Detector Support Group
Weekly Report, 2016-02-03

Gossary: EDC = Estimated Date of Completion.
PID = Proportional – Integral - Derivative

Ongoing Projects

I. **Hall D PLC Systems (**Peter, Tyler, Amanda, Mary Ann, Marc)

Task:	Locate and document (including spares) the eight PLC systems in use.
EDC:	03/15/2016.
Action:	Started generating instrumentation layout.
Comments:	BCAL PLC documentation missing.
Status:	**Work in progress**

II. **Hall B Gas System Hardware (**George, Sahin, Mindy, Anatoly)

Task:	Install Gas System hardware.
EDC:	TBD
Action:	Work on-going in gas shed.
Comments:	All nine Mass Flow Controllers (MFCs) leak-checked. Old piping to hall removed.
Status:	**Work in progress**

III. **Hall B Gas System Slow Controls (**Brian, George, Marc, Mary Ann, Amanda, Tyler)

Task:	Perform PID controller test with new Mass Flow Controllers.
EDC:	02/15/2016
Action:	Started replacing old MFCs with new ones.
Comments:	Once MFCs are replaced and control cables terminated, PID controller test can be conducted.
Status:	**Work in progress**

IV. **Hall B Magnet Slow Controls (**Brian, Peter, Amanda, Tyler)

Task:	Test Power supply.
EDC:	?
Action:	Set up communications with Danfysik control board.
Comments:	Established communication on 01/29/2016.
Status:	**Work in progress**

V. **Hall B HDICE (**Peter, Brian, Mary Ann, Amanda, Tyler, Mindy, Sahin)

Task:	Fabricate prototype RF cables.
EDC:	01/31/2016
Action:	All four cables fabricated and given to Wei for testing.
Comments:	An additional 10 foot long cable request was honored.
Status:	**Completed, 2/2/2016**

VI. **Hall B HTCC (**Mary Ann, Mindy, Anatoly, Sahin)

Task:	Fabricate cables.
EDC:	07/31/2016
Action:	Forty of 48 HV cables completed.
Comments:	Requested Youri to send delivery date of remaining connectors and cables. Youri Sharabian is yet to respond with dates.
Status:	**Work in progress.**

VII. **Databasing in SQLite (**Amanda, Mary Ann, Tyler, Brian)

Task:	Database and histogram HV currents of SVT modules.
EDC:	01/15/2016
Action:	Paper on findings written.
Comments:	
Status:	**Completed 02-03-2016**

Completed Tasks

I. **Hall B Gas System Slow Controls (**Brian, George, Marc, Mary Ann, Amanda, Tyler)

Task:	Complete PID controller test.
EDC:	01/31/2016
Action:	Performed data runs with different values of P, I, and D. From determined values, noted PID controller program works well.
Comments:	
Status:	**Completed 01/ 22/16**

II. Hall B Magnet Slow Controls (Brian, Peter, Amanda, Tyler)

Task:	Setup PLC workstations and look at code.
EDC:	01/15/2016
Action:	
Comments:	
Status:	**Completed 01/22/2016**

III. Hall B DC HV (Mary Ann, Anatoly, Sahin)

Task:	Clean and test DC HV crates and cards.
EDC:	02/15/2016
Action:	Available crates (4) and cards 39 tested and documentd.
Comments:	Eleven cards need repairing. Mark Taylor contacted CAEN. Repairing a card will cost ~$1,000. Mark has submitted PRs for repair.
Status:	**Completed 02/01/2016**

IV. Hall B Gas System Hardware (George, Marc, Mindy, Sahin)

Task:	Setup for PID controller test.
EDC:	01/15/2016
Status:	**Completed 01/13/2016.**
Comments:	Hall B Engineering ***still*** needs to fix: circuit breaker (extension cord is being used), bolt rack, and solenoid panel.
Action:	DSG communicated issue to Hall B Engineering. Rack bolted.
Status:	**Circuit breaker and solenoid panel need to be fixed.**

V. Hall B Detector pre-installation (Mary Ann, Mindy, Anatoly, Sahin)

Task: Fabricate, label and test 252 DC LV cables.
EDC: 01/29/2016
Status: Completed 01/16/2016

VI. **Hall B HDICE (**Peter, Brian, Mary Ann, Amanda, Tyler, Mindy, Sahin)

Task: Fabricate prototype RF cables.
EDC: 01/31/2016
Action: All four cables fabricated and given to Wei for testing.
Comments: An additional 10 foot long cable request was honored.
Status: Completed, 2/2/2016

Pending Projects

I. **Hall B DC Installation (**George, Marc, Mindy, Sahin)

Task:	Prepare for August installation!
EDC:	N/A.
Action:	No change in status.
Comments:	Installation scheduled to start 08/01/2016. For an estimated installation time of one chamber per week, installation would be completed end of January 2017. *This estimate does not include time contingency*. Plan is to first install all six chambers of RI, flow gas, and check the chambers, then proceed to RII and then to RIII. If an 'on-board' problem is detected after installation of a region, to fix the problem would require a week. If we anticipate problems with two boards of the total 252 boards (~1%), installation would be completed mid January 2017. If time contingency is included, completion date would be end of January 2017.
Status:	**Yet to start**

II. **Test Station (**Tyler, Amanda, Mary Ann, Peter, Brian)

Task:	Communicate to cRIO/ output to excel
EDC:	01/15/16
Action:	N/A
Comments:	Given the current work load, this project has been deferred to a later time.
Status:	**Communication established on 01/11/2016**

Antonioli, Mary Ann

Hall B

DC

- Tested 3 HV cards.
  - ✶ No problems found.
  - ✶ No more HV cards are available for testing.
  - ✶ PR submitted by M. Taylor for repairs.

SVT

- Input serial and batch numbers of sensors into SVT database spreadsheet for all modules.
- Input SVT module voltage and current data (528 values) for Feburary into spreadsheet.

HTCC

- Discussed label nomenclature with Y. Sharabian.
  - ✶ Ordered labels, which are scheduled for delivery on Thursday, 02/04/2016.

Hall D

- Began checking, editing, and cleaning up PLC system spreadsheets.

DSG

- Contacted Adobe to resolve issues with CS6 installation.
  - ✶ Installation finally complete.
- Updated website photo and archived replaced photo.

Arslan, Sahin & Sitnikov, Anatoly

Hall B

Gas System

- Leak tested newly installed MFC's.
- Working on replacing the old components with new components, and some modification on gas lines as needed.
- Labeled all cables and components.
- Provided spare bottle of N_2 to Forward Tagger detector.
- Provided N_2 for MicroMegas detector.

DC

- Replaced gas CO_2/Ar on R1S4 test stand chamber.

Bonneau, Peter

Hall B

Magnet Systems

- Setup and tested a 435NBX ASCII PLC Gateway module as a backup for Torus PLC/ MPS communication tests.

HDice

- RF Switching/Attenuation Unit
  - ✶ Improved design on the internal power distribution system.

- Improved internal RF distribution design by using the Molex RF cable and associated corresponding connectors.
- Writing components PR's for the 3rd RF Switching/Attenuation Unit

- Rotation of Target Polarization Program
  - Started update of program to LabVIEW Version 2015.

SVT

- Monitored SVT Hardware Monitoring System Interlocks on a daily basis.
  - SVT coolant temperature has stabilized to ~6°C this week.

Hall D

- Compiled PLC layout files on the "M" drive at M:\DSG_Slow_Controls\Hall D\PLC Systems\ PLC Layouts. These files will be checked for accuracy by the Rockwell PLC system reports and other documentation.

DSG

- Advised Marcus O'Flaherty at FNAL on how to proceed with his testing of CAEN SY527 systems.
  - Recommended using Wiener (MPOD) systems for HV/LV and use NI cRIO for testing and slow controls
  - Sent to FNAL the LabVIEW code by DSG for testing CAEN SY527 systems.
- Trained T. Lemon \ A. Hoebel on Allen Bradley PLC systems.
  - Showed how to setup the communication parameters on the 435NBX serial module used on the Hall B Torus MPS.
  - How to use the 435NBX diagnostics to test & troubleshoot serial communications.
  - Overview of the Hall B Torus MPS command structure.
- Trained T. Lemon \ A. Hoebel \ M. Antonioli on LabVIEW programming on HDice – Rotation of Polarization Program
  - The revised Ramp Hold feature of the program was reviewed.

Eng, Brian

Hall B

SVT

- Weekly meeting:
  - Updates on software packages, Jerry will be getting a new student shortly.

Gas System

- Tested RS232 communications between scale display and cRIO

Magnets

- Krister wired up Solenoid MPS so only control side would be powered, found out from Mark Todd that control board is in remote display chassis (despite manual saying otherwise).
- Verified MPS remote line communications with terminal emulator on laptop, also changed settings of MPS to enable auto-answer mode.

- Setup 435NBX and verified proper communications with MPS using built-in web server and diagnostic functions.
- Installed Ethernet/IP module and controller in Torus PLC system.
- Programmed PLC with Josh's code and ran it, has minor errors, but communications with MPS appear to be working properly.

Hall D

PXI

- Debugging and modifying LabVIEW code to remove newly added VTT signals splices and duplicates to 30x terminal blocks) so they wouldn't get passed to PLC, this was causing signal mismatched when doing the checkout procedure, i.e. voltage applied to VTT14 would show up on VTT20.

Hoebel, Amanda

Hall B

HDICE

- Discussed rotation of target polarization LabVIEW VI with Mary Ann, Tyler, and Pete.

Gas System

- Discussed gas flow for the drift chambers with Tyler, Amrit, and Marc.
  - Tyler had pictures of the gas setup on spaceframe level 3.

SVT

- Acquired module voltages stored in MYA from December.
- Updated module spreadsheet with current and voltage values for February.
  - Module from region 4 sector 9 top side recorded as operating at 5[V]. Further inspection shows this module side is now working properly (at 85[V]) and the low reading was probably from a trip.
- Wrote a report on SVT module performance.
  - Included graphs of current draws from Mathematica.

Detector

- Took pictures of magnet power supply and PLCs.
- Discussed RTA PLC connection setup with Pete.
- Attended CLAS Slow Controls meeting.
  - Hardware purchases and updates discussed.

Hall D

- Took pictures of PLCs with Tyler.

DSG

- Completed LabVIEW Core 1 training.

Jacobs, George

Hall B

Gas System

- Completed replacement of the last 3 MFCs in 96B. All 9 new MFCs in 96B are now in the piping systems
- Removed obsolete O_2 and H_2O monitors in GAS Shed (96B) along with piping and valves which are no longer needed.
- Removed LTCC C_4F_{10} return pumps and manifolds from the system in 96B
- Excessed obsolete equipment and hardware in 96B
- Labeled control cables for re-use in 96B
- Produced DCGAS PID pressure control diagram, dcgas-PID-Devel-29Jan2016.pdf
- Leak checked supply MFCs for DC R1, R2, and R3

Leffel, Mindy

Hall B

HDICE

- Terminated the last two of the four rack cables.
    - ✶ One each: 24” N- to -N and 18” N - to - BNC.
    - ✶ One additional cable, 10’ N - to - SMA.

HTCC

- Continued terminating signal cables.
    - ✶ Terminated 25 more, for a total of 40.

Lemon, Tyler

Hall B

HDice

- Reviewed rotation of target project file and VI with Amanda, Mary Ann, and Peter

Slow Controls

- Attended biweekly meeting
    - ✶ Reviewed hardware that needs to be purchased
    - ✶ All beamline VME crate modules being moved to a separate independent VME crate

Magnet

- Set up and troubleshooted with Brian communication between power supply control board to PC
    - ✶ Control board was not responding properly to commands given in terminal program
    - ✶ Tried using different terminal program but control board still did not respond properly

Hall D

- Documented with Amanda and Marc PLCs in the hall by taking pictures of the PLC systems

DSG

PLC Test Station

- Class by Peter with Amanda on how to set up and test communication to 435NBX module
- Completed LabVIEW Core 1 class given by National Instrument
    - ✶Programed a state machine

McMullen, Marc

Hall B

Gas System

- Rewired Chassis 2 (Gas Shed) to use analog input for current, reading voltage off of the 500ohm resistors caused interference while reading other voltage channels.
- Started testing LabView code which will read multiple MFCs in the gas shed.
- Started cabling list for gas shed controls and MFCs.

Hall D

PLC Systems

- Worked with Lemon and Hoebel on identifying the various PLC systems in the Hall. This information will be used to document the system.

DSG

Safety

Conducted monthly walkthrough. Submitted PR to have an emergency bulb changed in rm124.

Module Performance of the Silicon Vertex Tracker

Amanda Hoebel

This note presents the findings on the performance of the 66 modules in the Silicon Vertex Tracker.

The SVT has 66 modules, each of which has two sides – top (T) and bottom (B). Each side has three types of senors: Hybrid, Intermediate, and Far.

Figure 1 shows the burn-in current draw of a module-side measured at Fermilab and the current draw for module-sides calculated from the *original current draw of the sensors* measured by Hamamatsu.

The Gaussian fit for the current-draw of the module-sides based on the *original current draw of the sensors* has an average of 375[nA] and a σ of 30[nA]. Due to the lack of stringent quality control at the time of module fabrication at Fermilab, the distribution of the burn-in current draws cannot be fitted with a Gaussian curve.

Figure 1

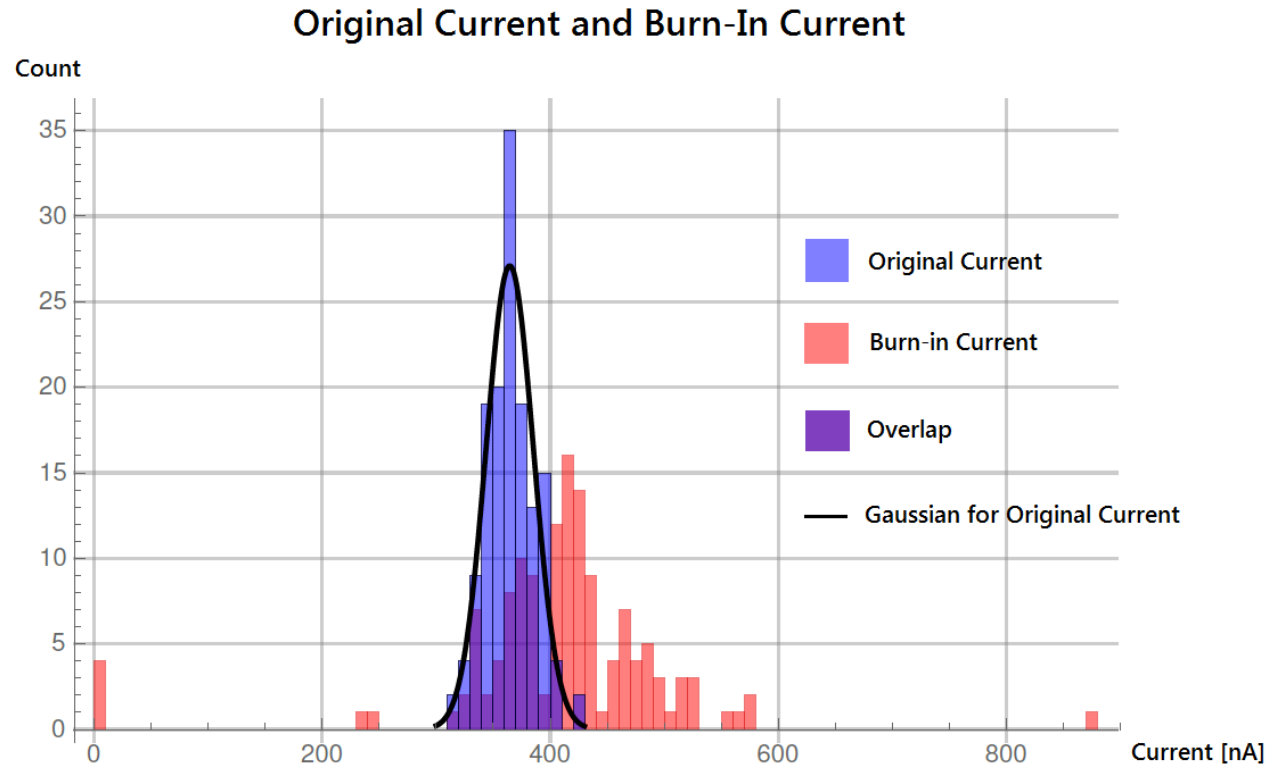

Figure 1 shows the distribution of original currents measured by Hamamatsu and burn-in currents measured at Fermilab. A gaussian curve is fitted over the original currents as the original currents have a gaussian distribution. The burn-in currents do not have a gaussian distribution.

Figure 2 shows, for the assembled SVT modules, the distribution of current draws measured in December, 2015 and the current draw of the module-sides based on the *original current draw of the sensors*. December, 2015 currents were lower than the currents of the module-sides based on the *original currents* because the modules' electronics were cooled to 10[^{O}C]. December, 2015 currents have a mean

value of 265[nA]. The data and the associated Gaussian are shifted 110[nA] to align the December, 2015 mean value with that of the mean value of the *original current*. The plots display nearly-identical Gaussian fits with a σ of ~ 30[nA] for both distributions.

Figure 2

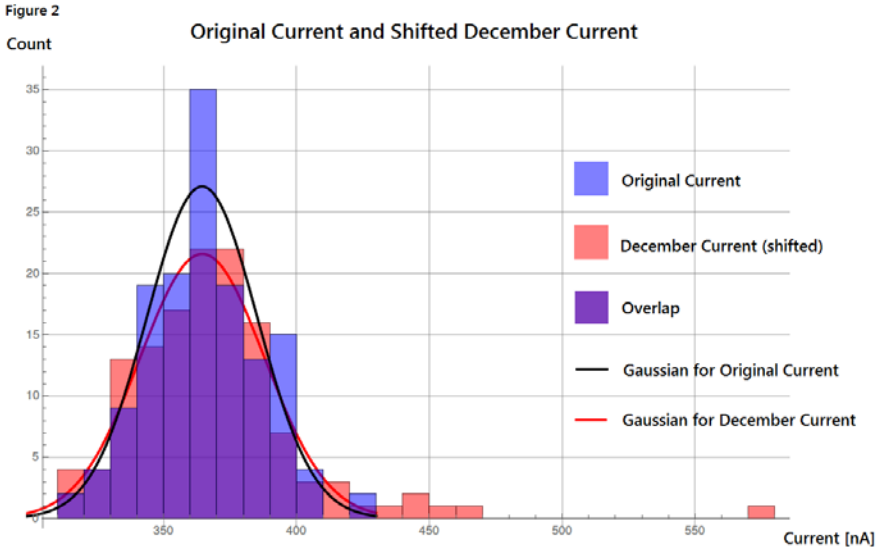

Figure 2 shows the original currents and December currents. The December currents are shifted by about 109 [nA] to display the nearly identical standard deviation of both distributions. Gaussian curves have been fitted on the original and December currents

Figure 3 shows the current values for December, 2015 and January, 2016. These values are not shifted. The Gaussian fit to the January, 2016 data has a mean value 240[nA] and a σ of 30[nA] and are lower than the December, 2015 values by ~20[nA]. This shift is because the electronics were cooled down to 7[^{o}C].

Figure 3

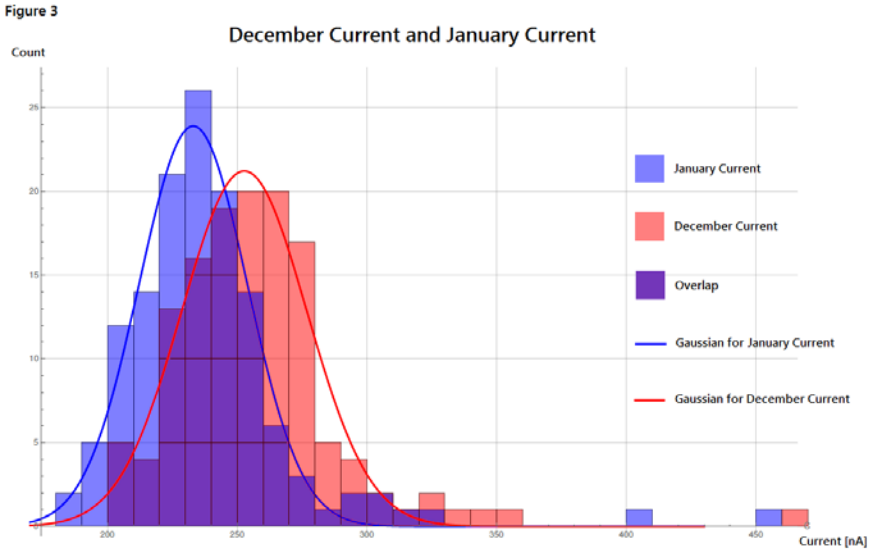

Figure 3 shows the currents for December and January. Gaussian curves are fitted on both December and January distributions. It is shown that the January values fall behind the December values by about 20 [nA]. We are looking into the reasons for the values above 400 [nA].

A module-side is said to perform poorly if:

$V_D - V_o > 10$ [V]; where V_D is the highest depletion voltage of the three sensor types which are used on a module-side (typically V_D ε [75[V] — 85[V]]) and V_o, is the operational voltage,

or

$I_{Vo} - \langle I \rangle > \sigma_{\langle I \rangle}$; where I_{Vo} is the current draw of the module-side at V_o, $\langle I \rangle$is the average current draw of the module-sides, and $\sigma_{\langle I \rangle}$ is the standard deviation.

Poorly performing modules were identified by performing a cut using a SQLite query.

December, 2015 measurements showed that 13 module sides were were performing subpar, while January, 2016 measurements indicated that that there were 14 module sides.

There were 12 module-sides common to both months; these sides are by region(R), sector(S), and side (T/B): R3S9T, R3S9B, R3S10B, R3S11T, R3S11B, R3S17B, R4S1B, R4S5B, R4S9B, R4S11B, R4S15B, and R4S18B.

There were 12 batches of sensors used on the SVT, with 10 out of the 12 batches used on the poorly-performing modules. Upon analysis of the failure rate of a batch per total use on the SVT (Figure 4), no correlation between batch numbers and poor module-side performance was determined.

Figure 4

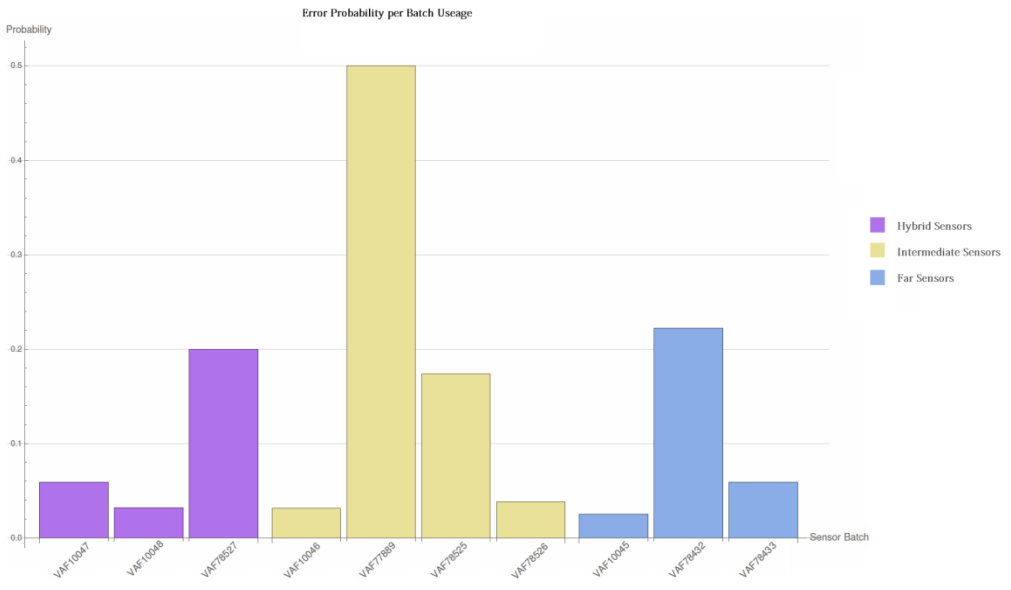

Figure 4 lists the sensors found on "poor" module sides and shows the probability of finding each sensor batch type on these modules per overall useage of each batch. No correlation was found between the "poor" modules and sensor batches.

Sensor batch VAF77889 appears to have a significantly higher failure rate compared to the other batches, a consequence of low statistics; this batch was found on a poorly-performing module side only once (out of a total of 2 uses).

This analysis assumes that all the sensors on the poorly performing module side are not working properly, which is not an accurate assumption, however, on which has to be made per-force because there is no way of isolating the three sensors on a module side while it is in the assembly.

To conclude, detecting poor module performance is essential for the overall tracking quality of the SVT. Out of the 132 module-sides, it was found that 12 module-sides performed poorly. Since most

of the poorly-performing sides were the bottom side, it is believed the poor performance is a a result of fabrication without satisfactory quality control. Module current draws and depletion voltages will be continued to be monitored for further decay in performance of the 12 aforementioned module-sides as well as for any new module problems that may arise.