75	1.00	2.00
	Safety	0.05	0.20	0.10	0.10	0.20
	Waste Management					
	Totals	0.20	2.25	1.85	2.10	4.20

Discipline	Functional Group	2008	2009	2010	2011	2012
Scientific	Accelerator Physics - Experimentalist	0.25	3.00	3.00	4.00	8.00
	Accelerator Physics - Theorist					
	Application Scientist		2.00	2.00	2.00	4.00
	Chemist					
	Magnet Scientist					
	Particle and Particle Astrophysics - Experimental	0.5	3.50	3.00	4.00	8.00
	Particle Astrophysics - Theorist					
	Particle Physics - Theorist					
	Post Doc		0.50	0.50	0.50	0.50
	RF Scientist					
	Totals	0.25	9.00	8.50	10.50	20.50

	DUSEL Beam Design					
Discipline	Functional Group	2008	2009	2010	2011	2012
Technical	AC Power Technician					
	Accel Operations					
	Alignment Specialist	0.05	0.30	0.20	0.20	0.40
	Chemical Lab Technician					
	CNC Machinist					
	Controls Technician					
	Cryogenic Technician					
	Designer - Electrical		0.30	0.40	1.00	2.00
	Designer - Mechanical		0.30	1.00	2.00	4.00
	Drafter - Electrical			1.00	1.00	2.00
	Drafter - Mechanical			2.00	3.00	6.00
	Electrical Assembly Technician					
	Electrical Technician					
	Electronics Technician					
	Generalist Technician					
	Instrument Machinist					
	Instrumentation Technician					
	Interlock Technician					
	JULIE Coordinator					
	Machinist					
	Mechanical Assembly Technician					
	Mechanical Technician					
	Power Systems Technician					
	Pulsed Power Technician					
	Quality Assurance					
	Quality Control Technician					
	RF Power Technician					
	Switch Mode and General Power Supply Technician					
	Tech Leader					
	Welder					
	Total	0.05	0.90	4.60	7.20	14.40

Interfacing to other stakeholders (February Triangles)




U.S. DEPARTMENT OF ENERGY
National Science Foundation
WHERE DISCOVERIES BEGIN
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DOE/NSF
Joint Oversight Group
(JOG)
National Science Foundation
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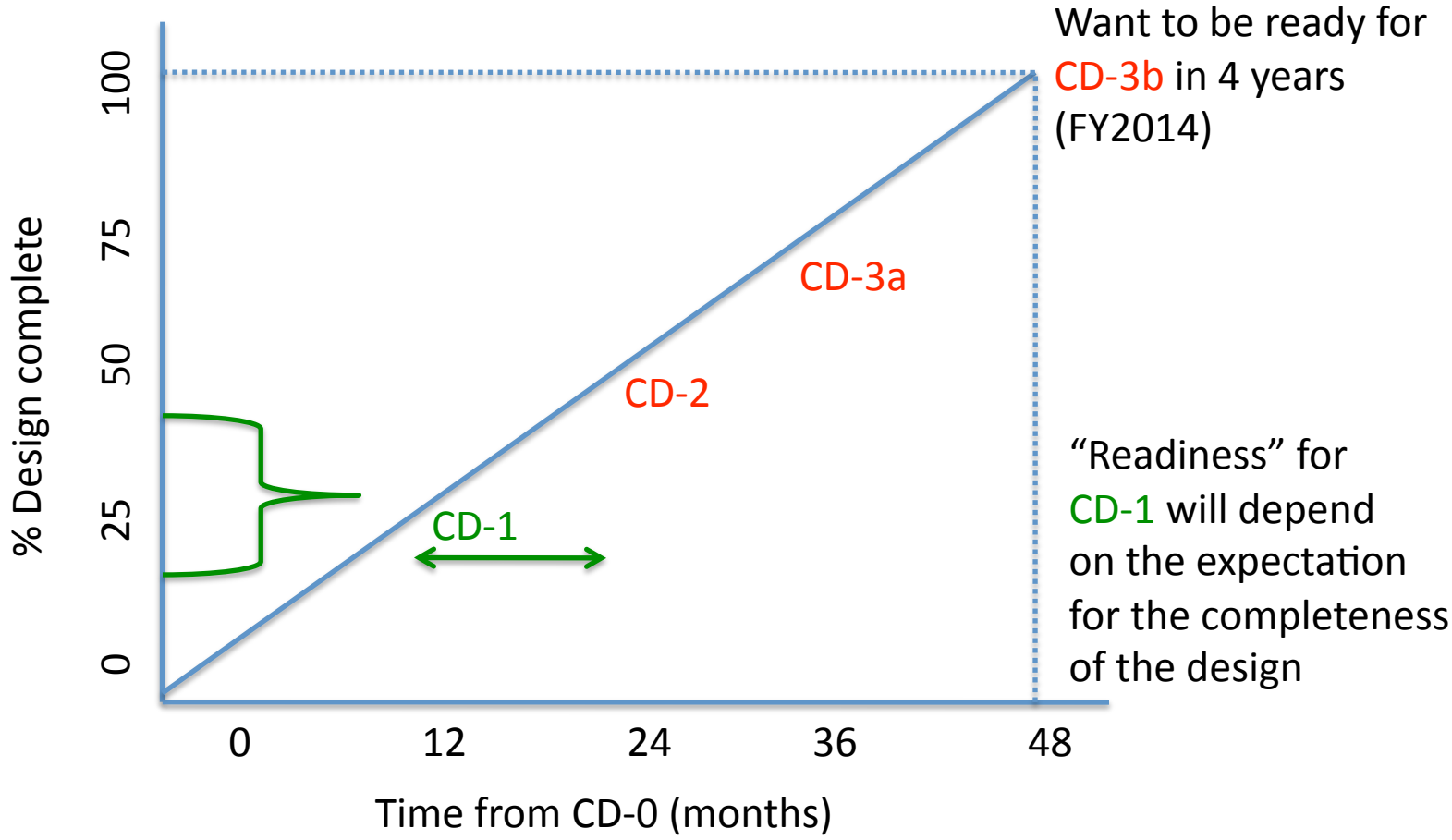
Mathematical & Physical Sciences (MPS)
Fermi National Accelerator Laboratory
Directorate
Group
Project
ν
Coordination
LBNE
Project Office
FNAL
HOMESTAKE
DEEP UNDERGROUND
SCIENCE AND
ENGINEERING LABORATORY
Project Office
LBNL
Integration Team
FNAL, BNL, LBNL
Science
Collaboration
Temp Ex-Com & IB
WC WG
LAr WG
Beam and Near
Detector WG
Large Cavity Design
Experiment/Facility
Interface
WC
Project Office - BNL
LAr
Project Office - FNAL
Neutrino Beam - FNAL
Near Detector - LANL

Goal for a CD Timeline



Major Challenges and Risks (to achieve the CD-1 timeline)

- Building consensus and converging on Conceptual Designs which can be used for determining a cost range and preliminary schedule, while at the same time pursuing alternative designs which may improve performance, reduce cost, reduce technical and schedule risk……
- Applying adequate engineering resources to the areas where the design work is needed for *this* phase
- Underestimating the time it takes to assemble a cost estimate and create a schedule
- Underestimating the time and manpower required to produce the documentation required, in addition to the CDR
- Not pursuing detailed engineering, even though it may be availably, prematurely