Project Status

John Cooper
Project Manager

ANU status

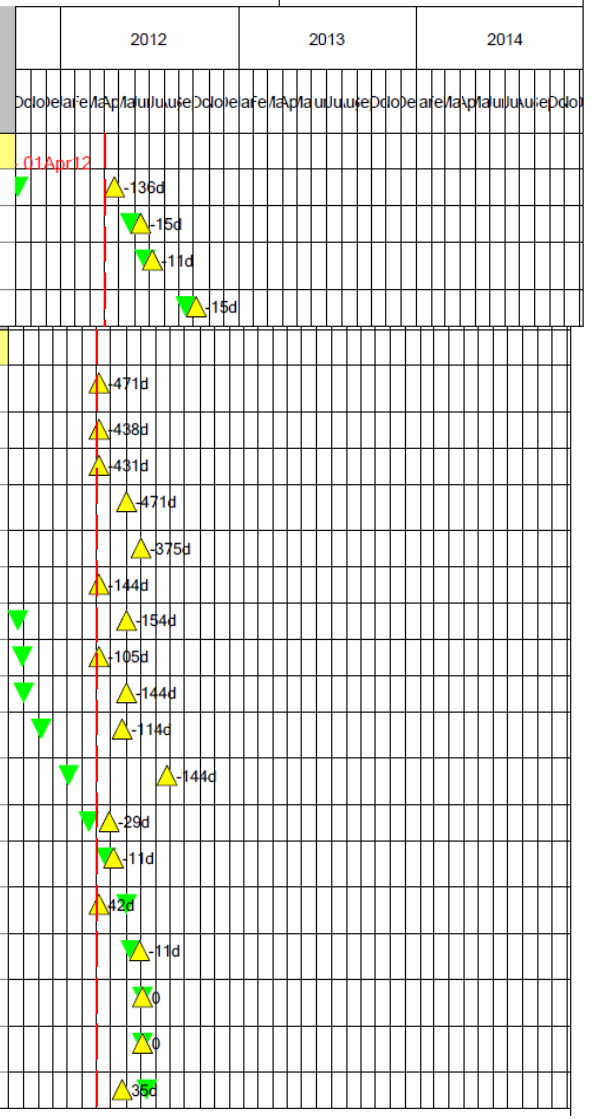
- Paul is at the Particle Accelerator Conference. Paul says:
  - Tunnel and target hall work has begun in earnest. Trades (riggers, pipefitters, electricians) are working in all areas, along with AD, TD, and PPD personnel.
  - In the MI tunnel, decommissioning and removal of elements is underway and proceeding well. The rigging crews in the MI tunnel are working efficiently and somewhat ahead of schedule.
  - Magnets are being rigged out of the NuMI beam line, to be replaced with magnets with better cooling for the implementation of the faster cycle.
  - Equipment is being staged in work areas for the injection line installation.
  - BPM cable is ready to be staged to the tunnel for the first service building pull (the MI50 area).
  - The target from RAL did get through customs and to Fermilab on May 10.
- Since one IPR recommendation was on ANU labor, we will try to report Open Plan and KRONOS synched in future PMGs
  - Otherwise, we will see these two disagree due to different month end dates and cause undue excitement.
- In future will report on all ANU shutdown milestones, next slides

ANU milestones during shutdown

NOVA Project
Milestone Gantt Chart
Progress Reporting - thru March 2012
Time Now: 01Apr12
Baseline: LastMonth

Baseline Milestone
Completed Milestone
Milestone

Activity ID	Milestone Description	Computed Status	Early/Actual Date	Baseline Date	Milestone Level
1.0 -- ANU Planning, Engineering & Design					
1.0.3.1.5.1	NuMI Charging PS Upgrade Design Complete	Planned	19Apr12	03Oct11	L.5
1.0.2.1.6.1	MI 2.5 Mhz Cavities Removal Complete	Planned	12Jun12	21May12	L.5
1.0.2.1.6.2	MI Decommissioning of A1 Extraction Line Complete	Planned	06Jul12	20Jun12	L.5
1.0.2.1.6.3	MI Machine Timing Complete	Planned	03Oct12	12Sep12	L.5
2.0 -- ANU Construction					
2.0.4.4.2.13	Off-Project:: NuMI Modified Horn 1 Ready for Installation	Planned	02Apr12	14May10	L.5
2.0.3.2.4.7	NuMI IHEP ME Target Accord Signed	Planned	02Apr12	01Jul10	L.5
2.0.1.1.5.4	RR ADCW Magnet Refurbish Complete	Planned	02Apr12	13Jul10	L.5
2.0.4.4.2.8	Off-Project: NuMI Horn 1 Modules Installed in Chase Complete	Planned	30May12	15Jul10	L.5
2.0.1.3.4.3	RR DCCT Ready for Installation	Planned	29Jun12	05Jan11	L.5
2.0.1.1.5.10	First MLAW Magnet Complete	Planned	02Apr12	01Sep11	L.5
2.0.1.3.4.5	RR BPM System Procurement Complete	Planned	31May12	18Oct11	L.5
2.0.3.2.4.4	NuMI Target Carrier Delivered	Planned	02Apr12	26Oct11	L.5
2.0.1.1.5.11	Second MLAW Magnet Complete	Planned	30May12	31Oct11	L.5
2.0.4.3.14	Ready for Shutdown to Install Accelerator Upgrades	Planned	21May12	06Dec11	L.5
2.0.1.1.5.12	All MLAW Magnets Complete (including spares)	Planned	23Aug12	01Feb12	L.5
2.0.4.4.3.7	RR Inj & GC Install PFNs in MI-14 & MI-39	Planned	23Apr12	13Mar12	L.5
2.0.4.4.3.10	RR Inj & GC Install Resonant Chargers in MI-14 & MI-39	Planned	03May12	18Apr12	L.5
2.0.4.3.13	ANU Shielding Assessment Updates Complete	Planned	02Apr12	31May12	L.3
2.0.3.1.5.2	NuMI Primary Beamline Ready for Faster Cycle Time	Planned	25Jun12	08Jun12	L.4
2.0.4.4.2.12	Off-Project:: RCRP Equipment & Procedures Ready for ANU Operations	Planned	02Jul12	02Jul12	L.5
2.0.4.4.2.11	Off-Project: Work Cell & Equipment Ready for ANU Operation	Planned	02Jul12	02Jul12	L.5
2.0.2.1.4.1	MI Vertical Quad Bus Upgrade Complete	Planned	22May12	11Jul12	L.4



Gold Stars Should Start to Appear

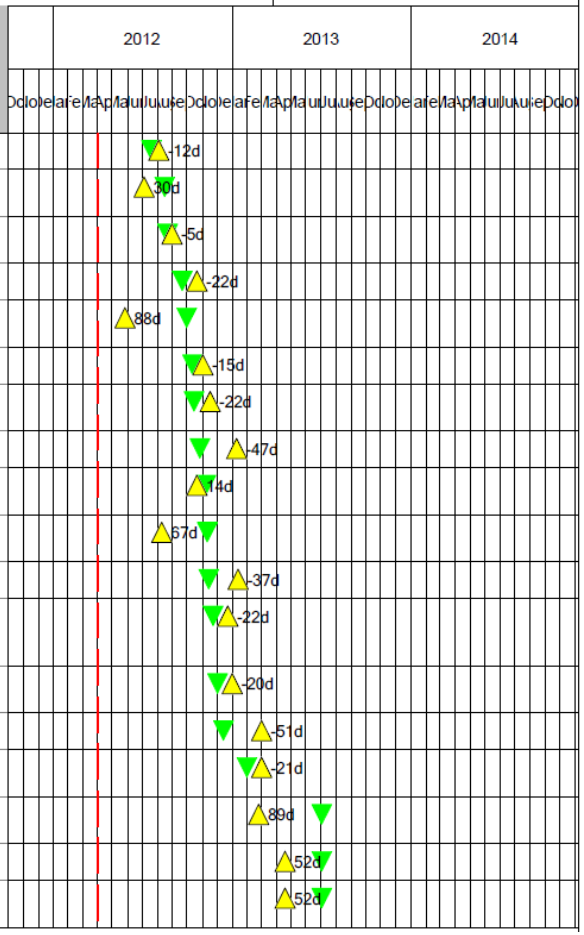
Approx 3 per month

More ANU milestones

NOVA Project
Milestone Gantt Chart
Progress Reporting - thru March 2012
Time Now: 01Apr12
Baseline: LastMonth

Baseline Milestone
Completed Milestone
Milestone

Activity ID	Milestone Description	Computed Status	Early/Actual Date	Baseline Date	Milestone Level
2.0.2.2.5.5	MI LCW System Mods Complete	Planned	02Aug12	17Jul12	L.5
2.0.1.3.4.6	RR BPM Transition Boards Ready for Installation	Planned	02Jul12	14Aug12	L.5
2.0.3.2.4.3	NuMI ME Target/Carrier/Baffle Assembly Complete	Planned	27Aug12	20Aug12	L.3
2.0.3.2.4.8	Replacement Hadron Monitor Delivered	Planned	17Oct12	17Sep12	L.5
2.0.2.2.5.4	MI RF Cavities (2) Installation & Testing Complete	Planned	23May12	28Sep12	L.3
2.0.3.4.4.2	NuMI RAW Systems Mods Complete	Planned	29Oct12	08Oct12	L.5
2.0.1.2.8.3	RR Beam Abort Kicker Checkout/Test Complete	Planned	13Nov12	12Oct12	L.5
2.0.1.1.5.5	RR LCW System Mods Complete	Planned	08Jan13	25Oct12	L.5
2.0.3.3.4.2	NuMI Installation of Target Chase Cooling Complete	Planned	17Oct12	06Nov12	L.5
2.0.3.4.4.3	NuMI Cooling Water (Non-RAW) Mods Complete	Planned	06Aug12	08Nov12	L.5
2.0.1.1.5.1	RR 53 Mhz RF Ready for Beam	Planned	10Jan13	12Nov12	L.4
2.0.1.2.8.4	RR Injection & Gap Clearing Magnets & Fluorinert Piping in Tunnel Checkout/Test Complete	Planned	21Dec12	19Nov12	L.5
2.0.3.1.5.1	NuMI Charging PS Upgrades Testing Complete	Planned	28Dec12	28Nov12	L.5
2.0.1.2.8.5	RR All Kicker Systems Ready for Beam	Planned	26Feb13	10Dec12	L.3
2.0.1.2.8.2	RR Extraction MI Injection Line Kicker Checkout/Test Complete	Planned	26Feb13	28Jan13	L.5
2.0.4.3.15	MI Ring Modifications Ready for Beam Transport	Planned	22Feb13	01Jul13	L.2
2.0.4.3.16	RR Modifications Ready for Beam Transport	Planned	16Apr13	01Jul13	L.2
2.0.4.3.17	Ready to Commission Upgrades with Medium Energy Neutrino Beam	Planned	16Apr13	01Jul13	L.2

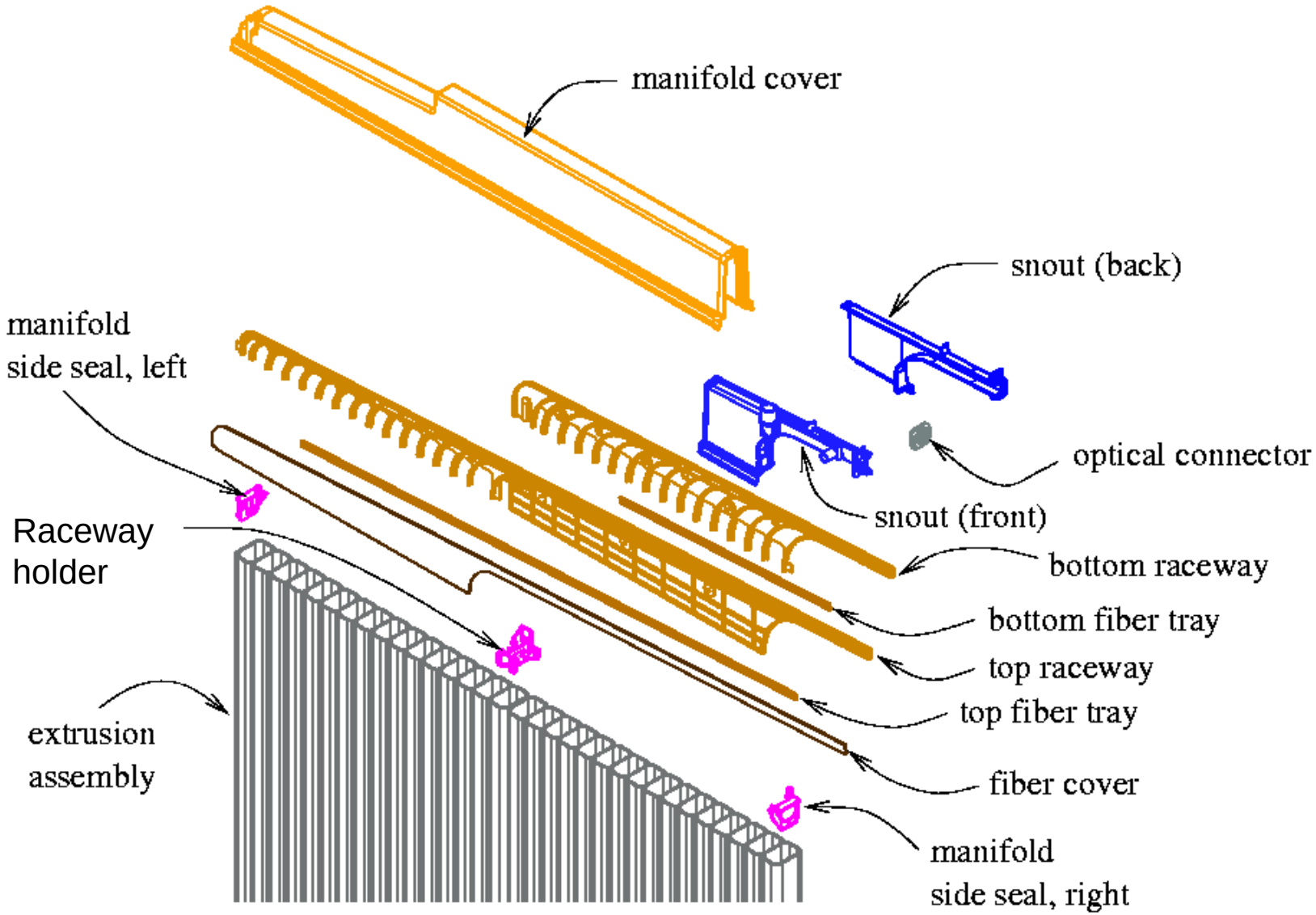


Status: Fiber Damage in Shipping

(another hot button from the IPR)

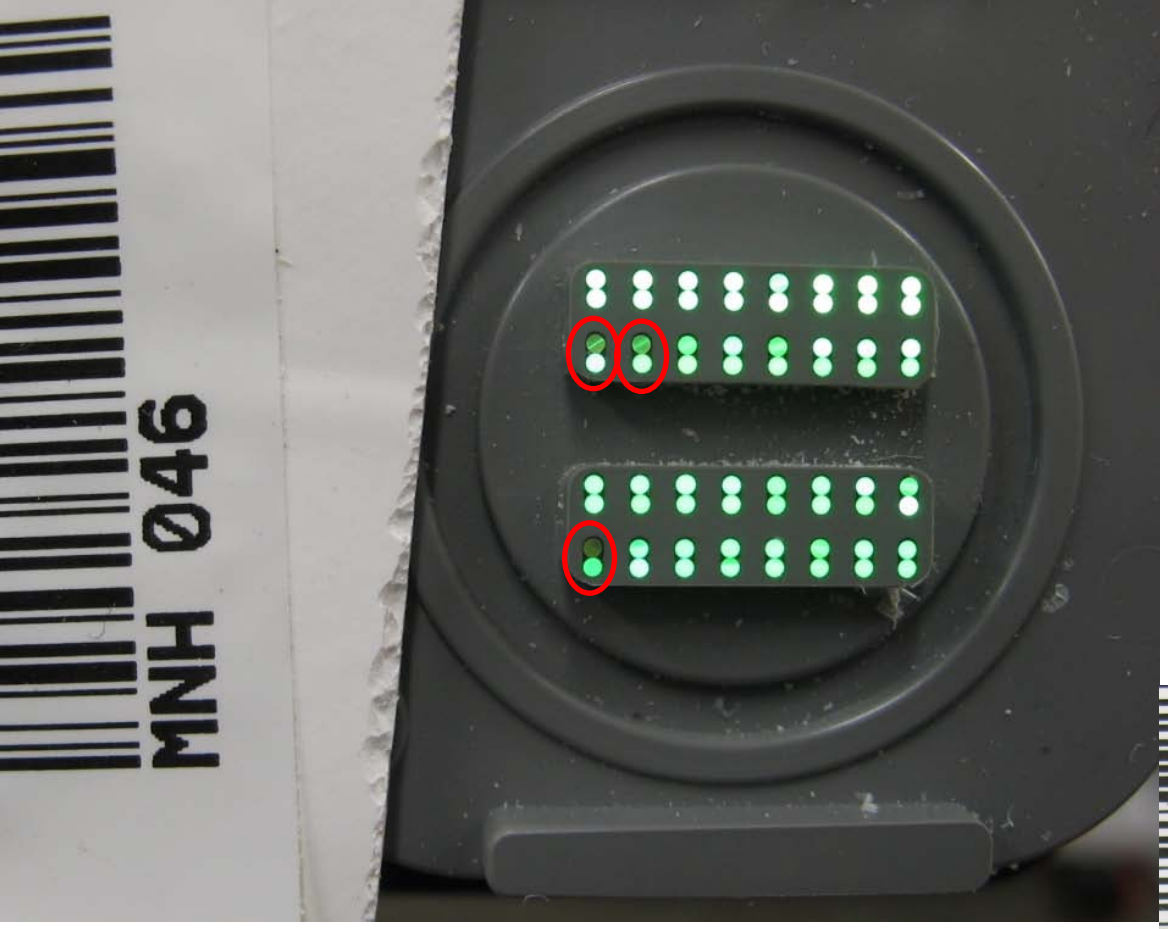
- At the May 8 Lehman IPR, Ken Heller said
  - Visual inspection of modules at Ash River by module factory personnel found damaged fiber
    - Note: "visual"
    - Note: "damaged", not broken
- Consensus of all parties is that the visual inspection shows a bright fiber end, just one end of the two ends of the ~105 ft long looped fiber.
  - Further consensus that this bright fiber indicates some damage "near" the end of the fiber – right at the end or perhaps further inside the 32-fiber manifold.
  - Fiber is bright because room light is reflecting off something near the end
    - Opinions vary on how far from end: mm → 1 ft
- Ken Heller's plan was to ship another stack of modules on a round trip to Ash River and back to Minneapolis
  - Monitor shock and temperature
  - Check for fiber damage
  - Autopsy any damaged modules to determine location for sure.

For Reference: Manifold Parts

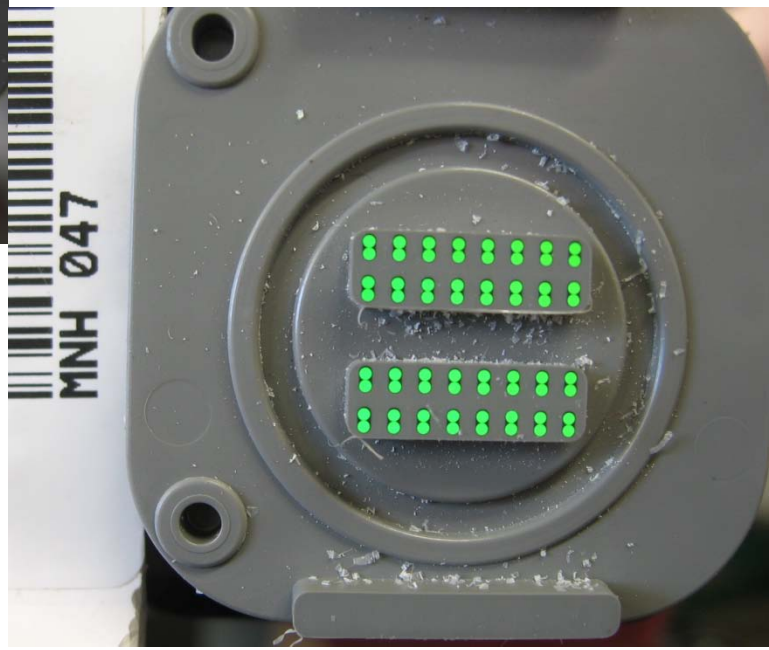


From NDOS production

2/5/2010



Obviously damaged fibers



No damaged fibers

More detail on “visual”

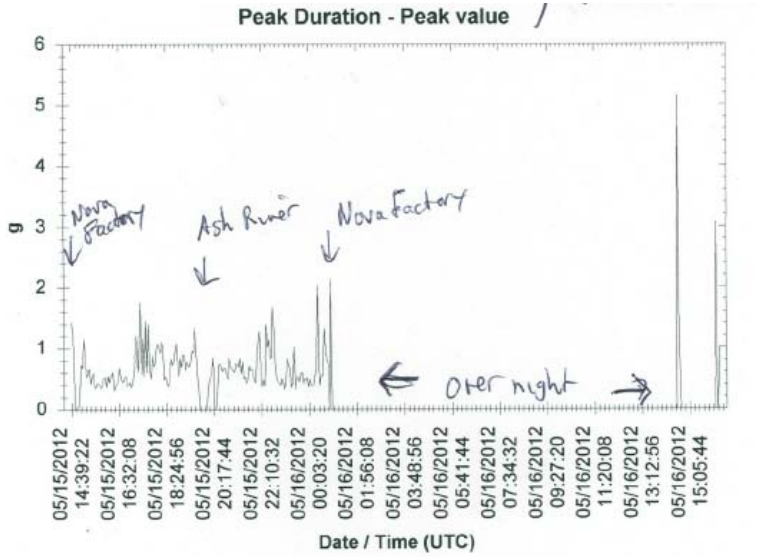
- The initial report at the Lehman IPR was on the 1st two shipments of 24 modules each sent to Ash River on April 1 and April 15.
  - Nathaniel Pearson (U Minn factory manager) found that 5 of 24 in one stack and 6 of 24 in the other stack of the 1st 2 shipments to Ash River showed damage at Ash River on April 26.
  - Rick Tesarek looked at part both shipments at Ash River last week and found 5 in one stack (but 11 fiber ends) and 12 in the other stack (but 27 fiber ends)
  - After the fact it was noted that two styles of modules were in the 1st shipment
    - Some with fibers glued in raceways near optical connector, but some not glued and “sometimes the raceways pinched the fibers”.
    - Of the initial shipment, 6 of 24 did not have glue. But of 6 “damaged”, 4 were glued, 2 were not glued. Seems not to be the problem.
- No autopsy yet done on any of 1st shipment modules. Pivoter had priority
- The 1st round trip transportation test was done on May 11
  - Initial report of 1 damaged module on return, later report was 5 (others looked).
- Clearly “visual” damage is somewhat in the eye of the beholder.
  - Consensus that people find more with time, probably because they are looking
  - There are more quantitative tests, will discuss in a minute

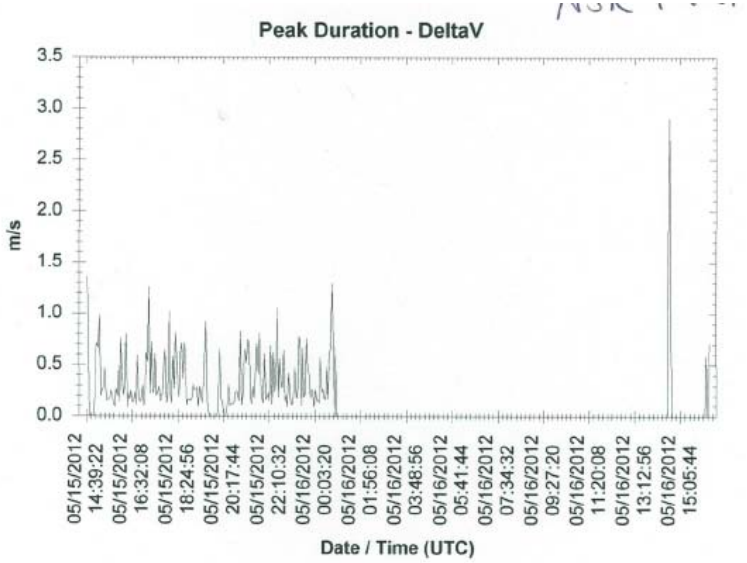
More on “Visual”

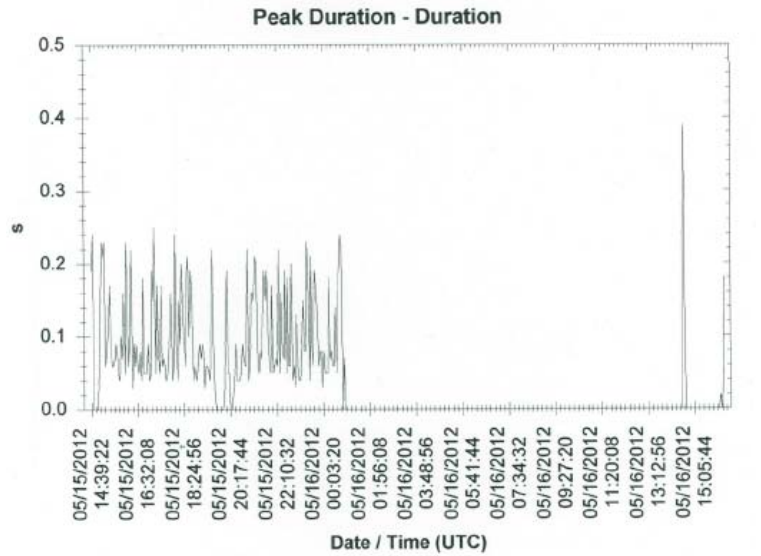
- A 2nd round trip transportation test was done on May 16
  - But on inspection 3 of the 24 in this stack showed damage before shipping.
  - Same 3 on return.
- Discovery of damage before shipping prompted a census of existing modules at Minnesota
  - 60 of 168 good modules produced show bright fiber damage (36%) , now using a “card test”
  - **This seems to put transportation to rest as the cause**
    - but checking will continue – a small amount of transportation damage may exist.
  - Modules with bright fibers have been pulled out of the “good” count and stacks.
  - Attention shifting to possible hole(s) in QA during construction
- A 3rd round trip is planned, shipping today
  - But with modules that have been studied extensively before shipping
- Directorate urged a QA team visit on these issues after IPR
  - Halley Brown, TJ Sarlina, JJ Schmidt, and Joe Howell visited on May 17-18
  - Early report says they are convinced transportation is not the issue (TJ details)

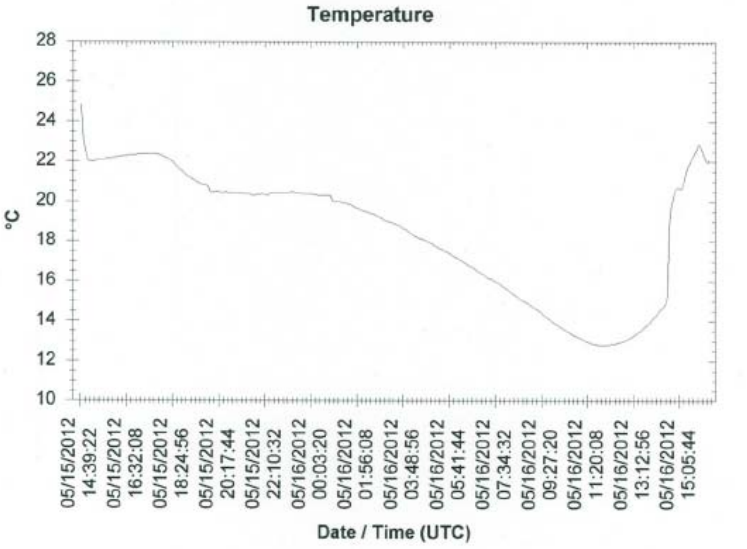
Shock and Temp on 2nd shipment

- Typical peaks of 0.5 – 2.0 g, temperature variation from 24 – 14 °C





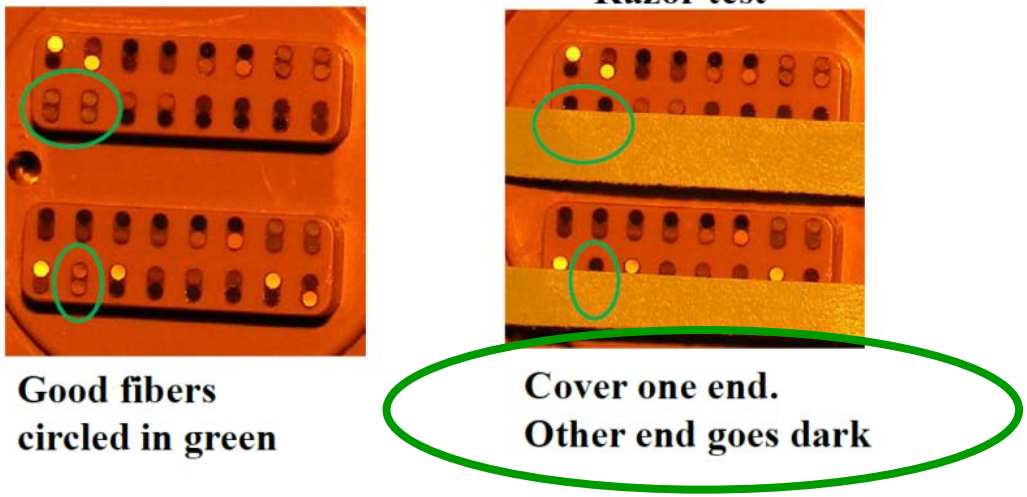




More fiber tests

- "Card Test"
  - For "obviously bright" fibers, adds no new information
  - For less obvious ones, it helps
  - Slide a card transverse to the fiber in a pair
    - Mask off the non-bright end, to see if transmission persists
    - Example of GOOD fibers below
  - Now using card test in QA after every fiber step.
    - Useful after 32 fibers cut with hot wire but before epoxy & flycutting since then the factory can replace only the single damaged fiber instead of all 32

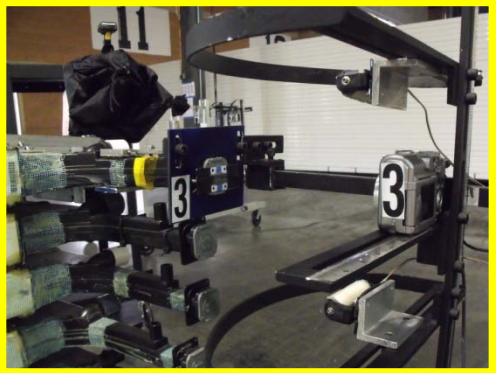
Use red light – fiber damage 15 m from end



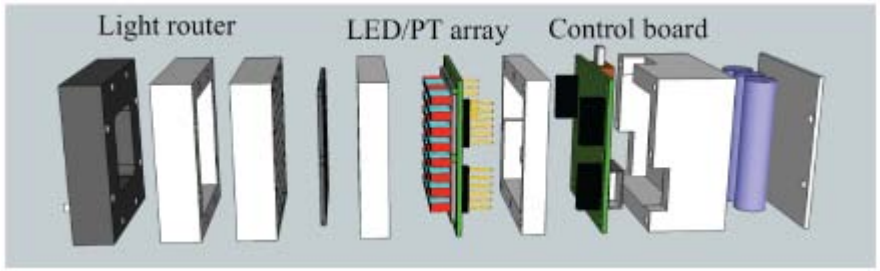
For near detector – white light is fine

There are TWO other fiber testers

- Minnesota design uses red light into one side of the loop, takes a CCD picture of the other side, then the photo is sampled to check transmission through the loop.



- MSU design uses red light into one side, phototransistor on the other side to measure transmission through loop



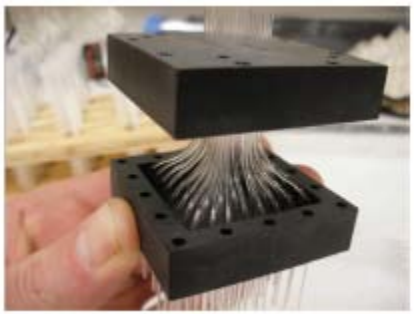


Fig. 2. Photo of light router during construction

More on Fiber Testers

- Both transmission testers were able to find damage in tests on a set of deliberately damaged fibers in a single 50 ft test module.
  - damaged specifically at the manifold (10-30% transmission loss),
    in the middle (10 – 40% loss), and
    at the far end (10-100% loss) of the module,
    plus some with no damage at all
  - Both found the same damaged fibers and the same undamaged fibers in this test.
  - For this special single module tested (NOVA-doc-7471)
    - The Minnesota version has a sigma of 7.6% in measuring transmission loss
    - The MSU version has a sigma of 0.2% and should more cleanly separated damaged fibers from undamaged ones as a result (sigma on several measurements of same fiber)
- **The MSU version has been used at the Minnesota factory for module production to date and is intended for use at Ash River**
  - **All 168 modules passed the MSU test**
  - **Now 60 show fiber damage with card test / visual test**
- The MSU version was used on all modules in the 1st shipment, BUT
  - found no damage before shipping
  - found only ONE fiber damaged on the round trip return (one of the unglued fiber modules)

Raw MSU tester data

- On 181 Far Detector modules just produced, for all 32 cells
- Variation due to clear fiber bends in light router
- Large damage obvious, subtle damage may not be

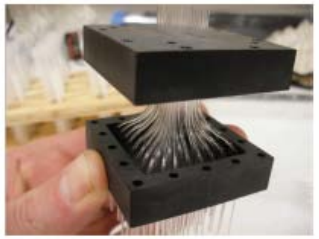
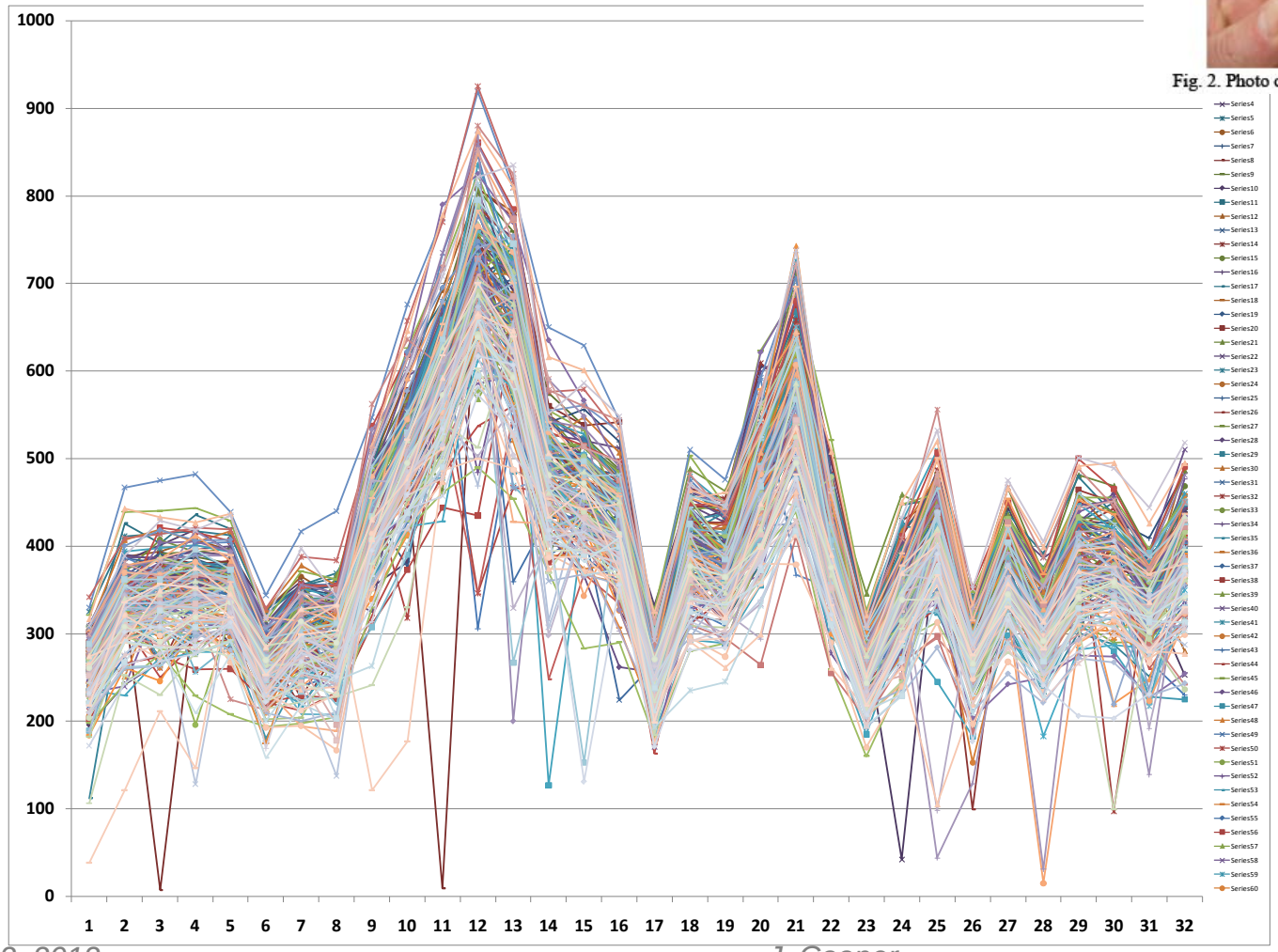


Fig. 2. Photo of light router during construction



Calibrated MSU tester (on Near Detector)

- Average N modules, look at ratios of single fibers to average
- Calibration procedure not yet done for Far Detector modules
  - Only using raw data
- As currently applied without calibration, the tester apparently can't see the "visual" damage (<10%?)

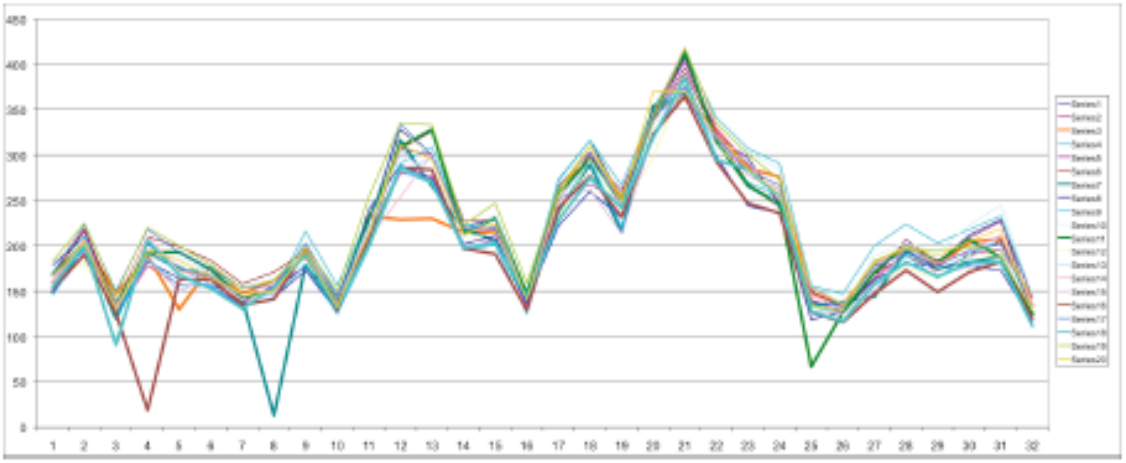


Fig. 3. Raw ADC counts for each of 32 channels in twenty NDOS modules

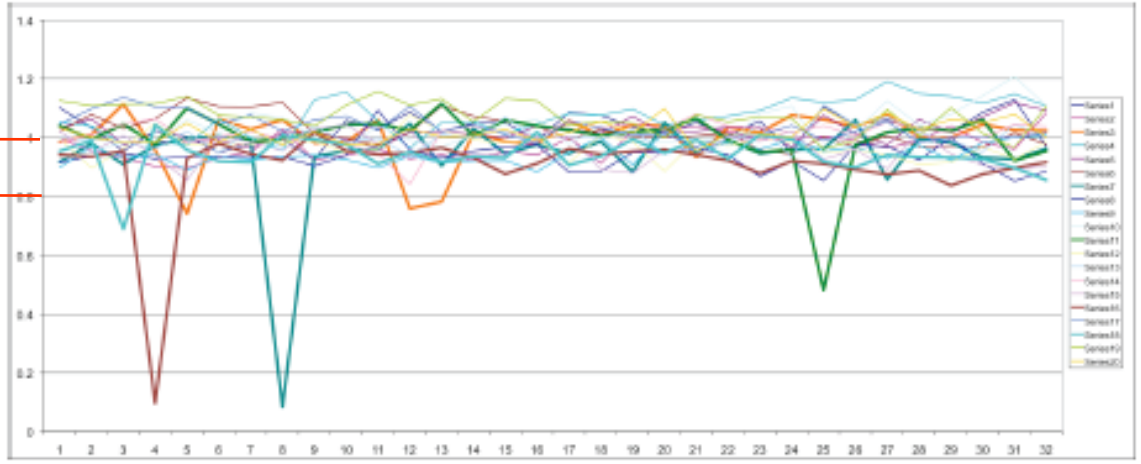
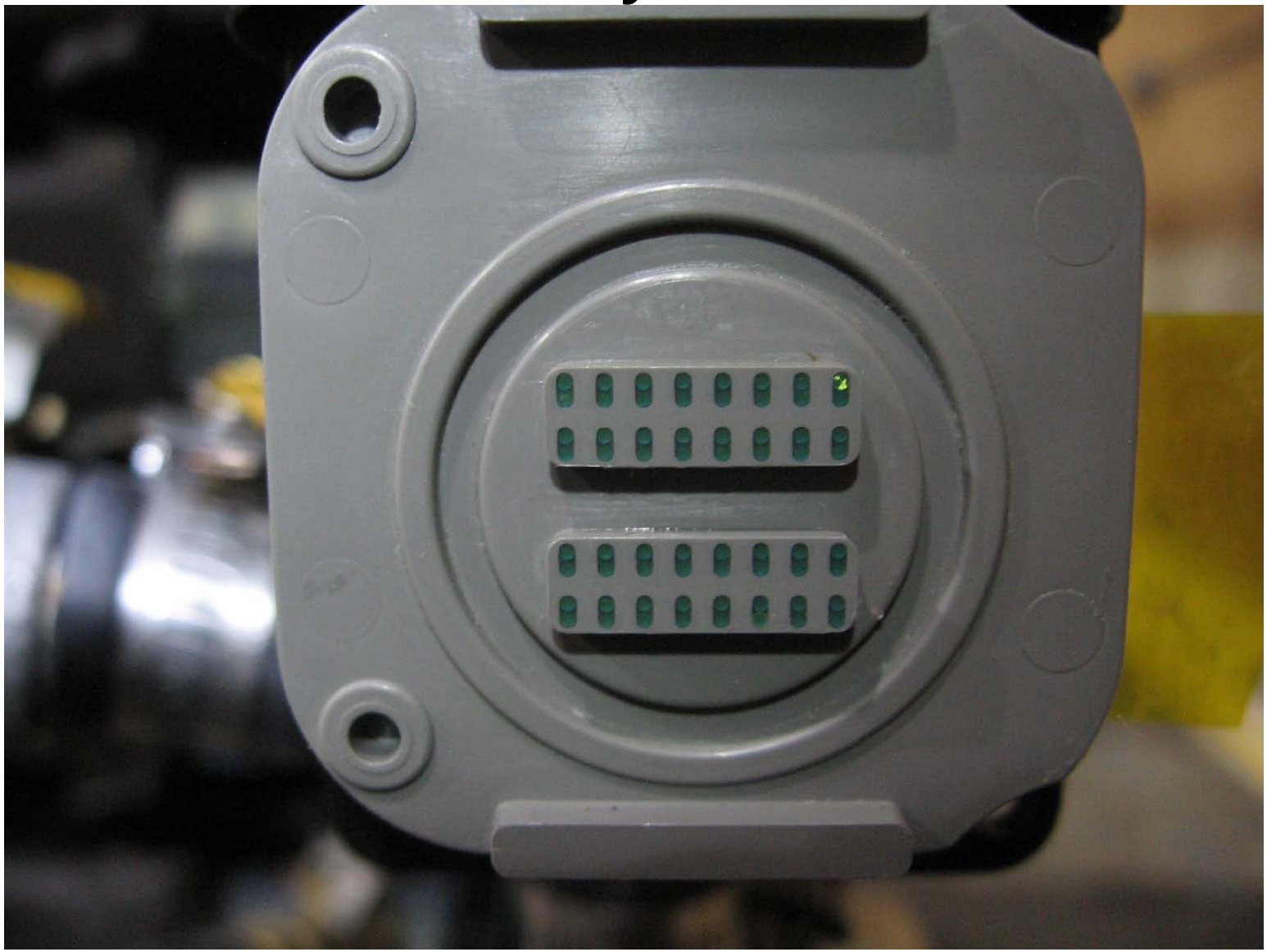


Fig. 4. Response of each channel relative to the mean in twenty NDOS modules

Example of “bright fiber” not seen by MSU tester



Current guesswork on causes for fiber damage, ranked by Ken Heller's guess at probability

- Handling problem in the stringing operation damages fiber near end
- Handling problem in the fiber cutting operation, hot wire
- Fly cutting vibrates fiber to damage
- Damage in hermetic seal glue injection process
- Fiber handling in stringing and threading introduces small amount of crazing which propagates with time.
- Stacking modules with vacuum lifter flexes modules, strains fibers
- Raising and lowering caster jacks on stacks of modules flexes modules, strains fibers
- Shocks in loading and unloading moves raceway parts, pinch fiber
- Vibration in shipping
- Uncured glue in optical connector or hermetic seal, chemically active or heat problem
- More paranoid thoughts….
- Attempting to narrow the field with tests…..

OR…

- Maybe this damage is not significant?
  - Transmission is what we want
    - MSU testers says transmission is OK at ~ 90% level
  - BUT could be a 10% damage effect
    - E.g., scatter light out of pixel area on APD via damage right at end of a fiber
  - And, it could get worse with time if due to internal crazing

- We were able to get rid of these in the prototype Near Detector, should be able to do it again.
  - Prototype Detector quality data:
    - 2% of last 200 modules built had a bad fiber.
      (NOVA-doc-5183 at August 2010 IPR)
  - Replaced fibers on 6% of modules during construction to achieve this.
    - 5% of modules had all fibers replaced due to a bad fiber after fly cutting.
  - Still, way better than the current Far Detector module loss rate of 36%

APD Status

(another hot button from the IPR)

- Trying to organize this by topic rather than as a long rambling historical account
  - Since we haven't solved the problem(s) yet, some topics may be more relevant than others
- APD Topics:
  - APD Installation Problems
  - APD Coatings
  - APD Seals
  - Current APD Status with all changes

APD Installation problems

- Data from Leon Mualem at May 8 2012 IPR:
  Did APDs work warm after installation?
- Fall 2010 / Winter 2011 (original mounting parts)
  - 315 of 435 APDs worked in initial installation (72%)
- A long list of problems discovered and addressed
  - Aug-Oct 2011: Internal NOvA Task Force redesigned parts
    - Original designers + installers + new eyes

Problem	Solution(s)
Dirt transferred from optical connector	Added procedure to clean optical connector during APD installation
Optical fibers touching APD	1. Add shims to APD spacer frame to move APD farther from optical connector. 2. Redesigned spacer frame to move APD farther from optical connector.
Installation Errors	1. Institute inspection procedures for APD installation. 2. Redesign APD mounting (spacer frame) to simplify installation. 3. Redesign FEB box to make attaching box top simpler. 4. Limit number of people installing APDs.
Dirt on APD surface causing APDs to fail.	1. Clean optical connectors. 2. Apply coating (silicone, parylene) to APD surfaces.

History: APD Installation progress

- Fall 2010 / Winter 2011 (original mounting parts)
  - 315 of 435 APDs worked warm in initial installation (**72%**)
- October 2011: (original mounting parts)
  - 5 of 6 worked warm (**80%)**
- December 2011: (redesigned mounting parts)
  - 4 of 9 Silicone coated worked warm (**44%**)
  - 6 of 6 Parylene coated worked (**100%**)
- April 2012: (redesigned mounting parts)
  - 3 of 9 Silicone coated worked warm (**33%**)
  - 8 of 9 Parylene coated worked warm (**88%**)
- May 2012: (redesigned mounting parts) (Ash River tech trained)
  - 11 of 11 Silicone coated worked warm (**100%**)
  - 3 of 3 Parylene coated worked warm (**100%**)
    - another 4 not working in box, not “installed” on optical connector, not counted
  - 7 of 15 initial installations recovered & Parylene coated worked warm (**47%**)
- **December + April + May 2012:** (redesigned mounting parts + new APD)
  - 18 of 29 Silicone coated worked warm (**62%**)
  - 17 of 18 Parylene coated worked warm (**94%**)

Statistics increasing

Additional APD installation history

- We are doing all our testing on the prototype Near Detector
- Quality Control on the optical connectors changed during construction and has changed since.

  - Fiber connector height window:
    - Early prototype Near Detector modules had ± 1.9 mil RMS (NOVA-doc-6357)
    - Late prototype Near Detector modules had ± 1.0 mil
    - 1st 48 Far Detector modules have ± 0.4 mil (NOVA-doc-7469)
- Clearly the Minnesota Factory is controlling this better now
- However, all our installation testing is happening on the prototype Near Detector. It is possible this variation may cause some installation failures on the prototype that will not appear at Ash River.
  - Current work (May 2012) has installations starting with a 9 mil shim to check that the APD works.
  - Then they try smaller shims.
  - Ideally we want the fiber ends to be no more than 9 mils above the pixels
  - Ideally we want the fiber ends to be about 6 mils above the pixels
  - Ideally we do not want the fiber ends to press on the APD surface.

APD Coatings

- The original APDs from Hamamatsu had passivation (~1 micron of SiO_2)
  - But the passivation was removed by Hamamatsu over the active pixel area since it acted as a transmission filter for 500 nm light
  - This meant the APDs were completely unprotected at the pixels.
  - This was a likely source of installation problems when we had dirty optical connectors or fibers touching the pixel surfaces (see slide 20)
- The 250 APDs delivered in March 2012 were different
  - Passivation left in place over pixels
  - TWO additional coatings tried
    - Silicone applied by Hamamatsu
    - Parylene applied by a US vendor through Caltech
- Silicone coating properties
  - Max of ~ 1mil, but Fermilab measurements show variation over surface with some spots possibly not coated; may have meniscus on sides of pixel area compromising installation; coats only pixel area; Hamamatsu did aging study;
- Parylene coating properties
  - Vacuum deposition process, so well controlled at 0.5 mil with uniform coating over all surfaces, no meniscus; coats pixel area and back of board where APD is bump-bonded; no aging study yet;

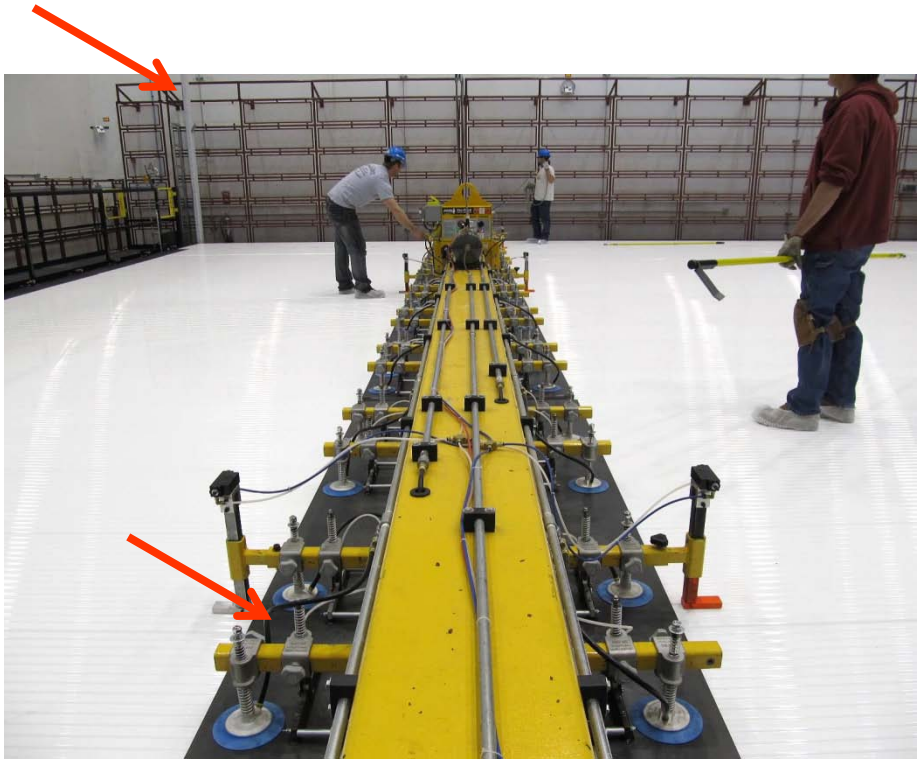
APD Seals

APD summary with all changes

- And results when run cold

Ash River Assembly Status

- 2 Layers of modules were stacked on the Pivoter table last week
  - Trained crews
  - Tested alignment fixtures
  - Used Flexane grout at bottom of vertical modules
  - Timed installation (2 of 24 modules were not < 20 min), implies more practice to come
  - Tested compression plates



EVMS Reporting Overview

- Data now available through April 2012
  - SPI = **0.978**, compare to 0.979 in Mar, 0.978 in Feb, 0.985 in Jan
  - CPI = **0.944,** compare to 0.946 in Mar, 0.943 in Feb, 0.951 in Jan

CPR1 Apr 2012

COST PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE

CONTRACTOR	CONTRACT	PROGRAM	REPORT PERIOD
NAME Fermi National Accelerator Laboratory	NAME	NAME NOvA project	FROM 01-Apr-2012 TO 30-Apr-2012

PERFORMANCE DATA

CTC-FndSrc CTC[2] Results... ITEM	CURRENT PERIOD BUDGETED COST WORK SCHEDULED	 WORK PERFORMED	ACTUAL COST WORK PERFORMED	VARIANCE SCHEDULE	 COST	CUMULATIVE TO DATE BUDGETED COST WORK SCHEDULED	 WORK PERFORMED	ACTUAL COST WORK PERFORMED	VARIANCE SCHEDULE	 COST	AT COMPLETION BUDGETED	LATEST REVISED ESTIMATE	VARIANCE
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
DA DOE-ACEL MIE													
2.0 ANU Construction													
Fully burdened AY$k	846	818	1,024	(28)	(207)	23,269	20,982	26,373	(2,287)	(5,391)	34,229	38,113	(3,884)
CTC-FndSrcTotals:	846	818	1,024	(28)	(207)	23,269	20,982	26,373	(2,287)	(5,391)	34,229	38,113	(3,884)
DC DOE-CA													
2.1 Site and Building													
Fully burdened AY$k	0	0	0	0	0	35,060	35,060	34,872	0	188	35,060	34,872	188
CTC-FndSrcTotals:	0	0	0	0	0	35,060	35,060	34,872	0	188	35,060	34,872	188
DD DOE-ACEL R&D													
1.0 ANU R&D													
Fully burdened AY$k	0	2	0	2	2	7,025	7,025	6,611	0	414	7,025	6,611	414
CTC-FndSrcTotals:	0	2	0	2	2	7,025	7,025	6,611	0	414	7,025	6,611	414
DE DOE-DET MIE													
2.1 Site and Building													
Fully burdened AY$k	63	63	142	(0)	(79)	6,991	6,983	5,925	(8)	1,057	7,043	5,987	1,056
2.10 Project Management - Nova Project - Construction													
Fully burdened AY$k	197	197	208	0	(11)	7,806	7,806	6,666	0	1,140	11,652	10,521	1,131
2.2 Liquid Scintillator													
Fully burdened AY$k	666	309	318	(357)	(9)	8,565	8,873	9,022	309	(149)	22,246	22,410	(164)
2.3 WLS Fiber													
Fully burdened AY$k	403	404	360	1	44	9,683	10,479	10,803	796	(324)	12,606	12,914	(309)
2.4 PVC Extrusions													
Fully burdened AY$k	1,177	846	1,037	(331)	(191)	15,055	15,854	15,997	799	(143)	30,695	30,702	(8)
2.5 PVC Modules													
Fully burdened AY$k	463	503	410	40	92	10,304	10,065	8,525	(238)	1,540	19,979	18,476	1,503
2.6 Electronics													
Fully burdened AY$k	387	244	357	(143)	(113)	7,040	5,422	4,940	(1,618)	482	12,299	11,867	431
2.7 DAQ													
Fully burdened AY$k	161	221	181	60	39	3,284	2,576	3,307	(708)	(732)	4,435	5,170	(734)
2.8 Near Detector Assembly													
Fully burdened AY$k	0	34	64	34	(30)	1,944	1,881	2,598	(63)	(717)	8,182	8,671	(489)
2.9 Far Detector Assembly													
Fully burdened AY$k	208	640	734	432	(94)	8,455	7,756	10,443	(699)	(2,687)	22,217	25,073	(2,856)
CTC-FndSrcTotals:	3,726	3,461	3,813	(265)	(351)	79,127	77,695	78,228	(1,432)	(533)	151,354	151,792	(438)

Another negative cost month, ½ of last month in size

Another negative month

CPR1 Apr 2012 continued

COST PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE

CONTRACTOR	CONTRACT	PROGRAM	REPORT PERIOD
NAME Fermi National Accelerator Laboratory	NAME	NAME NOvA project	FROM 01-Apr-2012 TO 30-Apr-2012

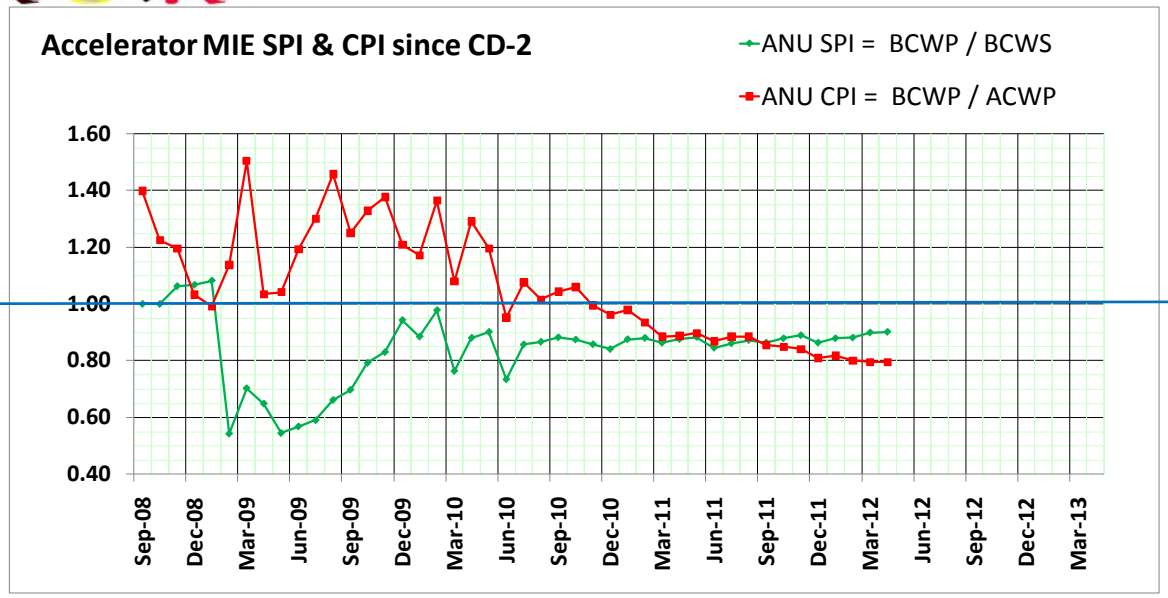
PERFORMANCE DATA

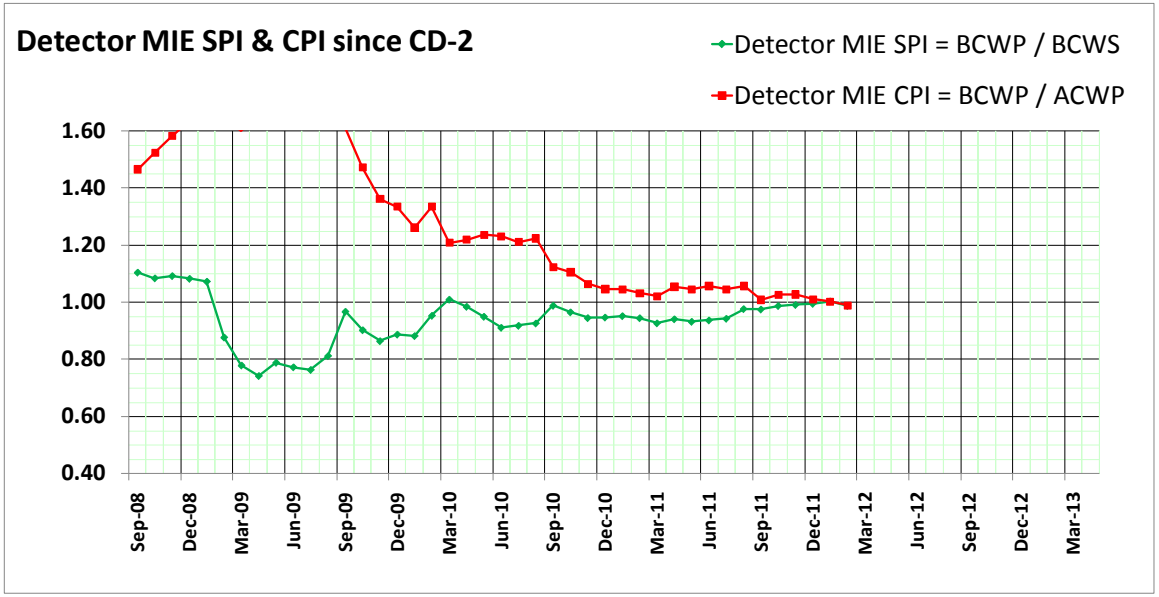
CTC-FndSrc CTC[2] Results... ITEM	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
	BUDGETED COST		ACTUAL COST	VARIANCE		BUDGETED COST		ACTUAL COST	VARIANCE				
	WORK SCHEDULED	WORK PERFORMED	WORK PERFORMED	SCHEDULE	COST	WORK SCHEDULED	WORK PERFORMED	WORK PERFORMED	SCHEDULE	COST	BUDGETED	LATEST REVISED ESTIMATE	VARIANCE
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
DO DOE-ACEL OPS													
1.0 ANU R&D													
Fully burdened AY$k	0	0	17	0	(17)	390	410	616	20	(206)	1,642	1,845	(203)
CTC-FndSrcTotals:	0	0	17	0	(17)	390	410	616	20	(206)	1,642	1,845	(203)
DR DOE-POST CD-1 DET R&D													
1.1 Site and Building R&D													
Fully burdened AY$k	0	0	0	0	0	3,630	3,630	3,168	0	462	3,630	3,168	462
1.2 Liquid Scintillator R&D													
Fully burdened AY$k	0	0	0	0	0	297	297	389	0	(92)	297	389	(92)
1.3 WLS Fiber R&D													
Fully burdened AY$k	0	0	0	0	0	341	341	375	0	(34)	341	375	(34)
1.4 PVC Extrusion R&D													
Fully burdened AY$k	0	0	0	0	0	1,369	1,369	2,084	0	(715)	1,369	2,084	(715)
1.5 PVC Module R&D													
Fully burdened AY$k	0	0	0	0	0	2,260	2,260	2,421	0	(160)	2,260	2,421	(160)
1.6 Electronics R&D													
Fully burdened AY$k	0	0	0	0	0	2,028	2,028	2,600	0	(572)	2,028	2,600	(572)
1.7 DAQ R&D													
Fully burdened AY$k	0	0	0	0	0	1,635	1,635	2,822	0	(1,186)	1,635	2,822	(1,186)
1.8 Detector Assembly R&D													
Fully burdened AY$k	0	0	0	0	0	3,123	3,123	4,929	0	(1,806)	3,123	4,929	(1,806)
1.9 Project Management R&D													
Fully burdened AY$k	0	0	0	0	0	383	383	559	0	(176)	383	559	(176)
CTC-FndSrcTotals:	0	0	0	0	0	15,067	15,067	19,347	0	(4,280)	15,067	19,347	(4,280)
DY DOE CD-0 TO CD-1 R&D													
1.9 Project Management R&D													
Fully burdened AY$k	0	0	0	0	0	8,801	8,801	8,801	0	0	8,801	8,801	0
CTC-FndSrcTotals:	0	0	0	0	0	8,801	8,801	8,801	0	0	8,801	8,801	0
Undist. Budget											0	0	0
Sub Total	4,572	4,282	4,854	(290)	(573)	168,738	165,039	174,848	(3,700)	(9,809)	253,177	261,381	(8,204)
Management Resrv.											24,823		
Total	4,572	4,282	4,854	(290)	(573)	168,738	165,039	174,848	(3,700)	(9,809)	278,000		

~ 60% ANU, 40% Det MIE

~55% ANU, 45% Det R&D

SPI & CPI for Active Work

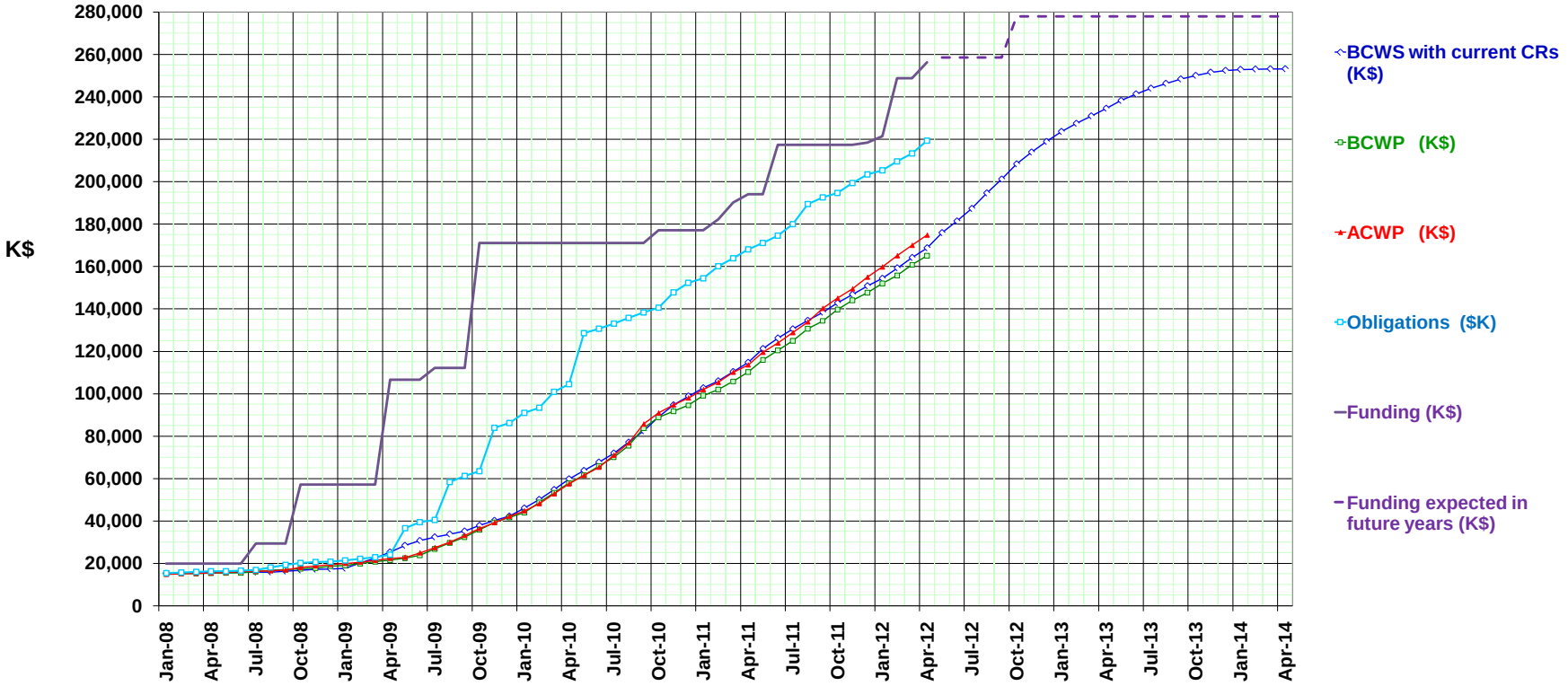




- ANU long slide down to CPI = 0.8
  - Stabilizing now that continuing labor overrun is re-estimated for future tasks in CR487
- Detector relatively constant near CPI = 1.0

EVMS Reporting Overview

- Basic data in BCWS, BCWP, ACWP, **Funding** & **Obligations** through Apr 2012
  - BCWS = Budgeted cost of work Scheduled
  - BCWP = Budgeted cost of work Performed
  - ACWP = Actual cost of work Performed
- Project is 65.2 % complete (BCWP/BAC = 165.0 M$ / 253.2 M$)
  - BAC = Budget at Completion (using EAC, get 63.1%)
- Project is 82.7 % obligated (Obligations/BAC = 209.5 / 253.2)
  - EAC = Estimate at Completion (using EAC, get 80.1%)



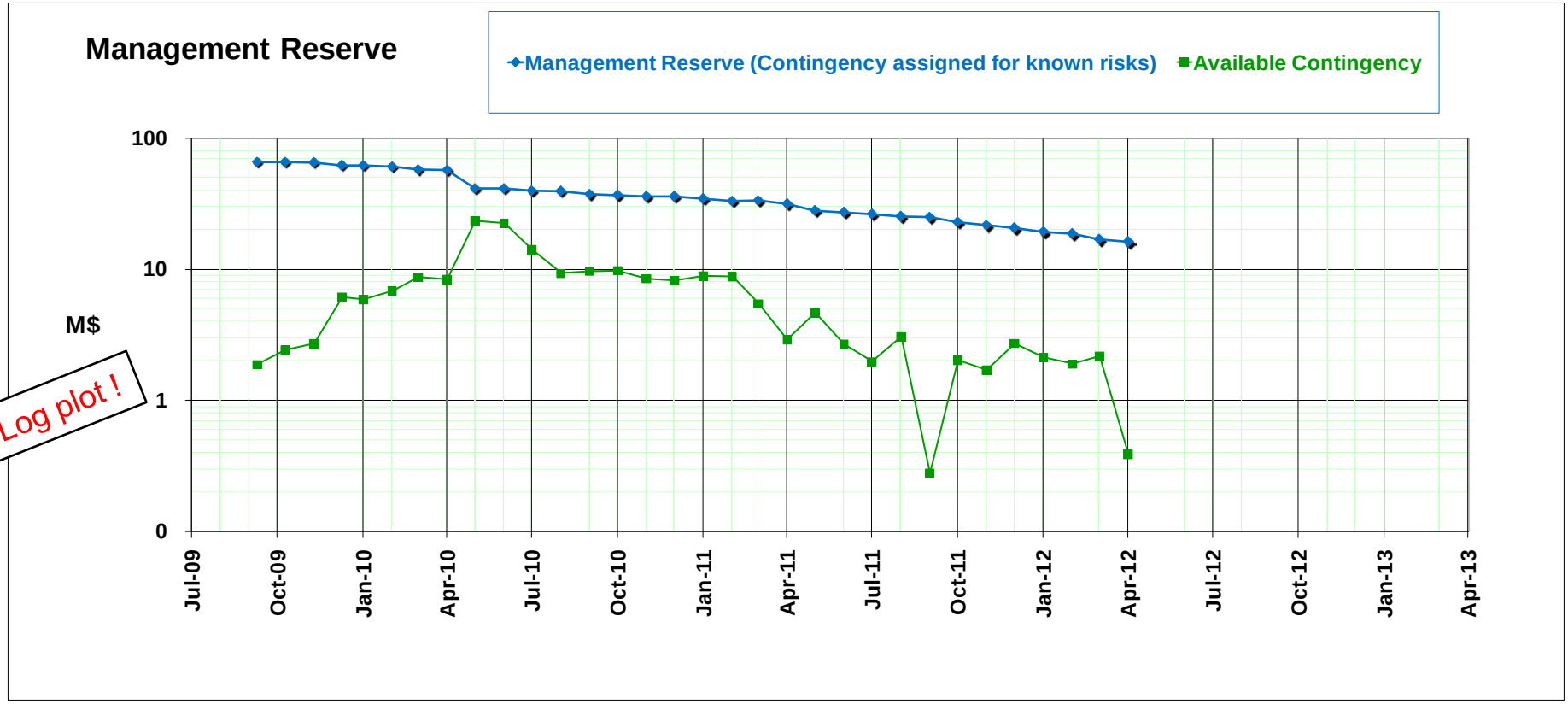
AY$ by Level 2 with MIE/OPC split

	WBS	Items	NOvA Costs to Date ($M) as of 30-Apr-2012	NOvA 's Cost Estimate AY $M (for May 1, 2012 to project end)									
				Estimated Cost (with indirects)			Mgmt Reserve Estimate			Contingency %			Total
				M&S	Labor[1]	Total	M&S	Labor[1]	Total	M&S	Labor[1]	Total	Cost
TEC	2.0	Accelerator & NuMI Upgrades	$ 26.4	$ 1.8	$ 9.9	$ 11.7	$ 1.0	$ 1.9	$ 2.8	52%	19%	24%	$ 41.0
	2.1	Far Detector Site and Building	$ 5.9	$ 0.1	$ 0.0	$ 0.1	$ -	$ -	$ -	0%	0%	0%	$ 6.0
	2.2	Liquid Scintillator	$ 9.0	$ 13.2	$ 0.2	$ 13.4	$ 3.2	$ 0.1	$ 3.3	25%	42%	25%	$ 25.7
	2.3	Wave-Length-Shifting Fiber	$ 10.8	$ 1.9	$ 0.2	$ 2.1	$ 0.1	$ 0.0	$ 0.1	5%	10%	6%	$ 13.0
	2.4	PVC Extrusions	$ 16.0	$ 14.1	$ 0.6	$ 14.7	$ 0.8	$ 0.1	$ 0.9	6%	20%	6%	$ 31.6
	2.5	PVC Modules	$ 8.5	$ 3.6	$ 6.3	$ 10.0	$ 0.3	$ 0.9	$ 1.2	8%	15%	12%	$ 19.7
	2.6	Electronics Production	$ 4.9	$ 5.9	$ 1.0	$ 6.9	$ 0.4	$ 0.3	$ 0.7	7%	29%	10%	$ 12.6
	2.7	Data Acquisition System	$ 3.3	$ 0.9	$ 1.0	$ 1.9	$ 0.2	$ 0.3	$ 0.5	22%	27%	25%	$ 5.6
	2.8	Near Detector Assembly	$ 2.6	$ 5.6	$ 0.5	$ 6.1	$ 1.0	$ 0.2	$ 1.2	18%	44%	20%	$ 9.9
	2.9	Far Detector Assembly	$ 10.4	$ 6.6	$ 8.0	$ 14.6	$ 1.3	$ 3.8	$ 5.1	20%	48%	35%	$ 30.2
	2.10	Project Management	$ 6.7	$ 0.2	$ 3.7	$ 3.9	$ 0.0	$ -	$ 0.0	24%	0%	1%	$ 10.6
		Subtotal Construction	**$ 104.6**	**$ 53.9**	**$ 31.4**	**$ 85.3**	**$ 8.4**	**$ 7.6**	**$ 16.0**	**16%**	**24%**	**19%**	**$ 205.9**
OPC		**R&D - Accelerator**	$ 6.6	$ -	$ -	$ -	$ -	$ -	$ -	0%	0%	0%	$ 6.6
		R&D - Detector	$ 28.1	$ -	$ -	$ -	$ -	$ -	$ -	0%	0%	0%	$ 28.1
		Cooperative Agreement	$ 34.9	$ -	$ -	$ -	$ -	$ -	$ -	0%	0%	0%	$ 34.9
		Operating	$ 0.6	$ 0.0	$ 1.2	$ 1.2	$ 0.0	$ 0.2	$ 0.2	42%	15%	16%	$ 2.0
		Total OPC:	**$ 70.2**	**$ 0.0**	**$ 1.2**	**$ 1.2**	**$ 0.0**	**$ 0.2**	**$ 0.2**	**42%**	**15%**	**16%**	**$ 71.7**
		Available Contingency							**$ 0.387**				**$ 0.4**
		TPC:	**$ 174.8**	**$ 53.9**	**$ 32.6**	**$ 86.5**	**$ 8.4**	**$ 7.8**	**$ 16.6**	**16%**	**24%**	**19%**	**$ 278.000**

Contingency Status, Apr 2012

- Total Contingency is 16.6 M$ (Mar=19.1, Feb=20.5, Jan = 21.4)
  - 19.2 % Contingency on remaining work (Estimated Cost is 96.8 M$)
  - 39.4 % on remaining Obligations (Obligations are ~ 44 M$ ahead of Costs)

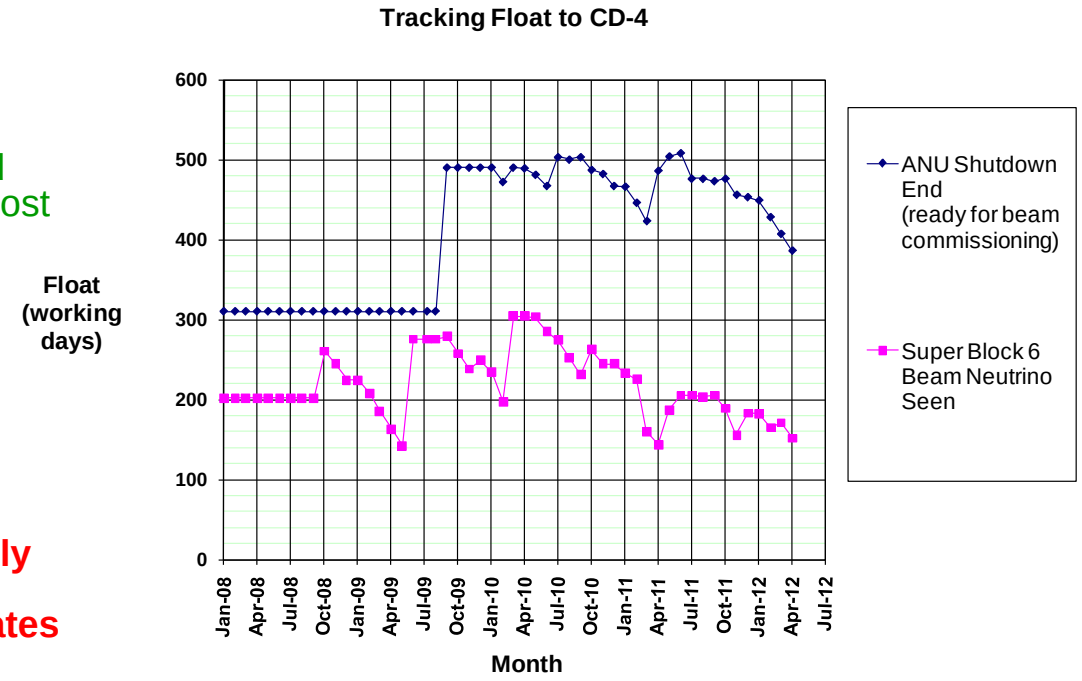
- **Available Contingency = $ 0.387 M$ (Mar=2.163, Feb=1.889, Jan = 2.124)**
- Assigned Contingency (Management Reserve) is assigned according to our estimate of remaining risks



Milestones: What about CD-4 ?

- **ANU lost 15 days of float in April -- Now at 386 days**
  - Kicker and RF schedules still drive this float.

- **The Detector lost 19 days of float in March -- Now at 152 days**
  - This is due to delay in start of Ash River assembly (Pivoter still in April).
  - Recall we compensated for lost float in February & March by adding a 5th workday every week for Ash River assembly of 13 blocks at Ash River. We can't continue this because the Minnesota Factory becomes the driver at Block #14.
    - Our assigned Ash River Assembly contingency was always set by the cost of perhaps adding overtime or a 3rd shift. We have now put overtime in the schedule & reduced the contingency by the 10% extra cost
    - This does not mean we "know" the assembly schedule better, but shows that we can compensate using our plan.
    - We won't know the required labor at Minnesota or at Ash River until we get to steady production.
    - **I do not see any point in artificially compensating the float further until we know both production rates**

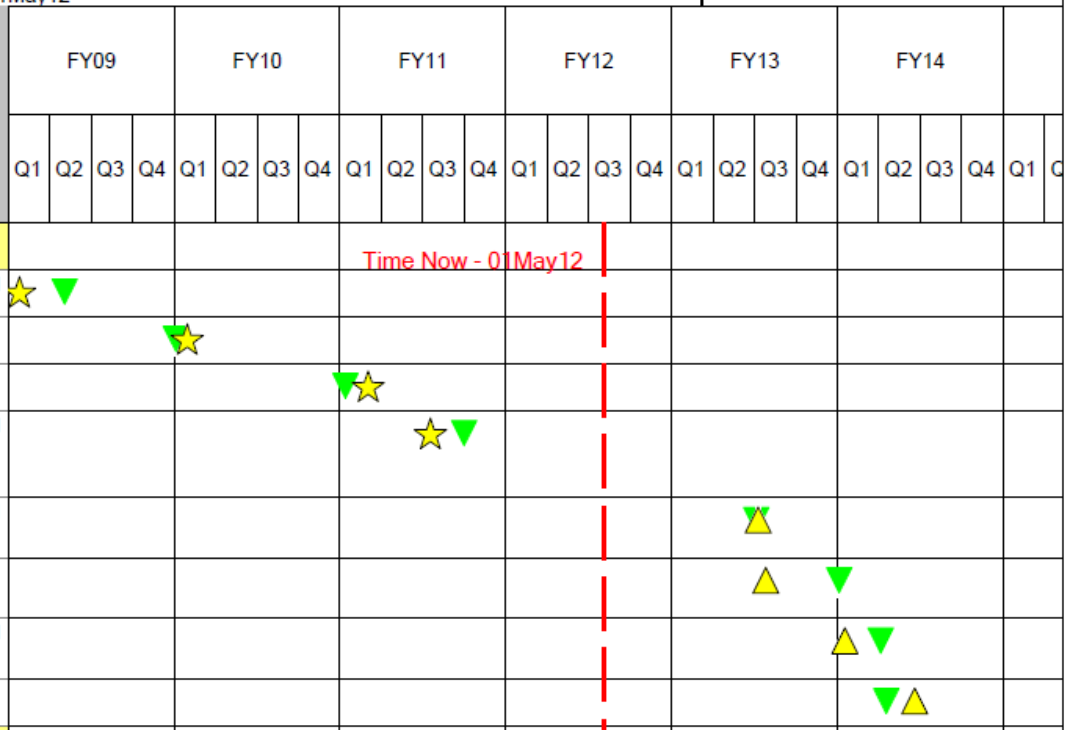


Milestones held by DOE - OHEP

Nova_Project
Milestone Gantt Chart
Nova_Milestones_L1_L2 = [BOOL.T] and ESDATE >= {10/1/08}
April 2012 Status
TimeNow: 01May12

Baseline Date ▼
Completed Milestone ☆
Current Forecast Date △

Activity Desc.	Baseline Date	Forecast / Actual Date	Baseline Variance
L.1 -- DOE - OHEP Associate Director Milestone			
CD-3a	02Feb09	24Oct08	63d
CD-3b	01Oct09	29Oct09	-21d
IPND ready to take data	11Oct10	30Nov10	-35d
Beneficial occupancy (Substantial completion) - far detector building construction	30Jun11	13Apr11	54d
Beneficial occupancy of near detector cavern	01Apr13	05Apr13	-5d
NuMI neutrino event observed in Superblock 1	01Oct13	25Apr13	109d
Near detector completed and ready to operate	02Jan14	14Oct13	51d
14 kt installation completed	16Jan14	19Mar14	-43d



No CRs in April

DOE Milestones – Fed Project Director

Nova_Project
Milestone Gantt Chart
Nova_Milestones_L1_L2 = [BOOL.T] and ESDATE >= {10/1/08}
April 2012 Status
TimeNow: 01May12

Baseline Date ▼
Completed Milestone ☆
Current Forecast Date △

Activity Desc.	Baseline Date	Forecast / Actual Date	Baseline Variance
L.2 -- DOE- NOVA Project Director Milestone			
DOE OHEP CD-3a Mini-review	15Jan09	24Oct08	52d
Site preparation purchase order released	06Apr09	22May09	-34d
Waveshifter PO issued	22May09	08Jun09	-10d
DOE OECM - FRA EVMS Certified	01Jun09	28Jan10	-164d
DOE OHEP CD-3b Review	01Jun09	23Jul09	-37d
Extrusion PO issued	01Oct09	11Dec09	-49d
WLS fiber PO issued	02Nov09	01Sep09	42d
Decision point for buying additional waveshifter powders	11May10	01Dec09	109d
IPND blocks (4 of 6) completed	12Jul10	09Jul10	0
Mineral oil PO issued	01Oct10	07May10	101d
APDs PO issued	18Jul11	15Aug11	-21d
Block pivoter completed	30Apr12	30Apr12	-1d
Decision point for buying additional WLS fiber	03Jul12	03Jul12	0
Decision point for buying additional APDs	01Nov12	21May13	-136d
Decision point for buying additional extrusions, modules, mineral oil, pseudocumene	13Feb13	14Aug13	-128d
Far Detector extrusions for 14kt completed	14May13	13Aug13	-63d
MI Ring Modifications Ready for Beam Transport	01Jul13	25Mar13	68d
RR Modifications Ready for Beam Transport	01Jul13	15May13	31d
Ready to Commission Upgrades with Medium Energy Neutrino Beam	01Jul13	15May13	31d

FY09 FY10 FY11 FY12 FY13 FY14
Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q

Claimed Pivoter Done

Milestones held by Directorate

Nova_Project

Milestone Gantt Chart

va_Milestone_L3_L4 = [BOOL.T] and (ESDATE >= {10/01/08} or BSDATE >= {10/01/08}) and BFDATE NOT_EMPTY

April 2012 Status

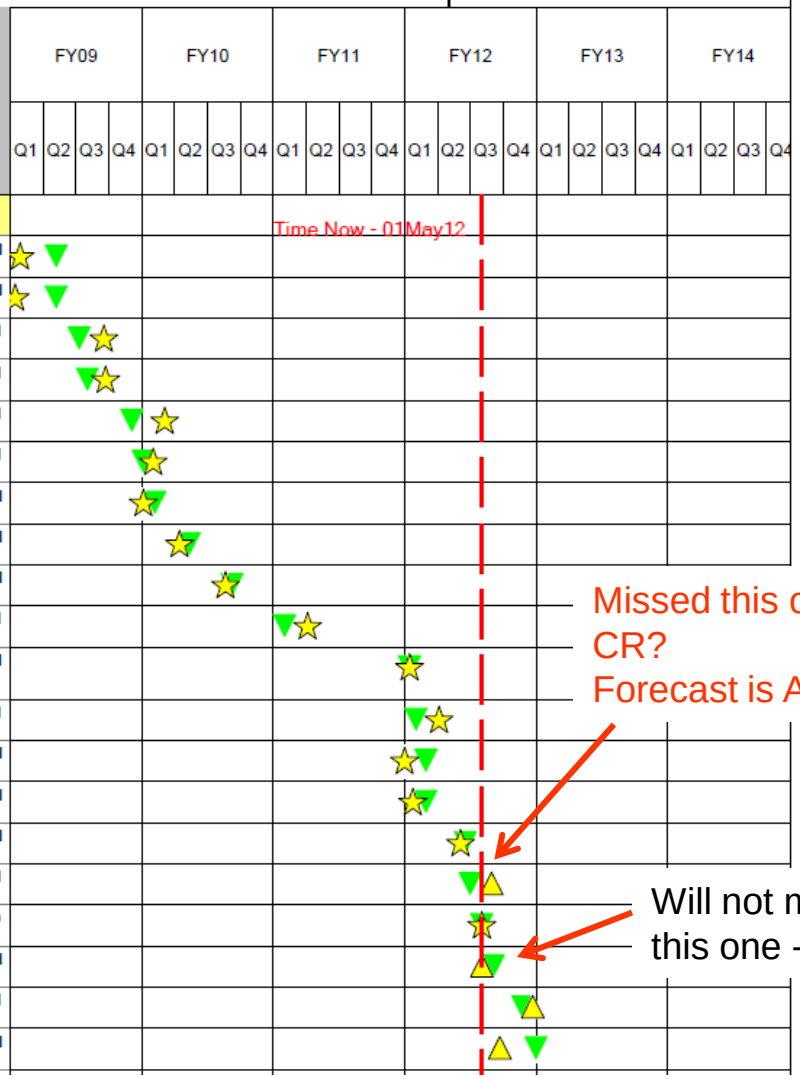
TimeNow: 01May12

Baseline Date ▼

Completed Milestone ☆

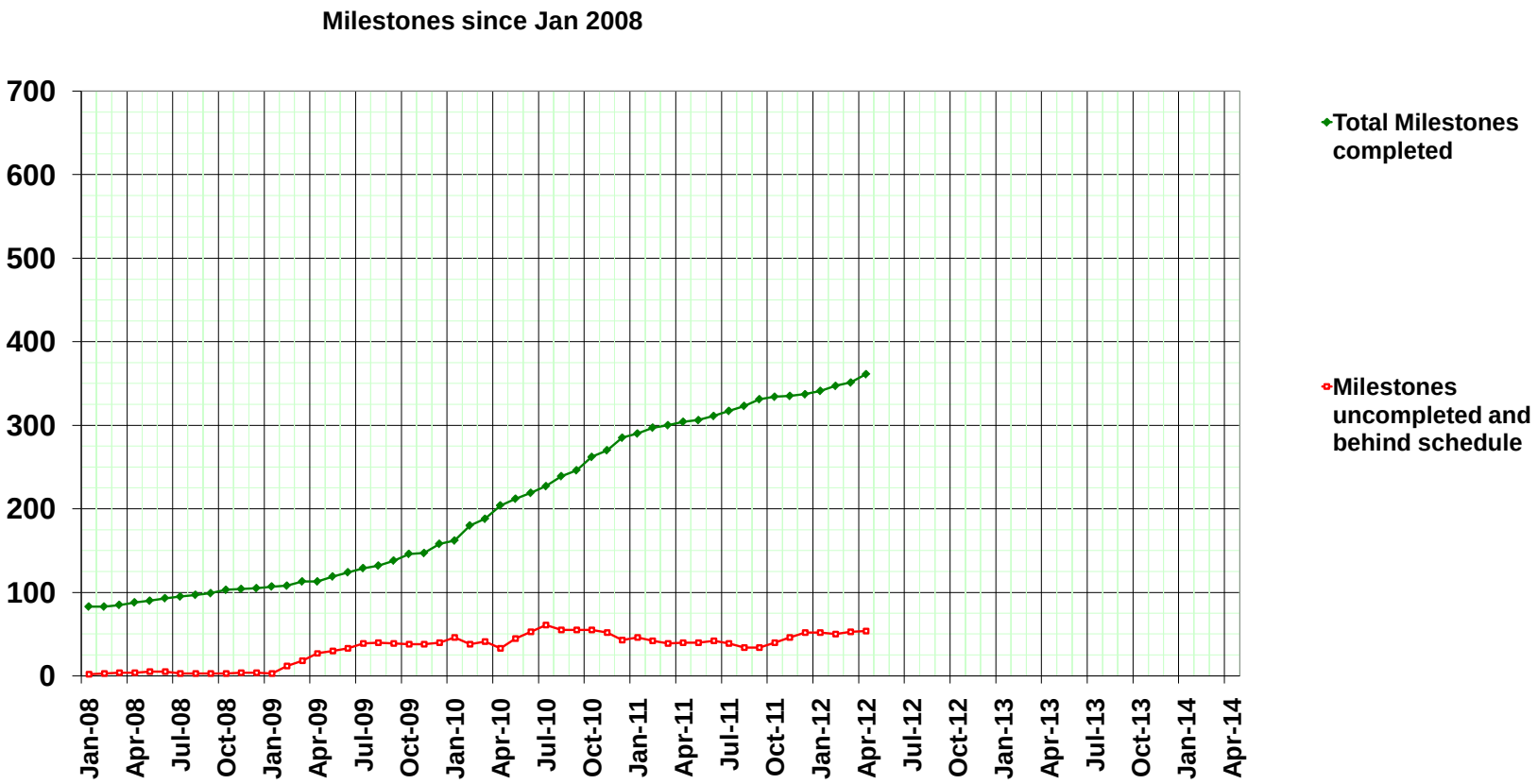
Current Forecast Date △

Activity ID	Activity Desc.	Baseline Date	Forecast or Actual Date	Baseline Variance
L.3 -- Fermilab Associate Director Milestone				
2.10.9.5	CD-3a Funds Available	02Feb09	24Oct08	63d
2.10.9.7	FY09 Funds Available	02Feb09	14Oct08	71d
2.10.10.3	2009 Shutdown Begun	06Apr09	15Jun09	-50d
2.10.9.24	Director's CD-3b Review	01May09	18Jun09	-34d
2.0.1.2.8.1	Gap Clearing/RR Inj Kicker Magnet Design Complete	01Sep09	01Dec09	-63d
2.10.9.6	CD-3b Funds Available	01Oct09	29Oct09	-21d
2.10.9.8	FY10 Funds Available	02Nov09	01Oct09	21d
2.3.2.1.6	WLS fiber production begins	09Feb10	12Jan10	18d
1.5.7.3.9	IPND block 4 module production completed	04Jun10	17May10	12d
2.10.9.9	FY11 Funds Available	01Nov10	03Jan11	-41d
2.1.2.5.23	Final acceptance/project completion - far detector building construction	10Oct11	10Oct11	-1d
2.10.9.10	FY12 Funds Available	01Nov11	03Jan12	-40d
2.0.3.3.4.1	NuMI Shielding Blocks & Carriage Complete	28Nov11	28Sep11	40d
2.0.3.3.4.3	NuMI Stripline Assembly Complete	28Nov11	19Oct11	25d
2.5.3.3.2.45.44	Far detector module assembly started	16Mar12	29Feb12	11d
2.7.2.1.2.8	Production data concentrators received	30Mar12	25May12	-41d
2.10.10.5	Accelerator Shutdown Begun	30Apr12	30Apr12	0
2.0.4.3.13	ANU Shielding Assessment Updates Complete	31May12	01May12	21d
2.0.3.2.4.3	NuMI ME Target/Carrier/Baffle Assembly Complete	20Aug12	21Sep12	-23d
2.0.2.2.5.4	MI RF Cavities (2) Installation & Testing Complete	28Sep12	18Jun12	71d

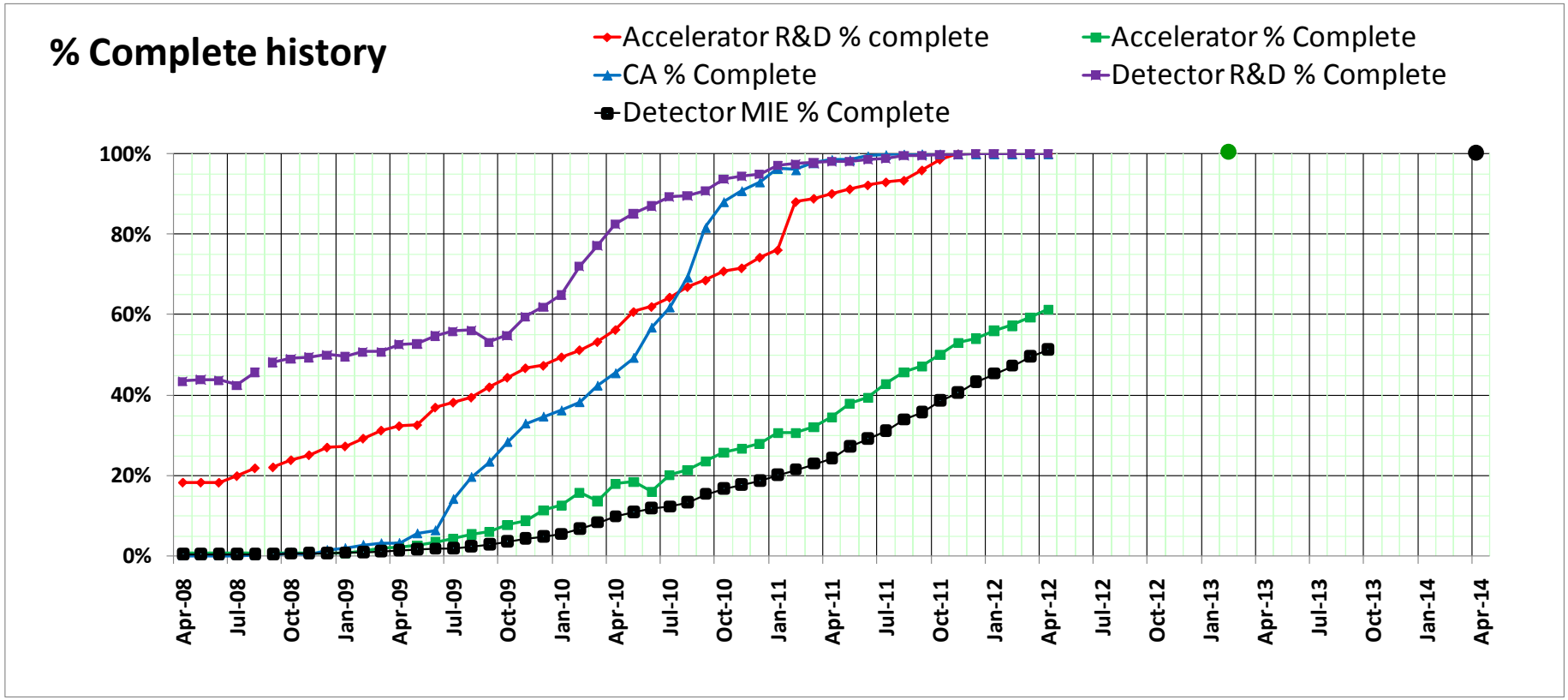


Analysis of all milestones

- **361 of 696 now complete**
  - 10 completed in April
- **Behind on 54**



% Complete history for the **5** Main parts of the Project



- Building & Detector R&D & ANU R&D are all done
- ANU at 61%, to be complete by ~ Feb 2013
- Detector at 51%, to be complete by ~ April 2014