Draft Closeout Bullets: Science and Technology (S&T) Review of the Thomas Jefferson National Accelerator Facility (TJNAF)
July 24-26, 2017

Significance and Merit

Experimental Program

Findings:

- All four Halls have completed their experimental equipment and demonstrated Key Performance Parameters (KPP's) and readiness for the beginning of data taking or have already begun taking data:
  - Hall A has already taken data on 3 experiments, completing 2; the tritium target is ready for installation and construction of all components of SBS is complete.
  - In Hall B, a detailed schedule for all remaining tasks before the Fall engineering run is in place.
  - Hall B has completed one non-CLAS12 experiment and taken initial data for another one.
  - Hall C has a detailed plan for commissioning and first data in the Fall.
  - Hall D has already collected 20 Program Advisory Committee (PAC) days-worth of data and produced a first publication.
- The laboratory presented a day-one experimental physics program including measurements addressing topics within each of the laboratory's major research themes.
- Highlights of the initial three-year plan include high-impact measurements of nucleon and nuclear structure using the tritium target, measurements of the neutron skin of calcium-48 (^{48}Ca) and lead-208 (^{208}Pb), the longitudinal structure of the nucleon, measurements of the generalized parton distributions (GPDs) and TMDs of the proton and neutron over broad kinematic ranges, studies of the charmed pentaquark, and high luminosity GlueX running.
- The laboratory highlighted several non-Department of Energy (DOE) contributions from a combination of foreign institutions and National Science Foundation (NSF)/Major Research Implementation (MRI) Program-funded university collaborations. These projects are typically managed by Thomas Jefferson National Accelerator Facility (TJNAF, or JLAB) with DOE involvement as appropriate, and go through the experimental readiness review (ERR) process to become part of the baseline hall equipment.
- The laboratory is involved in the review process and planning efforts for major long-term projects such as the Measurement Of Lepton Lepton Elastic Reaction (MOLLER), currently at Critical Decision-0 (CD-0), and the SoLID program, at a pre-conceptual stage.
- The laboratory has a backlog of approved experiments, and is addressing this by raising the bar for acceptance of new proposals and by implementing a Jeopardy process, developed in consultation with the users.
- The laboratory presented the current status and future plans for computing for the experimental nuclear physics program, including data acquisition and data analysis efforts. They have identified the need to significantly increase the computing resources available for experiment analysis by FY 2019. An Information Technology (IT)/Experimental Nuclear Physics Computing (ENP) committee on computing resources has been formed to propose a plan to address future computing needs.
- The detector group has contributed both to JLAB equipment and to new imaging methods serving society at large.

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Comments:

- An impressive amount of initial physics data in the 12 GeV era have already been taken and partially analyzed. It was gratifying to see preliminary results from the Hall A measurement of G_{Mp}, as well as raw data from the Proton Radius (PRAD) Experiment. The GlueX collaboration is to be congratulated to their first publication and their very efficient initial calibration and analysis of the Spring 2017 data. Several additional physics channels are at an advanced stage of analysis.
- A clear plan for the remaining work on CLAS12 readiness is in place, including detailed simulations of 7 different physics channels. The collaboration might consider identifying one or two experiments that lend themselves to a more rapid first publication.
- The 12 GeV physics program is very strong, highly competitive, and well-aligned with the priorities of the national nuclear physics community as presented in the 2015 Nuclear Science Advisory Committee (NSAC) Long Range Plan (LRP).
- The three-year physics program presented appears to be strongly representative of the PAC scientific ratings and the PAC designation of high-impact experiments.
- Equipment needed for the initial day-one physics program is in place and ready for the first set of experiments. The experimental staff are commended for their heroic efforts in juggling an impressive suite of activities associated with preparations of the 12 GeV Science Program.
- The accelerator is not yet in a state that would allow reliable, fully efficient running, in particular at the nominal maximum energy; this affects both the physics reach and the statistical precision of some early experiments.
- Timely and successful execution of the experimental program as presented will require demonstration of four-hall running capabilities, improved machine reliability, and an increase in the scheduled running time.
- The panel is concerned that there is not yet an experimental schedule available for FY 2018 running.
- All four halls appear to have well-considered plans for data analysis for the first year of experimental running. For CLAS12, the planned data challenges in August will be an important final validation step before the FY 2018 data taking begins. For the Super BigBite Spectromter (SBS) program, a detailed plan for software and simulation was not presented, but should be a priority for a planned FY 2019-FY 2020 run.
- The JLAB-managed SBS program appears to have been a great success; achieving or exceeding all technical and performance specifications on time and on cost.
- Hardware contributions from outside institutions appear to have sufficient oversight from JLAB and a clear path for integration into the lab programs.
- The proposed Jeopardy process will help reduce the backlog of approved experiments. Care should be taken to ensure that overlapping experimental programs making related measurements with different equipment (e.g. CLAS, SBS, SoLID) are examined in light of the overall JLAB program, especially where related experiments do not enter Jeopardy at the same time.
- The achievements and expertise in the detector group are impressive and could more strongly benefit detector development for the 12 GeV and electron ion collider (EIC) programs.
- The data acquisition systems appear to be sufficient for the anticipated running conditions for the next 3-5 years. Data storage needs are sufficient in the short-term and can easily be expanded to meet the anticipated needs over the next 3-5 years.

- The Laboratory's most recent projection for computing resources needed for data analysis and Monte Carlo simulation demonstrate that the current on-site computing ENP resources are below the FY 2018 projected need and well below the FY 2019 requirements. The effort to look for external resources for Monte Carlo and possibly bulk data processing is extremely important.

Recommendations:

- Generate a cost-effective plan to ensure sufficient computing resources for data analysis and simulation in FY 2018, and a longer-term approach to address the needs in FY 2019 and beyond. The plan for the FY 2019+ resources should include a timeline and detailed plan to evaluate the feasibility of the proposed approach, including off-site computing resources, such that the plan can be in place and tested before the FY 2019 running. Synergy with the theory computing needs should be considered. Submit to DOE by January 31, 2018.

Theory Program

Findings:

- Currently and future planned research at the theory group is focused into six main thrust areas:
  - Hadron spectroscopy from lattice quantum chromodynamics (QCD);
  - Application of analytical methods to hadron spectroscopy;
  - Nuclear structure and effective field theories;
  - Hadron structure from lattice QCD;
  - Phenomenology and global analyses of 3D hadron structure; and,
  - Perturbative QCD and effective field theory calculations of 3D hadron structure.
- The new theory director's vision is to combine the expertise in his group i.e. lattice QCD (LQCD), theory, and phenomenology, in order to advance the understanding of nuclear physics from quarks and gluons to nucleons and then to nuclei.
- The scientific activities of the theory group are aligned with the research areas identified in the 2015 NSAC LRP document.
- Examples of recent achievements include the first LQCD calculation of exotic states (consisting of two valence quarks and glueballs) and the first calculation of the sigma (0++) from LQCD. Their first exotic states calculation predicts a spectrum of exotics at about 2.2 GeV. This has been communicated to the experimental groups.
- The JLAB theorists are the first in the world to develop the lattice method to calculate coupled channels. They will use this method to get better control of the calculations of exotics so that effects from nearby states with the same quantum numbers are included.
- The Joint Physics Analysis Center (JPAC) center, established in 2013 with leadership from the JLAB theory group, is a joint effort between experimentalists and theorists to advance hadron spectroscopy using analytical methods. During the last couple of years this center has greatly expanded, with many new institutions around the world joining the effort.
- The theory group is working to establish a focused effort on GPDs.
- DOE funding of the theory group is strongly leveraged by close ties with collaborating institutions.

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Comments:

- The theory group is very well integrated with the experimental program and vital to the success of the 12 GeV program. The theory input crucially enhances the 12 GeV experimental program and is indispensable for its success and scientific discovery.
  - Impressive lattice calculation of the hadron spectrum, in particular hybrid hadrons, are the focus of GlueX and CLAS12 experimental programs.
  - Analytical calculations within the JPAC approach to hadron spectroscopy, provide important insight into the fundamental QCD parameters. In particular, JPAC predictions were nicely confirmed by the first data from GlueX at 12 GeV.
  - The ongoing comprehensive phenomenological analysis of the semi-inclusive DIS experimental data within the TMD framework, and extraction of the transverse momentum dependent parton distributions constrains the TMDs; this is a very important effort which will significantly advance the knowledge of the nucleon structure. Work on the GPDs is directly related to the DVCS program at 12 GeV as well as elastic vector meson production at EIC is important.
  - The theory group has made impressive contributions to the analysis of the collinear PDFs, including an important extraction of the u/d ratio at large values of x, CTEQ/JLAB global analysis of unpolarized PDFs, and first simultaneous fits of polarized and unpolarized PDFs for the strange quark component.
- The LQCD group's calculation predicting a spectrum of exotic states around 2.2 GeV is an exceptional achievement. The group is also highly commended for developing new methods for LQCD such as coupled-channel methods and pseudo-PDFs.
- Members of the theory group pioneered the rapidity evolution for small x physics. Recent efforts to merge this evolution with the standard collinear region will significantly advance the understanding the dynamics of QCD in the high energy region.
- The new theory director's vision to combine the broad expertise in his group from LQCD, theory, and phenomenology is applauded; this will serve JLAB both in the short and long term.
- The theory group has successfully initiated a joint experiment/theory effort through Laboratory Directed Research and Development (LDRD) which directly supports the JLAB 12 GeV program and EIC. The LDRDs are focused on mapping the hadronization from Monte Carlo generators to TMDs and next generation measurements with the EIC.
- The five-year strategic plan for efforts in QCD and the structure of hadrons and nuclei, as well as nuclear structure and reactions, are well thought out and well-articulated.
- Given the importance of the exploration of the partonic structure of nuclei at higher energies, it would be desirable to strengthen the group efforts in this area.
- Given the magnitude of the effort being undertaken, the group could benefit by an increase in the number of graduate students that can closely interact with staff. This is also important in training the next generation of students.
- The LQCD group crucially depends on having continued access to adequate computational resources, and there is a concern that this could be compromised by competing priorities at the laboratory. They need to retain control of the queues for a fast turn-around time and increased computing resources. The group is very well equipped to use such resources, having their own software physics stack, Chroma, which is optimized for the next generation machines.

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Recommendations:

- Develop a 5-year plan of computational needs related to Office of Nuclear Physics (NP) activities for the theory group on local JLAB computers, in the context of all available computing resources. Submit to DOE NP by June 1, 2018.

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Facility Operations and Future Facility Upgrades

Findings:

- The priorities for the accelerator division are to support and operate the 12 GeV program, to develop the JLAB EIC (JLEIC), to achieve deliverables for the Facility for Rare Isotope Beams (FRIB) and Linac Coherent Light Source II (LCLS II), to maintain core competencies in particular leadership in SRF capabilities, and to train and educate students.
- The accelerator division performs all work with appropriate planning and safe practices. The division works on reliability and availability of the accelerators, and develops new accelerator capabilities to support future program needs, manifested in the performance goals.
- The 12 GeV baseline beam parameters were successfully achieved. 12 GeV has been demonstrated but the operational energy is slightly below this level due to some cavity performance issues.
- The 12 GeV Continuous Electron Beam Accelerator Facility (CEBAF) Beam Transport is ready to support the physics program. The growth in emittance and energy spread due to synchrotron radiation effects in the arcs agrees well with the expectations from simulations.
- Particulates have been found on the Superconducting Radio Frequency (SRF) cavity and warm region surfaces likely originating from the warm region between girders. New procedures have been put in place to try to minimize particulate generation and migration during beamline vacuum work.
- Beam energy management, as well as achievement of low trip rates, require high performance cryomodules. A failure or deterioration of a C100 cryomodule, or even more likely an old C50 module, will reduce the available beam energy to below 12 GeV and increase the number of trips. The F100 in the Low Energy Recirculator Facility (LERF) can act as a hot spare in case of a failure. But building in a 100 MeV of margin per linac can mitigate a whole module loss.
- The C100 operational cavity gradients are lower than expectations. Over-performance in CM20/CM50 cavities has balanced the deficit resulting in a net -4% energy gap. The current operational energy level reflects a conservative approach that includes margin for addressing emergent problems during run periods. Reworking CM50 cavities to C75 cavities by the SRF group will be used to address the energy gap at minimal additional cost.
- A performance plan has been created to address the issues of critical spares and to close the gaps in beam availability, beam energy, and personnel resources. The estimated cost of fully executing the proposed plan in year one is $7 million.
- Critical components have been identified and the process to assess potential single point failures (risk analysis) of the operation of CEBAF is ongoing. This need was underscored by the CHL1 sub-atmospheric cold box issue with a cold compressor failure and resulted in the Performance Plan.
- Following the single point failure of the cold box, a new cold box is being procured. The cold box will arrive in 2019 and will be integrated over the next two years.
- The accelerator improvement project (AIP) program is used to fund new accelerator capabilities. In FY 2017 it funded the ¼ cryomodule fabrication and the full energy injector upgrade program, and the new C75 cavity pair. Current annual AIP funding is ~$1 million.

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- It was stated that the parallel beam delivery capabilities are restricted by incompatibility in energy, intensity and polarization. Also cryogenics sets limits to high power cryogenics targets running in parallel. A maximum multiplicity factor of 3.6 is estimated for four hall beam delivery.
- The Center for Advanced Studies of Accelerators (CASA) group is engaged in supporting the 12 GeV program through model analysis of the machine and algorithm and tool development, and through injector/source upgrades. An important contribution was the identification of a quadrupole equipment issue through accelerator optics modeling.
- The CASA group is engaged in code development in support of JLEIC research and development (R&D) needs, including simulations in support of the development of the energy recovering linac (ERL) cooler and separately the beam-beam effects in the EIC. Much of the code development is being done in partnership with Old Dominion University (ODU).
- The CASA group seeks to develop a core competency in beam instrumentation.
- The CIS group has an R&D program aimed at increasing injector performance of CEBAF and developing the injector technology for JLEIC. A small business innovative research (SBIR) collaboration achieved world record QE from a high polarization photocathode. The inverted-insulator gun to deliver higher energy beams has demonstrated 360kV during conditioning. Energies beyond 350kV would eliminate the need for capture before injection into the first CEBAF cryomodule.
- A strong partnership with the ODU CAS program has been useful for acquiring external funding from NSF and other sources. Efforts are underway to strengthen and diversify the partnership to support future EIC efforts.
- An LDRD has been funded to support the demonstration of magnetized beams for JLEIC electron cooling. The project has demonstrated 0.5 mA of magnetized beam with an ultimate goal of demonstrating 32 mA in a year.
- The SRF capability is a core competency for the Accelerator Division. Capabilities in this division have been refreshed over the years through production of cavities for external projects (SNS, LCLSII, etc.), and through the 12 GeV project. The teams are engaged in cavity development and refurbishment in support of CEBAF while in parallel meeting milestones for technical partnership deliverables.
- The new 200 kV gun will reduce space charge effects and supports reliable, high bunch charge operation. The new ¼ cryomodule will replace the oldest SRF element in CEBAF and integrate the capture efficiency, as the warm capture cavity can be removed.
- The injector test facility will be used to test critical CEBAF components before installation.
- JLEIC design has been refined over the last two years, motivated primarily by progress in R&D. Changes include a new electron ring with better magnets, the re-adoption of a strong cooling, higher stored ion current, and smaller beta-star.
- The laboratory has submitted a JLEIC R&D plan aligned with recommendations from the Jones report.

Comments:

- The panel congratulates the division on successful commissioning of the 12 GeV accelerator upgrade and achieving the baseline beam parameters.

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- The panel recognizes that operations of CEBAF at 37 weeks a year requires additional operations staff. A plan to increase this workforce is part of the performance plan.
- Issues related to the aging of machine equipment and lack of critical spares are of concern as they can significantly impact the 12 GeV program. The performance plan to invest monetary resources to address these issues is appropriate.
- The AIP funding profile is small and has been successful in targeting key investments that will result in CEBAF performance improvement.
- The migration of particulates from warm and not well cleaned sections to the cold sections of a superconducting linac is well known. The present procedure on vacuum envelope interventions do not address the particulate migration. The panel strongly supports a maintenance approach with focus on venting and pumping down procedures, and having areas of the beam line cleaned before vacuum intervention.
- Investigations into cavity contamination and gradient degradation should continue as a priority for the accelerator division. Understanding and mitigating long-term gradient degradation is important to both CEBAF performance and future machine performance. Additional focus in this area is advised.
- The SRF group demonstrates a very high performance and has a world-class facility available for research. Their R&D capabilities are impressive, especially the research in Nb_3Sn capabilities supported through an Early Career Award (ECA). They should broaden their improvement plan for the original CEBAF cryomodules with the goal of more reliable operation. The plan should include the consideration of new technologies that can achieve significantly higher gradients in order to retire old modules in the machine.
- Jlab should consider options for a faster implementation plan to gain the desired 100 MeV margin per linac (either an additional C100 cryomodule or the rework of C50 modules).
- CASA efforts are appropriately balanced between supporting the 12 GeV program and JLEIC R&D efforts.
- The CASA computational program is strong and the growth into areas aimed at JLEIC R&D is appropriate and consistent with the laboratory mission.
- The panel recognizes the goal of developing a core competency in beam diagnostics, but is concerned that the group is understaffed to achieve this goal.
- The performance goals in terms of reliability and number of trips should be re-considered in the long-term and an improvement plan be considered.
- Refinement of JLEIC design concept is progressing well. Results of R&D efforts in the last two years have impacted design decisions indicating that optimization is still in progress. Current R&D efforts are appropriately aligned with recommendations from the Jones panel and are progressing well.
- The magnetized source development is central to the JLEIC strong cooling concept and first results are encouraging. The development of a non-interceptive diagnostic for measuring magnetization is an attractive feature. The panel looks forward to the results of this project.
- The R&D progress in the CIS group is impressive and well aligned with CEBAF objectives and JLEIC R&D goals. The successful polarized photocathode collaboration underscores the value of the SBIR partnerships.
- The development of the new high voltage gun is very successful and important for the future upgrade of the CEBAF injector in term of beam emittance and reliability.

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Recommendations:

- None

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Scientific and Technical Staff

Findings:

- JLAB staff have published 88 papers over the last two years on experimental apparatus, planned experiments (including the EIC) and existing data both from the 6 GeV program and from the first set of experiments in the 12 GeV era.
- The theory group has 5 permanent senior staff, 11 joint faculty, 3 bridge faculty as well as 7 postdoctoral fellows. There are currently 7 graduate students supported by JLab. The members of the theory group possess expertise in a wide range of topics, which are closely related to the mission of the Laboratory.
- The accelerator division consists of 163 people dedicated to 5 primary functions: Operations, Injectors, Accelerator Physics, SRF R&D, and SRF Ops. There are 13 graduate students supported by the Division.

Comments:

- The number of ongoing experimental activities at this time related to preparing for the Day 1 physics program is staggering and the fact that they are successfully being implemented is a clear indication of the dedication, competence, and creativity of the experimental staff.
- Members of the theory group are internationally recognized experts in their respective areas of research. This is reflected by a large number of publications in peer-reviewed journals, invited talks and organization of workshops and meetings. The theory efforts on hadron structure, spectroscopy, LQCD and JPAC are exceptional and highly commended.
- The accelerator division continues to demonstrate world leadership in a number of areas, including but not limited to SRF capabilities, cryogenics, injectors, and ERLs.
- It is clear from the number of awards, invited talks, publications, and professional society roles that the JLAB staff are highly engaged and well recognized in the international community.
- Several high-quality presentations were given by junior scientists who either joined the staff recently or hold bridge positions.

Recommendations:

- None

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Scientific Community

Findings:

- The laboratory had 1444 users on site and 86 off-site users in 2016; this includes a large number of graduate students working on experiments, theory and accelerator science.
- The users are represented by an active users group board of directors (UGBoD). This includes a role on the PAC and membership on various lab committees.
- The lab is relying on significant (both in terms of time and expenditures) contribution from a large number of its users, including foreign groups.
- The PAC continues rating and approving new experimental proposals. The PAC emphasizes the value of grouping proposals into run groups for larger impact, and recommended a review of all experiments to elucidate the EMC effect.
- The members of the theory group contribute theoretical input to the PAC by providing reports with reviews of all the proposals.
- The accelerator division staff are engaged in research collaborations with other laboratories in the community, with private industry through SBIR collaborations, and with several universities.

Comments:

- Interactions with users, both directly and mediated through UGBoD, seem to work overall to the benefit of both the users and the lab.
- JLAB is playing key roles in the EIC Community.
- The level of engagement of the accelerator division with universities, in particular with ODU, is impressive and has resulted in a strong educational program in accelerator science.
- The SBIR partnership program is highly productive and forward looking. Continuing engagement with industry to address high-impact R&D is encouraged.
- Scheduling uncertainties can have a disruptive impact on the user community. The laboratory should put significantly more effort in communicating their plans for future running schedules. In particular, even in the presence of funding uncertainty, they should provide as much information as possible about the schedule under various scenarios.

Recommendations:

- None

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Management

Findings:

- Completing the 12 GeV Upgrade and starting the 12 GeV physics program are the stated top priorities of the lab.
- The new JLAB Director articulated his vision centered around 3 elements:
  - Enable community to deliver science
  - Develop a path in terms of facilities and capabilities to realize long-term scientific aspirations
  - Provide technology solutions that support the NP community, the larger DOE mission and societal needs
- JLAB management is in a transition period with the recently appointed laboratory director, theory director and current searches for a director and deputy for the accelerator division. There have also been recent losses in expertise in the cryogenics group.
- The management continues to nurture the laboratory's core competencies in superconducting RF and cryogenics, injectors & sources, lattice QCD computation, and advanced detector development. They are presently being sustained by a large number of high profile construction projects (e.g. LCLS II, FRIB, LARP) within the DOE complex. Approximately 60 full-time equivalents (FTEs) are engaged in LCLS II.
- The laboratory's position is that it is the Office of Science (SC) "go to" lab for Superconducting RF technology, cryogenics, and sources.
- The laboratory stated that budget and operational challenges have complicated the generation of a robust Day 1 experimental schedule. The lab is recognizing that original equipment needs to be better maintained and some parts are becoming obsolete.
- A Science Laboratories Infrastructure (SLI) proposal has been funded in FY 2017 for a new 2K cold-box.
- The laboratory management's plan for a flat (to FY17) budget scenario ($110 million) is to operate 12 weeks, and invest $3 million in the new facility performance plan. If an additional $4 million is found, it would go to the performance plan, with only additional funding beyond that going to additional weeks of operations.
- JLAB is responsible for approximately half of the LCLS II superconducting linac (18 cryomodules) and for the design and acquisition of two cryogenic plants.
- The partnership with ODU on accelerator physics offers opportunities for the laboratory to seek funds from outside sources.
- There are several programmatically-driven SRF activities, which include the 12 GeV energy reach and availability, the C75 upgrade program, the high efficiency magnetron RF source, developing concepts and prototypes for an EIC at JLAB, and following the priorities of the Jones report, and delivering on LCLS II commitments. In addition, there are focused R&D activities towards advancing SRF technology.
- There are multiple challenges facing the SRF enterprise at JLAB, both technical and resource-related:
  - the observed gradient degradation in the CEBAF cavity performance due to field emission
  - the C100 under-performance issues
  - the transition of ~ 36 FTEs as the LCLS II project effort completes

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- JLAB is investing up to $800,000/year into an LDRD program, which began in 2014 and so far has supported 7 projects.
- The laboratory is considering several directions for the utilization of LERF, the Energy Recovery Linac (ERL) capability. Those include the DarkLight proposal (NSF MRI), Medical Isotope Production R&D proposal, Cryomodule test facility for LCLS II (RF only, no beam), as well as test bed for: Accelerator R&D for CEBAF reliability, EIC R&D, Diagnostic development, Positron production for material science.

Comments:

- The laboratory's low injury rates are attributed to effective Work Planning and Control. The 2016 elevated rates point to the need for continued vigilance.
- The laboratory has done an impressive job in managing a complex portfolio of hardware projects.
- The new JLAB Director's vision and strategy are consistent and aligned with the 2015 NSAC LRP in regards to the 12 GeV, a future EIC, and a central role in technology.
- The current investment in facility maintenance is insufficient to ensure the accelerator facility operates reliably and with high availability. The performance plan, with support of laboratory management, aims to optimize the performance of the machine. Items addressed in the performance plan should be prioritized and executed. The panel endorses laboratory managements' bold decision of making investments to ensure robust reliability of the machine, as opposed to increasing weeks of operations. The panel notes that it is typical for a new machine to ramp up operations to optimal performance after a major project completion.
- Laboratory management is commended for working with Scientific Laboratory Infrastructure (SLI) in defining a project for a new 2K cold-box; this is a welcome and critically important development that will remedy a severe long-term vulnerability.
- Increased focus should be given to address the SRF technical limitations, understanding the underlying causes of gradient degradation, and devising mitigation measures. Indeed, JLAB is in a world-wide unique position to study and improve the performance of high Q and high gradient CW SRF systems in operation. Such an effort would directly benefit the operational efficiency of the 12 GeV CEBAF, and contribute to advancing CW SRF technology with benefits to other facilities around the world.
- JLAB is facing several challenges to the overall leadership role of the SRF group in support of the DOE Mission. The development of a clear strategy for maintaining that world-leadership is important to the lab, NP, and the Office of Science and would ensure an integrated vision for sustaining SRF as a JLAB core competency.
- With all of the issues facing the accelerator division it's imperative that the two accelerator division positions, Associate Laboratory Director (ALD) and deputy ALD, get filled expeditiously.
- The LDRD program, although modest, is well-managed and appropriately targeted to impactful projects.
- Substantial progress has been made over the past two years on the JLEIC design. The management has also worked to increase the EIC accelerator outreach and collaborations.
- The pursuit of additional joint and new bridge appointments in accelerator physics is encouraged to strengthen the existing partnership and Accelerator Physics as an academic

discipline. This would mirror the laboratory's efforts to make extensive use of joint and bridge appointments with universities to support both the experimental and theoretical research programs.

- Years after having lost Navy stewardship of LERF, there is still not a clear mission for the facility. Multiple opportunities were identified, but their merit, feasibility, and cost-effectiveness were not clear.

Recommendations:

- Develop an integrated and cost-effective strategy for maintaining a world-leadership position in SRF. Such a strategy should encompass: a) a coherent plan for operational improvements; b) an R&D program with a well-defined focus that leverages the unique strengths of the JLAB capabilities; c) the utilization of existing world-class resources and capabilities, considering as well those becoming available at the completion of the LCLS II project; and, d) the already strong student program. Present to DOE by June 1, 2018.