SLAC NATIONAL ACCELERATOR LABORATORY

FY16 SLAC Performance Evaluation and Measurement Plan Mid-Year Self-Evaluation

Document Approval (signature/date)

Laboratory Director:	3/30/16	Chi-Chang Kao

Goal 1: Provide for Efficient and Effective Mission Accomplishment

MAJOR ACCOMPLISHMENTS

BASIC ENERGY SCIENCES

- LCLS has continued to produce a significant array of high profile results. Recently published examples include:
  - The first 5 years of LCLS: A comprehensive article was published in Review of Modern Physics covering key highlights of the initial period of LCLS experiments. [Bostedt et al, 10.1103/RevModPhys.88.015007 (2016)].
  - Material Science:
    - LCLS experiments revealed the structure of the long-sought field-induced charge density wave (CDW) phase in a high-Tc cuprate via x-ray scattering within a high magnetic field (28 Tesla). The results unveiled an unexpected aspect of the rich CDW phenomenology in cuprates, providing new information toward understanding High-Tc superconductivity. [Gerber et al., Science 350 (6263), 949 (2015)]
    - The melting of bismuth in response to shock compression has been studied using femtosecond x-ray diffraction at LCLS. Both solid-solid and solid-liquid phase transitions were observed. The emergence of a broad, liquid scattering peak upon release from shock pressures up to 14 GPa reveals the sample melts in less than 3 ns, very much faster than previously believed. These results provide an upper limit for the time scale of melting of bismuth under shock loading. [Gorman et al, PRL 115, 095701 (2015)]
  - Imaging: A major advance in x-ray crystallography was published that can lead to much higher resolution images of important biomolecules for clean energy and medical applications. This study demonstrated that the continuous diffraction of imperfect crystals can be used to obtain higher resolution molecular images than with Bragg peaks alone. The method was applied to crystals of photosystem-II, and represents an approach in which no prior structural knowledge is required, and one that is applicable to the large number of systems that cannot easily be grown into macroscopic crystals [Ayyer et al., Nature, 10.1038/nature16949 (2016)].
  - High field atomic science: Investigations into the interaction between light and matter at the very highest intensities led to unexpected results that challenge our understanding of this fundamental process. Observation of concerted two x-ray photon Compton scattering shows unexpected sensitivity to bound-electrons and a new nonlinear x-ray interaction. This approach could be used to provide a new measurement technique combining atomic-scale structure and dynamics with chemical specificity [Fuchs et al., Nature Physics 10.1038/nphys3452 (2015)]
  - Life Science: Observations have been obtained of how synapses in the brain generate neurotransmitter signals, revealing the mechanism for calcium triggered synaptic vesicle fusion – of relevance to the study of a wide range of neurological disorders [Zhou et al., Nature 525, 62-67 (2015)]
  - Structural dynamics: LCLS was used to produce the first ever movie of ultrafast functional motions in a biological molecule. The response of micrometer-sized crystals of the protein myoglobin were observed on timescales of a few hundred femtoseconds when an attached carbon monoxide molecule was cleaved [Barends et al., Science Express 10.1126/science.aac5492 (2015)]. In other studies, LCLS was used to image how a diminutive nanomachine, less than 10 nanometers tall, brings two disparate substrates together at a cell membrane interface to catalyse a complex reaction.
- SSRL has enabled significant recent advances in material science and structural biology including:
  - Time resolved imaging of spin wave dynamics with 50 ps temporal resolution and 35 nm spatial resolution observed a spin wave with a p-like symmetry not predicted by existing theories. These results broaden the understanding of spin-wave dynamics at the nanoscale, with implications for the design of magnetic nanodevices (Bonetti, et al., Nature Comm. 6, 8889 (2015)).
  - A supported organometallic nickel complex with a precisely known crystal structure consisting of a $Ni_6(PET)_{12}$ (PET = phenylethyl thiol) complex was shown to outperform bulk NiO and Pt catalysts and showed an oxygen evolution reaction comparable to Ir. This study highlighted the importance of experimentalists and theorists studying nearly identical systems, and provided information on atomically precise nanocatalysts. (Kauffman et al., ACS Catal. 6, 1225 (2016)).
  - Next-generation Rapidly-Accelerated-Fibro- sarcoma (RAF) inhibitors that yield higher efficiency and improved safety in melanoma cancer treatments were identified using the SSRL macromolecular crystallography facilities. Previous-generation RAF inhibitors that killed cancer cells also stimulated other cancers to grow; these next- generation inhibitors maintain effectiveness in melanoma treatment without previous side effects (C. Zhang, et al. Nature 526, 583 (2015))
  - A combined approach using *operando* X-ray absorption spectroscopy (XAS), X-ray diffraction (XRD) and electrochemical impedance spectroscopy (EIS) revealed that an ultrathin Al_2O_3 coating on a Li-ion battery cathode protects the surface

chemistry at both very high and low voltages. This leads to an understanding of cathode protection mechanisms leading assisting in the development of long lasting Li-ion cathode materials (Wise et al., Chem. Mater. 27, 6146 (2015)).

- Support for NSLS users in the NSLS to NSLS-II transition continued in FY2016 for x-ray absorption spectroscopy (XAS) on BL2-2. The beam line performance was enhanced by the fabrication, installation, and commissioning of a new monochromator that will ultimately allow for rapid scanning XAS measurements for in-situ catalysis.

- UED@ASTA Beamline: Since October 1, 2015, SLAC has delivered more than 300 hours of beam time for ultrafast material science and gas phase chemical dynamics experiments.
  - Material science - Ultrafast Phonon Measurements with MeV Electrons: Ultrafast electron diffraction was used to detect the temporal evolution of non-equilibrium phonons in femtosecond laser-excited ultrathin single-crystalline gold films to establish the usefulness of ultrafast electron diffraction using MeV electron energies for dynamic momentum resolved phonon studies (*Appl. Phys. Lett. 108, 041909 (2016*)).
  - Gas phase chemical dynamics and atomic physics - Diffractive imaging of a molecular rotational wavepacket with femtosecond MeV electron pulses: Electron diffraction experiments using MeV electrons captured the rotational wavepacket dynamics of nonadiabatically laser-aligned nitrogen molecules. The combination of achieved temporal (100 fs rms) and spatial resolution (0.76 Å) made it possible to resolve the position of the nuclei within the molecule. (Accepted for publication in *Nature Communications* (2016)).
  - Energy and material science - Ultrafast electron-lattice interactions in hybrid perovskite thin films: MeV femtosecond electron scattering was used to probe for the first time the primary events following absorption of light, and in particular, the coupling of these carriers to the lattice. Hot carriers were shown to exhibit only weak coupling to the atoms, exhibiting long carrier lifetimes on tens of picosecond time-scales.
  - Nano-scale material science - Ultrafast spin-lattice coupling in laser-excited FePt nanoparticles: We used LCLS ultrafast x-ray and electron diffraction to disentangle spin-lattice coupling of granular FePt in the time domain. These results suggest a novel approach to laser-assisted magnetic switching in future data storage applications.

- Material science, ultrafast chemical science, and interface science and catalysis research efforts have achieved significant research advances, including:
  - SIMES:
    - Mapped high-temp superconductivity in 3D for the first time using pulsed magnetic fields at LCLS (Gerber et al, Science 350, 949 (2015).
    - Discovered that a Single Layer of Tiny Diamonds Increases Electron Emission 13,000-fold (http://www.nature.com/nnano/journal/v11/n3/full/nnano.2015.277.html#auth-1)
    - Since September 2015, SIMES researchers have published to date more than 40 publications, most in high profile journals
  - PULSE:
    - Research highlights for ultrafast chemical science during the performance period include: new advances on high harmonic generation in solid rare gases; new results from x-ray interactions with dense clusters; the capture of molecular motion using ultrafast electron diffraction; new insights into interfacial energy transfer, and the observation of quantum interference in dissociation of molecular hydrogen due to light-induced conical intersections.
  - SUNCAT
    - Research highlights for the catalysis program during the performance period include: new insight into selectivity patterns in syngas reactions, identification of new hydrogen evolution catalysts based on transition metal sulfides and phosphides, and the first massive screening of CO2 reduction catalysts.

HIGH ENERGY PHYSICS

- FACET has enabled significant advancement in our understanding of plasma-wakefield acceleration (PWFA):
  - FACET continues to address the key milestones laid out a few years ago: meter scale plasmas, multi-GeV/m acceleration, high efficiency acceleration, low energy spread beams, multi-GeV positron PWFA and emittance preservation with the last two being the primary focus of the FY16 run. Two techniques proposed for high brightness beam generation have been successfully demonstrated at FACET: plasma torch and Trojan horse injection. The result of this work, upon further processing of the collected data, will improve our understanding of low emittance beams in plasma accelerators and will likely result in a high impact publication.
  - Publications to date:

- S. Corde et al. “Multi-gigaelectronvolt acceleration of positrons in a self-loaded plasma wakefield” Nature 2015
- S. Gessner et al. “Demonstration of a Positron Beam-Driven Hollow Channel Plasma Wakefield Accelerator” submitted to Nature Communications
- C.E. Clayton et al. “Self-Mapping the longitudinal field structure of a nonlinear plasma accelerator cavity” submitted to Nature Communications
- S. Corde et al. “27 GeV plasma acceleration in a high-ionization-potential gas” submitted to Nature Communications
- B. O’Shea et al. “Observation of acceleration and deceleration in frontier gradient dielectric wakefield accelerators” submitted to Nature Communications
- M. Dal Forno et al. “Experimental measurements of gradient in electron beam driven mm-wave metallic accelerating structures” submitted to Physical Review Letters

o FACET has also shown dielectrics are capable of gradients in excess of a GV/m and in addition, E201 performed the only drive+witness experiment, using a dielectric, in the last decade and showed acceleration gradients 30 times larger than the last measurement and also showed the largest energy extraction efficiency in an advanced accelerator to date: 80%.

- General accelerator research and development achieved several important milestones:

o DLA:

- Dielectric Laser Acceleration (DLA) achieved important milestones and fostered collaborations through new $13.5M Moore-Foundation-sponsored Accelerator on a Chip International Program (ACHIP), which includes 6 universities, 1 industry partner, and in-kind support from SLAC and 2 other national labs (DESY and PSI).
- Achieved first major milestone for ACHIP with gradients of 1 GV/m in joint SLAC/UCLA experiments.
- Commissioned new test setup at UCLA Pegasus facility for experiments to reach 1 MeV energy gain in a single DLA stage.
- Initiated NSF-sponsored program with Stanford and Tel-Aviv Universities to test new concept for DLA plasmonic devices.

o Beam Physics, LCC, FCC:

- The SLAC AD Accelerator Research Division is actively contributing to the lattice and physics designs of the European Future Circular Collider (FCC), the Chinese Electron-Positron Collider (CEPC), the Linear Collider Collaboration (LCC) and general collider program, the FACET-II positron damping ring, and a collaboration with the FNAL PIP-II project is being formed.
- A general analytical model of coherent synchrotron radiation (CSR) impedance with shielding provided by two parallel conducting plates was developed that reduces calculation time and that was bench-marked against numerical simulations with the CSRZ computer code. The model is useful for calculation of the CSR effects in high brightness, high peak current lepton beams during compression and storage.

- Indirect and direct searches for dark matter, and studies of dark energy and inflation made significant progress within the Cosmic Frontier program:

o FGST:

- Completed a white paper, “Sensitivity Projections for Dark Matter Searches with the Fermi Large Area Telescope” for the Fermi IFC, summarizing the variety of indirect detection methods for dark matter using LAT data and current results, relative merits of the methods, and making projections for how the sensitivities will improve with continued data taking (submitted to Physics Reports in March).
- Provided prompt searches of the localization region of the LIGO GW150914 gravitational wave event within 90 minutes of the trigger time. The BH-BH mergers are not expected to have electromagnetic counterparts, and the LAT did not detect an associated signal (submitted to the Astrophysical Journal Letters).
- "Search for Gamma-ray Emission from Dark Matter Annihilation in the Small Magellanic Cloud with the Fermi Large Area Telescope”, Caputo et al., accepted for publication in Physical Review D (and highlighted as an Editor’s selection)
- "Resolving the Extragalactic gamma-ray Background above 50 GeV with Fermi-LAT”, di Mauro et al., accepted for publication in Physical Review Letters (and highlighted as an Editor’s selection), was led at SLAC.

o DES: Completed third year of five year observing planned for the Dark Energy Survey. Led production of DES catalogs for initial dark energy science results (20 published papers). (PAC)

- CDMS: The CDMS group carried out R&D for the proposed SuperCDMS SNOLAB experiment and contributed to the data analysis for SuperCDMS Soudan, including a key role in the low-threshold analysis of SuperCDMS Soudan data and the development of a paper analyzing direct detection experiments in an effective field theory framework.
- LUX/LZ: LUX/LZ group continued operations of the LUX experiment and have accumulated 250 live days of data towards their Run 2 goal of 300 days. Re-analysis of the 2013 data were carried out based on improved calibrations and reconstruction, leading to improved sensitivity to WIMPs down to 3.5 GeV. Papers are in review for new limits on both Spin Independent (arXiv:1512.03506) and Spin Dependent (arXiv:1602.03489) interactions.

- The Energy and Intensity Frontier efforts in the particle physics program produced a number of important results:
  - MicroBooNE: Data taking with neutrino beam began in October. Tracy Usher co-leads the MicroBooNE reconstruction effort, which has led to the first automatic reconstruction of neutrino interactions in a Liquid Argon TPC. Yun-Tse Tsai led the MicroBooNE DAQ group that successfully commissioned the system.
  - ATLAS: Two high profile physics analyses using the first 3 fb^{-1} of 13 TeV Run 2 data with SLAC leadership and Stanford students as principle analyzers are being released to 2016 winter conferences:
    - Search for Higgs boson pair production in 4 b quark final state
    - Search for top quarks with 1 lepton + jets + Missing Et final state
    - Successful deployment of physics performance tools for pile up mitigation and b-tagging with main SLAC responsibilities and key contributions to the development of new and improved utilities, and their calibrations.
    - Joint venture with Stanford Computing Department on data science yielded several promising developments on boosted object and flavor tagging using modern machine learning techniques, with enthusiastic participation of students from several Stanford Departments.
    - Major contributions to the detector operations, with key responsibilities in muon and pixel systems in particular, to bring the systems through successful first Run 2 physics operations after some major upgrades during the 2013-2014 shutdown.
  - EXO-200 published papers on searches for Lorentz and CPT violation in double beta decay, searches for excited state decays, ion mobility in Xenon, and backgrounds in Xenon136.

FUSION ENERGY SCIENCES

- There has been considerable progress in the scientific output from the MEC endstation in 2015/2016. There were twelve refereed publications In 2015 including four in high impact journals (Phys. Rev. Letts(2), Nature Communications and Nature Photonics). Another paper on shock compression of diamond has just recently been accepted in Nature communications. This compares to 9 total publications in the previous 3 years from 2012 to 2014
- The MEC short pulse laser and coherent LCLS x-ray beam were combined to provide phase contrast imaging of a relativistic pulse interacting with a solid carbon wire target. This experiment provided the first direct evidence of intense laser pulse hole boring through an overdense target. A new wide-aperture wavefront sensor and deformable mirror in a closed loop system allowed the laser to maintain a small focal spot on the wire target throughout the experiment, which in turn allowed the laser to remain in the relativistic intensities required for hole boring.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

- SLAC Science Focus Area (Coupled Cycling of Organic Matter, Uranium, and Biogeochemical Critical Elements in Subsurface Systems) initiated a new JGI CSP-funded project to perform deep 16s sequencing on a regional sample set from the upper Colorado River basin (CRB). Studies include elucidating regional biogeochemical models for organic-rich sediments and their impact on uranium mobility in the upper CRB. A thermodynamic-kinetic model was developed to describe metabolic limitations to anaerobic organic matter decomposition and uranium reduction in these sediment bodies, and a new surface complexation-precipitation model was shown to describe U(IV) behavior in these sediments.
- Important SLAC bioscience publications:
  - Selective Binding of AIRAPL Tandem UIMs to Lys48-Linked Tri-Ubiquitin Chains < http://www.cell.com/structure/fulltext/S0969-2126(16)00015-0 Rahighi et al. Structure, Vol. 24, Issue 3. This is a featured article of the Journal, and has been at the top of the list of "most read in the last 30 days" since its publication.
  - Probing RNA native conformational ensembles with structural constraints. Fonseca, R., van den Bedem, H. & Bernauer, J. KGSrna: (2016) J. Comput. Biol. In Press
  - Coupled Motions in β2AR:Gαs Conformational Ensembles. Dimitar V. Pachov, Rasmus Fonseca, Damien Arnol, Julie Bernauer, and Henry van den Bedem. J. Chem. Theory Comput., 2016, 12 (3), pp 946–956

- Atomic resolution experimental phase information reveals extensive disorder and bound 2-methyl-2,4-pentanediol in Ca2+-calmodulin. Lin, J., van den Bedem, H., Brunger A.T. & Wilson, A.M. Acta Cryst D72:83-92 (2016)
- The Yin and Yang of the microtubular sliding, detachment, and rupture. van den Bedem, H. & Kuhl, E. Tau-ism: Biophys. J. 109:2215–2217 (2015).

NATIONAL INSTITUTES OF HEALTH

- SSRL Structural Molecular Biology (SMB) science highlights reflecting on progress in biomedical science, enabled by SMB staff.
  - The structure of a complex of synaptic proteins that controls the release of signaling neurotransmitters, such as glutamate, dopamine and serotonin from brain cells in less than one-thousandth of a second, which ultimately could help unlock a new realm of drug research targeting brain disorders was determined in a collaboration between the Brunger lab (Stanford) and NIH-funded staff [Q. Zhou et al. Nature 525, 62 (2015)].
  - Resveratrol is reported to extend lifespan and provide cardio-neuro-protective, anti-diabetic, and anti-cancer effects by initiating a protective stress response. The crystal structure of resveratrol and tyrosine bound to the active site of TyrRS [(Schimmel et al. Nature 8, 547 (2015)], was solved using SSRL SMB facilities, and the results shed light on the mechanism of resveratrol.
  - Researchers determined the novel x-ray structure of a pharmacological binding site on a sodium channel enabling the rational development of highly selective pain inhibitors. This discovery established a structural blueprint for accelerating the design of drugs for treating pain and inflammation [S. Ahuja, et al. Science 350, 6267 (2015)].
- Support for NSLS macromolecular crystallography users during the NSLS to NSLS-II transition continued in FY2016 with access provided to SSRL BL14-1, with support provided from NSLS-II, NIH and BER.

WORKFORCE DEVELOPMENT FOR TEACHERS AND SCIENTISTS

- The strength and breadth of SLAC's scientific portfolio attracts top tier candidates for our WDTS programs. SLAC's summer internship and research programs provides participants exposure to our key areas of research and are directly linked to the lab's mission as well as the DOE and the Office of Science mission. SLAC provides an immersive experience to participants with the long range goal of developing the next generation of scientists and engineers. SLAC strongly encourages the interns to carve out a portion of the bigger project and own it, and at the end of the internship, require them to write it up as a stand-alone research project.
  - In 2015, SLAC hosted a summer session of the following WDTS programs:
    - Community College Internship (CCI) – 3 participants
    - Science Undergraduate Laboratory Internship Program (SULI) – 25 participants
    - Additionally, SLAC sponsors participants in the DOE Office of Science Graduate Student Research Program (SCGSR) – 3 participants.

LABORATORY STAFF RECOGNITION, HONORS and AWARDS

- Edward I. Solomon received the Alfred Bader Award In Bioinorganic or Bioorganic Chemistry by the American Chemical Society
- SIMES hired Yu Lin as its first recipient of the Early Investigator Fellowship to help increase our diverse workforce of scientists to pursue a path of scientific excellence and substantially contribute to SIMES, SLAC and the US Department of Energy (DOE) missions and goals
- Jen Norskov was awarded the Murray Raney Award, Organic Reactions Catalysis Society, 2016 and the Rigmor og Carl Holst-Knudsen's Award, Aarhus University, 2015
- Ming Yi awarded L'Oreal USA For Women in Science Fellowship
- Gregorz Madejski was elected a Fellow of the APS
- Roger Blandford was the co-recipient (with Roy Kerr) of the 2015 Crafoord Prize in Astronomy of the Swedish Academy of Sciences
- Leonardo Senatore won New Horizons in Physics Prize
- Steve Kahn was elected fellow of the AAAS
- Stefan Hoeche won the 2016 Henry Primakoff Award for Early-Career Particle Physics
- Helen Quinn was awarded the 2016 AIP Karl Compton Medal

STATUS OF NOTABLE OUTCOME(S)

- **BES**: Deliver impactful science and engineering to advance the Fuels from Sunlight Energy Innovation Hub -the Joint Center for Artificial Photosynthesis (JCAP)- as measured by the FY 2016 Progress Reports and Review. (Objective 1.1)

  (SLAC Champion: Tony Heinz)

  - Status – On-Track
    - The project has been ramped up rapidly from its initiation in September, 2015. More than ten staff members, students, and postdocs are currently working on all aspects of electrochemical CO_2 reduction.
    - We have developed a method to synthesize large-area copper thin films with specific crystalline orientations, namely Cu(111), Cu(100), and Cu(751). This has enabled us to investigate the surface structure sensitivity of the CO2 reduction reaction on these surfaces in detail.
    - Theoretical investigations into CO2 electroreduction (CO2R) have focused on both fundamental electrocatalysis with the aim of defining new descriptors for COR2R and on catalyst discovery with a focus on new active site motifs that allow for breaking the scaling between CO, CHO, and COOH adsorption energies on transition metals.

SIGNIFICANT CONCERNS AND MITIGATIONS

- Concern: None
  - Mitigation: None

Goal 2: Provide for Efficient and Effective Design, Fabrication, Construction and Operations of Research Facilities

MAJOR ACCOMPLISHMENTS

BASIC ENERGY SCIENCES

- LCLS has continued to perform well and has implemented a number of operational improvements and new capabilities:
  - The LCLS photon beam availability was 95.0% for Run XII, and is currently 94.7 % for Run XIII.
  - The scheduling of LCLS Run 13 (March – August 2016) introduced the adoption of "standard configurations", in which multiple user experiments can be scheduled using a common setup, leading to a higher efficiency and thus greater number of experiments for the same operational cost. This mode of operation has been welcomed by the user community, and is typically implemented for about a third of an instrument's available time. In Run 13, the average length of a user experiment will be 3.6 shifts, compared to 5.2 over the preceding four runs. As a consequence, we predict ~40% more user experiments in FY2016 compared to FY2015, of which ~17% is due to a longer runtime. The average cost of operating the facility will drop by more than 25% per user experiment as a result of these and other actions taken in FY16.
  - A large-scale "dechirper" device was introduced into the LCLS facility to more precisely control the x-ray FEL pulse bandwidth. This provides a path to reduced pulselength and user-defined x-ray pulse tailoring. This achievement was a collaboration with industry (Radiabeam Systems LLC), and is also part of a contract with the Pohang Accelerator Laboratory in South Korea.
  - LCLS has developed an integrated "data strategy" in consultation with its user community and key partners such as NERSC and ESNet. This covers all aspects of data infrastructure, tools, and underpinning techniques, and is designed to ensure robust transition to LCLS-II and to address priority requirements for ongoing experiments, including focused development of "online analysis" capabilities to allow optimum use of beamtime at LCLS. As part of this work, a collaboration with the Computer Science Department at Stanford has been initiated, along with partnerships with counterpart groups at LBL, BNL and PNNL, targeting key algorithms for future data processing needs.
  - LCLS scheduled a total of 40 user experiments in Run-12 (15 Oct 2015 – 22 March 2016), representing 27% of proposals submitted). For Run-13, 50 user experiments are planned (24 March to 9 August 2016), representing 29% of proposals submitted. In addition, LCLS performed 8 shifts for "Protein Crystal Screening (PCS)" in Run 12, and plans 9 shifts for Run 13 (where 2 experiments are typically perfumed per shift). 65 shifts for Run-12 and 52 shifts for Run-13 are allocated for in-house science, instrument development and experiments performed at the discretion of the director, in total representing 25% of the available shifts.
  - For many LCLS experiments advanced beam delivery conditions have been used, for example dual-color dual-energy beams and polarized x-ray beams with a degree of circular polarization up to 99%.
  - Progress has been made to reduce the energy jitter of the LCLS photon beam. We achieved our goal of < 0.05% RMS @ 1 keV, < 0.025% @ 8 keV and continue to further improve the performance, mainly to achieve this goal on a routine basis.
  - Progress has been made for the LCLS Mission Readiness program. A noteworthy accomplishment is the completion of the Sector 20 to 30 klystron modulator upgrade project. The upgraded modulators improve the LCLS accelerator reliability and also contribute to the photon beam energy stability.
  - Successful launch of the FEL undulator seeding task force to investigate narrower FEL X-ray bandwidths and high peak powers.
- SSRL has continued to improve efficiency and capabilities:
  - SSRL's availability for FY16 run to date is 94.4%. The overall MTBF for SPEAR3 is 190 hours and a frequent fill delivery of 99.4%.
  - The lower emittance AIP to reduce the emittance from 10 nm to 6 nm is scheduled to be installed in September-October 2016 and commissioned from November 2016 through May 2017. However, a manufacturing error on the critical injection septum magnet may delay this project one year.
  - The SPEAR3 booster RF upgrade to replace 40 year old klystron with a 64 kW solid state amplifier is scheduled to be completed by September 2016. The new solid state amplifier is to be delivered in May and the project is on schedule and budget.
  - Three new SSRL beam lines that will provide advanced capabilities are under construction. These include an undulator beam line for macromolecular crystallography BL12-1 (commissioning Q3 FY17), an undulator beam line for advanced spectroscopy BL15-2 (start unfocused commissioning Q1 FY17), and a soft x-ray bending magnet beam line for metrology BL16-2

(commissioning Q4 2016). Two additional beam lines are in the early phases of design and include a hard x-ray bending magnet beam line for metrology BL16-1 and an undulator beam line for energy sciences scattering BL17.

- SSRL has begun the implementation of new end station capabilities on BL5-4 for epitaxial growth of metal oxide superlattices and on BL10-1 with a state of the art superconducting Transition Edge Sensor detector that will enable soft x-ray fluorescence measurements at resolutions of 1 eV.

HIGH ENERGY PHYSICS

- FACET operations will continue until April 4th 2016. During the 2016 run, 14 experiments received beam time and average uptime was 86%.
- FACET-II Project CD-1 was signed in late December. A preliminary date has been set for the CD-2/3A review in Q4 of FY16.
- Test Facilities Operations:
  - At the End Station Test Beam (ESTB) five user experiments have been supported so far. A new silicon tracker telescope, on loan from Carleton University, Canada, is operational and will bring great benefit to the proposed ATLAS upgrade silicon detector tests. At NLCTA the Echo-75 program came to a successful end. A publication of the results is forthcoming. At ASTA, both the X-band acceleration structure development and the UED program are supported.
  - A small-area ePix100 detector was deployed in the end station test beam (ESTB) in hall A. This system provides real-time feedback on the position and profile of the electron beam. Users will be able to incorporate the particle-by-particle position information into their data analysis, which is critical for some experiments.
- The performance of existing Cosmic Frontier experiments were improved while planned for future G2 Dark Matter experiments continued to make progress:
  - LSST camera project: substantial improvements have been made to both the project Cost Performance Index and Schedule Performance Index, and remain on track to complete the Project as planned. LSST also did very well at the NSF Status Review, held February 8-10, 2016 in Tucson, where the Camera Team was called out explicitly as doing an excellent job in both the management and the technical implementation of the Project.
  - LSST Dark Energy Science Collaboration (DESC)
    - Helped produce the first DESC Science Roadmap, describing the main science activities needed to be ready for LSST first light. This involved SLAC-led studies of the collaboration's computing hardware and software infrastructure needs, captured in two collaboration reports that were used as input to DOE meetings at the end of November 2015 and at the Budget Briefing in March, 2016.
    - An end-to-end (simulations to analysis) DESC pathfinder project, called Twinkles, has begun, providing an example of how to develop DESC code and push bulk processing through a workflow system.
    - Following DOE guidance for DESC to maximize the resources it can find by transferring effort from other projects, SLAC explored the potential for transfers from Fermi LAT and camera support efforts (on the research budget), resulting in a commitment of 3 FTEs by late FY16, rising to 5 in FY18.
  - SuperCDMS SNOLAB: selected as a jointly funded DOE-NSF-Canada 2nd generation dark matter direct detection experiment, with a focus on the search for low-mass dark matter particles. SLAC was designated lead DOE laboratory for the SuperCDMS project and Blas Cabrera was appointed to serve as the Project Director. SuperCDMS SNOLAB was granted CD-1 approval in January 2016 and is in the process of completing design work in preparation for CD-2 and CD-3 reviews next fiscal year.
  - LUX/LZ: stablished operations in SLAC's IR2 hall of the Liquid Nobles Test Stand, and have had two successful runs of the LZ Phase-I system test. They are also operating the Kr Removal R&D system and are progressing toward a demonstration of the required purity for LZ xenon. Designs for the LZ grids, TPC and Kr removal production systems are advancing. The Resource Loaded Schedule for LZ is nearly baselined and SLAC participated in the successful pre-CD2 Director's review at LBNL in advance of April's CD2/3b review
  - FGST:
    - Brought "Pass 8" event reconstruction and filtering to Level 1 production in June 2015. Pass 8 processing of the LAT data provided a significant increase in the performance of the LAT. The gamma-ray photon rate from the LAT increased by about 75% as a result of the change from Pass 7 processing to Pass 8 processing.
    - The transition to Level 1 production was accompanied by public release through NASA of LAT gamma-ray data from the entire prior mission history, after it all LAT science mission data had previously been reprocessed on the computer farm at SLAC.

    - Worked with NASA to reduce the latency time of public release of LAT photon data by about 25% to 30% in the past few months, after requests within the LAT Collaboration for faster data processing and release. The median latency time has decreased from about 7.3 hours to about 5.2 hours.
    - Working with NASA to plan to meet the expected on-going need for LAT operations support beyond the first 10 years of the science mission, with the expectation of reduced DOE support.
- The performance of existing Energy and Intensity Frontier experiments were improved while planned for future upgrades continued to make progress:
  - ATLAS:
    - Advance in CMOS sensor and readout designs, and readout electronics to seed novel upgrade detector designs for the HL-LHC Inner Tracker. The full reticle design of CHESS2 Monolithic Active Pixel devices, as a candidate to replace silicon strip sensors is in final simulation phase for submission in April.
    - Fast ramp up of the conceptual design for the High Granularity Timing Detector in the forward region of ATLAS for HL-LHC, with leading roles in simulation studies and jet-finder ASIC development for frontend readout and trigger.
    - SLAC designed DAQ electronics based on the RCE readout concept in the form of COBs and HSIO-II, for ATLAS HL-LHC ITk upgrade development, have been distributed to 20+ collaborating institutions world-wide.
    - Planning activities started on clean room and construction equipment to establish SLAC as an ATLAS HL-LHC pixel upgrade stave assembly site.
    - In collaboration with Facilities, established a precision EUDET beam telescope on loan from Carleton ATLAS group at the SLAC End Station A Test Beam as a common utility to serve all users. HPS: The 2015 HPS Engineering Run data is fully calibrated and reconstructed, and data quality is at or above the levels projected in our proposals. Analyses are underway; publications should be submitted this summer.
  - HPS:
    - An HPS Physics Readiness Document to JLAB management demonstrating the status of HPS physics performance, and await formal approval from them of the remainder of the run time request made to the Program Advisory Committee.
    - HPS has been commissioning and taking data at JLAB on weekends since February 4, and will continue through the end of April.
  - EXO-200: completely recovered from the February 2014 fire and unrelated radiation release at WIPP. The UPS systems have been refurbished and fitted with new batteries, the cryostat refrigerators have been replaced, and the cleanrooms have been leveled to account for salt motion. As expected, the cryostat has been cooled and xenon liquefied, the xenon purity is good, and the resolution is as it was before the fire as measured with a calibration source. Improved electronics are now being commissioned which should improve the energy resolution significantly and a “deradonator” to improve backgrounds from airborne radon is also being commissioned. Low background data taking should be routine before June.
  - nEXO:
    - HV R&D tests at SLAC ongoing with >100 kV achieved for candidate HV cable/feedthrough. Engineering support of large "Phase III" HV test setup at LLNL ongoing - Thermal simulation and cooling system design nearly complete.
    - nEXO TPC mechanical design R&D ongoing with candidate field cage and photodetector support structure complete. Thermal simulations are ongoing for nEXO cryostat.
  - DUNE: The RCE-based DAQ system has been installed on the 35-ton Prototype Liquid Argon Time Projection Chamber for the DUNE neutrino oscillation experiment. It is now being used to collect Cosmic Ray data, which will be used to characterize the performance of this prototype. The RCE DAQ system has also been selected for use in protoDUNE, which will take data in a charged particle beam at CERN.

FUSION ENERGY SCIENCES

- MEC developments
  - A well-engineered system is currently being designed to support the new mode of “standard configurations”. This system will allow quick installation of laser beam paths, XRD and XRTS diagnostics. A dedicated assembly will allow control of the shock drive laser beam under vacuum. Two projects to automate and integrate (a) the laser energy measurements and (b) operation of the VISAR system have been initiated. Together, these activities will improve operational efficiency allowing faster shot rate for the glass laser experiments. These projects are expected to be complete by the summer of 2016.
  - New harmonic crystals (LBO) for the long pulse laser were purchased and installed in November 2015 resulting in a 20% boost to the laser energy (used for experiment LJ55). This was crucial in allowing the experiment to achieve pressures

required to reach the liquid iron state on the hugoniot (~4 Mbar). The crystals were also used in the very successful experiment (LJ55) to observe new phase transitions in silicon carbide.

- Experiments using the newly-commissioned 200TW laser in MEC have been delayed due to damage of the compression gratings. Increasing the laser footprint is the only viable mitigation. This will require a new compression chamber and enlargement of the transport entrance to the MEC chamber. MEC will continue to schedule intermediate power experiments and plans to commission 75-100TW experiments in the Fall of 2016. In order to maximize user time at MEC, the engineering work required for 200TW operation has been deferred until the FY17 shutdown to enable full power experiments in Run 15 (June 2017 onwards). Ongoing consultation with the user community is indicating a preference for a "split beam" approach (dual 100 TW), which is likely to form the basis of the updated configuration.
- A pair of CSPAD quad detectors was assembled and delivered to the MEC instrument. The addition of these triples the number of CSPAD quad detectors available to MEC scientists, with a corresponding increase in angular coverage and geometric flexibility.

- HED: Through operation of the S-10 laser laboratory, high-temporal resolution optical probing (<5 fs) and Fourier Domain Interferometry were developed in preparation for the first warm dense matter experiment at UED at SLAC.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH and NATIONAL INSTITUTES OF HEALTH

- The Macromolecular Femtosecond Crystallography (MFX) instrument, the newest instrument within the LCLS complex, received its first light on 12 January 2016, bringing to fruition the combined investment of multiple stakeholders including BER, BES, NIGMS and Stanford. It represents a significant advance by providing broader and more optimized access for structural biology users, while optimizing the overall facility for higher scientific productivity. The first user experiments are planned for July 2016.
- SSRL is developing and implementing new methodology and instrumentation for the DOE-BER and NIH-NIGMS synergistically funded Structural Molecular Biology program, for the macromolecular crystallography, small-angle x-ray scattering, x-ray spectroscopy and x-ray absorption spectroscopy imaging beam lines, following the program review in 2014.
  - SSRL beam line upgrades were completed and a user science program initiated on BER BL9-2 (macromolecular crystallography) and 9-3 (x-ray absorption spectroscopy). New mirror optics (the so-called M_0 mirrors) and a new front end have been installed and commissioned on the BER-funded beam line 9.
  - X-ray spectroscopy - the development to augment the experimental facilities with a software suite for theoretical calculations, enabled by a computing cluster was initiated; the imaging facilities were enhanced by high-performing electronics; new web-based data acquisition software was developed; and the engineering of new instrumentation for advanced spectroscopy was started.
  - Small-angle x-ray scattering - advances were made in automation for sample delivery; testing of a new SAXS-size-exclusion-column setup was initiated; time-resolved SAXS was further developed; and significant software development progress was made in particular for instant data analysis for "live" results at the beam line during the data acquisition.
- Support for NSLS macromolecular crystallography users during the NSLS to NSLS-II transition continued in FY2016 with access provided to SSRL BL14-1, with support provided from NSLS-II, NIH and BER.

STATUS OF NOTABLE OUTCOME(S)

- **BES**: Effectively manage and execute LCLS-II work scope in accordance with the Project Execution Plan and achieve Critical Decision CD-2, *Approve Performance Baseline*, and Critical Decision CD-3, *Approve Start of Construction*, in FY 2016. (Objective 2.2)

  (SLAC Champion: John Galayda)

  - Status – On Track
    - The DOE Office of Project Assessment conducted a review of LCLS-II to determine readiness for approval of CD-2 and CD-3. The review report concluded that the project was ready for CD-2/3 approval, contingent on the project responses to 12 recommendations. The project responses to these recommendations were presented to the subcommittee chairs, who confirmed that the project had satisfied all requirements for CD-2 and CD-3 in February.
    - The DOE Project Management Risk Committee met on 23 February to consider LCLS-II readiness for CD-2/3. The PMRC had no reservations, clearing the way for ESAAB.
    - The DOE ESAAB meeting to approve CD-2/3 for LCLS-II was held on 21 March. CD2/3 was approved and the LCLS II project was baselined and is now authorized to start construction.

- **FES**: Deliver standardized experimental configurations for X-ray diffraction (XRD) and X-ray Thomson scattering (XRTS) to increase the number of experiments and improve operational efficiency on the MEC instrument. (Objective 2.3)

  (SLAC Champion: Mike Dunne)

  Status – On Track

  Four experiments have been scheduled in Run 13 that will use the X-ray Diffraction and X-Ray Thomson Scattering standard configurations. These 4 experiments will take place over a 10 day period in May 2016. Fielding these experiments has resulted in a 25% increase in the number of user experiments scheduled in Run 13 compared equivalent periods in previous runs. The experimental configuration for these experiments has minimized and controlled the changes between experiments, ensuring a rapid turnaround between the 4 user groups over this 10 day period, which will lead to significant operational efficiencies.

SIGNIFICANT CONCERNS AND MITIGATIONS

- Concern: None
  - Mitigation: None

Goal 3: Provide Efficient and Effective Science and Technology Program Management

MAJOR ACCOMPLISHMENTS

BASIC ENERGY SCIENCES:

- LCLS
  - An external review was held in October 2015 of the plans for new instrumentation for LCLS-II. A team of international experts assessed and subsequently endorsed the LCLS facility's plans for 4 new instruments that will be optimized for the soft- and tender- X-ray beams from the high repetition-rate LCLS-II accelerator. The LCLS SAC then provided recommendations on prioritization of these plans. More detailed plans will be assessed later in the year, and will be published for comment by the wider user community.
  - The LCLS/SSRL annual users meeting attracted ~460 attendees, who participated in 11 workshops of relevance to LCLS. Specific attention was paid to the plans for LCLS-II science, covering aspects of instrumentation, detectors, optics, sample delivery, data systems, accelerator development, and a variety of specific scientific themes.
- SSRL
  - SSRL's developments in operando studies continues to grow SLAC's science program in the areas of energy materials and catalysis. This includes building collaborative programs with individual companies, consortia (such as CalCharge, Bay Area Photovoltaic Consortium, Solar Energy Materials Network), and programs at DOE centers/national laboratories (such as JCESR and Critical Materials Institute Hubs).
  - SSRL continues to partner with LCLS on developing the nanocrystallography station, MFX, at the LCLS as well as building complementary capabilities at SSRL (BL12-1).
  - SSRL has also leveraged LDRD funding to build a high resolution soft x-ray detector which has been delivered and is being commissioned and to develop a microcrystallography program in collaboration with the Stanford GCEP to study CO_2 sequestration and enhanced oil recovery.
- Accelerator R&D
  - Collaborated with RadiaBeam on the dechirper project and successfully commissioned the dechirper in the LCLS and demonstrated electron energy chirp and FEL bandwidth control. Made innovative use of the dechirper to control head/tail parts of the bunch that lases in different undulator sections, and hence provided two-color FEL capability with variable delays and with intensity much higher than was possible before.

HIGH ENERGY PHYSICS:

- FACET
  - The 14 experiments run at FACET in 2016 were approved by the program advisory committee and the time allocated to each experiment was based on the committee recommendations.
- PWFA-Applications Task Force
  - Successful launch of the Plasma Wakefield Accelerator (PWFA) task force with the aim to have an initial proposal by the end of the calendar year.
- In response to the DOE/HEP RFI for workforce development in accelerator physics, we developed a concept for an Accelerator Research and Education Center and delivered a white paper to HEP in December 2015. The white paper details possible growth of accelerator physics graduate students from 18 (current level) to about 50 in 2020. SLAC discussed the Center proposal with the Stanford Applied Physics Department (March) and the plan is currently being refined. SLAC also made initial contacts with UC Santa Cruz, Caltech, Cal Poly, UCLA and others about recruiting students.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

- The Bioscience Division conducted a Science Advisory Committee review of this new enzyme to ecosystem program. Key is new collaborations with LLNL and JBEI.
- SSRL cross-user facility research interactions: Plans and processes for interactions between SSRL and other BER-funded user facilities have been initiated and meetings have been held with potential national laboratory counterparts.

WORKFORCE DEVELOPMENT FOR TEACHERS AND SCIENTISTS:

- The SLAC Regional DOE Science Bowl:
  - The Science Bowl is an academic competition using a fast-paced question and answer format that tests high school students' knowledge in biology, chemistry, Earth Sciences , physics, energy and math. The winning team qualifies to compete in the

DOE National Science Bowl in Washington, D.C. The Science Bowl encourages local students to excel in science and math and pursue careers in these fields. Many of the past students have gone on to post-graduate studies, have thriving careers in STEM, and have also returned to this annual event at SLAC to help run the competitions as moderators and science judges. At this year's Science Bowl, 24 teams (roughly 120 high school students of diverse backgrounds) competed and about 50 people volunteered at the event.

EERE:

- In mid-February, Stanford and SLAC served as host to a number of leaders from EERE who discussed their programs, goals and vision for the future. Stanford and SLAC faculty and staff also had the opportunity to meet with EERE staff and present their research ideas in breakout sessions about specific program areas.

KEY LABORATORY RECRUITMENTS

- Simon Bare has been recruited to lead the catalysis effort at SSRL and form a bridge with the Chemical Sciences Division at SLAC.
- Natalia Toro and Philip Schuster joined Particle Physics Theory Group as Associate Professors.
- Lia Merminga was recruited as Associate Laboratory Director for the Accelerator Directorate.

SLAC STAFF SCIENCE COMMUNITY LEADERSHIP POSITIONS

- Phil Bucksbaum: Chair, Committee on Opportunities in the Science, Applications, and Technology of Intense Ultrafast Lasers, National Academy of Science; Presidential Advisory Committee, Optical Society of America; and Physics Section, National Academy of Science
- Piero Pianetta: Chair, Experimental Systems Advisory Committee for the APS-U project and ex-officio member of the APS Scientific Advisory Committee; University of Chicago Advisory Committee for the Advanced Photon Source; Beam Line Review Committee for the Shanghai Lightsource (2015); and Beamline Advisory Team: imaging research at the National Synchrotron Light Source
- Keith O. Hodgson: Chair, Science Advisory Board, Center for Structural Systems Biology, Hamburg, Germany and Science and Technology Advisory Committee, National Synchrotron Radiation Research Center)NSRRC), Hsinchu, Taiwan
- Ingolf Lindau: Chair, Elettra Science Advisory Council; and Photon Factory Science Advisory Committee
- Lia Merminga: Chair, IUPAP Working Group on Accelerator Science
- Bob Hettel: Chair, HEPS/Beijing International Advisory Committee; Sirius/Brazil Machine Advisory Committee; and Co-Chair of BES-CAS (China) Workshop on X-ray Optics and Detectors
- Nan Phinney: Speaker of the APS Council of Representatives, Chair of Council Steering Committee and Member of APS Board of Directors
- Tor Raubenheimer: Chair-Elect of APS Division of Physics of Beams
- Robert Schoenlein: Chair, Gordon Research Conference on Ultrafast Phenomenon in Cooperative Systems (2018)
- JoAnne Hewett: Chair, APS Division of Particles and Fields
- David MacFarlane: Chair, Advisory Committee on TRIUMF; Long-Baseline Neutrino Committee; and LSST Corporation Executive Board
- Norbert Holtkamp: Chair, CERN Machine Advisory Committee
- Chi-Chang Kao: Executive Council, National Laboratory Directors' Council (NLDC)

STATUS OF NOTABLE OUTCOME(S)

- **BES**: Working in conjunction with LBNL and JCAP-South, successfully execute a plan to transition JCAP R&D from hydrogen production to carbon dioxide reduction for the second phase of the Hub as measured by the FY 2016 Progress Reports and Review. (Objective 3.2)

  (SLAC Champion: Tony Heinz)

  - Status – On Track
    - Weekly web-based meetings have been established across JCAP to ensure effective program integration of research in CO_2 reduction chemistry.
    - JCAP has a new project structure reflecting the focus on CO_2 reduction. Tom Jaramillo is in charge of the Thrust on electrochemical CO_2 reduction

- The JCAP all hands meeting at Asilomar on March 22-24 clearly shows commitment from JCAP to concentrate efforts on CO_2 electrochemistry. A large fraction of the time is spent on developing collaborative projects in this area.

- **BES**: Provide effective leadership, management, and integration of LCLS-II Partner Laboratories and Collaborating Institutions to ensure project requirements are met. (Objective 3.2)

  (SLAC Champion: John Galayda)

  - Status – On Track
  - The LCLS-II participating labs are prepared to begin construction upon approval of CD-3, which is expected to occur in late March 2016.
    - SLAC and the partner labs have a functioning collaboration that has produced a robust integrated project plan.
    - Integration of the collaboration's plans has been accomplished in the resource-loaded schedule.
    - All tools for tracking and assessing project status are in place and functioning.
    - SLAC has assembled a competent cryogenics staff that is monitoring and indeed participating in partner labs' work on LCLS-II.

SIGNIFICANT CONCERNS AND MITIGATIONS

- BES Notable Outcome for LCLS II
  - Concern: LCLS-II requires SLAC guidance on controls hardware standards in order to complete design and manufacture of real-time controls for LCLS-II. A down-select by the end of the FY would be beneficial to the project.

    Mitigation: SLAC and LCLS-II have hired a controls expert to provide independent expert advice to LCLS-II, AD and LCLS in order to clarify the issue of standards selection for SLAC management.
  - Concern: The project is encountering challenges with effectively meeting cost and schedule for design activities at FNAL.

    Mitigation: FNAL has adequate technical staffing to meet design cost and schedule project requirements. LCLS-II and FNAL management are working to improve communication between SLAC and FNAL teams to anticipate cost growth and take appropriate action. LCLS II continues to consider possible options for EVMS and cryogenic distribution design and acquisition.
  - Concern: Safety management; LCLS-II project work is about to begin at SLAC and partner labs.

    Mitigation: .Good ISM is required at SLAC and partner labs. LCLS-II management will survey and reinforce safety roles and responsibilities for project personnel at SLAC and at the partner labs.
  - Concern: Sufficient staffing at JLAB to support FRIB project and LCLS II cryogenic plant design.

    Mitigation: LCLS II and JLAB management are working to increase on-site operational support and staffing at JLAB to fully support the project. SLAC has dedicated four SLAC employees to support work at JLAB. Additional support may be required; two more cryogenics experts have been hired by SLAC and will be assigned to support work at JLAB.

Goal 4: Provide Sound and Competent Leadership and Stewardship of the Laboratory

MAJOR ACCOMPLISHMENTS

Elements in support of 4.1 – Leadership and Stewardship of the Laboratory

- SLAC implemented a process for each mission and operations organization to prepare a business plan that is aligned with the SLAC Strategic Plan, Annual Lab Plan and SLAC Agenda. These business plans help Senior Management Organizations to set objectives and priorities, assign accountability and monitor progress. A key objective of developing the business plans is to align and link Laboratory tactical and strategic goals and objectives with employee performance goals.
- At the Senior Management Team (SMT) retreat in March 2016, SLAC conducted strategic planning sessions focused on: 1) (re)evaluating our science strategy; 2) aligning and optimizing our operational support; 3) planning cross-lab collaborative opportunities; 4) addressing leadership and workforce skill needs, and 5) organizational engagement and operating needs.
- SLAC continued strengthening the engagement with Stanford University through joint efforts and initiatives. For example, SLAC is working closely with the Stanford Precourt Institute of Energy to launch a new Energy initiative "Bits and Watts" in August 2016, and are collaborating on a number of "smart grid" projects.
- SLAC is promoting awareness of the Laboratory's research and capabilities to the local community via public lectures and offsite events. SLAC's Public Lecture program, which is open to the local community, organizes presentations on a monthly basis to highlight important areas and accomplishments emerging from SLAC research.
- SLAC through its core capabilities in x-rays, accelerators and detectors continued establishing new and maintaining existing partnerships with scientific communities.
  - Executed a CRADA with ESS (European Spallation Source) to collaborate on next generation LCLS-II technology that will result in technological advancements at both ESS and SLAC.
  - Entered into a strategic partnership agreement with IHEP (Institute of High Energy Physics), a Chinese government institute, to provide expertise and assist in the design of the Circular Electron Positron Collider, which is a complement to the International Linear Collider. This project has particular strategic importance for DOE and the international high energy physics community.
- SLAC continued to leverage relations with private industry aligned with the research missions of the Laboratory.
  - Closed on an intellectual property license with a long term industry partner who fabricates klystron components for SLAC. The license will enable the industry partner to manufacture these SLAC-designed components and sell them commercially, which not only increases their manufacturing capabilities which will be beneficial to SLAC, but also results in royalties for SLAC.
  - Executed a CRADA and intellectual property license simultaneously with a new industry partner. This arrangement is a new approach for SLAC, which will bring in industry funds to increase our capabilities in sensor engineering, while also resulting in a strong likelihood of commercialization of new sensor designs as well as royalty payments based on the resultant commercialization.
- SLAC Contractor Assurance collaborated with the DOE-HQ program office and subject matter experts from across the DOE complex to draft significant revisions to DOE Order 232.2, "Occurrence Reporting and Processing of Operations Information" and DOE Order 210.2A "DOE Corporate Operating Experience". The collaboration will results in revised orders that significantly improve alignment with Contractor Assurance principles.
- SLAC ESH Director, serving as the representative of the National Lab Director's Council, has been participating as a senior management representative for the re-write of DOE Order 151.1-D, "Comprehensive Emergency Management." The re-write of this order is intended to address deficiencies in the existing order, some of which were cited in the DNFSB critique of the WIPP incidents of 2014. The collaboration includes federal representatives of NNSA, SC, and other elements of DOE, plus contractor SMEs from LLNL, LBNL, PNL, and NNSS. The collaboration will produce a revised order that significantly improves the Departments ability to plan for, train for, and respond to emergencies.

Elements in support of 4.2 – Management and Operation of the Laboratory

- SLAC has enhanced our business performance metrics reporting used in DOE program budget reviews to demonstrate our strong management of SLAC's cost of doing business. SLAC provided DOE SSO a white paper describing our strategy from FY2009 to FY2014, which includes reducing support costs while managing indirect rates to create an investment portfolio large enough to achieve our mission readiness strategies and to create an LDRD program..
- SLAC redefined the "Performance Guidance Process" and enabled more accurate linkage of all employee efforts to the Laboratory's mission and operations. The redefined process provides a mechanism for fostering productive, growth oriented feedback, coaching, and a performance growth orientation.

- SLAC is nearing completion of the major revision of the SLAC Issues Management Program (IMP). The revision includes a significant revision of the institutional IMP document to include improvements to the issues management process and alignment of the SLAC issues management software tool (now called the Action Tracking System) with the process. The changes emphasize that the purpose of the program is to sustainably manage issues rather than just track progress on closing corrective actions. The IMP document also incorporates the improvement to the abnormal event investigation process, including the fact finding process for significant operational events. The IMP document will be completed in the spring of FY16. Software upgrades, which include improved reporting capability, are targeted to be completed by the end of the FY.
- SLAC completed a significant revision of the Enterprise Assessment Program (EAP) document. The program and document provide a risk-based, aligned portfolio of tactical and strategic monitoring and feedback mechanisms that enable innovative, effective, efficient, safe, and compliant mission achievement and operational excellence. The revised EAP is aligned with the SLAC Enterprise Risk Management Program (ERMP) and DAC Charter and will be issued in March of 2016.

Elements in support of 4.3 – Contractor Value-added

- Following a discussion between Vice President for SLAC and DOE Secretary Moniz, and in response to the report by the Commission to Review the Effectiveness of the National Energy Laboratories, Stanford is leading a major effort, working with the DOE Stanford Site Office, to develop a new model Management and Operating Contract for fundamental science research laboratories in the DOE system.
- Major construction of the Photon Science Laboratory Building (PSLB) continues in 2016. The Stanford-funded portion of the PSLB project is on schedule to be completed in late CY2016. The three-story, 105,000 square-foot building will provide much-needed space for the Laboratory's growing portfolio of research in materials, chemical, biological, energy sciences, and other areas and enhance collaborations between Stanford and SLAC scientists. SLAC is developing plans and designs regarding the specific scientific program usage of the laboratory spaces in PSLB. The plans include supporting the LCLS and SSRL user programs.
- Working with the Stanford Vice President for SLAC and Board of Overseers (BoO), the Laboratory continued to improve the linkage between the Laboratory's Enterprise Risk Management Program (EMRP) and Director's Assurance Council (DAC) Charter and Process with assessment planning. In November 2015, the BoO, SSO, and SLAC held a very effective joint session to review the SLAC ERMP process, the Executive Risk Register, and the planned SLAC assessment schedule. Through the session, SLAC, Stanford, and SSO worked together to help ensure SLAC performed risk-based assessments that drove operational improvements.
- SLAC completed the development of a new report, "SLAC+Stanford", that presents an overview of SLAC-Stanford interactions. The report, which will updated annually, showcases and consolidates important SLAC+Stanford collaborations, initiatives, and science highlights for the year.

STATUS OF NOTABLE OUTCOME(S)

- **SSO**: Develop and implement a risk-based campus infrastructure strategy that fully supports the ongoing and future mission requirements including a plan to mitigate the funding risk of the k-subs that incorporates a successful cost, scope, and schedule for FY2016. (Objective 4.2)

  (SLAC Champion: Russ Thackston)

  - Status – On Track
    - The newly formed Infrastructure Planning division of Facilities and Operations has been staffed and is focused on mission readiness, long range planning, operational planning, and space planning.
    - Using information gathered from infrastructure system assessments, direction provided in the SLAC Strategic Plan, goals outlined in Business Plans and the ALP, a comprehensive list of projects that integrates ongoing and future mission requirements was developed.
    - Infrastructure Planning implemented a process to score infrastructure projects based on risk-based criteria for mission, cost and schedule, health/safety/security, and environmental. The process, adapted from a DOE methodology, results in a prioritized list of projects.
    - Funding for the K substation project has been authorized. Design is funded for FY16. A contract for long lead equipment needed for K substation replacement of linac sectors 0 to 8 has been awarded.

SIGNIFICANT CONCERNS AND MITIGATIONS

- Concern: While PSLB provides a significant growth opportunity for SLAC, specific program usage is still being identified.
  - Mitigation: PSLB space planning will be fully aligned with SLAC's growth strategy and include support of LCLS and SSRL user programs. SLAC has begun active communication with program sponsors to determine space and design needs.

Goal 5: Sustain Excellence and Enhance Effectiveness of Integrated Safety, Health and Environmental Protection

MAJOR ACCOMPLISHMENTS

Elements in support of 5.1 – Provide an Efficient and Effective Health & Safety Program

- SLAC has targeted effort in FY16 toward implementing a program and achieving results in reducing the severity and frequency of non-office ergo-related injuries. Efforts to date include the following:
  - Developed an ergonomic training module for the AD109 Sector 0-10 Equipment Relocation Orientation course. This course is required for all SLAC employees and their supervisors performing work associated with this project. As of 03/18/16, 263 employees have registered and 85 have completed the course . All registered employees are expected to complete the course by 03/31/16.
  - Conducted nine ergonomic screening assessments associated with tasks scheduled to be performed as part of the AD Equipment Relocation Project. Additional screening assessments are planned. Based on these assessments, work practices, equipment and tools to reduce risk and increase efficiency have been identified. Ergonomic equipment/tools purchased and in use to date include rolling platform ladders and taller Genie lifts to minimize awkward postures and enhance productivity and electric copper tube cutters and electric drills to reduce repetitive motions and increase efficiency.
  - Through the end of Q2, total recordable cases (TRCs) and (days away/restricted time cases (DART) are down 30% over the same period last year. Although this is a positive indicator, it is too early to ascertain if these are a result of the above interventions.
- Published General Laser Lab Safety and Lab-Specific SOP-Contract documents for laser labs and held Laser Safety All Hands Meeting.
- Reduced inventory of radioactive sealed sources, including 40 sources inside obsolete BSOIC radiation detectors, through waste disposal.
- Triennial DOELAP on-site assessment on external personnel dosimetry program was conducted with no deficiency findings.
- Supported substantial radiation safety design for LCLS-II: i) FAC, Director, and DOE CD2/3 reviews; ii) external review of high power dumps; iii) stoppers and collimators for FEL beam containment; iv) Finalized HX2 LCW system requirements for BSY dump and EBD; v) PPS modification for BTH access, vi) electron ray study for BSY HXR.
- Supported SSRL design and commissioning of new Gun Test Facility; BL15-0 design.
- Supported LCLS design and commissioning of new LCLS MFX beamline in hutch 4.5; hazard analysis and controls for MEC 3-J solid target and gas target experiments.

Elements in support of 5.2 – Provide Efficient and Effective Environmental Management System

- SLAC's Zero Waste Program was implemented in Building 051 in January 2016, further expanding the program to a total of 13 buildings and two trailers (representing approximately 74% of the staff). SLAC continues to exceed the DOE's municipal waste reduction goal of 50%.
- In support of the Associate Director of Science for BES and the Manger of the Brookhaven Site Office, SLAC department head for Environmental Protection served as Committee Chair for the U.S. DOE Review Committee on the Long Term Stewardship Program at the Brookhaven National Laboratory to assess accomplishments for FYs 2014 and 2015 and evaluate planned activities for FYs 2016, 2017, and 2018.
- Applied in-situ chemical oxidation (ISCO) to reduce concentrations of Volatile Organic Constituent's and 1,4-Dioxane at the Former Solvent Underground Storage Tank (FSUST) and analyzed results to guide second application with the goal of reducing concentrations of contaminants in groundwater.
- Accelerated contaminated soil removals are planned at 6 sites. An expedited draft work plan, including delineation of excavation boundaries and documentation of the removal process, was developed and submitted to the California Regional Water Quality Board for review.
- The Final Baseline Risk Assessment for the West SLAC Operable Unit and the Final Feasibility Study for the research Yard were submitted to the California Regional Water Quality Control Board for approval. These are substantial deliverables required under the California Regional Water Quality Control Board Order Site Cleanup Order issued to Stanford University and the US DOE for the SLAC National Accelerator Laboratory.
- Initiated planning efforts to support site cleanup activities associated with Stanford benefactor funded work to begin in Q3. Identified 3K yd^3 of concrete, 25 temporary trailers that can be decommissioned (pending resolution of SHPO issues – see section 7.2), 80 connex/sea-train containers, 13 bulk storage tanks, and several large metal structures that are candidates for demolition/removal.

STATUS OF NOTABLE OUTCOME(S)

- **SSO**: Evaluate/update the current Cryo/Pressure safety program(s) to adequately address the current SLAC and future LCLS-II mission needs.(Objective 5.1)

  (SLAC Champion: Brian Sherin)

  - Status – On Track: SLAC has made many improvements to Cryogen and Pressure Safety programs, including the following:
    - Thorough review of program documentation and benchmarking with LCLS-II partner labs' analogous programs. This resulted in programmatic changes both to Pressure Safety Systems (Chapter 14) and Cryogen Safety (Chapter 36). Changes included updating of Codes and Standards, a greater emphasis on working with helium, better descriptions of engineered controls and a strengthening of the interface between cryogens and pressure safety to ensure an LCLS-II and SLAC needs are addressed.
    - Improved SLAC programs to anticipate/address mission needs precipitated by LCLS-II, including development of engineering notes. These engineering notes serve to: align and document collaborating partner labs' design codes of record; describe the requirements of LCLS-II project pressure systems during installation; and facilitate collaboration.
    - Conducted reviews of designs and risk-assessments related to the Project. This resulted in the Preliminary ODH Assessment Review Committee giving feedback to the Project on areas for improvement.
- **SSO**: Demonstrate effectiveness of line management implementation of hazardous waste management requirements at the waste generating locations around the site. (Objective 5.2)

  (SLAC Champion: Brian Sherin)

  - Status – On Track.
    - The annual (2015) Hazardous Waste Inspection conducted by the San Mateo Office of Environmental Health (CUPA) reported site wide improvements in housekeeping particularly seen at the machine shops, a 200% improvement from 2014, and a high degree of compliance with regulatory requirements. No violations were documented. This indicates that SLAC personnel are committed to 'doing it right 'and are consistently working to improve their work practices
    - SLAC Waste Management Group continues to provide 'focus trainings' to different groups resulting in more targeted training where specific hazardous waste management issues are quickly identified and resolved. Ongoing monthly assessments of waste generating areas are being conducted for continuous and consistent compliance.

SIGNIFICANT CONCERNS AND MITIGATIONS

- Concern: During FY16 Q2, it was determined that some pressure systems for equipment may be designed to the European Union Pressure Equipment Directive rather than American Society of Mechanical Engineers (ASME) codes.
  - Mitigation: SLAC's pressure safety subject matter expert has developed a white paper describing an equivalent level of protection between the standards. The equivalency is being reviewed with the Site Office and will be included in the May update of the Worker Safety & Health Plan.

Goal 6: Deliver Efficient, Effective and Responsive Business Systems and Resources that Enable the Successful Achievement of the Laboratory Mission(s)

MAJOR ACCOMPLISHMENTS

Elements in support of 6.1 – Provide an Efficient, Effective, and Responsive Financial Management System(s)

- Implemented the process for each directorate to prepare a business plan derived from the SLAC Strategic Plan, Annual Lab Plan and SLAC Agenda. These help directorates set objectives and priorities, assign accountability and monitor progress.
- Internal Audit completed a post-implementation review of Accounts Payable, including a review of overall ERP system security access. Management actions related to their observations, including the review of privileged access, are scheduled to be completed before year-end. ERP controls are also being tested as part of the annual A-123 process.
- A WBS Drill Down tool was released in February 2016. It provides the ability for project managers and business staff to drill down into summary or detail levels for costs or commitments and provides links to transactional information to address many reporting requirements.
- ICAB is completing a review of service catalogs from ES&H, IT, and F&O documenting what services are performed and guidance on how they are paid for. This effort has gone a long ways to reducing concern in the system around consistency in charging.

Elements in support of 6.2 – Provide an Efficient, Effective, and Responsive Acquisition Management System and Property Management Systems

- Conducted a limited external review of our procurement system. Team concluded we were operating effectively and should pass a full PERT review. Some improvement areas were noted in terms of quality of documentation and Davis Bacon compliance documentation.
- PERT was rescheduled from May 2016 to August 2016 to accommodate PERT review team. SLAC SCM is conducting a formal self-assessment in March 2016 as a required deliverable to the PERT team.
- Property Control continues to meet all reporting requirements and is properly accounting for SLAC/government assets.
- Improved outreach and training (meetings, newsletters, online resources) for users of the PeopleSoft SCM system.
- Implemented a flag in PeopleSoft to easily identify cost-type contracts in accordance with OIG recommendation.

Elements in support of 6.3 – Provide an Efficient, Effective, and Responsive Human Resources Management System and Diversity Program

- Updated “Performance Guidance” practice being implemented that reinforces aligning the annual goals of all employees to the Lab Plan, provides improvement oriented feedback, and increased development coaching.
- New recruiting and selection process designed and being implemented that better sources qualified diverse candidates and provides for bias mitigating vetting, decision-making and selection processes. Overall D&I strategy is being benchmarked by external organizations as a strong culture change practice.
- Analyzing results of an employee survey to identify opportunities to improve employee engagement and operating efficiencies.
- Workforce Analytics being regularly used in Business Plans and lab operating efficiency and culture discussions.
- Next lab wide talent assessment and planning cycle begins March 2016 and becomes feeder information for full lab planning.

Elements in support of 6.4 – Provide an Efficient, Effective, and Responsive Contractor Assurance System, including Internal Audit and Quality

- Piloted a process in February 2016 to conduct a fact finding and investigate a non-ES&H related issue. Contractor Assurance partnered with Information Technology (IT) management and staff to identify the principal causes of a computer server outage that affected accelerator and LCLS operations. The process, which was the first of its kind, was very successful and engaged IT, LCLS, and AD management and staff in identifying actions to sustainably improve preparedness and response to computer infrastructure problems in the SLAC Data Center. Actions from the process will be tracked in the SLAC Action Tracking System (ATS).
- Completed the assessment plan for the internal independent assessment of Integrated Safety and Work Management (ISM/IWM) at SLAC. The assessment is being performed in response to a risk on the SLAC Executive Risk Register related to concerns with an existing or emerging risk at SLAC that inadequate work management could result in inconsistent and ineffective execution of work planning and control (WPC). The independent assessment is sponsored by the Directors Assurance Council (DAC) and is the first of its kind at SLAC. The goal of the assessment is to determine whether the implementation of ISM/IWM and WPC is aligned with the spirit and intent of DOE policy and expectations regarding ISM/IWM and WPC. The assessment is scheduled to be performed in March/April of FY 2016.

- Contractor Assurance collaborated with the Chief Financial Officer (CFO) to develop and issue the new institutional policy, "Audit Management, Resolution, and Follow-Up Program". The policy defines the requirements and responsibilities for managing, tracking, resolving, and closing all findings and recommendations from external audits and assessments by the DOE Inspector General, US Government Accountability Office, DOE Office of Enterprise Assessments, and Stanford University. The document also enables SLAC to meet the Contractor Requirements Document (CRD) associated with DOE Order 227.1A, "Independent Oversight Program".
- Contractor Assurance regularly collaborates with colleagues from LBNL, LLNL, and LANL on developing improved SLAC policies and procedures. Most notably, through the collaboration, SLAC Contractor Assurance and Facilities and Operations (F&O) management completed the development of a new institutional policy for managing the Davis Bacon determination process at SLAC. The new Davis Bacon policy is expected to be issued in April of 2016.
- Internal audit is on track to complete the 2016 audit plan on a timely basis.

Elements in support of 6.5 – Demonstrate Effective Transfer of Technology and Commercialization of Intellectual Assets

- Facilitated the disclosure of 4 new invention disclosures resulting from innovative research performed at SLAC.
- Negotiated and closed 2 new IP licenses with industry partners. The first IP license was directed toward SLAC-developed technology and will allow a long-standing industry partner to commercialize this technology. The second IP license is relative to a cooperative research agreement with an industry partner where technology will be jointly developed at SLAC and commercialized by the industry partner.
- Consolidated the Research Partnerships & Technology Commercialization functions under the office of the Chief Technology Officer, which will enable closer coordination of scientific and commercialization activities at SLAC.
- Increased SLAC involvement and visibility among DOE and National Lab communities by joining several committees including the Technology Transfer Working Group metrics committee, the National Lab Technology Transfer management committee, and the DOE SPP community of practice working group.

STATUS OF NOTABLE OUTCOME(S)

- **SSO**: Assure effective implementation of the ERP systems, internal controls and regulatory compliance to advance the efficiency and effectiveness of SLAC business systems. (Objective 6.1)

  (SLAC Champion: Suzanne Davidson)

  - Status – On Track
    - Oracle Databases that underlie the PeopleSoft HR and Finance/SCM systems have been upgraded to the latest version. The PeopleSoft Webservers hosting the PeopleSoft HR and Finance/SCM systems have been upgraded with the latest Oracle WebLogic Critical Patch Updates.
    - The PeopleSoft HR Image Upgrade project is underway to upgrade PeopleTools and implement the latest HR patches and features (moving from image 0 to image 16). The project is planned to be completed in August 2016
    - The project to upgrade PeopleTools and implement the latest Fin/SCM patches and features (moving from image 5 to image 18) has begun. New features and impacts on our current system are being evaluated, while test scripts are being updated. The actual upgrade, development, retro-fitting and testing will begin next fiscal year, after completion of the HR Image Upgrade Project.
- **SSO**: Complete the implementation of the SLAC Procurement Strategic Sourcing Module for bidding and external collaboration. (Objective 6.2)

  (SLAC Champion: Suzanne Davidson)

  - Status – On Track
    - All system fixes are complete. SCM will test a small number of procurement actions with a limited number of buyers into early Q3 of FY 16 before expanding use of the sourcing module to all staff in mid to late Q3 of FY 16.

- **SC**: In support of DOE's requirement to submit all peer-reviewed accepted manuscripts to DOE through the OSTI E-Link system, we are asking each Laboratory to (1) analyze the current status of submissions with respect to comprehensiveness, accuracy, and appropriate acknowledgement of DOE support; (2) identify any barriers to compliance; and (3) submit, with the next annual lab plan, a proposal and timeline for achieving full compliance. (Objective 6.5)

  (SLAC Champion: Suzanne Davidson)

  - Status – On Track
    - Current system and related integrations are under evaluation for re-architecture/re-engineering to meet guidelines. Proceeding according to projections.
    - Initiated the P-Card check point for Journal transactions – 147 journal articles identified as of 1/15/2016
    - OSTI reports identifying backlog initiated and backlog is being worked down (recommend augmenting resource)
    - Began use of DOE E-Link system for accepted manuscripts and journal articles; evaluating as possible component of solution

SIGNIFICANT CONCERNS AND MITIGATIONS

- Concern: None
  - Mitigation: None

Goal 7: Sustain Excellence in Acquiring, Constructing, Operating, Maintaining and Renewing the Facility and Infrastructure Portfolio to Meet Laboratory Needs

MAJOR ACCOMPLISHMENTS

Elements in support of 7.1 – Manage Facilities and Infrastructure in an Efficient and Effective Manner that Optimizes Usage, Minimizes Life Cycle Costs and Ensures Site Capability to Meet Mission Needs

- SLAC has made significant progress on implementing the infrastructure maintenance plan, including the following:
  - Approximately 95% of mechanical equipment is currently documented in the maintenance system and preventative maintenance cycles established
  - Electrical system baseline test reports and maintenance cycles were established
  - Electrical projects are being developed to correct areas noted in an FY15 cable assessment
  - Condition assessments for 16 substations completed and critical areas addressed through immediate corrective actions or by developing initial projects for prioritization
  - Safely completed a significant number of electrical repairs and maintenance activities during the FY16 Winter Shutdown
  - Predictive maintenance program has been successful in identifying several electrical and mechanical issues before failure, allowing replacement of parts during planned outages instead of unplanned
  - IR ports are routinely being added to electrical equipment during maintenance activities to improve our ability to complete the predictive maintenance without having to have an outage
  - Increasing coverage of remote sensors and monitors to leverage our predictive maintenance capabilities
  - Preventative maintenance activities are now a routine part of our daily tasking and we are currently measuring on time performance and actual durations of the PM work to establish a baseline performance measure
  - Conducting reviews of job plans and tasks routinely to validate and work to optimize our PM schedules
- SLAC has continued implementing the Building Management Program and consolidating, de-activating and controlling excess, decommissioned, unused facilities and buildings and spaces, including the following:
  - For the first half of FY16, drawings and specifications for the removal of six vacant trailers have been completed.
  - Vacating and de-activating four additional trailers in FY16 is expected to yield $64,000 in annual savings.
  - Approximately 15 trailers will be closed this fiscal year. This includes removal of all items and locking exterior doors for security and safety.
  - Approximately 110 personnel out of approximately 150 have received Building Management training to date.
  - Facilities Use Agreements that outline service levels for facilities support have been signed by three clients, with several more currently in review.
- Funding for the K substation project has been authorized. Design is funded for FY16. A contract for long lead equipment needed for K substation replacement of linac sectors 0 to 8 has been awarded.
- We've made progress on the Ignition System SCADA that will one day allow control and monitoring of all systems from a single platform; approximately 50% of the Honeywell DCS functionality has been matched. The recent hire of a controls engineer will add to technical expertise for instrumentation and controls.
- Mission Readiness Process Manual is in final review process and ready for release. Created project list database of all major capital projects for Annual Lab Plan and IFI Crosscut creation. Coordinated schedule and project prioritization with individual directorates.

Elements in support of 7.2 – Provide Planning for and Acquire the Facilities and Infrastructure Required to Support the Continuation and Growth of Laboratory Mission and Programs

- Mission Readiness
  - Completed the Infrastructure Mission Readiness (IMR) Manual and improved the project/risk database. The Mission Readiness Process will be used to develop a risk based and prioritized ten-year plan that dovetails with the Campus Strategy and Annual Lab Plan. The goals are to increase infrastructure reliability, demonstrate efficient use of funds, and to address compliance requirements.

- Major Projects
  - Stanford University funded PSLB shell continues to progress on schedule for completion in the fall of 2016.
  - For the DOE-funded PSLB outfitting project, CD-1 was approved in September 2015. SLAC received 50% preliminary design and 95% early construction package: elevators, stairs, toilets, office space, and core for review and approval.
  - SUSB received Final Certificate of Occupancy on 1/8/16.
- LCLS II preparations
  - Supported the Radiation Protection Sectors 00 to 10 Equipment Disposal portion of the LCLS II Project.
  - Conducted a preliminary arc-flash analysis for LCLS II. Several recommendations for arc flash incident energy reduction have been submitted to the Project.
  - An analysis of the startup of the LCLS II 2500 HP compressors with soft starters as specified in the J-Lab design resulted in acceptable voltage dips at the master substation 12.47 kV bus and at the compressor motor terminals - pending confirmation of acceptability of the motor starting voltage dips for all other (non-compressor) cryoplant loads, including the cooling tower.
- Water Usage

  Awarded 2016 Silcon Valley Water Conservation Award for a Government Agency. Diligent efforts to reduce water usage through water capture and reuse, efficient drip irrigation systems, and replacing lawn area with drought resistant landscaping was recognized in the most competitive program since the water agency launched the program in 2009. SLAC's actions resulted in a 23% reduction in indoor water usage and 80% reduction in potable irrigation water.

STATUS OF NOTABLE OUTCOME(S)

- **SSO**: Improve the maintenance and operation of mission essential critical systems. (Objective 7.1)

  (SLAC Champion: Russ Thackston)
  - Status – On Track
  - Implementing the Electrical System Maintenance Plan, including completion of:
    - Maintenance for the LCLS KSub in Sectors 20-30
    - Replacement of the DC charger and batteries in Substation 507, 519, 521, and IR 4
    - Maintenance of VVS in Sectors 20-30
    - Implementation of a procedure to red tag equipment at risk of catastrophic failure
    - Assessment of the compressed air system and evaluating solutions to avoid single points of failure
    - Installed additional sensors and instrumentation to monitor performance of critical systems
    - Conducted inventory and checks of critical spares for mechanical equipment
  - Power Systems Activities:
    - Automatic Transfer System for IR2 serving LSST and LZ Hut have been installed and are operational to provide uninterrupted power for critical systems
    - South Final Focus power system has been recommissioned, to provide power for LSST camera test stand and B750 loads
    - SLAC-CPA-SU interconnect studies have been completed. The team has endorsed the CPA-SU proposal as technically viable.
    - Two mission-critical areas have been identified: transformer T3B in Substation BSY and the main transformer in Substation K-14A. Mitigations have been proposed and projects added to the prioritized project list.
    - LINAC K-subs 12 kV switches are being removed from all Federal Pacific style K-subs and replaced with bus-bars
    - Funds have been secured for LINAC EAST Substation K-CT2 segregation and VV3 12 kV cable repair. Both mission critical projects will be completed in Q3
    - Organizational changes implemented in March directly support the stewardship model and created a work management department in support of this goal. We are currently mapping the existing work planning processes and exploring the available suite of metrics available in our maintenance data system that will best trend critical, mission support and non-critical infrastructure spending.

- **SSO**: Complete scope, cost, and scheduling for the deactivation/decontamination and demolition for the Sectors 0-10 to ensure LCLS II mission needs are met. (Objective 7.2)

  (SLAC Champion: Brian Sherin)

  - Status – On Track
  - Working with the F&O, identified an excellent primary Project Manager to oversee the coordination of all three of the major elements of this project: Equipment Removal, Linac Demolition, & Material Disposition
  - Successfully completed two requests for proposals to support the work. Civil construction of the laydown areas (40 ksf) has been completed. Supply Chain Management is finalizing procurement activities for demolition and disposal contract and contract should be authorized by the end of March.
  - Prepared detailed energy isolation plans and conducted energy isolation reviews for equipment removal and demolition projects. Completed WPC reviews for saved equipment removal.
  - Developed Construction Access Plan to define access requirements for all activities in the Sector 0-10 region throughout the duration of the Linac Equipment Removal and Disposition project..
- **SSO**: Work to reach agreement with the California State Historic Preservation Office regarding completing the Section 110 process at SLAC. (Objective 7.2)

  (SLAC Champion: Brian Sherin)

  - Status - Progressing
    - In January, SLAC, Stanford University and DOE representatives met with the State Historic Preservation Office (SHPO) in Sacramento, where an agreement was reached on a survey methodology towards completion of Section 110. An outcome of the application of the survey will be submitted in a report to SHPO in April 2016.
- **SC**: Successfully deliver crosscut GPP projects on schedule. (Objective 7.2)

  (SLAC Champion: Russ Thackston)

  - Status - On Track
  - The following projects were completed on schedule.
    - Construction a light electronics laboratory in B027 enabling smart grid research
    - Design of a new laser lab in B040 enabling laser development for LCLS
    - Renovated B040 Director's offices for the Science directorate
    - Design of the site security upgrade project enabling the open access to the 900 area from the central campus
    - Design Drawings (90%) for the renovation B006 Room 110 for a new Cryogenics laboratory
    - Planning for the relocation of B950 utilities for upcoming B950 building renovation

SIGNIFICANT CONCERNS AND MITIGATIONS

- Concern: Providing adequate levels of labor resources for F&O operations, facility construction management, and project support in order to safely achieve on-time completion of linac sector 0 through 10 equipment removal and disposition.
  - Mitigation: Comprehensive planning of labor resources began in early 2016 by establishing an enterprise-level summary of planned labor needs from resource loaded schedules of the BSY, LCLS-II, and equipment disposition projects. Collaboration with department managers and stakeholders identified needs and resource requirements. The final output was used to develop service level agreements of the needed labor resources with LCLS-II. Weekly coordination meetings with F&O and project leadership facilitate discussion regarding upcoming resource needs, provide feedback on performance, and issue resolution.
  - Mitigation: F&O is establishing task order contracts for construction management, rigging, architectural/engineering, project controls and construction resources prior to May 2016 to enable surge support of construction, and project labor resources.

Goal 8: Sustain and Enhance the Effectiveness of Integrated Safeguards and Security Management (ISSM) and Emergency Management Systems

MAJOR ACCOMPLISHMENTS

Elements in support of 8.1 – Provide an Efficient and Effective Emergency Management System

- The ESH Division Director, serving as the representative of the National Lab Director's Council, has been participating as a senior management representative for the re-write of DOE Order 151.1-D, "Comprehensive Emergency Management." The re-write of this order is intended to address deficiencies in the existing order, some of which were cited in the DNFSB critique of the WIPP incidents of 2014. The collaboration includes federal representatives of NNSA, SC, and other elements of DOE, plus contractor SMEs from LLNL, LBNL, PNL, and NNSS. The collaboration will produce a revised order that significantly improve the Departments ability to plan for, train for, and respond to emergencies.
- Initiated employee training program for Active Threat Situations, including the completion of two town hall meetings with presentations by Stanford University Department of Public Safety (i.e., police department). Active threat/lockdown exercise is being prepared for Q3.
- Coordination with Menlo Park Fire Protection District continues to result in rapid (average response times of 5 minutes) and effective emergency response.

Elements in support of 8.2 – Provide an Efficient and Effective System for Cyber Security for the Protection of Classified and Unclassified Information

- SLAC completed work on the final remaining OIG finding on cyber security, 13-SLAC-IT-04 (Vulnerability Management). All conditions identified by OIG have been resolved. Automation has been implemented to ensure scanning covers new networks, and weekly reports provide visibility into failures in vulnerability scanning. Undocumented exceptions to vulnerability scanning have been eliminated, increasing scanning coverage of nearly 1,000 systems.
- SLAC completed work on 2 of 7 findings from Enterprise Assessments issued in FY16. SLAC has eliminated a significant vulnerability in shared administrator passwords on Windows computers. Additionally, SLAC has deployed Symantec Endpoint Protection antivirus to Mac computers. Plans of action and milestones are in place for all remaining findings.
- SLAC has put in place an implementation plan to complete the rollout of multifactor authentication by September 2016 in compliance with the OMB directive.
- SLAC has been active in the DOE community with regard to MFA, leading the Office of Science in the advancement of appropriate exceptions for standard users.
- SLAC implemented LOA3 for the remaining privileged users in December 2015 and has a plan to implement LOA4 for privileged users in compliance with the September 32016 deadline.

Elements in support of 8.3 – Provide an Efficient and Effective System for the Physical Security and Protection of Special Nuclear Materials, Classified Matter, Classified Information, Sensitive Information, and Property

- Finalized and received approval for updated Site Security Plan.

STATUS OF NOTABLE OUTCOME(S)

- **SSO**: Complete physical security upgrades (that) are in accordance with the cost, scope, and schedule. (Objective 8.3)

  (SLAC Champion: Brian Sherin)

  - Status – On Track
  - Completed design activities for implementation of next phase of physical security upgrades. Design package has been sent out for request for proposal, with expected award in April. Project on schedule for completion by August 2016.

SIGNIFICANT CONCERNS AND MITIGATIONS

- Concern: None
  - Mitigation: None