Operations Manpower and Budget/Far Detector Status and Maintenance

Rob Plunkett
Fermilab Neutrino Division Technical Support Department

Talk Outline

- Completion of far detector
- Status of far detector
- Transition to operations
- Budget and Support responsibilities
- Far detector spares
- Documentation and procedures
- Conclusions

NOvA Collaboration

ARGONNE NATIONAL LABORATORY (ANL)

UNIVERSITY OF ATHENS (GREECE) (ATH)

BANARAS HINDU UNIVERSITY (BHU)

CALIFORNIA INSTITUTE OF TECHNOLOGY (CIT)

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY (CUSAT)

INSTITUTE OF PHYSICS OF
THE ACADEMY OF SCIENCES OF THE CZECH REPUBLIC

CHARLES UNIVERSITY IN PRAGUE,

UNIVERSITY OF CINCINNATI

CZECH TECHNICAL UNIVERSITY

UNIVERSITY OF DELHI (DU)

JOINT INSTITUTE FOR NUCLEAR RESEARCH, DUBNA (JINR)

FERMILAB (FNAL)

UNIVERSIDADE FEDERAL de GOIAS

INDIAN INSTITUTE OF TECHNOLOGY, GUWAHATI

HARVARD UNIVERSITY

IIT HYBERADAD

UNIVERSITY OF HYBERADAD

INDIANA UNIVERSITY (IND)

IOWA STATE UNIVERSITY (ISU)

UNIVERSITY OF JAMMU

LEBEDEV PHYSICAL INST. (RUSSIA) (LEB)

MICHIGAN STATE UNIVERSITY (MSU)

UNIVERSITY OF MINNESOTA - DULUTH (UMD)

UNIVERSITY OF MINNESOTA (MIN)

INSTITUTE FOR NUCLEAR RESEARCH, MOSCOW (INR)

PANJAB UNIVERSITY

UNIVERSITY OF SOUTH CAROLINA (USC)

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY (SDMT)

SOUTHERN METHODIST UNIVERSITY (SMU)

STANFORD UNIVERSITY (STN)

UNIVERSITY OF SUSSEX

UNIVERSITY OF TENNESSEE (TENN)

UNIVERSITY OF TEXAS AT AUSTIN (TEX)

TUFTS UNIVERSITY (TUF)

UNIVERSITY OF VIRGINIA (UVA)

WICHITA STATE UNIVERSITY (WSU)

COLLEGE OF WILLIAM AND MARY (WM)

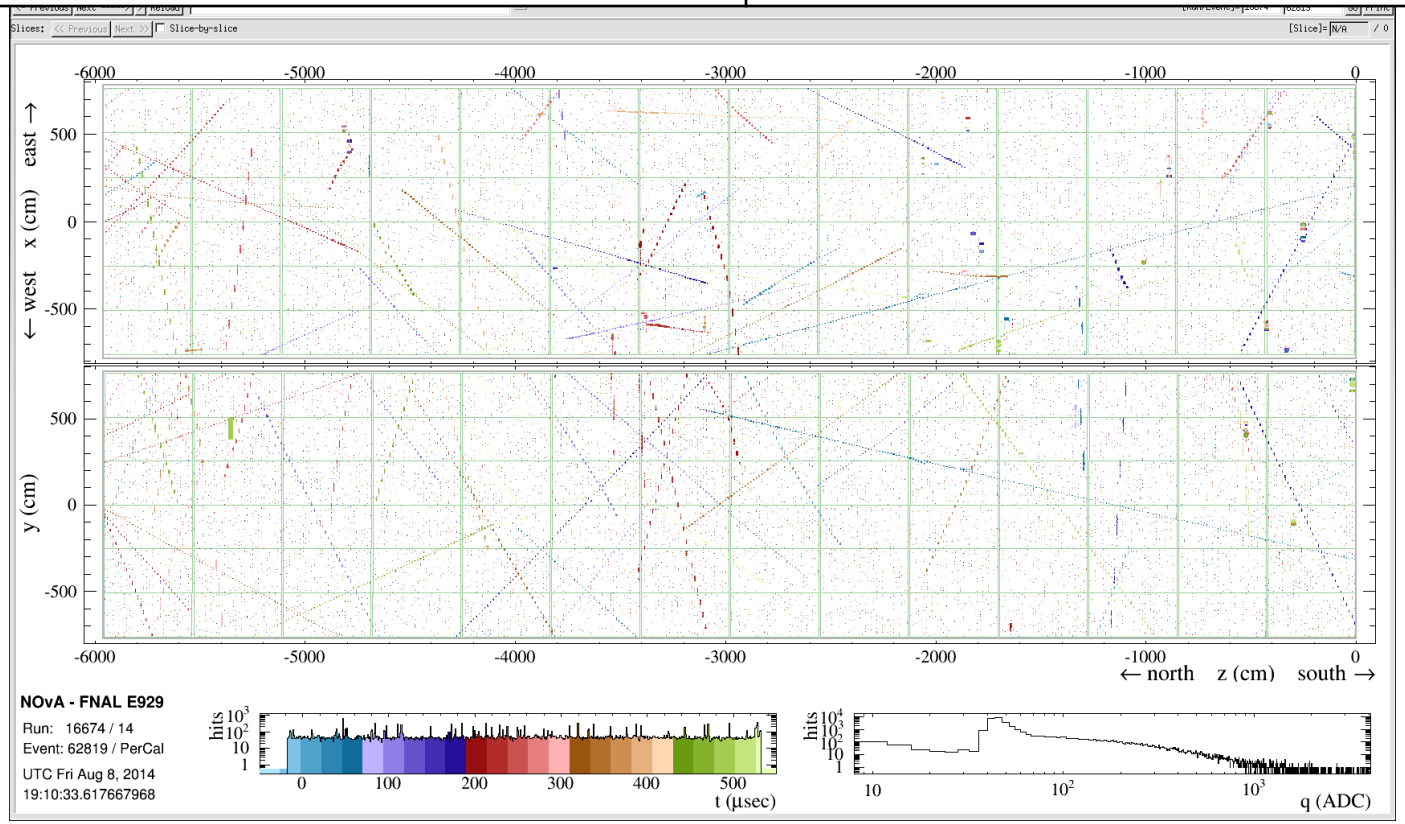
WINONA STATE UNIVERSITY (WIN)

38 Institutions
7 Nations

24/7 shift operations since August 2013

Far Detector works!

1. Detailed Far Detector Technical Performance	Status
Must have a fully functional data acquisition system that can read-out the entire detector and record specific events	**Completed 29July2014.** The data acquisition system was required to read out all the APDs for the cosmic ray pictures shown below.

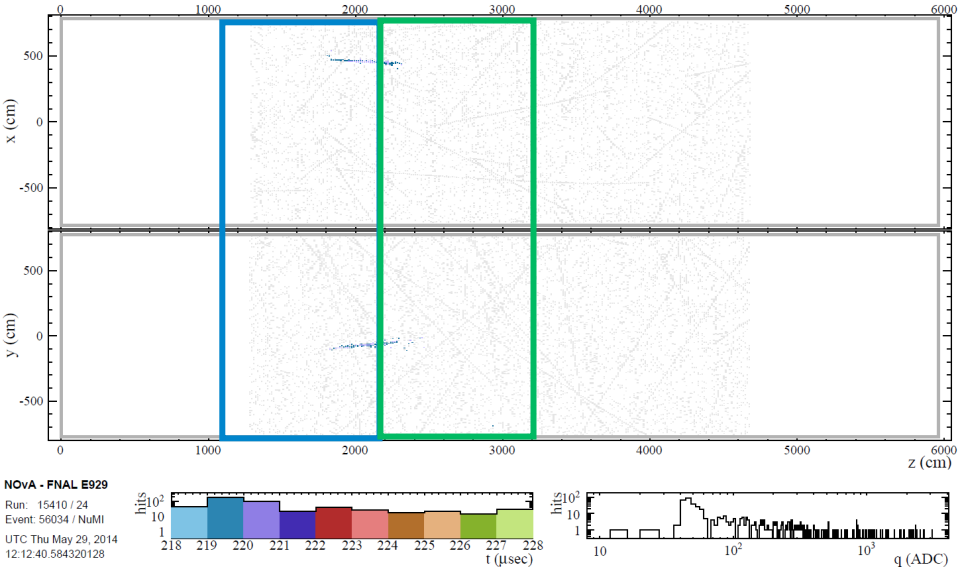


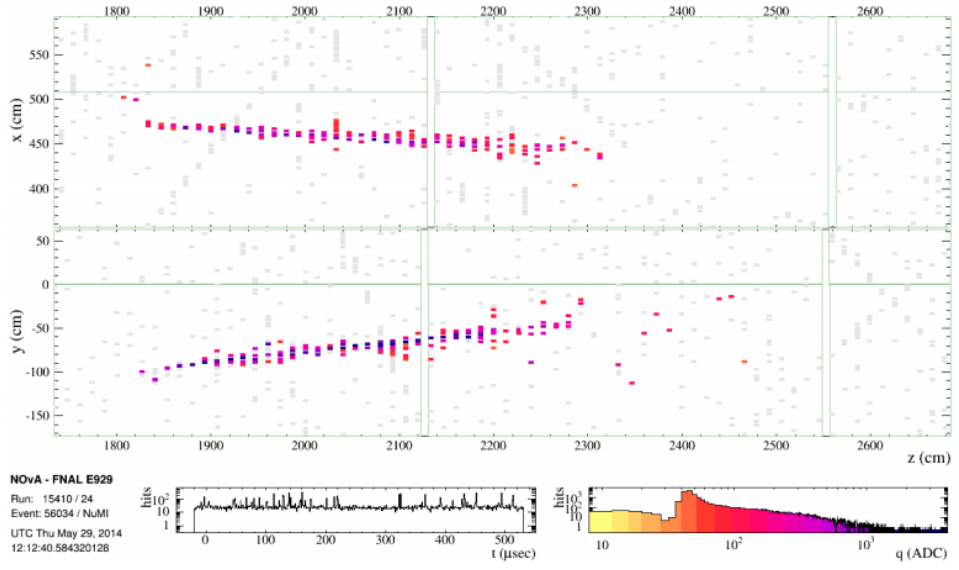
08Aug2014 graphic: Cosmic rays in all 28 blocks of the detector (vertical green line for every 2 blocks). The data acquisition system was live for 550 continuous microseconds of data for this picture.

The upper half of the picture is the top view of the detector, the lower half is the side view of the detector.

Far Detector neutrino events

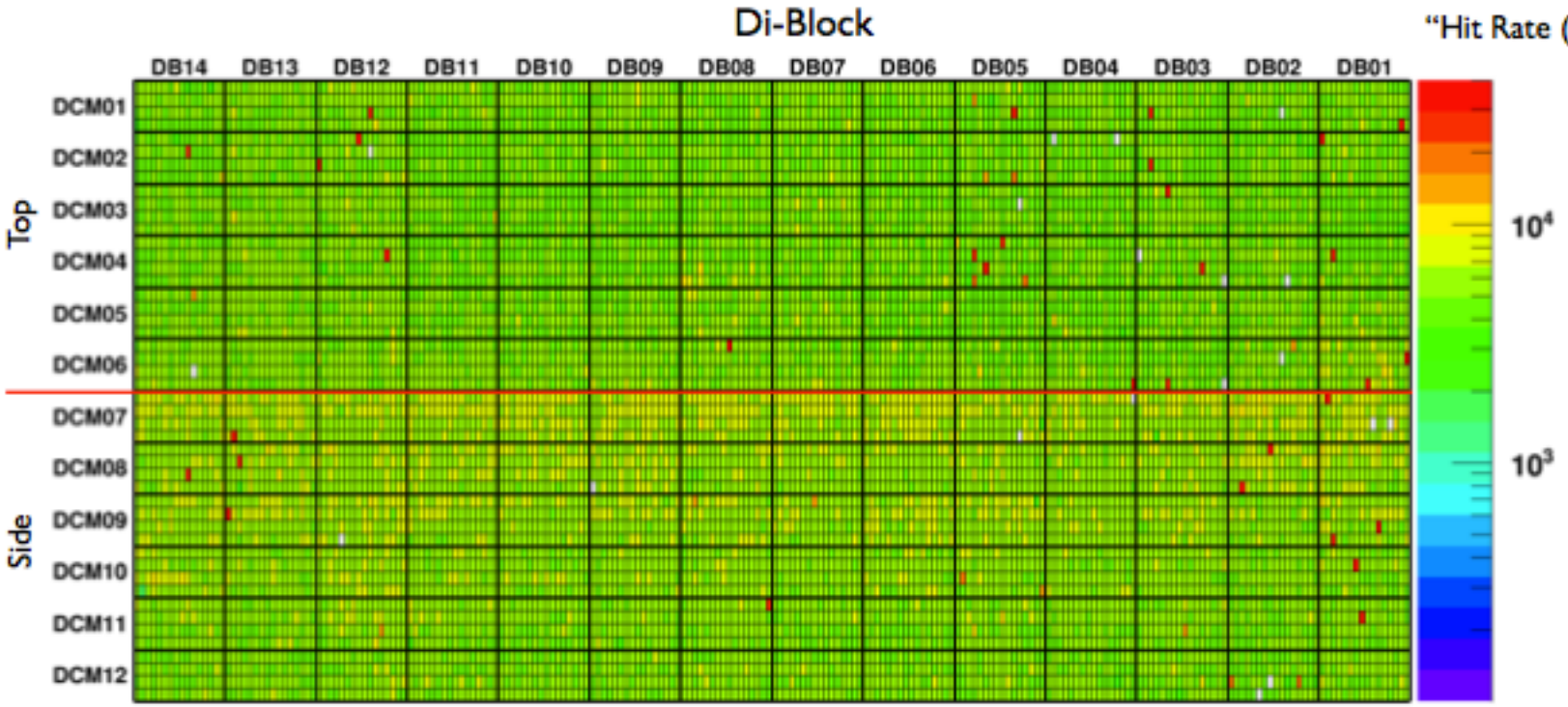
Neutrino event in Superblock 2 & 3 (consisting of detector blocks 5-14, #2 outlined in blue, #3 outlined in green), **data from 29May2014:**





Zoomed in version of the display. The inset diagram in the lower left corner of the full detector view shows that this event is within the NuMI beam time window at 219 microseconds. This is a CC electron neutrino event with an outgoing electron shower.

Readout Map of Far Detector



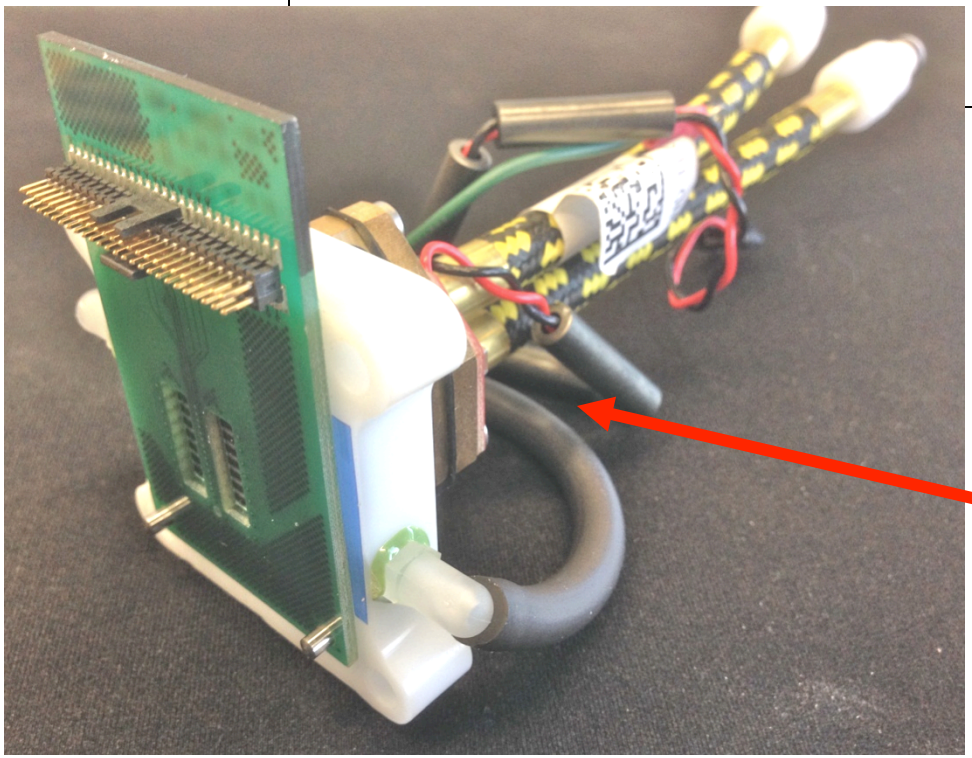
Problem	Number	Fraction
APD Not Cooled	20	0.19%
FEB Masked Off	66	0.61%
FEB Noisy	47	0.49%
Total	123*	1.14%*

Some technical details about detector commissioning in NOvA-doc-11877

*The totals double count some FEB/APDs that are uncooled and masked. This includes 3 modules that have no scintillator, FEB or APD.

Far Detector

1. Detailed Far Detector Technical Performance	Status
Must be outfitted with electronics	**Completed 29July2014.** Avalanche photodiode (APD) installation on every module was the last piece of electronics installed. With all APDs in place and all the higher level electronics completed, cosmic rays could be seen throughout the detector. See Detailed Far Detector Technical Performance item III.6 below.



Picture of an APD assembly. APD mounted on a spacer frame (white) attached to a heat sink (brass) and water cooling lines (yellow/black).

August 2014 picture showing an APD being installed on the side of the detector.

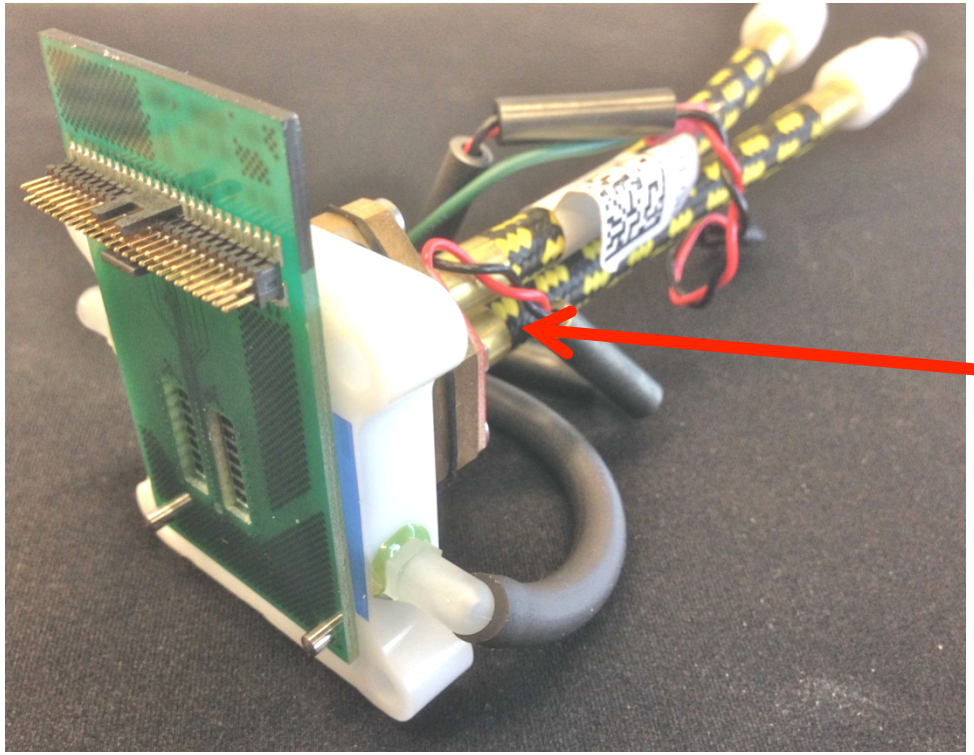
Channel Status of Far Detector

- Reporting types
  - Noisy
  - Masked (= dead, but a response of system to too much noise).
- Current rate of bad channels.
  - 0.25% to 0.8%, depending on metric
- 12 Diblocks fully active.

Status of Far Detector - Retrofit

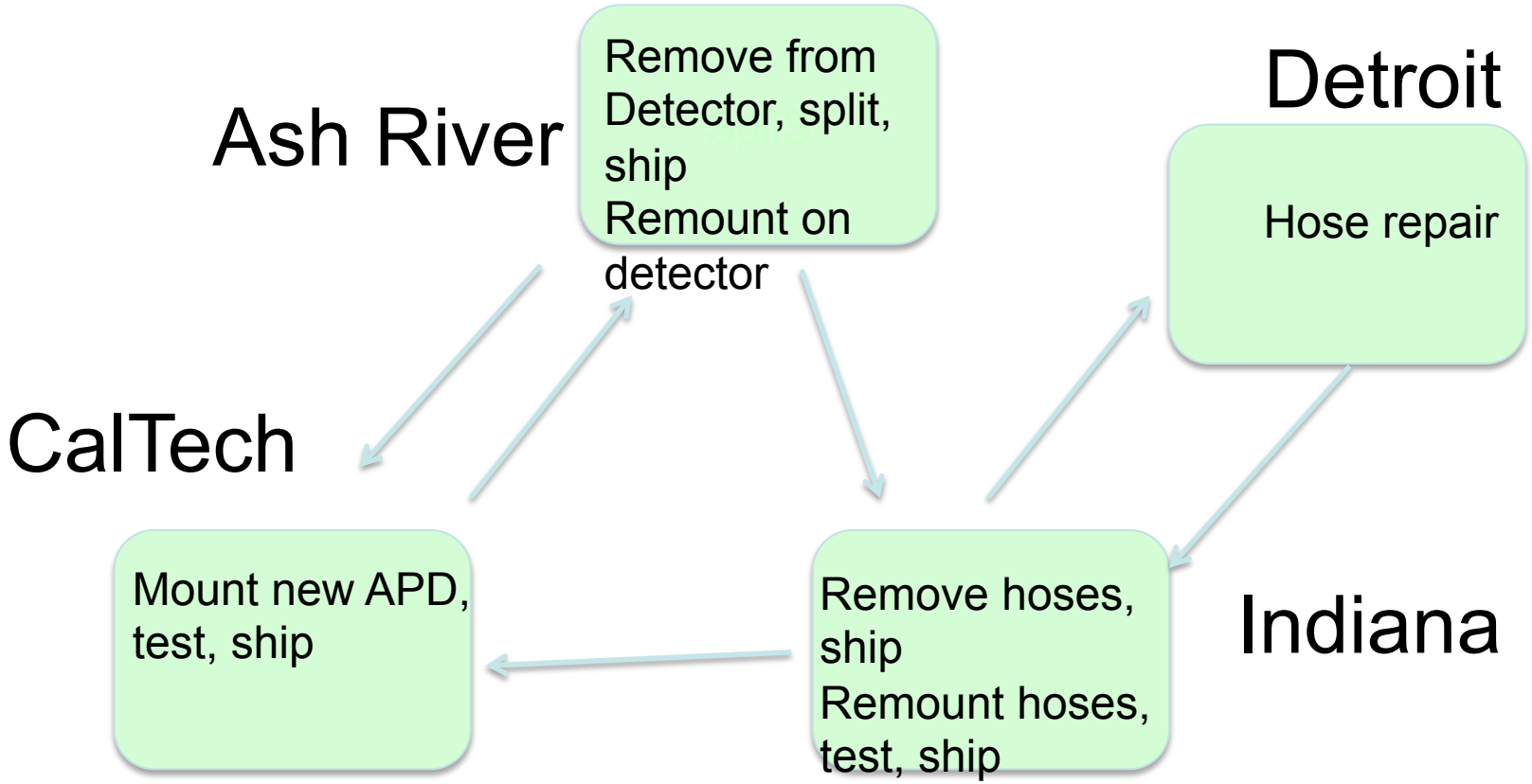
- Improvements to NOvA detector to avoid maintenance and performance headaches.
- 2688 poorly manufactured water cooling fitting sets being replaced with stainless steel fittings, as already in most of detector.
- Simultaneously, earlier APD's are upgraded.

Unit which is replaced

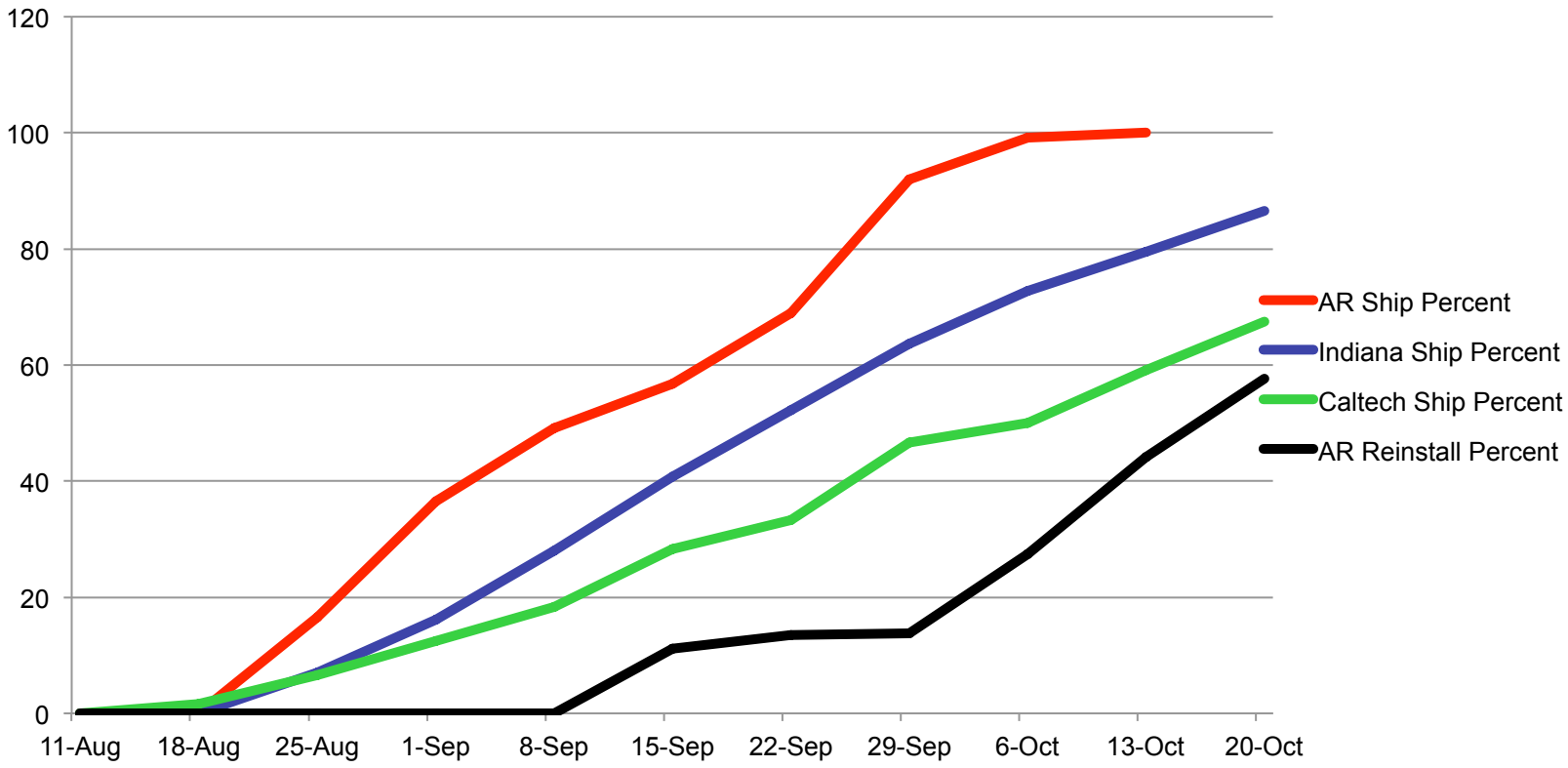


A break here causes unacceptable maintenance losses by water leak.

Retrofit supply chains



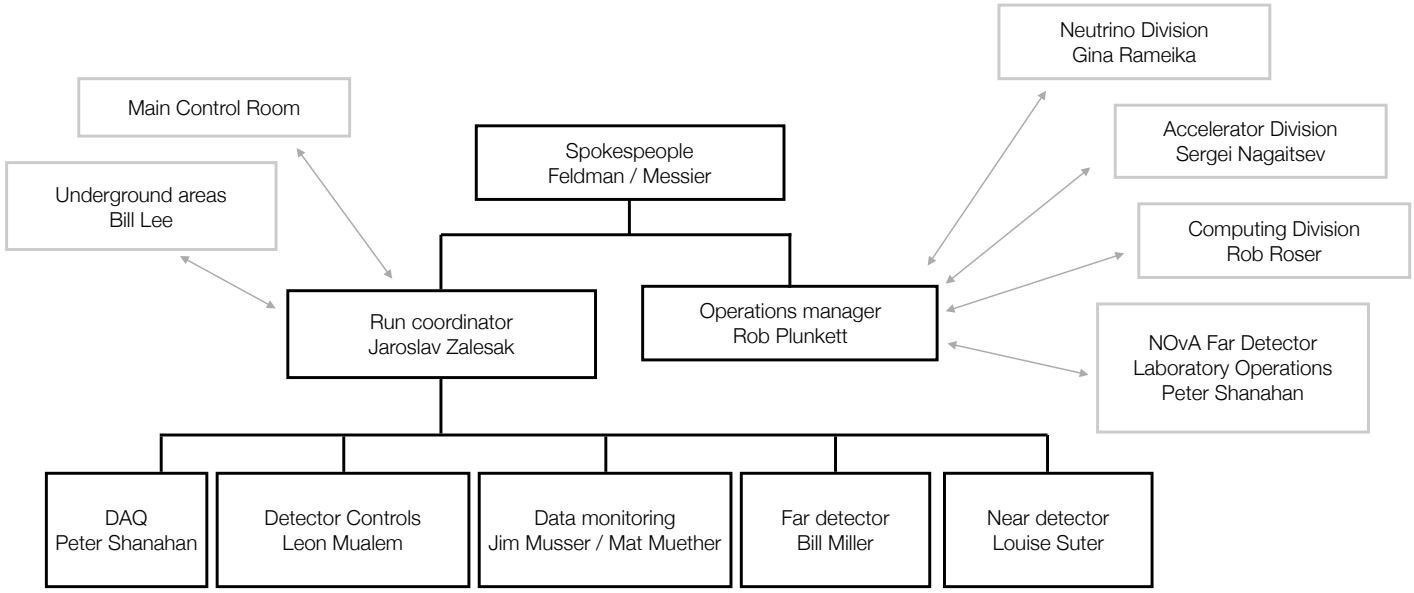
Retrofit Status



Overview of OperationsTransition

- NOvA is operating!
  - Shift coverage 24/7 for more than one year.
- Detector commissioned, taking data
- Stably operating 12 Kton of neutrino detector while completing final improvements on 2 Kton.
- This talk will present
  - The operating detector's processes
  - Organization and resources going forward.

Collaboration Operations Organization



Roles and responsibilities discussed in next slides.

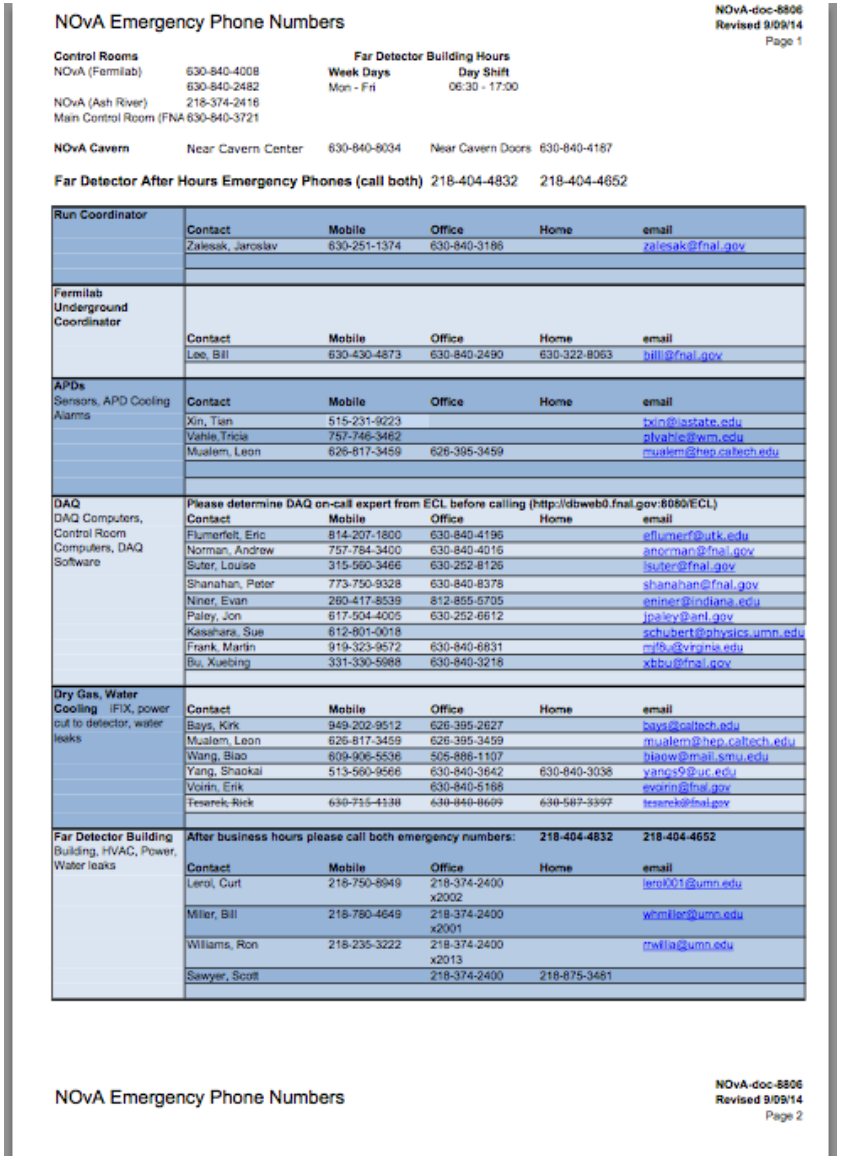
Operations Groups

- The **DAQ** working group
  - Development, maintenance, and online support of the data acquisition systems. Initiate and track problems with the DAQ hardware and software, contact the appropriate personnel, and ensure that appropriate repairs are carried out.
- The **DCS (Detector Control Systems)** group
  - Development, maintenance, and online support of the detector controls hardware and software. Initiate and track problems with the DCS hardware and software, contact the appropriate personnel, and ensure that appropriate repairs are carried out.
- The **Data Monitoring** group
  - Development, maintenance, and online support of tools to monitor data quality and with giving regular feedback on the performance of detector hardware
- The **Far Detector** group
  - Responsible for executing maintenance and repair work scheduled by the Run Coordinator on the far detector.
- The **Near Detector** group
  - Responsible for executing maintenance and repair work scheduled by the Run Coordinator on the near detector.

Operations Leadership

- The **Run Coordinator**
  - Optimizing the use of the near and far detectors to meet the physics goals of the experiment.
  - Directing detector systems development and maintenance and decide the priority and scheduling of detector systems development and maintenance.
  - Scheduling shifts, maintaining shift procedures, and maintaining the systems expert on-call list.
  - Supported by Deputy Run Coordinators
- The **Operations Manager** is responsible for
  - Oversight of NOvA operations
  - Long-term strategic planning of NOvA operations; regular oversight of procedures and status of operations.
  - Liaison between the NOvA Operations group and the Fermilab operations support groups inside the Neutrino Division, Computing Division, and the NOvA Far Detector Laboratory Operations Manager.
    - This position is currently held by head of Fermilab Neutrino Division Technical Support Department

Call list for experts



NOvA Emergency Phone Numbers

NOvA-doc-8806
Revised 9/09/14
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Control Rooms

NOvA (Fermilab)	630-840-4008	Week Days	Day Shift
	630-840-2482	Mon - Fri	06:30 - 17:00
NOvA (Ash River)	218-374-2416		
Main Control Room (FNA	630-840-3721		

Far Detector Building Hours

NOvA Cavern Near Cavern Center 630-840-8034 Near Cavern Doors 630-840-4187

Far Detector After Hours Emergency Phones (call both) 218-404-4832 218-404-4652

	Contact	Mobile	Office	Home	email
Run Coordinator	Zalesak, Jaroslav	630-251-1374	630-840-3186		zalesak@fnal.gov
Fermilab Underground Coordinator	Lee, Bill	630-430-4873	630-840-2490	630-322-8063	bill@fnal.gov
APDs Sensors, APD Cooling Alarms	Xin, Tian	515-231-9223			txin@iastate.edu
	Vahle,Tricia	757-746-3462			plvahle@wm.edu
	Mualem, Leon	626-817-3459	626-395-3459		mualem@hep.caltech.edu
DAQ DAQ Computers, Control Room Computers, DAQ Software	**Please determine DAQ on-call expert from ECL before calling (http://dbweb0.fnal.gov:8080/ECL)**				
	Flumerfelt, Eric	814-207-1800	630-840-4196		eflumerf@utk.edu
	Norman, Andrew	757-784-3400	630-840-4016		anorman@fnal.gov
	Suter, Louise	315-560-3466	630-252-8126		lsuter@fnal.gov
	Shanahan, Peter	773-750-9328	630-840-8378		shanahan@fnal.gov
	Niner, Evan	260-417-8539	812-855-5705		eniner@indiana.edu
	Paley, Jon	617-504-4005	630-252-6612		jpaley@anl.gov
	Kasahara, Sue	612-801-0018			schubert@physics.umn.edu
	Frank, Martin	919-323-9572	630-840-6831		mjf8u@virginia.edu
	Bu, Xuebing	331-330-5988	630-840-3218		xbbu@fnal.gov
Dry Gas, Water Cooling IFIX, power cut to detector, water leaks	Bays, Kirk	949-202-9512	626-395-2627		bays@caltech.edu
	Mualem, Leon	626-817-3459	626-395-3459		mualem@hep.caltech.edu
	Wang, Biao	609-906-5536	505-886-1107		biaow@mail.smu.edu
	Yang, Shaokai	513-560-9566	630-840-3642	630-840-3038	yangs9@uc.edu
	Voirin, Erik		630-840-5168		evoirin@fnal.gov
	~~Tesarek, Rick~~	~~630-715-4138~~	~~630-840-8609~~	~~630-587-3397~~	~~tesarek@fnal.gov~~
Far Detector Building Building, HVAC, Power, Water leaks	**After business hours please call both emergency numbers:**			**218-404-4832**	**218-404-4652**
	Lerol, Curt	218-750-8949	218-374-2400 x2002		lerol001@umn.edu
	Miller, Bill	218-780-4649	218-374-2400 x2001		wmiller@umn.edu
	Williams, Ron	218-235-3222	218-374-2400 x2013		rnwilla@umn.edu
	Sawyer, Scott		218-374-2400	218-875-3481	

NOvA Emergency Phone Numbers

NOvA-doc-8806
Revised 9/09/14
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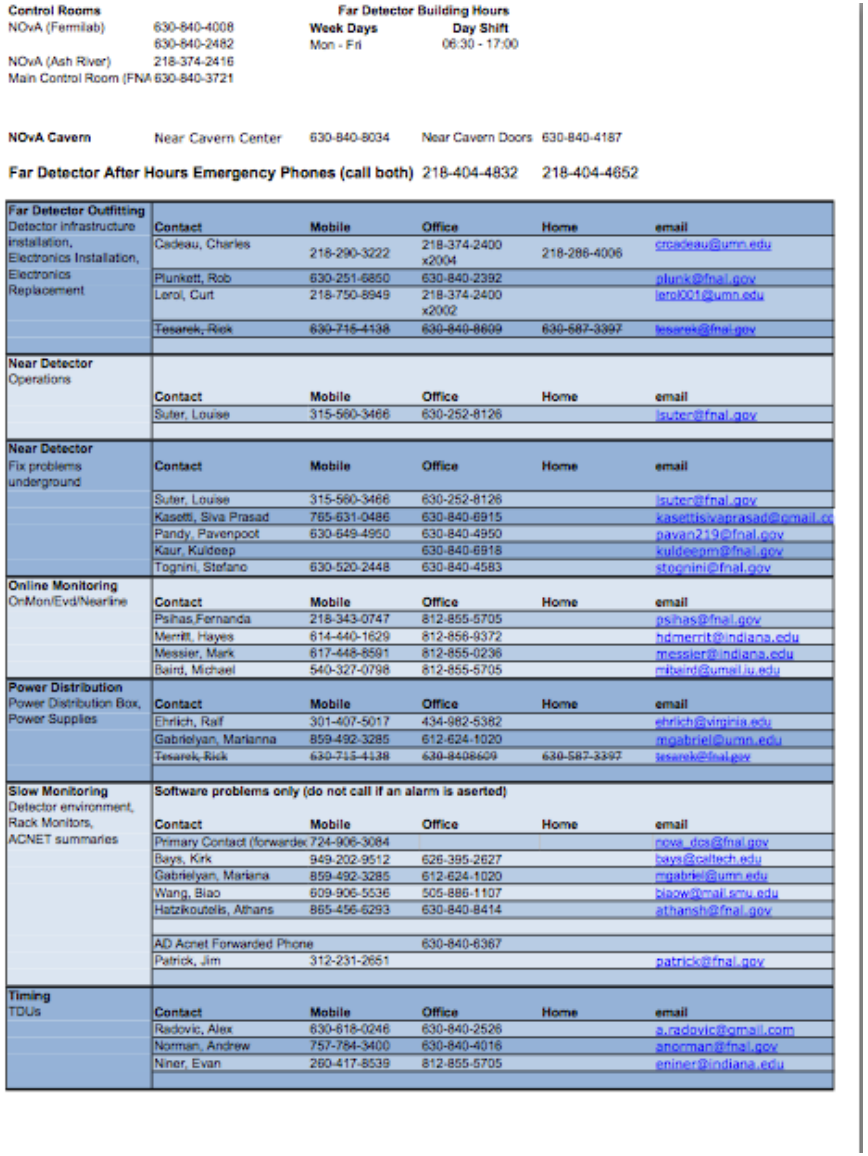

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Far Detector Building Hours

NOvA Cavern Near Cavern Center 630-840-8034 Near Cavern Doors 630-840-4187

Far Detector After Hours Emergency Phones (call both) 218-404-4832 218-404-4652

	Contact	Mobile	Office	Home	email
Far Detector Outfitting Detector infrastructure installation, Electronics Installation, Electronics Replacement	Cadeau, Charles	218-290-3222	218-374-2400 x2004	218-286-4006	crcadeau@umn.edu
	Plunkett, Rob	630-251-6850	630-840-2392		plunk@fnal.gov
	Lerol, Curt	218-750-8949	218-374-2400 x2002		lerol001@umn.edu
	~~Tesarek, Rick~~	~~630-715-4138~~	~~630-840-8609~~	~~630-587-3397~~	~~tesarek@fnal.gov~~
Near Detector Operations	Suter, Louise	315-560-3466	630-252-8126		lsuter@fnal.gov
Near Detector Fix problems underground	Suter, Louise	315-560-3466	630-252-8126		lsuter@fnal.gov
	Kasetti, Siva Prasad	765-631-0486	630-840-6915		kasettis@fnal.gov
	Pandy, Pavenpoot	630-649-4950	630-840-4950		pavan219@fnal.gov
	Kaur, Kuldeep		630-840-6918		kuldeepm@fnal.gov
	Tognini, Stefano	630-520-2448	630-840-4583		stognini@fnal.gov
Online Monitoring OnMon/Evd/Nearline	Psihas,Fernanda	218-343-0747	812-855-5705		psihas@fnal.gov
	Merritt, Hayes	614-440-1629	812-856-9372		hdmerrit@indiana.edu
	Messier, Mark	617-448-8591	812-855-0236		messier@indiana.edu
	Baird, Michael	540-327-0798	812-855-5705		mbaird@umail.iu.edu
Power Distribution Power Distribution Box, Power Supplies	Ehrlich, Ralf	301-407-5017	434-982-5382		ehrlich@virginia.edu
	Gabrielyan, Marianna	859-492-3285	612-624-1020		mgabriel@umn.edu
	~~Tesarek, Rick~~	~~630-715-4138~~	~~630-8408609~~	~~630-587-3397~~	~~tesarek@fnal.gov~~
Slow Monitoring Detector environment, Rack Monitors, ACNET summaries	**Software problems only (do not call if an alarm is aserted)**				
	Primary Contact (forwarde	724-906-3084			nova_dcs@fnal.gov
	Bays, Kirk	949-202-9512	626-395-2627		bays@caltech.edu
	Gabrielyan, Mariana	859-492-3285	612-624-1020		mgabriel@umn.edu
	Wang, Biao	609-906-5536	505-886-1107		biaow@mail.smu.edu
	Hatzikoutelis, Athans	865-456-6293	630-840-8414		athansh@fnal.gov
	AD Acnet Forwarded Phone		630-840-6367		
	Patrick, Jim	312-231-2651			patrick@fnal.gov
Timing TDUs	Radovic, Alex	630-618-0246	630-840-2526		a.radovic@gmail.com
	Norman, Andrew	757-784-3400	630-840-4016		anorman@fnal.gov
	Niner, Evan	260-417-8539	812-855-5705		eniner@indiana.edu

Staffing at Ash River Laboratory

- Staff starting Nov. 17th will be 7 full time and 2 part time(50% time safety officer and 50% administrative assistant)
- The 7 full time employees are on rotating 24/7 on-call in teams of 2 (2 weeks out of ever 7)
  - Response time is usually less than one hour
- 4 employees are trained in all aspects of detector maintenance
- New safety officer is being trained over next 3-4 months.

Shifts on an operating detector

- Shifts are a collaboration responsibility
- NOvA runs shifts 24/7.
- Shift calendar includes on-call shifts for experts.
- ECL software allows flexible schedul
- Stably operating from ROC West control room at Fermilab.
- Commissioning remote shift capability.

Operational Procedures

- NOvA has many maintenance procedures that are used during operations.
- A catalog has been created in the Docdb
- The catalog is Docdb 11943
  - "Listing of NOvA Operations Procedures"
- In addition, Docdb 6672 lists FD safety procedures separately.

Example catalog page

List of Procedures for NOvA Operations, Group 1

10167-v1
FD Dry Gas and Water systems expert response procedure
(Approved - 22 Oct 2013)
Kirk Bays *et al.*
Far Detector
FD Water Cooling
19 Aug 2014

11790-v2
NOvA Far Detector Building Power Outage Recovery Control Room Procedure
(Approved - 18 Aug 2014)
Rick J Tesarek
Far Detector
Control Room
Operations
18 Aug 2014

10764-v2
Chiller Alarm Reset Procedure
(Approved - 09 Aug 2014)
Charles R Cadeau
FD Water Cooling System
18 Aug 2014

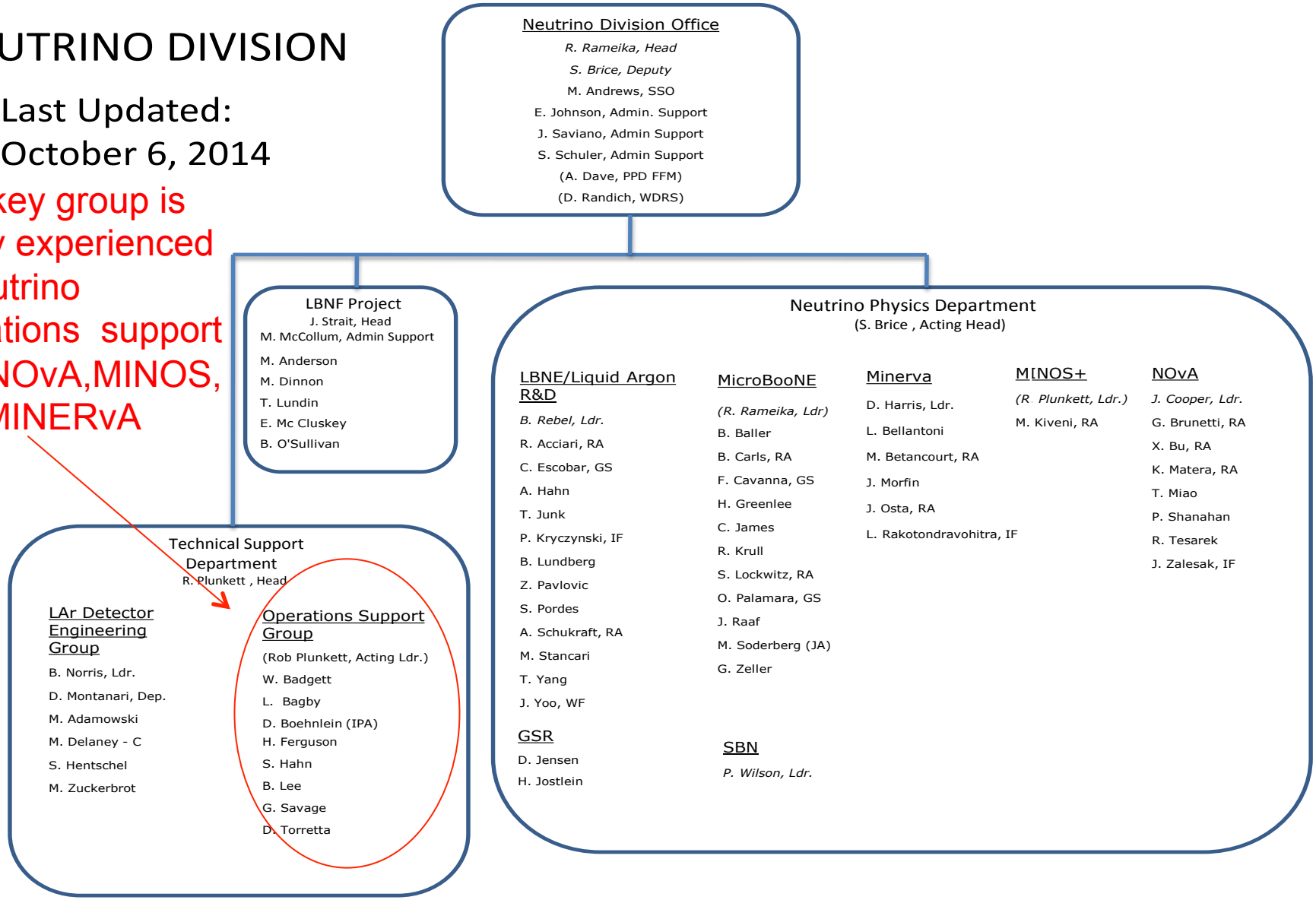
4775-v31
APD testing and installation procedures
(Approved - 17 Jun 2014)
Leon M. Mualem *et al.*
WBS 2.6 Electronics Procedures
APDs
Electronics
Detector Assembly

Fermilab Organized for Neutrinos

NEUTRINO DIVISION

Last Updated:
October 6, 2014

This key group is highly experienced in neutrino operations support with NOvA,MINOS, and MINERvA



Response Model for Maintenance

- Incidents/problems are initiated by relevant operations group experts.
  - Reports to experts from shifters, Run Coordinator, or self-monitoring
- Group expert, Run Coordinator, or Operations manager takes action to cause appropriate maintenance and repair, with notifications
- For Fermilab resources, ELO (Experimental Liaison Officer) in ND/OSG (Neutrino Division Operations) is POC, and mobilizes appropriate actions.

Hardware Support

- Collaboration/Fermilab teamwork
  - Computing TSW
  - SOW's with universities coordinated through Neutrino Division (under final development).
- Power supplies – Fermilab PREP (commercial).
- Power distribution – U. of Va.
- APD's – CalTech
- Thermal coolers - Fermilab
- Front end boards – Harvard/FNAL knowledge transfer. Harvard to maintain consulting.
- Data concentrator chain and timing – Fermilab
- Detector controls – Fermilab IFIX + universities

Far Detector Spares availability

- FEB/Tecc assembled, few hundred, parts for 1000
- TEC goal is 1000 spares, with 500 more in FY15 purchase.
- APD final left (~300) + 725 more proposed FY15 purchase
- ~50% HV controllers (1/2), HV crates (1/2)
- 15% HV (2/12) and 9% LV power supplies (5/56)
- 18% DCM (31/168), 3% PDB (5/168)

Budgeting for an operating detector

- MOU via U. of Minnesota for far detector laboratory.
  - Dedicated oversight at FNAL
- Annual Operations budget through Neutrino Division for both detectors
- Joins family of NuMI experiments.

FY15 Ash River Operations Budget

WBS	Description	Cost	With Overhead
4.1	Crew Labor	$705,484	$888,910
4.2	Utilities	$461,542	$581,543
4.3	M&S (ex-Utilities)	$135,033	$170,142
Total		$1,302,060	$1,640,595

Ash River Budget Breakdown

- Labor
  - 2 FTE Lab Supervisors
  - 6 FTE Technical Support (down to 4 in FY15Q2)
  - 1.75 FTEs admin, grounds, safety
- Utilities
  - 85% electricity – building, cooling, electronics, computing
  - Biggest piece of Other M&S is safety, >30%.
- Future
  - Technical staff may be reduced in future depending on experience in FY15.
  - Utilities and Other M&S are well established now.

Fermilab FY15 Ops Budget Request

Operations of Far Detector not covered by Shanahan (that is, all DETECTOR items vs. "Facility" items)	
At Project & Retrofit end expect to have ~ 350 "no A174" APDs, propose to buy another 725 before Hamamatsu stops making them. This would be 10% spares for Ash River.	$ 271,875
TEC (thermoelectric coolers) are a custom item, expect to have ~1,000 spares at Project end. Propose to buy 500 more.	$ 5,190
Project will have built every possible heat sink as part of the Retrofit. Should be OK as all will then have stainless steel hose fittings.	$ -
FEBs. Should be OK on FEB4s at Ash River. Short somewhat on FEB5s for the Near Detector. Also need some support for Harvard to repair / build anything new.	$ 50,000
Project has some spare DCMs but estimates there are not enough. Propose here to buy more. Computing does the work.	?
Power Supplies? Believe this is being handled as a PREP item??	$ -
Dry gas system and Water cooling system maintenance, assume 25% of initial cost (tubing & piping should remain OK, just mechanical parts here) + two trips by Erik Vorin to Ash River	$ 70,750
Assume replace 1/3 of computing (CPUs, switches, monitors) at Ash River every year. Initial budget was 3*185K$ spread over FY12,13,14, so FY15 is first installment. Assuming here that the M&S is held in PPD, but Computing does the purchase and uses a PPD task code.	$ 185,000

Final allocations to subsystems in progress.

University SOW's being developed

Documentation

- MOU between The University of Minnesota and Fermilab for Operation of the NOvA Far Detector Laboratory and the NOvA Far Detector: nova-docdb-11785
- NOvA Experimental Operations Plan: nova-docdb-12225
- TSW between NOvA Experiment and Fermilab Computing sector: nova-docdb-11788
- Operational readiness clearance for NOvA far detector, nova-docdb-11843
- Operational readiness clearance for NOvA near detector, nova-docdb-11419
- NOvA Shift Handbook: nova-docdb-10512
- Expert On Call List: nova-docdb-8806
- NOvA 2014 Computing Portfolio Review: nova-docdb-11221
- NOvA Far Detector Building On-Call List: nova-docdb-10685
- Repair and restart procedures.

Conclusions

- After commissioning with beam, operations is in place for NOvA.
- Detectors complete and running.
- Fermilab Neutrino Division/Technical Support provides clear POC for laboratory
- Fermilab Experiment Management Group regularly reviews NOvA operations status.
- Service positions filled by dedicated collaboration.