Summary Report from the *OPS 2015 StayTreat*

Contributors:
Geoff Krafft, Rongli Geng, Jay Benesch,
Mike Spata, Steve Suhring, Todd Satogata,
Matt Bickley, Bill Merz, Ken Baggett, Joe Grames,
and Tom Oren

Editor:
Arne Freyberger

August 7, 2015

Abstract

Summary of the *OPS 2015 StayTreat* is presented. The *OPS 2015 StayTreat* topics included a full day of presentations on SRF, RF power and cryogenic systems followed by two days of presentations on all aspects of CEBAF Operations and preparing for operating CEBAF at design energy in Fall 2015. Each day of the *OPS 2015 StayTreat* was divided into four sessions. This report provides a brief summary of each session and links to the presentation. Each session summary highlights the accomplishments as well as any opportunities for improvement. The session summaries will be followed by action items, if any, that were identified during the *OPS 2015 StayTreat*.

1 Introduction

The *OPS 2015 StayTreat* builds upon the SRF/RFpower/Cryo Internal Workshop held in April 2014 [1]. The first day of this years stay treat retained the focus on the CEBAF SRF, RF-power and cryogenic system. The following two days were much broader in subject scope and participation. During these two days, experimental users, accelerator scientists, software developers, engineers and radiation health physicists made presentations on various aspects of CEBAF operations to date as well as plans for future operations of CEBAF and other JLab facilities (LERF and UITF).

Each session had an assign chair that worked with other chairs to developed the program. This report structure is a replica of the *OPS 2015 StayTreat* agenda, each session has a subsection that contains links to the presentations, a short summary and actions items, if any, for that session. Actions items are appear with the assigned name first and then the action. These session summaries are followed by an overall summary by the Director of Operations. A *google forms* survey was conducted after the *OPS 2015 StayTreat*, the results of that survey can be found in the appendix.

1.1 *OPS 2015 StayTreat* Goals

In developing the program for the *OPS 2015 StayTreat*, the following goals were used as guidance:

1.1.1 Day One: SRF/RF-power/Cryo

The purpose of this one day workshop is to review progress in SRF/RF/Cryo operations since last year's workshop. Review plans to achieve 12GeV operations in the Fall of 2015 and future gradient maintenance plans.

1.1.2 Day Two and Three: CEBAF OPS

The purpose of this two day workshop is to provide a forum for presentations and discussions on CEBAF operations during the recent commissioning operations. The presentations should present a balance of successes and shortcomings, with the ultimate goal of improving CEBAF operations, prepare for the challenges of 12GeV operations and **establishing routine multi-user operations at the 12GeV design energy**.

Additional items to be addressed during the workshop include, improving user⇔OPS⇔Eng communications, reducing the duration for CEBAF restoration and configuration change, reducing the duration for Hall setup, improving CEBAF reliability, and regaining the confidence of the user community that CEBAF and OPS can support the experimental program.

2 Day One: SRF/RF-power/Cryo

2.1 Introduction and Data Management Session (Chair: G. Krafft)

2.1.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. Welcome and Meeting Goals, Review Action Items from last years StayTreat (A. Freyberger).
2. SRF CEBAF Operational Performance (R. Bachimanchi).
3. CEBAF SRF Data Management (G. Krafft).
4. Cryo Status and Plans: include info on He and N2 losses, contamination mitigation (J. Creel).

2.1.2 Chair Summary

2.1.3 Action Items

2.2 SRF Operations (Chair: A. Freyberger)

2.2.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. C100 Microphonics Update (K. Davis).
2. EmaxOPS vs. Operational value (C. Mounts).
3. Gradient Calibration: Status and Plans (J. Benesch).
4. MO/LO Performance Summary and Maintenance Plans (T. Plawski).
5. RF Separation Status (M. Wissmann).

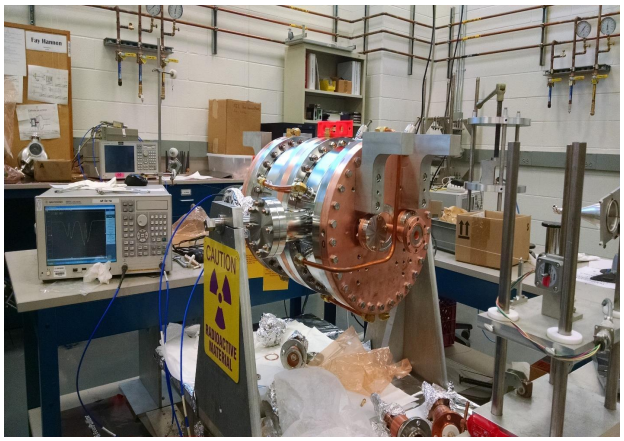


Figure 1: One of the four 750MHz separator cavities in its test stand for optimization prior to installation in the CEBAF tunnel.

2.2.2 Chair Summary

This session reviewed the SRF/RF system performance during the recent 12GeV beam commissioning periods. The object was to identify opportunities for improvement and develop a list of actionable items. This session consisted of five presentations; topics ranged from cavity microphonics to the status of the new 750MHz separators.

The status of the C100 microphonic level was presented. There are four C100 cryomodules, C100-0 (formerly R100) and C100-1..3, installed in CEBAF that were constructed with the original thin tuner plate. Detailed comparison of the micro-phonic sensitivity of C100-1, thin tuner plate, with C100-5, thick tuner plate, show that C100-1 has twice the measured microphonic content. For reference the four C100 with thin tuner plates are presently installed in the following CEBAF zones:

C100-0 0L04 (injector)

C100-1 2L23

C100-2 2L2?

C100-3 1L22.

This higher micro-phonic content consumes RF power to maintain resonance control and is a suspect in the observed high trip rate of the 0L04 module. Helium pressure and local heating may also contribute to the 0L04 poor performance. Measurements by the *PIT microphonics team* continue and means of mitigating the coupling via external modifications are still being explored.

As noted in [2] the operational gradients are often substantially below the gradients achieved during commissioning. The C20 operational gradients are lower than the commissioning values in order to minimize the fault rate. The C50 and C100 operational values should be the same as the commissioning values but often are lower. Some C50 cavities are limited by control system limitations that would be eliminated if the control system was upgraded. Constant vigilance, communication and feedback between the operations staff and a proposed gradient management team during operations is needed to minimize the *lost gradient*.

Gradient calibration of the SRF system is important it has implications for the quadrupole magnet settings in the linac. The goal is to have the cavity gradients known at the 3% level (RMS). To date achieving such precision in an efficient manner has been elusive.

A new technique is proposed that relies on shifting the phase of the cavities not the gradient in the cavity. This new technique will require several days of steady beam delivery (one-pass) and will scheduled as part of the Fall2 2015 commissioning program.

The CEBAF Master Oscillator (MO) and its distribution came under scrutiny during the Spring 2015 beam operations. Low conductivity water (LCW) is used to temperature stabilize components in this system; an incorrect use of the LCW system which is designed to carry away heat not control temperature. Several proposals to modify the MO system so that the system stability is within specifications and also to minimize the impact on downstream MO consumers when the MO power level changes significantly were presented.

The 750MHz separator cavities were commissioned Spring 2015 with beam energy of 9.6GeV. The cavities and RF power system were nearly maxed out during this commissioning period and the need to improve the system to support the design energy of 11GeV was identified. During the Spring 2015 operations the system performance was not optimal due to poor resonance control, poor field flatness (input power coupling), and insufficient RF power from the IOT. All three issues are being actively addressed during the 2015 Summer shutdown and the plan is to operate this system at design energy, 11GeV, in Fall 2015. Figure 1 shows one of the four 750MHz cavities in its test stand for measurements to optimize the power coupling.

2.2.3 Action Items

Freyberger Form a gradient monitoring team (GMT) and czar. The GMT will monitor gradient settings during beam operations, work with operations to maintain gradients at near E_{maxOPS} values, document any cavities cannot be operated near E_{maxOPS}, work with Operability to plan RF recovery efforts and report gradient status at the weekly Wednesday scheduling meeting. Deadline is 2015-10-01.

Hovater Hold a review of the MO stability proposals by 2015-08-30. Make recommendations of the appropriate path forward to the Director of Operations.

Nelson Remove the 3dB pads on the C50 zones before the two week RF soak period in Oct-2015.

2.3 Field Emission and Q_0 (Chair: Geng)

2.3.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. Helium Processing Status and Results to Date (M. Drury).
2. C20/C50/C100 RF Soak plans: Fault Minimizing, Egain Maximizing (R. Bachimanchi).
3. CEBAF Particulate Field Emitter Control (R. Geng).
4. Dynamic Heater Controls (T. Powers).
5. Q0 Precision: what is required, what has been achieved? (J. Benesch).
6. LEM Upgrade Path (H. Zhang).

2.3.2 Chair Summary

Six talks are presented in the session of Field Emission and Q0. Highlights of presented materials are given below. Open questions and action items are summarized in the following section.

Helium processing (Drury) New results on cavity helium processing since June 16 were presented. 9 modules processed since June 15, 2015. The field emission is gauged by Bremsstrahlung X-ray, measured by Geiger-Mueller tubes placed at various locations of a cryomodule. The change in X-ray dose rate, measured by specific Geiger-Mueller tubes before and after helium processing, is used an indicator of the processing effect. On average, there is a gain in field emission suppression: (1) X-ray dose rate at the maximum gradient of each cavity is reduced by 3-7 R/h, a significant value; (2) X-ray onset gradient is raised up by about 1 MV/m

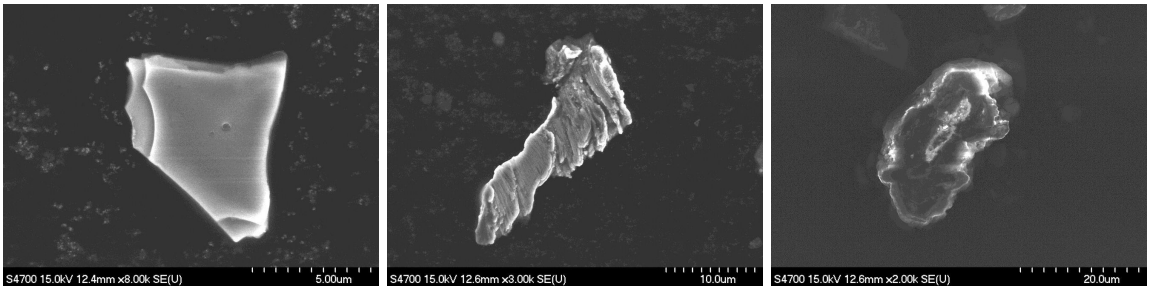


Figure 2: Examples of particulates of Ti/Ta(left), stainless steel(center) and air-borne dust(right), aka "clay", found on the cavity surface of C50-12 before refurbishment.

on average with 5-cell cavities and 7-cell cavities combined. In summary, the helium processing effort so far obtained a gain in "X-ray free voltage" of about: 4 MV per module on average based on 7 each C20/C50 style module. 8 MV per module on average based on 2 each C100 style module.

C20/C50/C100 RF Soak plans: Fault minimizing, Egain maximize (Bachimanchi, Benesch) A detailed plan was presented for a two week long campaign of RF operation of all cryomodules. The objectives are: Find stable operating points with all cavities RF on simultaneously in a C100 and C50 module. Acquire trip rate data for C20 modules with all cavities RF on simultaneously.

CEBAF Particulate Field Emitter Control (Geng) New data on field emission particulates collected from cavities in the current C50 refurbishment cryomodule were presented. The outstanding particulates are (1) Titanium/Tantalum; (2) Stainless steel; (3) Air-borne dust ("clay"), see Figure 2. Several mitigation solutions and further investigation action items were proposed. The proposed high priority action items include: Optimize procedure for ion pump on/off operation Replace beam line ion pumps with Non-Evaporable Getter, or NEG, pumps.

Dynamic heater controls (Powers) The rationale of applying resistive heating on top of the cavity dynamic heat load was presented: avoiding step change in heat load to the cryogenic systems. The issue of critical heat at the riser between the liquid helium tank and the two-phase pipe was presented:

1. Experiences from the module FEL3 (aka SL21 in the year of 2003), the riser diameter being 42 mm, were given;
2. Past results measured by Ed Daly from a C100 module, the riser diameter being 82 mm, were presented;
3. More recent results measured from R100 module were given.

Several suggestions are given for actions and future studies, including: Individual heater for each cavity (note by convener: this was an action item from last years' SRF/RF/Cryo workshop and has been implemented); optimize heater algorithm. Study correlations between helium boiling off, helium level oscillation, and "boiling induced quenches". Study options for raising critical heat: lower bath temperature; allow lager gas flow.

Q0 Precision: What is Required? What has been Achieved? (Benesch) An analysis of Q0 accuracy was presented. A suggestion was made to measure the "average Q per zone" by using liquid level sensor for C20/C50 modules. A scheme was proposed to gauge C100 Q0 by using state of the Joule-Thomson valve as a feedback.

LEM Upgrade Path (Zhang) The algorithm, genetic algorithm, for simultaneous minimizing the linac trip rate and cryomodule dynamic heat load, a upgrade of the LINAC Energy Management (LEM), was presented. A user friendly genetic algorithm package in C++ is being developed, in parallel to investigation of an alternative algorithm called "particle swarm". Future work requires knowledge of gradient dependence of Q0 for each cavity.

2.3.3 Action Items

Drury Analyze and present the change in cavity performance due to Helium processing in terms of overall energy gain (or hopefully not loss) or MV/m.

Drury, SRF Analyze the 2L24-7 quench and other anomalies associated with Helium processing C100 cavities.

Everyone, including Mont Increase the effort in understanding the root cause of cavity related faults.

Geng, SRF Repeat the particulate study on the next C20 module removed from CEBAF for refurbishment. Have the effort costed/included in the FY16 AWP.

Geng,SRF Evaluate ion pump as the source of Ti/Ta particulate on the cavity surface. If ion pumps are the found to be the source, evaluate a replacement or develop a mitigation plan.

Mounts,Plawski? Study correlations between helium boiling off, helium level oscillation, and "boiling induced quenches".

Mounts,Plawski? Study optimal resistive heat compensation procedure.

Krafft Determine the appropriate format for the cavity $Q(E_{acc})$ curves and extract the $Q(E_{acc})$ curves out of the cavity commissioning data in the agreed upon format.

2.4 SRF Projects and Long Term (Chair: Benesch)

2.4.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. New Ideas and Approaches to Raise CEBAF Q0 - Initial Results and Proposed Studies R. Geng).
2. The C75 Concept (R. Rimmer).
3. Klystrons and 20yr vision for RF Power (R. Nelson).
4. Obsolence and Anticipated Upgrades (C. Hovater).
5. The $\frac{1}{4}$ cryomodule and C50-12 Status Update (T. Reilly).

2.4.2 Chair Summary

Raise Q0 (Rongli Geng) Rongli found in 2014 that much of the factor of two loss in Q0 from VTA to tunnel was due to magnetic material in the tuner. SRF production group still needs to find a source for replacing one of the three offending parts. The FNAL and Cornell work on thermal currents has been replicated here. Where modules can be gainfully cryocycled in the tunnel is not clear because magnetic material and field emission likely dominates the thermal currents. No relative values were presented. Surface resistance increase due to multiple quenches without cycle over 10K was shown to be irrelevant to CEBAF. Whole module degaussing was tested at FNAL with magnetic shields open at the ends. No modeling to determine if it is worthwhile with shields as installed was shown. Impurity doping of original CEBAF cavities has been a disaster. This may be due not to the doping but to the preliminary EP which sharpens edges on pre-existing fusion zone defects which BCP dulled. The old BCP open vat system was destroyed when TEDF was constructed; the forced flow BCP system produces Q slopes steeper and deeper than those shown in this talk.

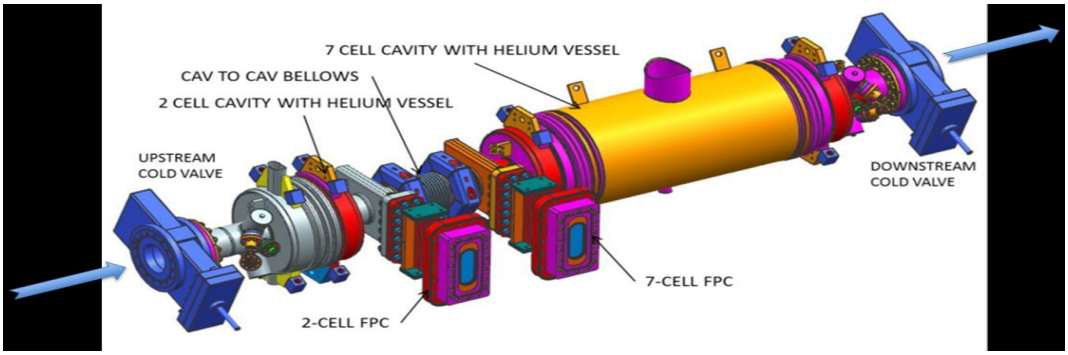


Figure 3: Model of the new $\frac{1}{4}$ cryomodule, which consists of a 2-cell and a 7-cell cavities.

The C75 (Bob Rimmer et al.) Bob presented several variations on the theme of refurbishing or replacing old modules. V/$ presented did not include RF or LLRF costs and so were not definitive. Principal gains are from changing cell shape to improve ratio of accelerating to wall E field from 1:2.56 in old cavities and more cells in the 10m slot. Moore's Law has improved computers enough that one can now model full cavity including FPC, elbows and HOM loads in Microwave Studio. JB remarked that the HOM ports should be rotated 45 degrees to eliminate skew quad if reused. Damping is a lot better than C100s.

RF Power (Rick Nelson) Klystrons remain the logical choice given costs of solid state and IOTs at 1497 MHz. Look again at situation in 2020. For now, start spending $500K/year to rework 16 damaged tubes in the machine and build up spares inventory. (JB) During the 2000 6 GeV test after helium processing in the late 90s, we failed one tube per day. Failure rate may go up again as we push C25 and especially C50 modules to get 1090 MeV/linac.

LLRF Obsolescence and Anticipated Upgrades (Curt Hovater) LLRF anticipates funding to upgrade one to two C50 zones to digital electronics per year. It may be that this will free up enough spares that the remainder of the RFCMs can be kept going until the end of CEBAF in spite of parts which are no longer available.

Quarter CM and C50-12 (Tony Reilly) C50-12 module refurbishment work continues; dis-assembly is complete, HOM cans fabricated, all major procurement purchases completed. C50-12 cavity work is also going well. C50-12 is on schedule to be completed by early summer 2016 and ready for commissioning in the UITF.

A new $\frac{1}{4}$ cryomodule is being constructed as part of the injector upgrade. This new $\frac{1}{4}$ cryomodule has a 2-cell and a 7-cell cavity, see Figure 3 to accelerate the beam from 200keV to 5-10MeV. This new $\frac{1}{4}$ cryomodule will enable the removal of the copper capture structure and has been designed to not introduce beam X-Y coupling. Quarter CM 7-cell cavity has had problems including early onset of field emission and needs another vertical test (at least) before helium jacket is welded on. The new $\frac{1}{4}$ cryomodule will be ready to install by the end of June 2016.

2.4.3 Action Items

Rimmer Develop a formal plan for a C75 module within the lab AWP system for FY16 and beyond.

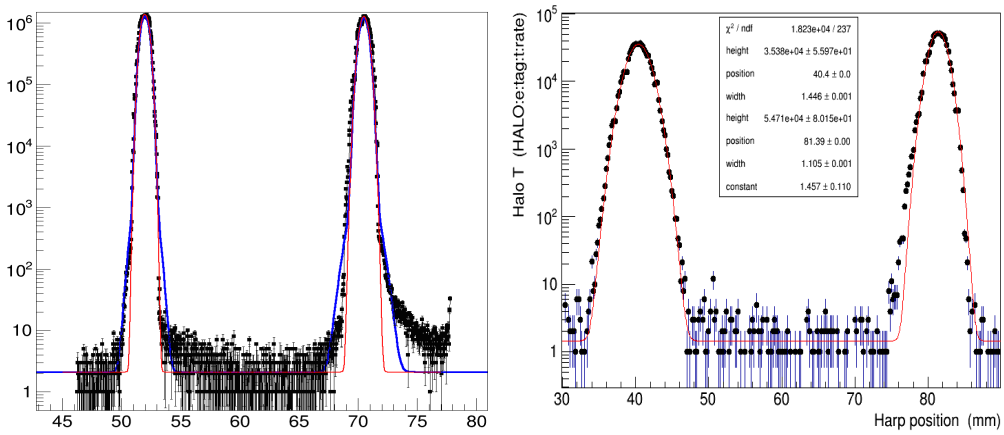


Figure 4: Large dynamic range beam profile measured in Hall-B(left) and medium dynamic range profile measured in Hall-D(right) during 12GeV commissioning.

3 Day Two: Operations

3.1 Operations and the Users (Chair: Freyberger)

3.1.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. Welcome and Meeting Gaols (A. Freyberger).
2. Hall-A User Feedback (T. Keppel).
3. Hall-B User Feedback (F-X. Girod).
4. Hall-D User Feedback (H. Egiyan).
5. Hall-C Plans (T. Keppel).
6. OPS and the Users (M. McCaughan).

3.1.2 Chair Summary

The first session of the second day consisted of presentations from the Halls and the Operators. The session highlighted many of the significant accomplishments over the past few years and along the way some areas of improvement were identified and elaborated.

The physics program in Hall-A was starting to get momentum with the measurement of one q^2 point in Fall 2014. Unfortunately the power event on March 25th prevented further experimental progress. The commissioning of the hall line did not go as smoothly as desired. Feedback from the users identified that there was not a "*clear understanding of which individuals or even which laboratory division are responsible for each piece of equipment. As the de-facto commissioners of 11 GeV Hall A operations, we would appreciate a more detailed picture of the organizational responsibilities of the various equipment along the Hall A Beamline and who to contact for problems.*"

The HPS experiment in Hall-B completed the commissioning of the new experiment. They were able to insert the silicon strip vertex detector to within 0.5 mm of the beam and take production data for a few days. Beam tuning efforts to establish the design beam aspect ratio and stability were substantial and ultimately successful during Spring 2015 operations. In addition to establishing production ready HPS experiment, large dynamic range profiles were made in the experimental hall. Figure 4 shows the beam profile measured in Hall-B, clean over six decades, not that different than that measured during the 6GeV era [4].

Hall-D commissioning status was presented. An impressive array of beam devices and experimental detectors have been commissioned in Fall 2014 and Spring 2015. A medium dynamic range profile from the Fall 2014 operations shows a clean, halo free beam on 5.5passes at 10 GeV, see Figure 4. Remaining devices/systems to commission include the fast feedback system and the active collimator.

The role of the machine control center staff, operators, crew chiefs, engineering support staff and accelerator scientists, is multifaceted yet incomplete in regard to operating CEBAF. The end-station users and staff play an important role in establishing proper operational restrictions and other operational aspects. There are several roles to facilitate communication between the various groups. In addition there are standing meetings as forums. There was discussion about the various meetings, with most of the issues concerning the daily PD/Run Coordinator 7:45am meeting which has turned into a much larger meeting.

3.1.3 Action Items

Freyberger/Keppel Develop an interface control document for Hall-A (and then C) similar to Hall-D to assign roles and responsibilities to beamline components.

Freyberger Consider setting up a liaison meeting in Sept 2015 with all the individuals on slide 10 of McCaughan presentation to discuss the roles going forward.

3.2 Beam Transport (Chair: Spata)

3.2.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. The Injector Process Driven Setup Status (A. Hofler).
2. ORFP Status (T. Satogata).
3. Pathlength/MO Status and Plans (M. Tiefenback).
4. Extraction/Separator Setup (M. Spata).

3.2.2 Chair Summary

3.2.3 Action Items

3.3 Reliability (Chair: Suhring)

3.3.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. RAR Summary (R. Michaud).
2. Bellows: RAR Report Summary (B. Freeman).
3. Vacuum: Hardening for 12GeV Operations (A. Dipette).
4. Harps: Reliability Improvement Plans (O. Garza).
5. Downtime: Global Analysis (R. Michaud).

3.3.2 Chair Summary

The Reliability Session looked at sources of downtime of the CEBAF machine, analysis of downtime, and two areas of concern that warranted inclusion in the Reliability Session.

Figure 5: Fighting fires or preventive maintenance? What is the CEBAF Operations culture? Does it need to be changed? How do we enable change?

Downtime at Jefferson Lab's accelerator is collected in a database for any incident that lasts longer than 5 minutes. Incidents shorter than this are counted and tabulated by type for further analysis.

Downtimes longer than 4 hours are usually studied more thoroughly using the RAR process, a Repair Assessment Report. This report is generated by a team of knowledgeable people from Accelerator Operations, Operability, Engineering, and Software in order to thoroughly document a problem, perform a root cause analysis, and assign reasonable action items.

A discussion of the 'Arsonist – Fireman Syndrome' also was presented. In summary the "Arsonist-Fireman Syndrome is a cultural phenomenon. Its most prominent symptom is a focus on "firefighting" (i.e. troubleshooting a problem once it has happened) rather than "fire prevention" (i.e. preventing the problem in the first place)." [3]

The selection of two systems of particular interest, Vacuum and Wire Scanners, came as a result of problems encountered in the recent past.

The vacuum presentation addressed the recent failures of viewer bellows. The talk expanded to include the steps taken in preparation for the 12GeV era. These included the methodology for identifying improvements, status of work progress, and examples of upgrades applied throughout the machine to improve vacuum reliability.

The talk on wire scanners showed examples of the most common failure modes, presented the solutions being implemented before the next run and work plans for the next two years.

Finally, an overview of the sources of CEBAF Downtime was presented. The major source of Downtime for FY15 was due to problems in the Cryogenics systems that came as a result of a significant loss of power event from Dominion Virginia Power: a cold compressor failed hard and system contamination.

Included in this talk was a look at the major issues from an Office of High Energy Physics report: Accelerators for America's Future. In the areas of Energy & Environment, Medicine, Industry, and Discovery Science, the primary R&D need is Reliability.

This lead to a discussion on Reliability issues of the CEBAF machine and the importance of making data driven decisions. As was stated by R. Edwards Deming, "Without data you're just another person with an opinion."

3.3.3 Action Items

Teifenback Provide a list of noisy wire scanners (substandard potentiometers).

Tiefenback Provide a wire scanner specification.

Garza/Michaud Investigate fabrication options to reduce wire scanner frame costs and improve product.

Freyberger/Michaud Consider forming a working group to review all reported downtimes for accuracy of information.

Spata Form a Tune Team to investigate Tune downtimes. M.Spata

3.4 Beam Physics (Chair: Satogata)

3.4.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. Transverse Emittance (T. Satogata).
2. Model Developments and Status (Y. Roblin).
3. qsUtility/eDT Update (D. Turner).
4. Bunch Length Measurements and Plans (M. Ahmad).

3.4.2 Chair Summary

3.4.3 Action Items

4 Day Three: Operations

4.1 Software and Tools (Chair: Bickley)

4.1.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. CED Status: New Deatures and Data Maintenance (T. Larrieu).
2. Lock Configuration and Management (B. Bevins).
3. FSD: Fault Determination and Plans (R. Slominski).
4. Getting the Most from Your Requests for Help with Software (M. Joyce).
5. Content of a Good e-log Entry (R. Lauze).

4.1.2 Chair Summary

4.1.3 Action Items

4.2 Safety and Metrics (Chair: Merz)

4.2.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. Service Buildings access and B&D Rapid Access Plans (V. Vylet).
2. PSS Status and Plans (H. Robertson).
3. OPS and PSS (P. Vasilauskis).
4. DOE Metrics: Reliability (A. Freyberger).

4.2.2 Chair Summary

Service Buildings, B and D Rapid Access Plans (Vashek Vylet) Re-evaluation of beam loss scenarios and radiation with new calculations performed
Calculations validated with data taking during 12 GEV operations
Current Policy and postings appear to be overly conservative
Proposals floated to implement changes
Option to place physical barriers over penetrations
Add alarming radiation monitors to warn workers
Cost –Benefits to changes presented
Cost estimate done, some funding found
Less Radcon overhead for monitoring work
Data gathering and history of problems available
Changes to Rapid Access System pending or in progress
Hall B - Restoration needs evaluation during beam operation
Hall D – Work funded, implementation in progress
Questions/Comments
Training on changing conditions needs to be done prior to start up for personnel

PSS Status and Plans (Henry Robertson) Accelerator and LERF status – FY15
Certification Update LERF done , CEBA- TBD after shutdown and before startup
12 GEV PSS installation for SHMS in Hall C completed
FY16 Work Plans near term
Some PLC and PA upgrades
Injector Gun HVPS and Laser upgrades
FY16 – FY19 Plans - long term
More PLC, PA ODH upgrades
MPS, BLM, HMI, and other hardware improvements presented
Problems going forward
Staffing level is lower than desired
Recent staff turnover requires training to get up to speed.

OPS and the PSS (Paul Vasilauskis) Polling OPS on PSS Headaches
Hall D PSS state transitions
Interrupts other Halls, Drops Gun, requires excessive recovery time
Beam Transport Monitor- Hall D Tagger/Transport PS interlock
Documentation, training and monitoring inadequate
Compounds problems during Hall D state transitions
In Line Dump Operation
Changes to control require Injector segment to drop during insertion and retraction
Gun required to go off and ramp back with each operation of ILD
PSS changes do not get OPS input during design and review processes.
Procedures and training implemented slowly for the listed changes.

DoE Metrics and Availability (Arne Freyberger) History and projections for Operating weeks, operating budget and anticipated reliability target presented for years FY14-FY21
Operation expected to reach a low of 16 weeks in FY16 and increase to 28-30 weeks in out years.
Reliability gradually increase to 85% over % the span
Basis for DoE reporting of performance presented and methodology for reliability calculation presented
Availability metric, a user assessment of beam utility, will be developed by Physics Div.

Reliability for FY15 is above target Level for FY16

4.2.3 Action Items

4.3 Active Projects (Chair: Baggett)

4.3.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. Dogleg Upgrade (A. Kimber).
2. Hall-D Feedback (T. Allison).
3. High Power Dumps (A. Dipette).
4. Laser/Injector Upgrades to Support 4-Hall Ops (J. Grames).
5. AIP Plans (A.Freyberger).

4.3.2 Chair Summary

Dogleg Upgrade Project (Andrew Kimber) The dogleg upgrade project is proceeding on schedule. All changes to the physical magnets have been completed and the remaining scope is limited to the upgrade of the power supplies. To meet the project specification, magnets will be powered using off-the-shelf power supplies with enhanced regulation using a loop control system built in-house. The controls are currently being tested and the power supplies and chassis are expected to be installed by October 2015. Remaining scope includes outlining the EPICS signals, completion of firmware, and "torture testing" of the system at full power. It was noted that there would be a cost overrun on labor. An estimate for the expected overrun should be completed and communicated.

Hall D Feedback (Trent Allison) The status of the Hall D FFB system was presented. As with the other Halls, the Hall D FFB is used to compensate for 60Hz line motion using data from two BPMs to control two sets of correctors. The current plan is to complete the Hall D FFB system by implementing the Hall A and C FFB algorithm, commissioning the cavity BPMs and active collimator, and iterative optimization of the system. This will require beam test plans that need to be developed and scheduled. It was noted that 30nA is required for the striplines to be in a position to support fast feedback. It was also noted that the cavities are on beam center but that BPM alignment offsets should be verified to be input into the CED. Further verification is needed to be sure that the offset values are used in the HLA/LLA applications. Hall D uses several new electronics built in-house. The choices for the BPMs and correctors should be reevaluated by the Hall D APEL to ensure they are still appropriate based on system evolution. Close collaboration with the Hall is required to ensure all changes are communicated.

High Power Dumps (Anthony Dipette) The Hall C high power dump upgrade project is underway and expected to be completed by March of 2016. Many of the lessons learned from the Hall A dump upgrade have been migrated to the Hall C dump upgrade. As part of the planning process, the power density requirements were copied from Hall A to Hall C. These numbers should be checked to make sure that they are correct for the Hall C dump. A NDT on the dump face should be completed and analyzed by operations and engineering to determine if it has been thinned or damaged. If so, replacement of the dump face may be opportunistic during the upgrade process. There is also no plan to repair or replace the burn through detector because other mitigations are in place. The new decontamination gel is working well and will have applications beyond this project.

Laser/Inj Upgrade (Joe Grames) The injector laser system must be upgraded to support four hall operations. This requires adding a 4th fiber laser, generating bunch trains at 499 and 249.5 Mhz and demonstrating sharing in the 3-beam chopper. Three solutions were presented including analog gain switching, digital gain switching, and optical pulse picking. FY16 will use the analog gain switching and this remains plan 'A' moving forward. Detailed scope, schedule, and costs associated with other options still needs to be developed and a discussion of cost/benefit of other options, with Accelerator operations and B-team, must be completed to determine the path forward. System changes have been identified that ensure the new LLRF digital gain switching is not prone to 180 degree phase shift. These changes should be implementation and documented. Discussions with CASA and the B-Team would be useful in determining if the system meets beam destination configurations outside of current specifications. It was noted that off-normal configurations should be expected and the as-built system range should be documented

AIP Plans (Arne et. al) An overview of Accelerator Improvement Projects (AIP) was presented. AIP projects are characterized as machine improvements, not maintenance, that may span several years and cost more than $500k. The presentation detailed many of the goals for the CEBAF injector upgrade. It was noted there was no plan for a spare $\frac{1}{4}$ cryomodule as part of the upgrade. Operations would revert back to the capture layout if there was a failure of the unit. The scope of the upgrade includes Gun 200kV operation, warm RF upgrade, $\frac{1}{4}$ cryomodule commissioning and installation. G. Kraft offered a general comment that, since AIP projects are tracked, leadership should focus on projects that will be seen as high impact by the DOE.

4.3.3 Action Items

Action Item (Kimber)

Kimber Estimate any expected cost and labor overruns and communicate them to Accelerator Operations.

Allison Develop the beam test plans required to fully commission the Hall D FFB system. Communicate the plans to the B Team leader (T. Satogata) and Accelerator Operations.

Allison Verify that the fiducialized beam center information for the Hall D BPMs has been input into the CED and are used in the calculations by HLA/LLA.

Dipette Verify that the power density requirements, copied from Hall A, and correct for Hall C.

Dipette Document the shelf life and costs per additional unit for the decontamination gel.

Grames Detail the scope, schedule, and costs associated with the three options for the four hall capable laser system upgrade. Work with Accelerator Operations and B-team to select the best option.

Grames Document how changes to the new LLRF digital gain switching option will prevent the previously witnessed 180 phase shifts.

Freyberger) Identify a project leader/manager to revisit the scope of the full energy injector upgrade, create a detailed component list, and move the project forward.

4.4 Long Term Plans (Chair: Grames)

4.4.1 Session Presentations and Links

The presentations and presenters for this session are listed below. The presentation titles are active links to the presentation slides.

1. SRF Long Range PIT (G. Krafft).
2. Parity Quality Beam Working Group Report (R. Suleiman).

3. LERF Plan (S. Benson).
4. UITF Status and Plan (M. Poelker).
5. Wrap Up (A. Freyberger).

4.4.2 Chair Summary

SRF Long Range PIT (Geoff) The main goals of SRF PIT are to investigate, understand and improve SRF performance. In particular the group wants to better appreciate "system wide" problems and implement rational data management. Highlight activities include helium processing, individual cryomodule heater controls, microphonic analysis and improved bandwidth pressure sensors, optimization of control loops and characterizing klystron drive cable crosstalk. An action item is to improve documentation; ia PRSTAB paper summarizing 12 GeV performance is contemplated.

Highlights of the SRF/CRYO session were summarized:

- C100 gradients during SRF commissioning are reported,
- SC1 CC4 back-up ball bearings failed and did not protect unit,
- Modified tuners have improved microphonic quality and stability with time,
- Microphonic tests comparing C100 to R100, a long term accelerometer study of R100, installed pressure sensor with >50Hz bandwidth, and implementing accelerator-site vibration monitoring system are future priorities,
- Local chillers are being considered to improve service building LO stability,
- Helium processing of both linacs is on schedule; processing of SL indicates average gain of 3.9MV for C20/C50 and 8.2MV for C100 for an average gain of 5.2MV,
- Degradation of C20/C50 is 0.21 MV/m year, root cause unknown, and insufficient data from C100 so far,
- Boiling measurements are desired and can be done with implementation of individual cavity heaters,
- Tests of nitrogen doping for improving cavity Q is planned,
- A program for CEBAF energy maintenance vs. cryomodule design indicates the C75 program provides best value of 23.6 Volts/USD,
- New injector QCM assembly and commissioning is expected in FY16.

Parity Quality Beam Working Group Report (Suleiman) The proposed landscape of upcoming parity violation experiments in the 12 GeV era was described (see Fig. 6). In Hall A PREX-II and C-Rex are tentatively scheduled for 2017 and Moller for 2022.

Two issues from the QWeak experience were mentioned: a) beam halo can develop a large charge asymmetry and then contribute to the experiment detectors, and b) the measured BCM noise floor of 65ppm is larger than the 10ppm required by Moller suggesting improvements of the digital receiver are needed.

In FY16 Hall A plans to install for testing the QWeak halo monitor, a BCM with new digital receivers, a QQQ cavity triplet and restore the beam modulation system. Synchrotron radiation will be a new feature of 12 GeV era and the effects on average polarization and spin precession are being studied now. Tables of laser table, injector, accelerator and Hall A tasks are summarized in the presentation.

LERF Plans (Benson) The operation of a high current Low Energy Research Facility (LERF) for nuclear and accelerator research was described. The program mainly aims to support the dark matter search Darklight experiment, but hopes to continue supporting a design of the Project E EUVFEL. Proposals for isotope production, MEIC studies, positron production and

Experiment	Energy (GeV)	Pol (%)	I (μA)	Target	A_{pv} (ppb)	Maximum Charge Asym (ppb)	Maximum Position Diff (nm)	Maximum Angle Diff (nrad)	Maximum Size Diff ($\delta\sigma/\sigma$)
QWeak (Achieved)	1.155	89.0	180	^{1}H (35 cm)	281±46	8±15	5±1	0.1±0.02	10^{-4}
PREx-II	1.0	90	70	^{208}Pb (0.5mm)	500±15	100±10	1±1	0.3±0.1	10^{-4}
C-REx	2.2	90	150	^{48}Ca (5mm)	2000±42	100±10	1±1	0.3±0.1	10^{-4}
MOLLER	11.0	90	60	^{1}H (150 cm)	35.6±0.74	10±10	0.5±0.5	0.05±0.05	10^{-4}

Figure 6: A table of achieved QWeak performance and desired PV experiment parameters was presented.

diagnostic studies are also being considered. In particular, diagnostics for beam halo, short bunch length and spare charge effect can be studied at LERF in support of the CEBAF program.

The LERF can provide an electron beam with energy up to 170 MeV in either an Energy Recovery Linac (ERL) mode (8 mA) or a fixed target mode (0.5 mA). To sustain a program with high-current operation a 350kV inverted gun using robust long lifetime alkalai antimonide photocathodes is under development; this gun would also allow for using polarized GaAs photocathodes too. Immediate plans in FY15 call for resuscitating the LERF. Main goals of FY16 include testing, installation and beam commission of the DarkLight internal target.

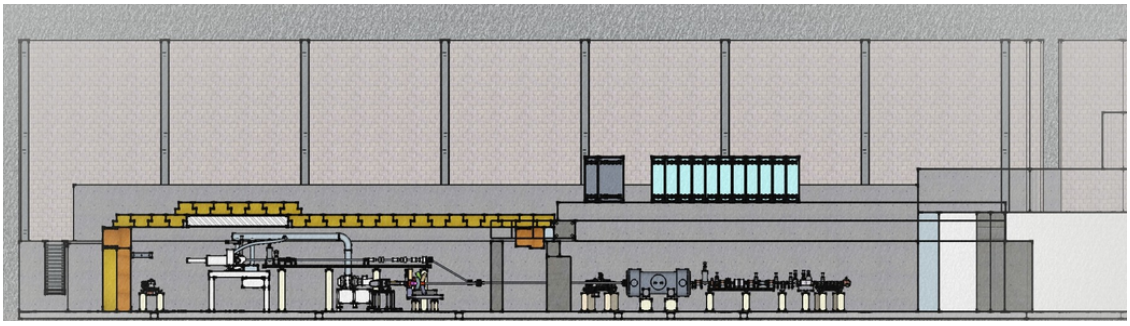


Figure 7: UITF side view shows preliminary cross-section with 350kV photo-gun on right and HDIce on left (beam travels left-to-right through a cryounit).

UITF Status and Plans (Poelker) The motivation for the Upgrade Injector Test Facility, see Figure 7, is to demonstrate the capability of the HDIce polarized target to successfully operate with an electron beam. Other activities that are highly considered include commissioning the new CEBAF 2-cell/5-cell SRF capture/booster cryomodule, polarized beam and diagnostic studies to support more demanding parity violation experiments, and providing a facility to perform the low energy Bubble experiment and development of a polarized positron source.

A broad spectrum of laboratory resources spanning Facilities, Engineering, Operations, CIS, CASA and Physics staff are involved. FY15 goals focus on civil construction to repurpose and expand upon the present cave and engineering to complete the mechanical layout and engineer

required support services (cryogenics, electrical, LCW, DC power, controls, diagnostics). FY16 goals focus on building a 350kV polarized photo-gun and beam line in Fall 2015, commissioning te cryounit in Winter of 2016 and providing a 10 MeV beam to HDIce by the summer of 2016. Upcoming tasks include assessing Cryomodule Test Facility LHe capacity, integration and review of the beam line and HDIce target, radiological assessment, documentation and operating costs.

4.4.3 Action Items

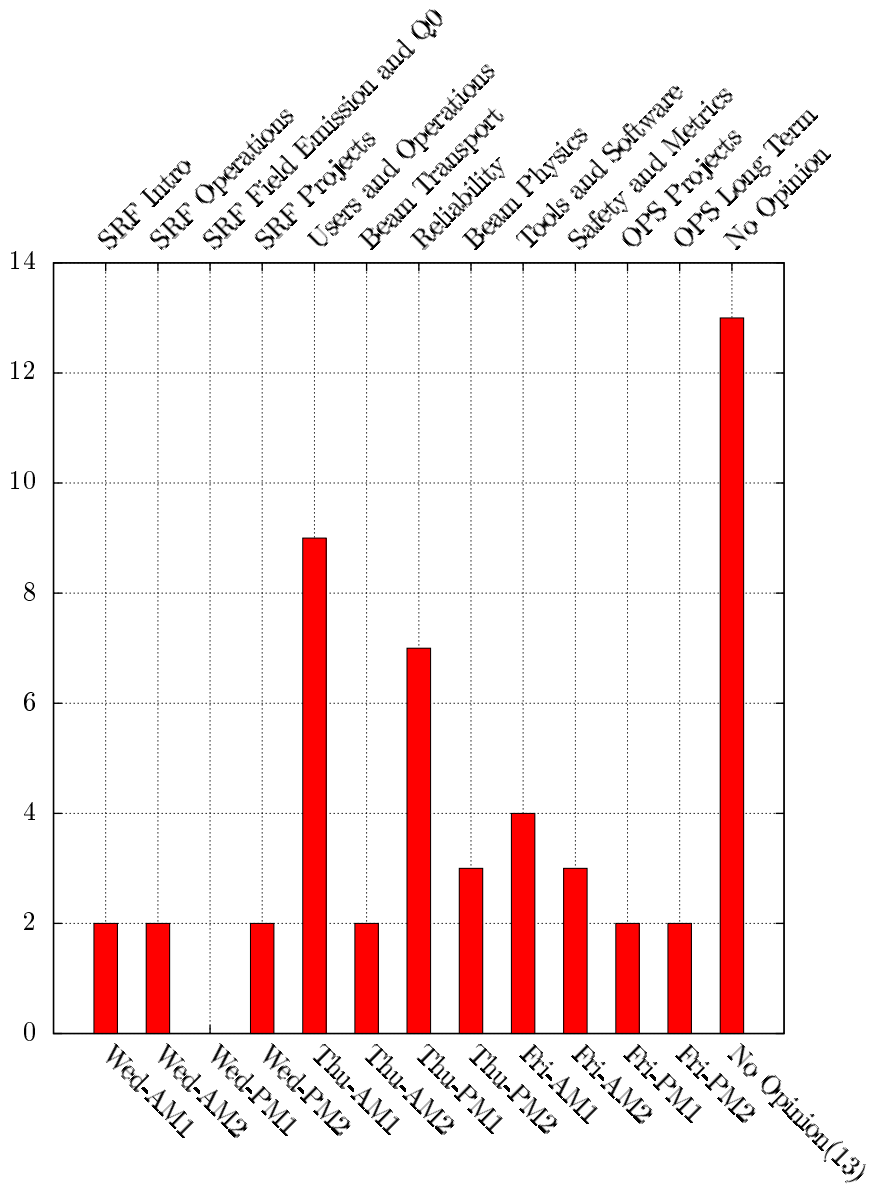
5 Director's Summary

All is good.

A Results of the *OPS 2015 StayTreat* Survey

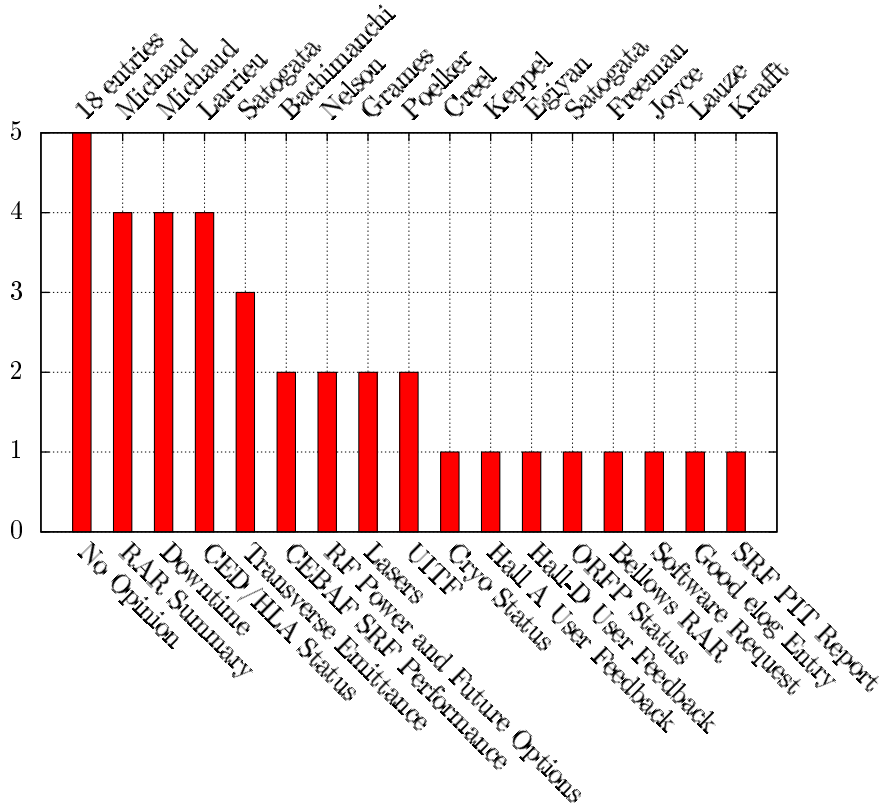
A *google forms* survey was created and distributed to the *OPS 2015 StayTreat* invitee list after the *OPS 2015 StayTreat*. There were 50 respondents to the survey and this appendix presents and summarizes the results. Where applicable general comments related to the survey query will be capture in the appropriate query summary.

A.1 The sessions that was most useful?



It is interesting to compare the results of this question to the individual session ratings in A.14. The *most useful* session is Thu-AM1-Users and Operations whereas the highest rated session in A.14 is Thu-PM1-Reliability. Clearly both of these session were highly valued by the participants and should be repeated in future StayTreats.

A.2 Best Presentation at the StayTreat?



The best presentation of the *OPS 2015 StayTreat* is a three way tie between two of Michaud's presentations and Larrieu's presentation on CED/HLA status. The style of these talks, open, well paced, probing and non-defensive, should be used as guidance for presenters at future StayTreats. **All** the presentations were all done at a very high level and in general well received. Some of the general comments on the presentations:

- The goal is to generate discussion.
  - Avoid conference style presentations
  - Avoid status reports
- Do not be defensive, this is a internal meeting, you are among friends.
- Be provocative, present questions/problems that you need help resolving.

A.3 Next year I'd like to give a talk on?

The list of responses is presented below, unfiltered from the survey. The challenge next will be identifying to proposer with the subject.

- 12GeV CEBAF Operations and initial Physics at design energy
- CASA/Ops interactions
- CEBAF/SRF performance with upgrades to the RF system
- Chopper upgrade

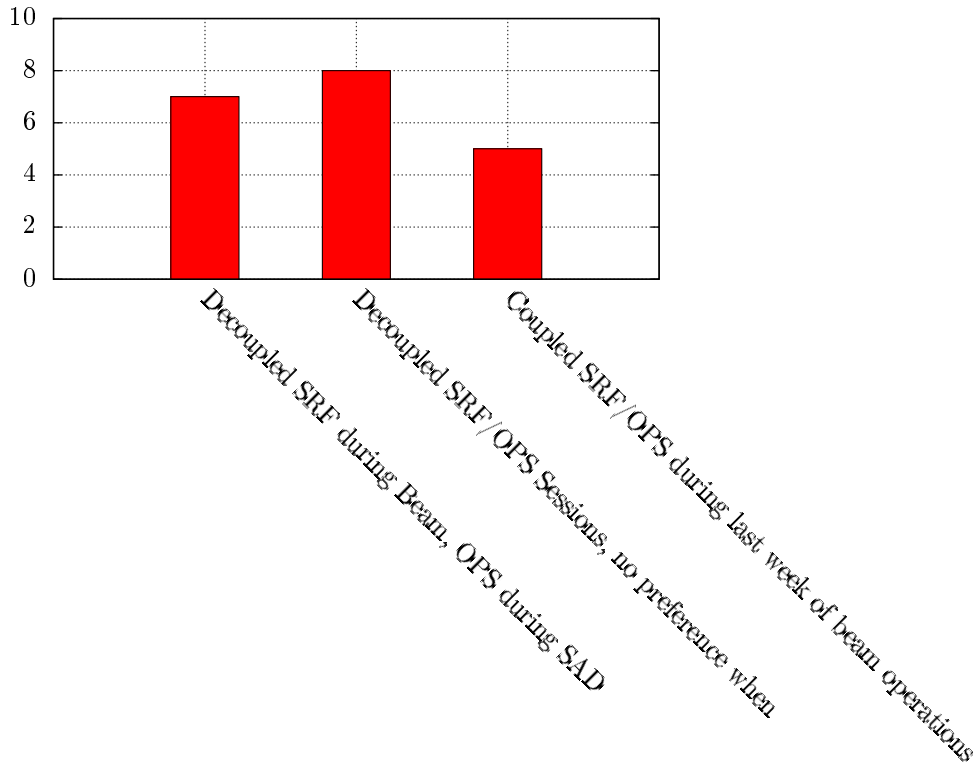
- Continuous Improvement Projects
- Critical Control Parameters for the Accelerator
- LERF Ops
- Perhaps whatever I present at WAO (TBD)
- PQB
- Retirement
- Something related to injector upgrade
- Successful Deployment of opsbot

A.4 Next year there should be a talk on?

The list of responses is presented below, unfiltered from the survey. Of note are the two entries related to the Hall performance.

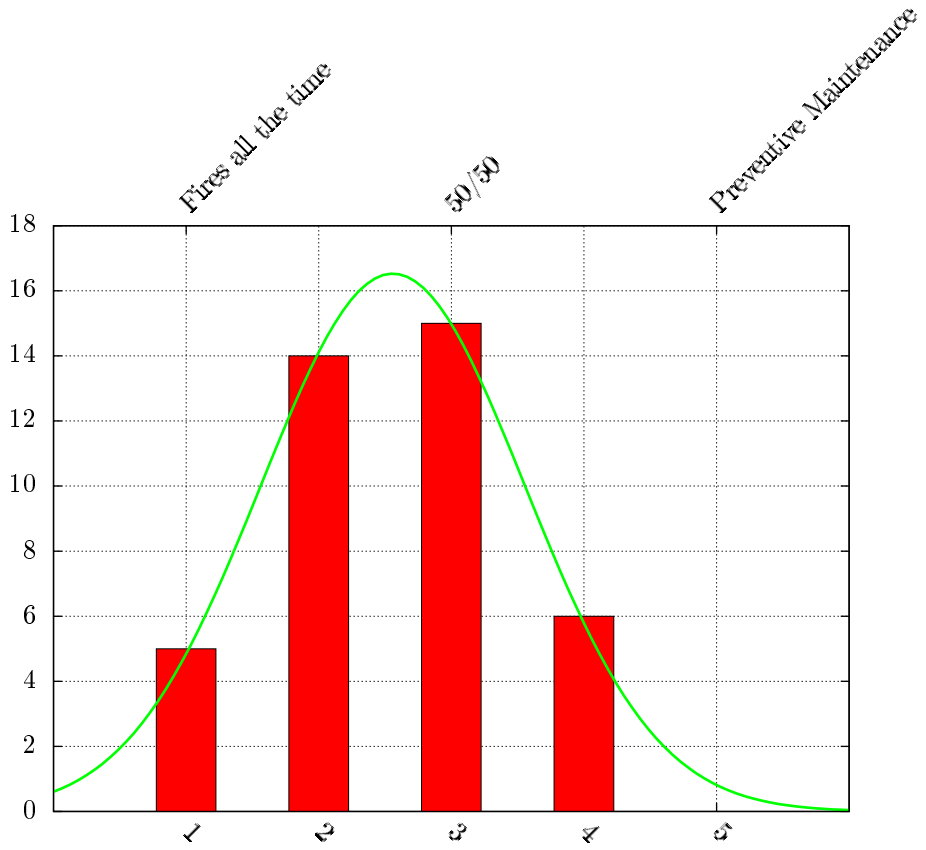
- Hall Metrics: What are they? What is their relation to Operations?
- Physics publication performance
- Diagnostics Development
- Cryo Heat management and Analysis
- MEIC beam requirements
- Maintenance Management
- How the Sponsor (DoE) Views Us
- Effective communication during cross-divisional projects
- Sync Radiation
- Retirement
- Operations speaker from another lab
- Tracking performance of support groups

A.5 Next StayTreat should decouple from SRF? Decouple from Summer shutdown?



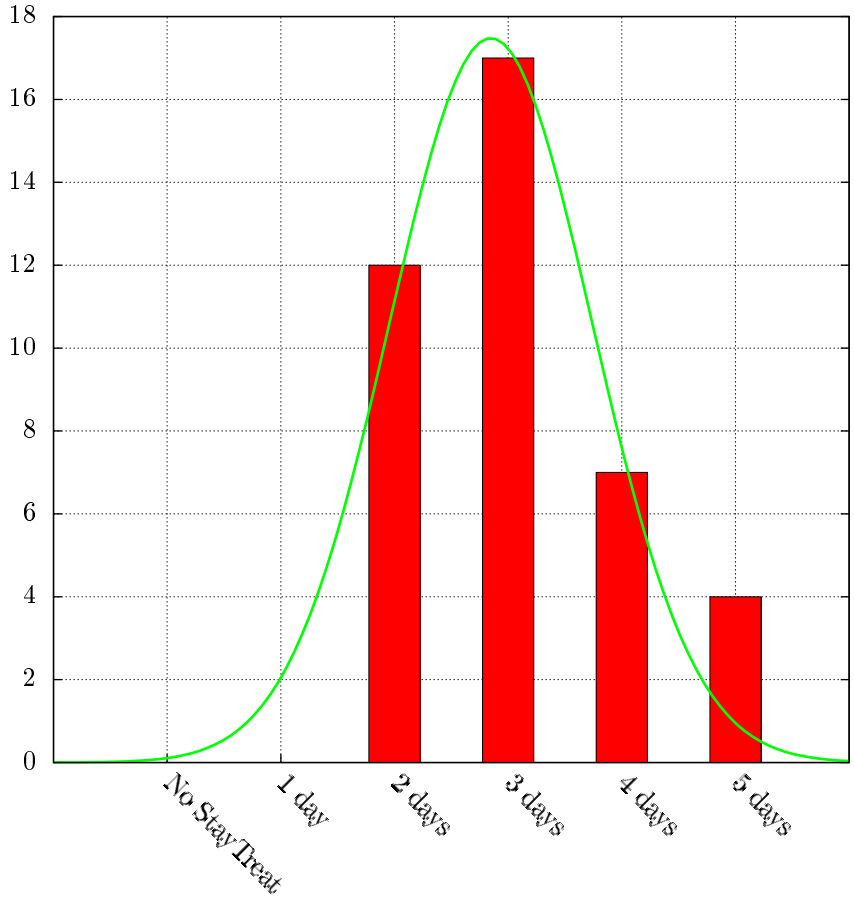
It is not a secret that the *OPS 2015 StayTreat* was planned somewhat in a rush and on a shoe string budget. The result was not optimal and this is reflected in this survey. There is a preference to decouple the SRF/RF/Cryo session from the Ops session and to hold the sessions either in the final weeks or soon after beam operations. It is also noted that this is a malformed question so extracting information out of the responses is problematic.

A.6 OPS Culture, arsonists or fire prevention?



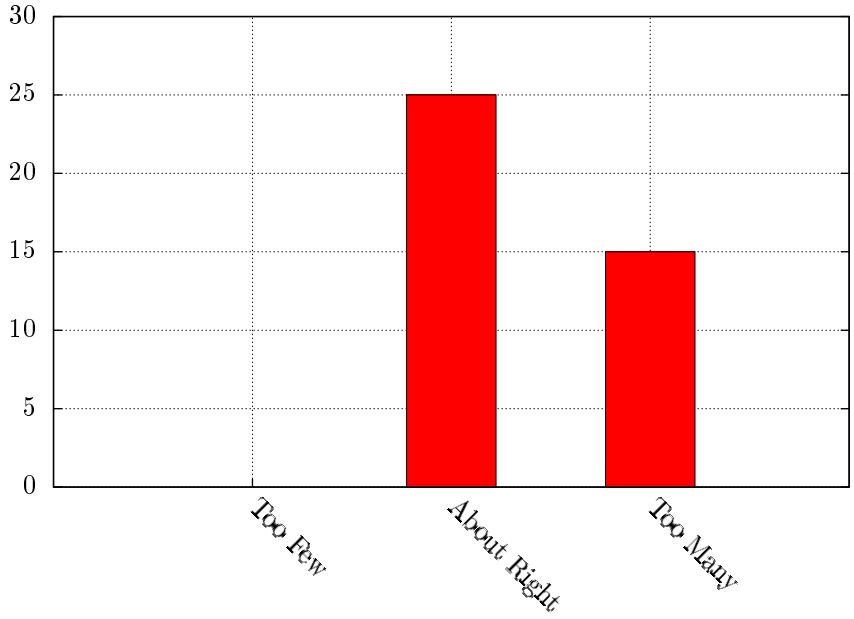
With an average response of 2.6, the perception is that CEBAF Operations leans towards the arsonist/Firemen approach to system maintenance. It is striking that there were no fives. This question will remain on future StayTreat surveys and the average tracked. What value is the ideal value for CEBAF Operations?

A.7 Staytreat length?



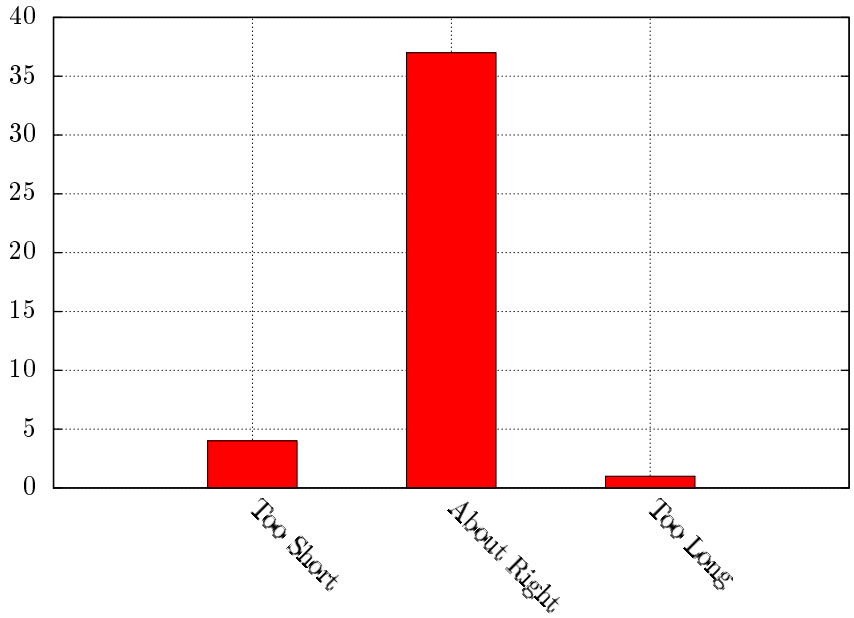
The average of the response is 2.8days, with a minimum at 2days and 4 responses at 5days (really?). Seems that three days is a good length for the StayTreats. Also of significance is that there were no 0day or 1day responses, clearly the *OPS 2015 StayTreat* had value to the participants.

A.8 Number of presentations?



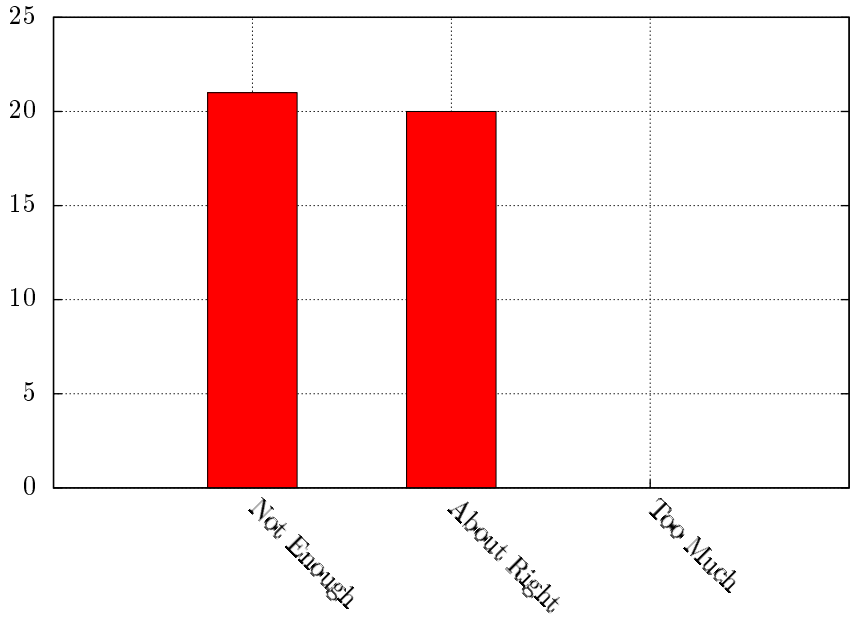
No one responded that there were too few presentations, even those who suggested the StayTreat be 5days long A.6. While the majority felt the number was about right, about 1/3 felt that 58 presentations in three days is too much. See A.8 and A.11 for the complete picture on discussion time and presentation number.

A.9 Talk Length?



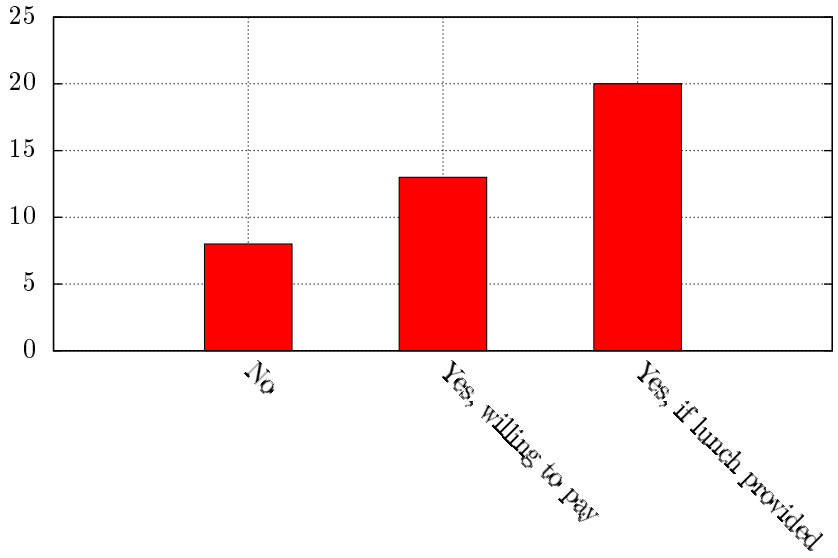
The talks were all 15min or 20min in length. This duration for a presentation appears to be about what the audience wants, with only a few responding for shorter or longer presentations.

A.10 Amount of discussion time?



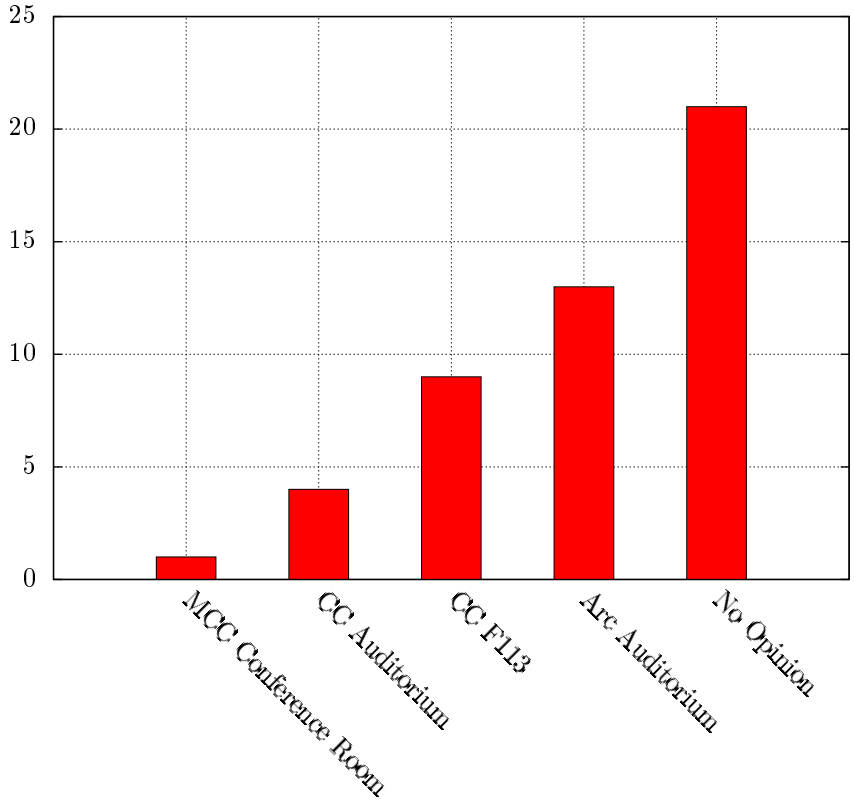
The simple majority of the responses thought there was not enough discussion time at the *OPS 2015 StayTreat*. This question coupled to the response in A.11, A.9, A.8 and A.7 will improve the format of future StayTreats.

A.11 Should there be lunch discussion sessions?



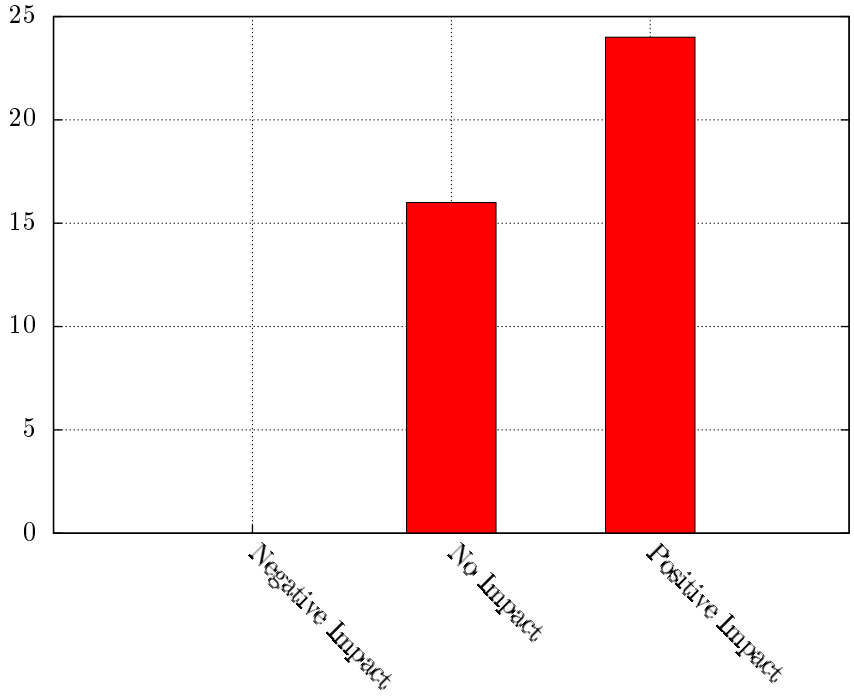
A lunch time discussion session would provide time for the much desired discussion time and the pole reflects that participants desire to use lunch time sessions for discussions. Something to strongly consider for future StayTreats.

A.12 StayTreat location?



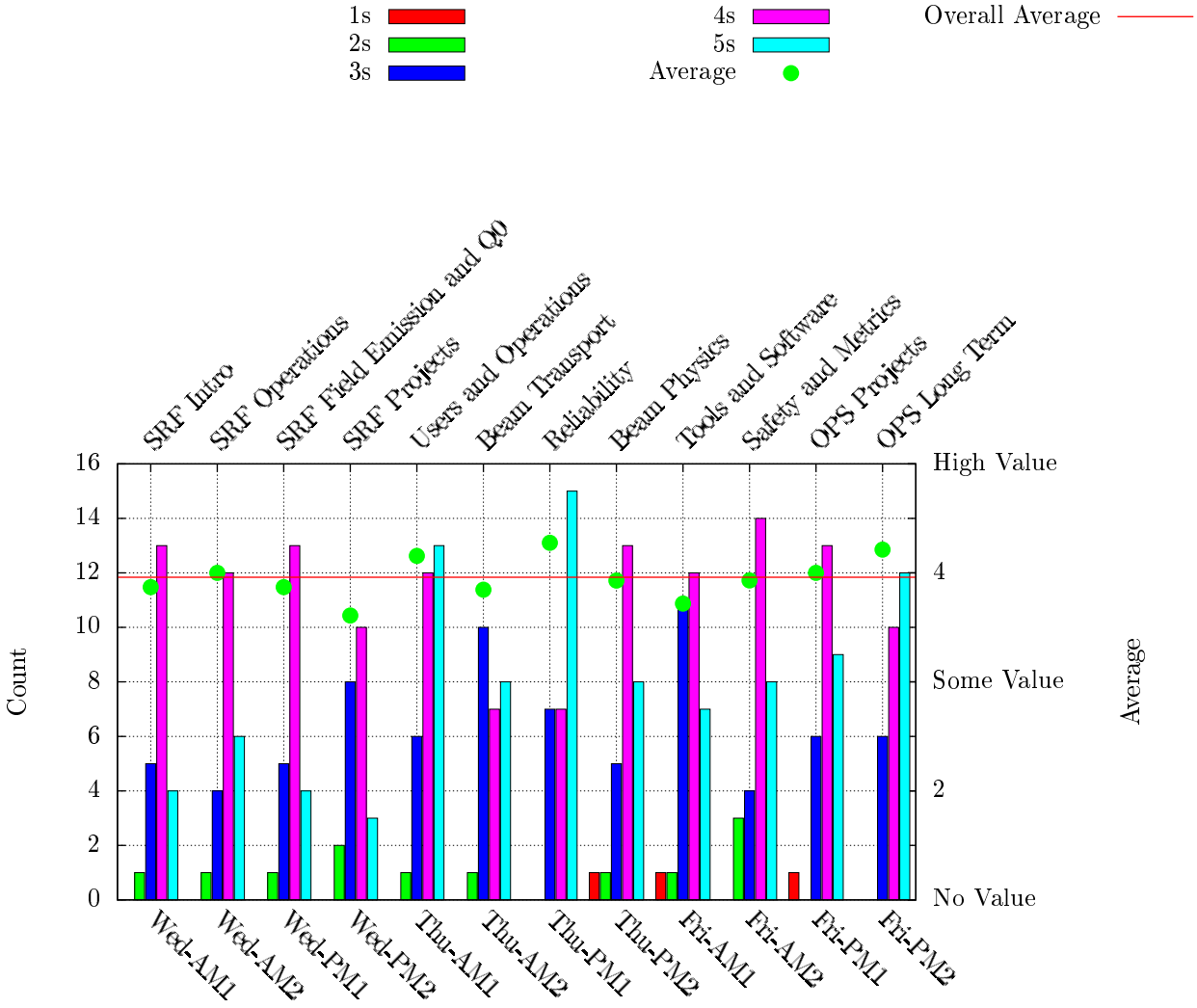
Majority of the responses were agnostic about which room to hold the StayTreat. The Arc Auditorium worked well this year and is likely to be used in the future. Some general comments related to this question expressed a desire to hold a real retreat at an offsite location and some express dissatisfaction with the seat comfort in the Arc Auditorium.

A.13 Perceived impact on 12GeV operations in Fall 2015?



Most participants felt that the *OPS 2015 StayTreat* had a positive or neutral impact on the preparations for the Fall 2015 beam plans. This is good, at least the *OPS 2015 StayTreat* did no harm!

A.14 Session ratings



Each session was rating from 1 to 5, where 1 meant that the session had no value and should not be repeated at future StayTreat and 5 meant the session had a high value and should be repeated in nearly the same form in the future. The plot of the results above has the count distribution for each session (bars) along with the average (green dots). There is a lot of information contained in this plot:

- The SRF raters are tough graders as there are very few 5's for the first day.
- Every session got at least 3 fives.
- Only three sessions got ones.
- Only two sessions had threes or higher.

On average the *lake wobegon effect* is in full force here with all sessions averaging above 3.5! The overall average was 3.96 this is displayed on the plot by the red line.

A.15 General Comments

The general comments were on a whole very positive about the StayTreat. There were many comments on the perceived low attendance and lack of discussion time. Several constructive comments on how to generate more discussion and avoid one-way, no dialog, presentations. These and many of the comments are constructive and will be used to improve the next StayTreat.

One comment resonated and distilled quite effectively the need for these StayTreats:

> The general proceedings illustrated the fruit of years of stove-piping at JLab. If the culture is to continue to be one of communal consensus, then we need more such "norming" events, to effect cross-calibrations and cross-pollination of expertise.

References

[1] The CEBAF SRF/RF/cryo Workshop, JLab, April 3, 2014,
Agenda with links to presentations can be found at: `https://www.jlab.org/indico/conferenceTimeTable.py?confId=69#20140403.detailed`.

[2] R. Bachimanchi, et. al, *2014 Update: CEBAF Energy Reach and Gradient Maintenance Needs*, JLAB-TN-14-024.

[3] Robert Reid, *Does Your Company Suffer from "Arsonist-Fireman Syndrome"?*, posted March 14 2012, `http://www.processexcellencenetwork.com/lean-six-sigma-business-transformation/articles/how-to-tell-if-your-company-suffers-from-arsonist`

[4] A. Freyberger, *Large Dynamic Range Beam Profile Measurements.* Proceedings of DIPAC 2005, Lyon, France, `http://accelconf.web.cern.ch/AccelConf/d05/PAPERS/ITMM04.PDF`