Report from Fermilab's DUSEL Beamline Working Group

Jeffrey A. Appel, Fermilab

Workshop on Underground Detectors Investigating Grand Unification (UDiG)

October 16, 2008

Outline

- Charge
- Membership
- Meetings
- NuMI Lessons Learned
- Typical Project Team at Fermilab
- WG Not the Project Team
- Fermilb Policy

Working Group Charge

Fermilab is intent on pursuing the strongest possible program to make use of our proton beam capabilities. In the future, especially with the pursuit of Project X, this will include further development of very-long-baseline neutrino experiments. One of the options may be for a beam directed at a Deep Underground Science and Engineering Laboratory (DUSEL) at the Homestake Mine site. We need to develop a plan for the beam for this opportunity in order to understand the optimum parameters, costs, and possible schedule for such a beam.

The DUSEL Beamline Working Group is charged with development of a conceptual plan for an appropriate beam from the Fermilab Main Injector to DUSEL, starting with work already available, and understanding relevant trade-offs in capability and cost or schedule, and other issues which may arise in its studies. The plan should include (but not be limited to) issues related to matching the DUSEL beamline optics to the optics of the MI60-extracted beam, new civil construction, targeting, other beamline optics, beamline components, near detector hall, and beamline instrumentation. The plan should incorporate the assessment and mitigation of all potential safety hazards and environmental impacts, and include public involvement initiatives.

June 6, 2008

Working Group Membership

Jeffrey Appel (Chair)

Mike Andrews
Dixon Bogert
Alan Bross
Sam Childress
Don Cossairt
Bill Griffing
Nancy Grossman
Dave Harding
Jim Hylen
Vic Kuchler
Chris Laughton
Byron Lundberg
Mike Martens
Elaine McCluskey
Rob Plunkett
Gina Rameika
Gueorgui Velev
Bob Zwaska

- Ex-Officio: Young-Kee Kim and Steve Holmes
- Laboratory Coordinators

  ANL: Bob Wagner
  BNL: Mary Bishai, Stephen Kahn, and Milind Diwan
  LBNL: John Corlett and Mike Zisman

Meetings

- First meeting was April 30, 2008.
- Now, weekly at 11:00 (Central Time) on Mondays.
- Presentations and summaries of meetings are publicly available.
- See them at URL

  http://beamdocs.fnal.gov/SNuMIpublic/DocDB/ListBy?topicid=97

First Meeting Topics

- Understanding the Charge
- Defining the relationship to Project X
- Preliminary look at siting of the beamline
- Personnel needs to get to a CDR for the beamline
- Project planning tool (WBS spreadsheet and timing)

Relation to Project X

- Major overlapping items in the Project X:

  Target
  Horn system
  Remote handling facilities.

- In spite of overlaps, the parameter differences and their implications might be quite important.

- Note: effects of beam specification differences on the target, possible differences in focusing horn neck and peak currents (200 KA vs 250 KA), and corrosion issues relating to differences in the environments (proton-on-target power, if different, and possible differences in atmosphere).

- There is a $1M item in the Project X WBS for a prototype horn for NuMI – out of a total Project X R&D M&S of $4M.

Siting and Relation to NuMI

- See Dixon Bogert presentation at November Project X workshop on a DUSEL beam being sited at Fermilab.
- Concept is to connect to the NuMI Carrier Tunnel with a 5.84 degree down-sloping, compound-curve tunnel toward DUSEL.
- Closest interference is with the bottom of the NuMI target shaft, but not expected to be a problem.
- The target surface building would be in an existing meadow (as opposed to the middle of an actively-used area).
- Extraction from MI-10, even with a shorter decay pipe, was not viewed as possible – given the shorter straight section there, relative to the MI-60 region where NuMI extraction occurs now .

Why Lessons Learned from NuMI Now?

- Many people have been scaling things from the NuMI experience, so it seems appropriate to go back to that and learn what we can from it.
- This would be worthwhile even in its own right, of course!

Lessons Learned from NuMI

8/25	Target, Horns, and Enclosures	Jim Hylen
9/08	Decay Pipe/Window and Cooling	Dave Pushka
9/15	Underground Experience	Chris Laughton and Tom Lackowski
9/22	ES&H Experience	Don Cossairt and Mike Andrews
9/29	Systems Integration and Extraction/Primary Beam	Sam Childress .
10/13	Public Liaison	Judy Jackson
10/20	Radiology	Byron Lundberg
10/27	Tritium Mitigation	Rob Plunkett
11/3	NuMI Magnets	Dave Harding
11/10	Geodesy and Alignment	Virgil Bocean

Examples of Lessons and Discussions

What follows are examples of what the Working Group has been hearing and discussing.

There are many, many more things one can learn, and that were presented and/or discussed.

Some specific recommendations also appear.

The presentations and meeting summaries are meant to be resources for the future efforts.

Cost of Being a Flagship

With the DUSEL beamline and physics becoming the flagship for Fermilab, it will not be acceptable to take the level of risk associated with the NuMI project.

There are serious cost implications of this point, and it will not be appropriate to simply use the NuMI cost escalated and with some small additional contingency to get to the cost for the DUSEL beamline.

DOE requirements have also become much more strict now, relative to the NuMI project era.

Targets/Horns/Enclosures

Three most serious problems:

1. tritium production and mitigation
2. decay pipe window corrosion and safety
3. lack of early spares for target and horns

Recommendation: reduced reliance on longevity of components; rather, more (cheaper and more rapidly assembled) spares and designs for rapid component replacement

Underground Work

- Points: underground work costs are hard to predict, NuMI turned out well in the end, and that ES&H are a constant concern.
- Value engineering was done with unit pricing. However, inadequate consideration was given to “indirect costs” in some of the effort. Unit pricing is not the whole story.
- “Validation of costs” likely to be more useful than “independent cost estimates” since the indirect costs will likely be distributed differently, and be hard to track directly.
- Costs should be reviewed “early and often” – all the way to the bid time. In NuMI, the negotiations with the selected contractor on how to reduce costs to stay within budget, took from November to March the next year!

Decay Pipe

Went to a helium-filled pipe after corrosion was observed at the beam spot on the decay-pipe window.

Had the design been He-filled from the start, the windows could have been thinner, leading to less beam-generated heat.

Window failure calculations were only done after the corrosion was observed, being viewed as unneeded since the system was built “to code”. The concern about the window was not so much the corrosion itself, but the expectation that there were fracture cracks developing through the aluminum – an effect reported in x-ray environments.

In discussion, we were reminded that it is important to understand the underground environment better to help us foresee problems.

ES&H Lessons

- Start early and leave enough time for agency processes to occur. Starting early means not having all the information you would like to get details right on documents such as NEPA, PSAD, etc.
- Working early and closely with the DOE on ES&H formalities was very helpful and useful.
- Getting the Lab's ES&H culture understood by contractors and established with their workers early is critical to success. Include this in the specifications of what is required for bidding on, and executing a project. Contractor ES&H plan!
- NSF would be involved, even if beamline is a DOE project; NSF making "Connected Action".

Primary Proton Beam

- Don’t be lulled into thinking that beamline design is easy because beams are familiar.
- Recognize that the requirements are hard to achieve; need to attend to the design appropriately.
- Beam requirements affect civil construction; e.g., ability to maintain a FODO lattice for the full length of the beamline.

Primary Proton Beam - Keys

- Robust, open aperture optics – with beam tails addressed
- Solid protection system – Don’t give a beam permit unless you know beam will be good.
- Beam stability – including auto-tune capability, with check of data quality before tuning
- Stable power supplies – including regulation and correct return to values after having been off

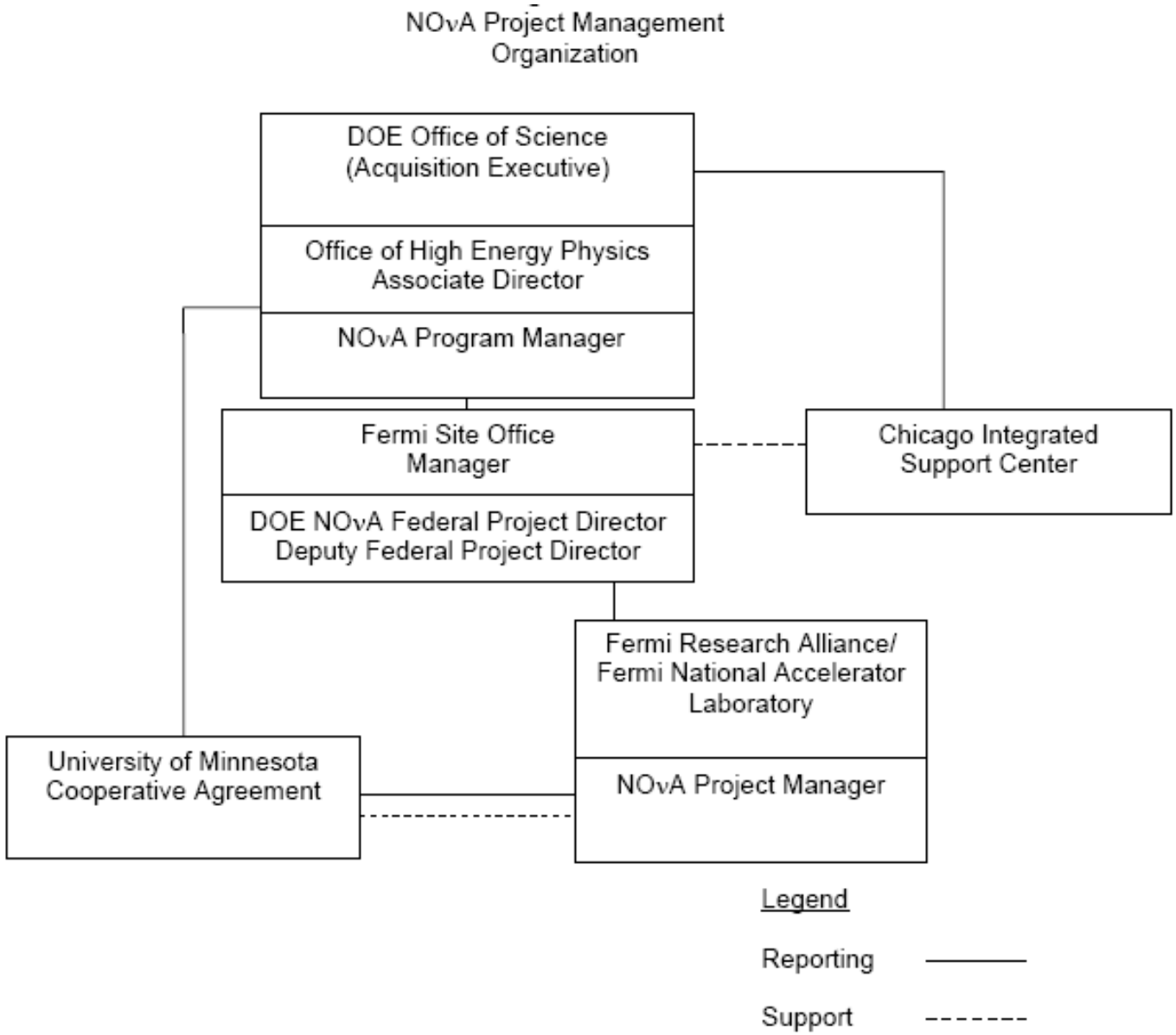
Public Participation

- Dealing/interacting with the public is very different now from the time of the NuMI project (was DAD = Decide, Announce, Defend), based in part on the experience with NuMI.
- Important to involve the community around the Laboratory as soon as the outline of a major project is known, in particular its location and likely effects on neighbors.
- Got/get professional help from public participation experts (paid for it, of course).
- The project stands to benefit at least as much as does the local community if this is done well.
- Note that the title is “Public Participation”.

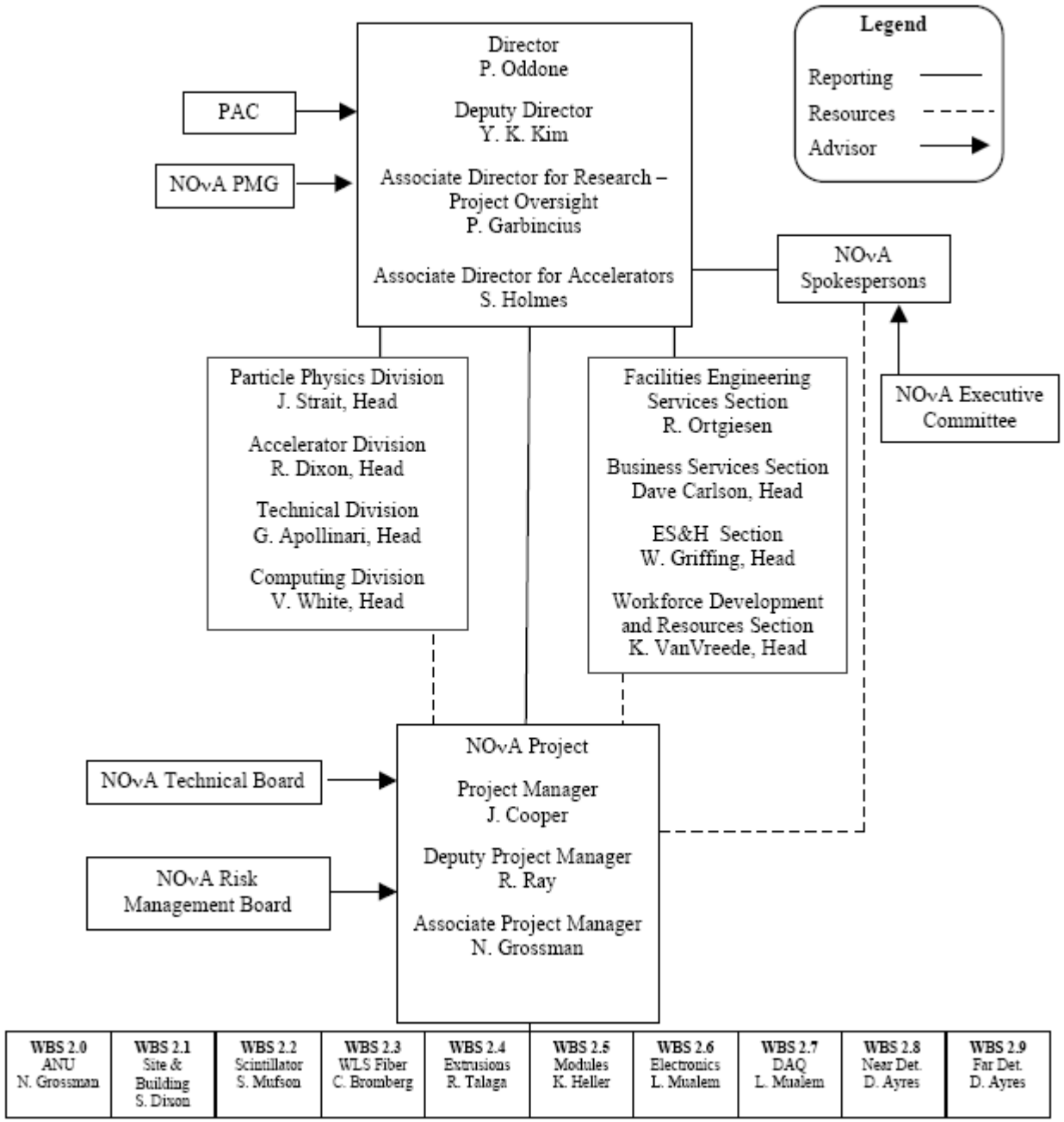
What Does It Take?

- Aside from a well functioning physics collaboration, there is a rather large organizational structure and effort to bring major DOE projects to fruition.
- We do not have this in place for a DUSEL beamline project.
- So, let me show you what is in place, and has been, for NOvA.

From the NOvA Project Execution Plan

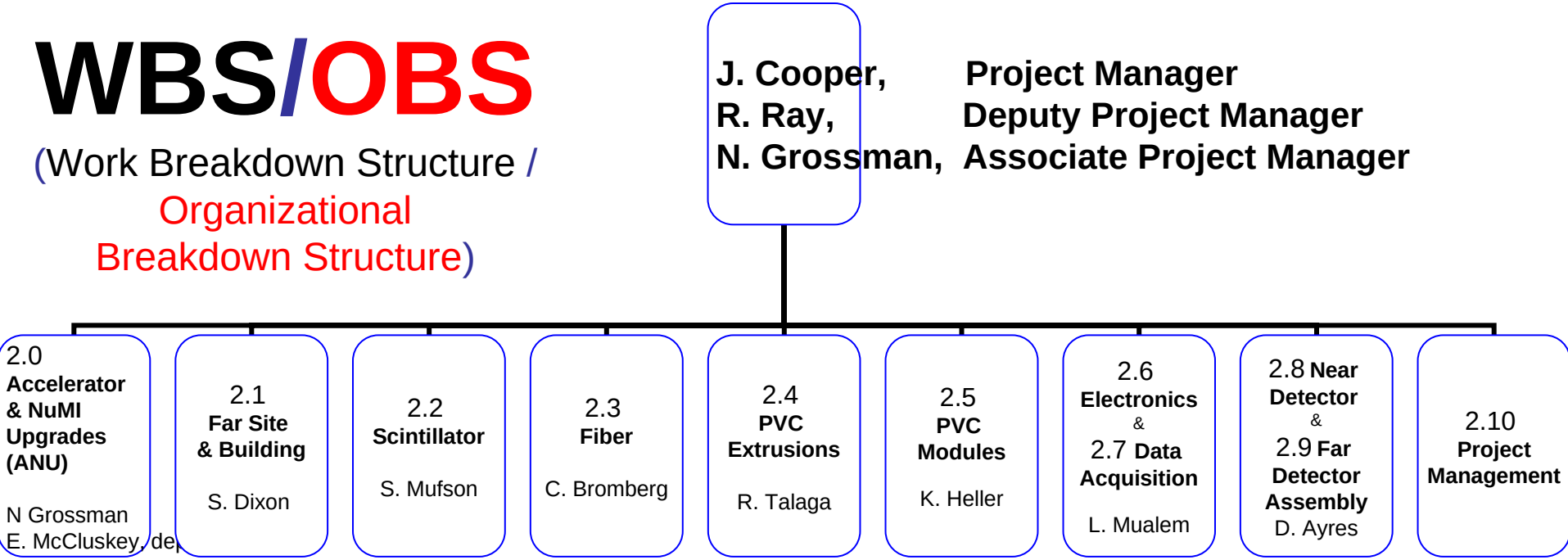


From the PEP and the Project Management Plan



WBS/OBS

(Work Breakdown Structure / Organizational Breakdown Structure)



WBS 2.x for the construction project, similar WBS 1.x for R&D/Ops

Project Office Staff:

Dave Pushka, Mechanical Project Engineer
John Oliver, Electronics Project Engineer
Anna Pla-Dalmau, Project Chemist
Suzanne Pasek, Project Financial Officer
Bill Freeman, Project Scheduler
Ken Doman, ANU scheduler
Harry Ferguson, Assistant Project Scheduler

Keith Schuh, ES&H Detector, EA, pSAD
Mike Andrews, ES&H for Accelerator side
Alan Wehmann, websites / document databases
Nancy Grossman, QA oversight
Elaine McCluskey, Configuration Control
Bob Bernstein, Expediter & Document Coord.
Jon Paley, databases

The Working Group is Not the Project Team

- WG does include many experts with NuMI experience.
- Fermilab will not set up a project team until the DOE defines a project.
- Fermilab is trying to prepare for that time now, but can only go so far.

Fermilab Commitment

- Fermilab fully endorses the P5 recommendations and physics priorities.
- Fermilab would like to build a neutrino beam to DUSEL.
- Fermilab will do so as fast as DOE approvals and funding permit.