Advanced Scientific Computing Research
High Performance Computing and Networking
Facilities Management Plan
June, 2012

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1. Purpose

The ASCR High Performance Computing (HPC) and Networking scientific user facilities assist in meeting the needs of its **stakeholders**; i.e., universities, National Laboratories, industry, and the Department of Energy (DOE) Office of Science (SC) Program Offices (ASCR, Basic Energy Sciences, Biological and Environmental Research, Fusion Science, High Energy Physics, and Nuclear Physics).

This Plan describes the Advanced Scientific Computing Research **(**ASCR) **Management** of **Facilities** Upgrades, Transition to Operations, and Operations.

To accomplish this purpose, this Plan includes the ASCR program and project management **Tailoring** of the following:

- DOE **Program** and **Project** Management Order 413.3b of November 29, 2010.
- SC Tailoring of the DOE Order.
- DOE Integrated Project Team Guide.
- OMB Circulars A-11 (Operations Guide), A-123 (Management's Responsibility for Internal Control), and A-131 (Operations Evaluations).

The **audience** for this Plan is the HPC and Networking staff at ASCR, SC HPC National Laboratories (Argonne, Berkeley, and Oak Ridge), and the respective DOE Site Offices.

2. Background

The **Mission** of the ASCR program is to discover, develop, and deploy HPC and Networking capabilities to analyze, model, simulate, and predict complex phenomena important to DOE. The ASCR HPC and Networking scientific user facilities have uptimes in excess of 90% in delivering forefront capabilities; e.g., 1000s of trillions of calculations per second. The HPC facilities are required to protect the propriety information of some of thier users. The homepages for these HPC and Networking scientific user facilities can be accessed via the ASCR facilities homepage (http://science.energy.gov/ascr/facilities/).

The **Leadership** Class Facility (LCF) is a world-leading HPC dedicated to breakthrough science and engineering, The LCF provides very large allocations of HPC processor hours to the science community, including users not financially supported by DOE. The DOE High-End Computing Revitalization Act defines Leadership System as a high-end computing system that is among the most advanced in the world in terms of performance in solving scientific and engineering problems. The components of the LCF are:

-The Oak Ridge Leadership Computing Facility (**OLCF**).
-The Argonne Leadership Computing Facility (**ALCF**).

The other 2 ASCR facilities are the following:

- The National Energy Research Scientific Computing Center (**NERSC**) at the Lawrence Berkeley National Laboratory provides HPC for basic scientific research and has over 4,000 users. The DOE High-End Computing Revitalization Act defines a **High-end Computing** System as a computing system with performance that substantially exceeds that of systems that are commonly available for advanced scientific and engineering applications.
- Energy Sciences Network (**ESnet**) is a high-speed network serving thousands of DOE researchers and collaborators worldwide; and is managed and operated by the ESnet staff at Lawrence Berkeley National Laboratory,

Facility Users are the PIs, co-PIs, and various collaborators who have been authorized to use the facility as part of an approved research project and who have completed lab-specific user agreements. This excludes facility staff and vendors unless they are also members of a research project.

A user facility is a federally sponsored research facility available for external use to advance scientific or technical knowledge under the following conditions:

- The facility is open to all interested potential users without regard to nationality or institutional affiliation.
- Allocation of facility resources is determined by merit review of the proposed work.
- User fees are not charged for non-proprietary work if the user intends to publish the research results in the open literature.
- Full cost recovery is required for proprietary work.
- The facility provides resources sufficient for users to conduct work safely and efficiently. The facility supports a formal user organization to represent the users and facilitate sharing of information, forming collaborations, and organizing research efforts among users.
- The facility capability does not compete with an available private sector capability.

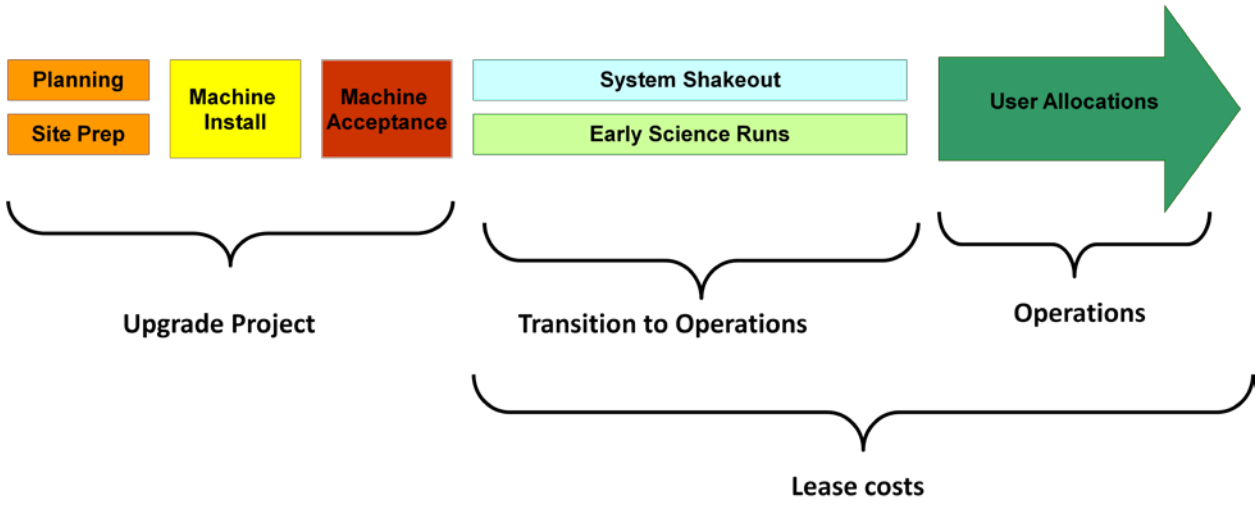
ASCR HPC scientific user facilities are **similar** to other SC user facilities in that:

- The goal for the facility is to enable scientific research by users who are mostly not employed by the facility.
- Scientific projects are chosen through peer review.
- An Upgrade can have a significant impact on facility operations, due to the additional effort required by staff already committed to operational activities.

ASCR HPC scientific user facilities Upgrades **differ** from other SC projects in that:

- The useful life of HPC technology is much shorter than that for other SC facilities; e.g., new technology can significantly lower costs per processor hour. The Upgrades must be deployed as soon as practical to provide the capability to the science community before the technology is made obsolete by advances in the industry.
- Given the level of complexity of the systems being acquired, it is possible that a given upgrade may require multiple stages of Acceptance Testing, which necessitates precise specifications.
- Each HPC Upgrade is unique in its objectives, deliverables and tactics, and requires flexibility in the structure of its management to successfully address the context and specific environment.
- HPC Upgrades may require multiple stage of Acceptance Testing and, possibly multiple Transitions to Operation.
- In the Budget submissions to Congress, operations and project budgets are not separated.

As discussed in more detail in the following sections, the facility functions can be described as Upgrades, Transition to Operations, and Operations, as illustrated in the **flowchart** below. A facility often performs more than one of these functions at a time.



Note: Steady State costs begin with the Transition to Operations and also include maintenance and operation of the HPC and Networking Facilities.

Maintenance is the activity necessary to keep an asset functioning as designed during its operations and maintenance phase of an investment. Maintenance costs include costs needed to sustain an IT asset at the current capability and performance levels including: corrective hardware/software, voice and data communications maintenance; replacement of damaged or obsolete IT equipment; and associated overhead costs. Where appropriate, maintenance activities that follow agency defined project management methodologies should be managed and reported as projects and reported in Section B of the Exhibit 300B. Examples of maintenance projects include operating system upgrades, technology refreshes, and security patch implementations.

Operations mean the day-to-day management of an asset in the production environment and include activities to operate data centers, help desks, operational centers, telecommunication centers, and end user support services. Operational activities are reported through Section C of the Exhibit 300B. Operations costs include the expenses associated with an IT asset that is in the production environment o sustain an IT asset at the current capability and performance levels including: Federal and contracted labor costs; and costs for the disposal of an asset.

3. Guiding Principles

A. Congress

The DOE High-End Computing Revitalization Act of 2004 (Public Law 108-423) requirements include that DOE:

- Develop and deploy high-end computing systems for advanced scientific and engineering applications.
- Support both independent and multidisciplinary team of investigators.
- Provide sustained access by the research community in the U.S. to high-end computing systems and to Leadership Systems, including provision of technical support for user of such systems.

B. DOE

The DOE **Strategic Plan** includes the "Maintain a vibrant U.S. effort in science and engineering as a cornerstone of our economic prosperity with clear leadership in strategic areas", with a Target Outcome of continuing to deliver HPC.

The DOE Order 413.3b **Objective** is to deliver every project at the Performance Baseline (PB), on schedule, within budget, and fully capable of meeting mission performance, safeguards and security, sustainability, and environmental, safety, and health requirements.

The DOE Order **Principles** for successful project execution include the following.
- Line management accountability.
- Sound, disciplined, up-front project planning.
- Well-defined and documented project requirements.
- Development and implementation of sound acquisition strategies that incorporate effective risk handling mechanisms.
- Well-defined and managed project scope and risk-based PBs.
- Development of reliable and accurate cost estimates using appropriate cost methodologies and databases.
- Properly resourced and appropriately skilled project staffs.
- Effective implementation of all management systems supporting the project; e.g., integrated safety management, risk management, change control, performance management and contract management.
- Early integration of safety into the design process.
- Effective communication among all project stakeholders.
- Utilization of peer reviews throughout the life of a project.

The DOE Order states that **Tailoring** is necessary for the efficient delivery of projects and should be applied to all projects considering size, complexity, cost, and risks. Tailoring may involve consolidation or phasing of Critical Decisions (CDs), substituting equivalent documents and concurrency of processes. Tailoring may also include adjusting the scope of Independent Project Reviews (IPRs) and delegation of acquisition authority, and other elements. Major tailored elements such as consolidating or phasing CDs or delegation of Acquisition Executives (AEs) must be specified in the Project Execution Plan (PEP) approved by the AE.

C. SC

I. The SC program **goals** include the following:
   - Facility Operations: Maximize the reliability, dependability, and availability of the SC scientific user facilities.
   - Future Facilities: Build future and upgrade existing facilities and experimental capabilities to ensure the continuing value of the SC scientific user facilities.

II. The SC Management System (**SCMS**) provides guidance on SC Budget and Financial Management System; e.g., the purpose of the System is to assure that the Office of Science is exemplary in its stewardship of fiscal resources. Funds are distributed on a routine basis in an efficient and effective manner, and subsystems and controls are in place to ensure that Congressional and Administrative Funding Control Points are not exceeded. The SCMS states that the SC Program Offices are to provide the following:

- Establish and maintain effective systems for the administrative control of funds allotted.
- Ensure that funds are not obligated in excess of available budgetary resources.
- Ensure funds are used for the purposes for which they were appropriated.

III. The SC Office of Project Assessment is the SC Project Management Support Office (PMSO) and provides guidance on Upgrades; e.g., **Lessons Learned** includes the following:

- The Project's purpose and benefits must be clear and effectively communicated to all stakeholders; e.g., users, sponsors. etc.
- Integrated Project/Program Team (IPT) success depends on establishing and nurturing strong working and personal relationships.
- Front-end planning is an essential mechanism for identifying and addressing risk in all project phases.
- Project reviews provide necessary "Checks and Balances" to keep the project on track and build credibility.
- Sound baselines are important.

Note: "PMSO" is the term in the DOE Order. The SC PMSO is the "Office of Project Assessment" (SC-28).

4. ASCR

The ASCR Upgrades are based on scientific **need.** Acceptance Testing includes scientific applications. ASCR determines the scientific need by frequent interactions with the research community and the SC research Program Offices.

The ASCR **goal** is to maximize the science produced by the HPC and Networking facilities, within the available budget.

For the HPC and Networking scientific user facilities, ASCR **tailors** the various guidance documents; e.g., the DOE Order,

The "**Steady State**" costs for the HPC and Networking facilities are the operating costs not included in the Upgrade Project Execution Plan (PEP). Steady State costs also include leases and the purchases of small items of equipment.

The HPC and Networking facilities implement a **risk**-based approach, utilizing best practices in industry, NIST guidelines, and experiences of the facilities. Each facility manages and tracks their risks via routine reviews and reporting of the major risks identified in the Risk Register for each facility. The facilities maintain cost and schedule contingencies commensurate with their major risks. Leading indicators are identified and tracked for event or time-based risks. The Risk Register changes as the Upgrade is executed. The Risk Management Plan describes the process of how risks will be identified, rated and managed. The disposition of the major risks is a key element of management reporting. Risks are managed using a three phase process:

- Identification (scope, cost, and schedule risks).
- Assessment (both qualitative and quantitative); e.g., Severity = Probability X Impact. .
- Mitigation and Management; e.g., early procurement of long-lead time equipment.

The Risk Register identifies all risks and the risks with more than a Low impact will be included in a Risk Management Plan, utilizing one of the following approaches:

- Avoid: Eliminate uncertainty; e.g., change scope. Take prior action to eliminate the likelihood and/or impact of the risk.
- Transfer: Transfer responsibility or liability; e.g., to a vendor.
- Mitigate: Reduce the size of the risk exposure; e.g., order spares.
- Accept**:** Recognize risk, plan to monitor and control; e.g., funding and schedule contingencies.

Risks at a HPC Center can include:

- HPC not performing according to specifications; e.g., can't provide sufficient processors hours to users.
- HPC unreliable; e.g., buggy.
- HPC does not provide sufficient uptime; e.g., crashes too often.
- HPC hard to use; e.g., users find it difficult to use their codes.
- HPC not available when planned.
- Cyber security not sufficient.
- Software problems; e.g., does not sufficiently support scientific applications.

ASCR provides oversight of the HPC and Networking Balance of Plant (**BOP**) issues, which include power, cooling, site preparation, cyber security, property protection (given the cost of the facilities), sustainability, environment, safety, and health. As an example: An Exascale (1,000 Petaflop) HPC might have a design goal of maximum of 20 Megawatts (MW) per ExaFlop, as compared to the present power requirements of 3 MW per PetaFlop.

Documents and reports are **not** intended to be **stand-alone**.

ASCR **archives** key documents.

5. Operations

The **Focus** of ASCR facility operations is to enable scientific discovery by performing the following:

- Deliver, maintain, and support HPC and Networking services to scientists nationwide.
- Manage cyber security.
- Manage the infrastructure.
- Manage operational risks.
- Measure effectiveness in fulfilling the needs of the users.

Allocations:

The purpose of the HPC Centers is to provide HPC allocations (processor hours) for users. The primary objectives of the HPC Allocation Policy are the following.

- Provide substantial allocations for a small number of high-impact, scientific research projects.
- Provide substantial allocations for a small number of high-risk, high-payoff projects.
- Provide numerous allocations for SC mission critical projects at NERSC.

The ASCR Allocation Policy is available at:
http://science.energy.gov/~/media/ascr/pdf/incite/docs/Allocation_process.pdf .

1. The Innovative & Novel Computational Impact on Theory and Experiment (**INCITE**) program seeks computationally intensive, large-scale research projects with the potential to significantly advance key areas in science and engineering. The program supports high-impact scientific advances on some of the world's most powerful supercomputing resources through the use of ALCF and OLCF. The proposals undergo a peer review process to assess scientific merit and to identify research projects that would not be possible without the world-class computing capabilities and computational support. The peer review process includes computational readiness reviews to assess whether the proposed work can effectively utilize large fractions of the LCFs. The award decisions are made by the LCF Centers in a combined process. Minimum awards are 10 million processor hours and average awards are over 20 million hours. The awards are multiyear. The proposals are typically due during the 3rd quarter of the Fiscal Year.
2. The ASCR Leadership Computing Challenge (**ALCC**) program allocates up to 30% of the computational resources at ALCF, OLCF, and NERSC. Open to scientists from the research community in national laboratories, academia and industry, the ALCC program is for high-risk, high-payoff simulations in areas directly related to the DOE energy mission, such as advancing the clean energy agenda and understanding the Earth's climate, for national emergencies, or for broadening the community of researchers capable of using leadership computing resources. The award decisions are made by ASCR. The 2011 awards ranged from 4 to 60 million hours, with an average of 19 million hours. The proposals are due during the 2nd quarter of the Fiscal Year. Applications submitted will be subjected to scientific merit review (peer review) and will be evaluated against the following evaluation criteria from 10CFR605: (1) Scientific and/or Technical Merit; (2) Appropriateness of the approach ;(3) Qualifications of the personnel and Adequacy of facilities; and (4) Reasonableness and Appropriateness of the request.
3. The NERSC Energy Research Computing Allocations Process (**ERCAP**) provides programmatic allocations of processor hours and data storage to accelerate the pace of scientific discovery in the SC community by providing high-performance computing, information, data, and communications services. NERSC is the principal provider of high performance computing services to SC programs: Advanced Scientific Computing Research, Basic Energy Sciences, Biological and Environmental Research, High Energy Physics, Magnetic Fusion Energy, and Nuclear Physics. Fundamental to the mission of NERSC is enabling *computational science at scale,* in which large, interdisciplinary teams of scientists address fundamental problems in science and engineering that require massive

calculations and have broad scientific and economic impacts. Examples of these problems include astrophysics, climate modeling, combustion modeling, computational biology, and magnetic fusion. The award decisions are made by the SC Programs, based, in part, on the peer reviews performed by the SC Programs. The awards range from less than 0.1 million hours to over 1 million hours. The proposals are due during the 4th quarter of the Fiscal Year.

4. The HPC Center **Directors** each have 10% of the capacity for allocations that typically range from 10,000 processor hours to 100s of thousands of processor hours. Proposals can be submitted at any time. Allocations are typically made in the first 3 quarters of the Fiscal Year. Examples if these awards are the following**:**

- A new research area.
- New programming techniques that take advantage of multicore compute nodes.
- Developing new algorithms that increase the ability to do science; e.g., running at a higher scale.

As detailed in Section 7 of this Plan (Responsibilities), **Budgets** are prepared to fund the HPC and Networking Centers. The ASCR Budgets include narratives that describe the program and facilities at a high level; e.g., Mission Needs, scientific capabilities, upgrades. ASCR holds annual Budget Reviews with the HPC and Networking Centers. These Budget Reviews provide ASCR oversight of the OMB Exhibit 300s and provide information to ASCR for establishing the budget for next year, options for supplement funding, and management of carryover funds.

In addition to periodic conference calls with the HPC and Networking Centers, Operational **Assessments** (OAs) are external reviews of the HPC and Networking facilities to evaluate the status and operation of these scientific user facilities. The OA focuses on user satisfaction (e.g., annual user surveys), business results (e.g., availability), strategic results (e.g., scientific accomplishments), financial performance, innovation (e.g., best practices), current status of risk and risk mitigation, and current status of cyber security. On a 3 year rotation, the HPC and Networking Centers have an on-site OA. During each of the intervening years, mail reviews are held with the other Center Directors serving as peer reviewers. The OAs provide ASCR oversight of the OMB Exhibit 300s and the HPC Center Directors allocations.

ASCR requires monthly **operations** reports; e.g., on performance metrics.

Operating **contingency** funds (“management reserves”) are held at the HPC and Networking facilities.

6. Upgrades

Upgrades to the HPC and Networking Centers are required in order to meet the evolving **Needs** of the users. Requirements gathering Workshops with the scientific community are held to identify the Upgrades opportunities for the HPC and Networking Centers.

The following requirements are the basis for a **Tailoring** of the DOE Order 413.3b (for Upgrades $\geq$ \$20 million and < \$20 million).

The DOE Acquisition Management System establishes principles and processes that translate user needs and technological opportunities into reliable and sustainable facilities, systems, and assets that provide a required mission capability. The system will be organized by **Critical Decisions** (CDs), progressing from broadly-stated mission needs into well-defined requirements resulting in operationally effective, suitable, and affordable facilities, systems, and other products. Within DOE, projects typically progress through five CDs, which serve as major milestones approved by the AE. Each CD marks an authorization to increase the commitment of resources by DOE and requires successful completion of the preceding CD. The amount of time between decisions will vary. Some cost estimate, or cost range, should be provided at each CD gateway, but the degree of rigor and detail for a cost estimate should be carefully defined, depending on the degree of confidence in project scale and scope that is reasonable to expect at that stage. Whatever figure or range that is provided should explicitly note relevant caveats concerning risks and uncertainties inherent in early estimates at CD-0 and CD-1 stages given the immature requirements definition at this juncture. The CDs are the following:

CD-0 is Approve Mission Need. There is a need that cannot be met through other than material means. ASCR will identify a credible performance gap between its current capabilities and capacities and those required to achieve the goals articulated in its Strategic Plan. The Mission Need Statement (MNS) is the translation of this gap into functional requirements that cannot be met through other than material means. It should describe the general parameters of the solution and why it is critical to the overall accomplishment of the ASCR mission, including the benefits to be realized. The cost range provided at CD-0 should be Rough-Order of Magnitude (ROM) and is used to determine the AE authority designation. It does not represent the PB, which will be established at CD-2.

CD-1 is Approve Alternative Selection and Cost Range. The selected alternative and approach is the optimum solution. This process uses a systems engineering methodology that integrates requirements analysis, risk identification and analysis, acquisition strategies, and concept exploration in order to develop a cost-effective, preferred solution to meet a Mission Need. The recommended alternative should provide the essential functions and capabilities at an optimum life-cycle cost, consistent with required cost, scope, schedule, performance, and risk considerations. It should be reflected in the site's long-range planning documents. The CD1 documentation includes the Alternatives Analysis and Acquisition Strategy/Plan.

CD-2 is Approve PB. Definitive scope, schedule and cost baselines have been developed. The documentation must include the long-lead time Request(s) For Proposals and clearly specify the project's approved PB, which includes the TPC, CD-4 date (month and year), scope and minimum Key Performance Parameters (KPPs) that must be achieved prior to CD-4.

CD-3 is Approve Start of Construction/Execution. The project is ready for implementation; e.g. the procurenebt contract is approved. The project is ready to conduct all construction, implementation, procurement, fabrication, acceptance and turnover activities.

CD-4 is Approve Start of Operations or Project Completion. The project is ready for turnover or transition to operations, if applicable. CD-4 is the achievement of the project completion criteria defined in the PEP and the approval for Transition to Operations. The approval of CD-4 is predicated on the readiness to operate and/or maintain the system, facility, or capability. Transition and turnover does not necessarily terminate all project activity. In some cases, it marks a point known as Beneficial Occupancy Date (BOD) at which the operations organizations assume responsibility for starting operations and maintenance. The

AE approves CD-4 upon notification from the project team via an ESAAB that all project completion criteria defined in the PEP have been met. The document signed by the AE approving CD-4 must clearly specify the scope accomplished, the TPC, Key Performance Parameters met, and the completion date (month and year) as it relates to the original CD-2 performance baseline and latest approved baseline change. The date the AE signs the document represents the CD-4 completion date. The CD4 documentation includes Acceptance Testing results and final risk analysis.

Design-Build is a project delivery method whereby a single contract is awarded for both design and construction.

(1) The Design-Build approach requires the development of a functional design and clearly stated operating requirements that provide sufficient information to allow prospective contractors to prepare bids or proposals. It also allows the flexibility to implement innovative design and construction approaches, Value Engineering, and other cost and time savings initiatives. The overall objective of the Design-Build approach is the following.

- Enhance efficiencies in project design integration into construction execution.
- Reduce the total cost to DOE.
- Deliver projects faster than by using the traditional Design-Bid-Build approach.

(2) Since the requirements are well-defined early in the process and much of the cost and schedule information and key design criteria are known, CD-1, CD-2 and/or even CD-3 may be accomplished simultaneously. Essentially, in requesting a simultaneous approval, CD-1/2, CD-1/2/3 or CD-2/3, the IPT is asserting the following.

- The project functions and requirements are well known.
- A cost and schedule baseline can be established.

The DOE Order allows early CD-3 approval, namely CD-3A, for **Long-Lead** item procurement. While there is potential risk in procuring equipment before the design is complete, the potential schedule improvement may be significant and more than compensate for the risk. If CD-3A is anticipated, the need for this decision and the process should be documented in the PEP. When exercising Long-Lead procurement, the FPD must consider design maturity and the associated project risk. Activities such as site preparation work, site characterization, limited access, safety and security issues are often necessary prior to CD-3, and may be pursued as long as project documents requesting funds to procure the Long-Lead items and funding approvals are in place.

For HPC Upgrades, **ASCR** typically tailors the CD in the manner listed below because: (1) the Upgrades must be deployed as soon as practical to provide the capability to the science community before the technology is made obsolete by advances in the industry; (2) each HPC upgrade is unique in its objectives, deliverables and tactics, and requires flexibility in the structure of its management to address successfully the context and specific environment for each endeavor, and (3) the HPC Centers **typically** use firm-fixed price, Lease-To-Own (LTO) for HPC equipment.

- CD-0: Mission Need (the LCF has a one MNS for the 2 sites).
- CD-1/3A: Site preparation and the long-lead time LTO Request For Proposal.
- CD-2/3B: Contract approval with Vendor Milestones and Acceptance Testing Criteria.
- CD-4: Upgrade completed; e.g., Acceptance Testing completed.

In some cases, there may be intermediate CDs for prototype HPC equipment. The CDs include the Total Project Costs.

The **Project Execution Plan** (PEP) is the core document for the management of a project. The Federal Project Director (FPD) is responsible for the preparation of this document. It establishes the policies and procedures to be followed in order to manage and control project planning, initiation, definition, execution and transition/closeout, and uses the outcomes and outputs from all project planning processes, integrating them into a formally approved document. It includes an accurate reflection of how the project is to be accomplished, the minimum KPPs for CD-4, funding requirements, technical considerations, risk management, configuration management, and roles and responsibilities. A **preliminary** PEP is required to support CD-1/3A. This document continues to be refined throughout the duration of an n Upgrade; e.g.,

the detailed Scope of work and Acceptance Testing Criteria are developed for CD2/3B. PEP revisions are documented through the configuration management process (a sample PEP is available in the guidance for DOE Order 413.3b).

The **Performance Baseline** (PB), as established in the PEP, defines the Total Project Cost (TPC), the Total System Cost (TPC + leases, including financial charges and taxes), CD-4 completion date, performance and scope commitment to which the project must be executed and is based on an approved funding profile. The PB includes the entire project budget (total cost of the project that includes contingency) and represents the DOE commitments to Congress and the OMB. Although only Operating Funds are used for the ASCR Upgrades, the approved PB is controlled, tracked and reported from the beginning to the end of a project to ensure consistency between the PEP and the OMB Exhibit 300s

A PB **Deviation** occurs when the approved TPC, CD-4 completion date, or performance and scope parameters cannot be met. The FPD must promptly notify ASCR whenever project performance indicates the likelihood of a PB deviation. When a deviation occurs, the AE must make a specific determination whether to terminate the project or establish a new PB by requesting the FPD to submit a Baseline Change Proposal (BCP). Additionally, all PB deviation decisions must be reported to the ASCR Facilities Program Manager. An approval by the AE is not required when a PB deviation is determined by the FPD to be beneficial to the project; e.g., lower TPC, earlier completion date, or significant scope enhancements.

A PB **Change** represents an irregular event. The approval by the AE does not constitute approval of individual contract changes and modifications. If a contract change is necessary, the Contracting Officer has exclusive authority to issue changes and modify contracts, but only if the changes or modifications comply with regulatory and statutory requirements. It is critical that the FPD and the Contracting Officer ensure that changes to the contract are identified, issued, administered, and managed in a timely manner over the life of the project and contract. The document signed by the AE approving the BCP must clearly specify the project's revised PB, which includes the TPC, CD-4 date (month and year), scope and minimum KPPs that must be achieved at CD-4. In addition, the AE must endorse any reduction in funding that adversely affects the project's approved funding profile. PB change approval thresholds and authorities should be defined in the PEP. These approval levels must be incorporated into the change control process for each project.

A **Key Performance Parameter** (KPP) is defined by CD-2 and is the Upgrade Scope that if changed would have a major impact on the system or facility performance, schedule, cost and/or risk. In some cases, a minimum KPP or threshold value should be highlighted for CD-4 (project completion) realizing that in many instances full operational capabilities may take years to achieve.

Risk Management is an essential element and must be analytical, forward looking, structured and continuous. Risk assessments are started as early in the project life-cycle as possible and should identify critical technical, performance, schedule and cost risks. Once risks are identified and prioritized, sound risk mitigation strategies and actions (including risk acceptance) are developed and documented in the Risk Register. Post CD-1, the risk register (including new risks) should be evaluated at least quarterly. Risks and their associated confidence levels are dependent on multiple factors such as complexity, technology readiness and strength of the IPT. Risks for should be analyzed and reflected in contingencies, budgetary requests, and funding profiles. If an Upgrade has a PB change, this may need to be included in budgetary requests and funding profiles.

The FPD shall organize and lead the Integrated Project/Program Team (**IPT**). The IPT is an essential element in DOE's acquisition process and is involved in all phases of a project. This team consists of professionals representing diverse disciplines with the specific knowledge, skills and abilities to support the FPD in successfully executing a project. The team size and membership may change as a project progresses from CD-0 to CD-4 to ensure that the necessary skills are always represented to meet project needs. Team membership may be full or part time, depending upon the scope and complexity of a project and the activities underway. However, the identified personnel must be available to dedicate an amount of time sufficient to contribute to the IPT's success. Qualified staff (including contractors) must be

available in sufficient numbers to accomplish all contract and project management functions. Project staffing requirements should be based on a variety of factors, including project size and complexity, as well as the management experience and expertise of the project staff. Regardless of the methodology used, once the appropriate staff size has been determined, programs should plan and budget accordingly. The FPD and the team will prepare and maintain an IPT Charter that describes:

- Membership.
- Responsibilities and authority.
- Leads (as appropriate);
- Meetings.
- Reporting.
- Operating guidance.

The IPT will:

- Support the Federal Project Director.
- Work with the Contracting Officer to develop a project Acquisition Strategy.
- Ensure that project interfaces are identified, defined and managed to completion.
- Identify, define and manage to completion the project environmental, safety, health, security, and risk requirements.
- Identify and define appropriate and adequate project technical scope, schedule and cost parameters.
- Perform periodic reviews and assessments of project performance and status against established performance parameters, baselines, milestones and deliverables.
- Plan and participate in project reviews, audits, and appraisals as necessary.
- Review all CD packages and recommend approval/disapproval.
- Review and comment on project deliverables (e.g., drawings, specifications, procurement, and construction packages).
- Review change requests and support Change Control Boards.
- Participate in Operational Readiness Reviews.
- Support preparation, review and approval of project completion and closeout documentation.
- Ensure safety is effectively integrated into design and construction.

An **Acquisition Strategy** (AS) is a key activity formulated by the IPT leading up to CD-1. The AS is the FPD's overall plan for satisfying the mission need in the most effective, economical and timely manner. Supporting the execution of the AS is the procurement strategy that must be documented in writing. The AS represents a high level plan which is approved through the CD review and approval process, and provides greater focus on the analysis and strategies needed to appropriately execute procurements in accordance with sound business practices, statutory, regulatory and policy requirements. The AS references portions of the Acquisition Plan required by the Federal Acquisition Regulations.

A clear and concise **Alternatives Analysis** (AA) shall be developed to include the basis for the alternative selected, how the alternative meets the approved mission need, the functions and requirements that define the alternative and demonstrate the capability for success, and the facility performance requirements, planning standards and life-cycle cost assumptions. The AA or PE should also clearly and concisely describe the KPPs that will form the basis of the Performance Baseline at CD-2. When the purpose of the project is remediation, restoration, or demolition, other forms of documenting the requirements and alternative(s) may be used. The AA or PEP shall describe the following.

- Scope required to satisfy the Program mission requirements.
- Project feasibility.
- Attainment of specified performance levels.
- Assessment of project risks and identification of appropriate risk handling strategies.
- Reliable cost and schedule range estimates for the alternatives considered.
- Project design parameters.
- Impact on the site Sustainability Plan.

The CD1/3A **documentation** includes (but is not limited to):

- Alternative Analysis.
- Acquisition Strategy/Plan.

- Preliminary PEP.

The CD2/3B documentation includes:

- Risk Management Plan (including the Risk Registry tied to cost and schedule contingencies).
- Detailed Project Cost Estimate and contingencies, including general Funding Profile, time-phased budget details, and assumptions; e.g., vendor quotes, historical data, and engineering judgments.
- Resource loaded Schedule with contingencies, Critical Path, and near Critical Path items.
- PEP, including Work Breakdown Structure (WBS) and WBS Dictionary.
- Acceptance Testing requirements.

The CD4 documentation includes the results of an independent review to verify the conditions for CD4 have been met.

The post-CD4 documentation includes the project Closeout Report and the Lessons Learned report; and the close out of the project in PARS (discussed immediately below).

For project $\geq$ $20 million, the Project Assessment and Reporting (IT) System (**PARS**) is used to evaluate the project monthly against the current approved PB, using the following criteria.

- Green – Project is expected to meet its current PB.
- Yellow – Project is at risk of not meeting an element of the current PB.
- Red – Project is highly at risk of requiring a change to the PB by the AE or is not being executed within the AS and PEP.

The FPD prepares the monthly PARS input and loads it into PARS, based on the PARS schedule, and then the ASCR Program Manager assesses the input.

The ASCR Program Managers conduct **quarterly** IPT reviews, where appropriate.

7. Transition To Operations

The **DOE** Order states that the Transition to Operations should clearly define the basis for attaining initial operating capability and full operating capability.

During the Transition to Operations of **ASCR** facilities, the hardware and software environment, including file systems and software libraries, may need to undergo further testing at scale to confirm that the HPC facility is ready for scientific studies; e.g., establishment of procedures for allocating resources and the measurement of computing performance in a steady state. With the concurrence of ASCR Program Managers, the HPC facilities solicit proposals or users to test the Upgrade under the conditions similar to Routine Operations. An Early Science period may also be initiated, with large amounts of dedicated time. Following the Transition to Operations, the HPC facility is opened to projects awarded in accordance with the ASCR Allocations Policy. The Upgrade Risk Management Plan should include the risk of the Transition to Operations.

The DOE Order allows Alternative Financing. The HPC Centers typically use firm-fixed price, **Lease**-To-Own (LTO) for HPC equipment, which has the following benefits:

- Financial burden shifted from the Federal Government to the Vendor.
- Flexibility in payment schedules.
- Lease payments do not start, in general, until after successful acceptance testing (for small businesses, advanced payments are sometimes authorized after delivery of the HPC equipment, but before Acceptance Testing).

Analyses are performed on the LTOs. Since the HPC refresh periods are about 5 years, the LTO contract duration are, therefore, typically for not more than 5 years.

ESnet **leases** circuits.

8. Responsibilities

Note: This section includes responsibilities for ASCR and the Sites for Upgrades, Transition to Operations, and Operation.

ASCR Associate Director (**AD**)/Acquisition Executive (**AE**):

- Approves annual Budgets, monthly Financial Plans, and the degree of Tailoring for Upgrades and maintenance activities, appointments of Federal Project Directors, Missions Need Statements, Acquisition Strategies, PEPs, and CDs.
- Requests SC PMSO (SC-28) conduct Independent Project Reviews (IPRs) and SC ESAABs.

ASCR Facilities **Division** Director:

- Prepares annual Budgets.
- Approves annual OMB Exhibit 300s, Upgrade Funding Profiles, monthly Dashboards, monthly Upgrade Watch List inputs (if appropriate), Performance Baselines (e.g., LTO contract scope, cost, and schedule), Baseline Change Proposals (as delineated in the PEPs), and updates to this Plan.
- Chairs ASCR ESAABs.
- Requests Budget Reviews (aka "Deep Dives") and Operational Assessments (OAs).
- Issues annual Budget Review Guidance and annual OA Guidance.
- Concurs on monthly Financial Plans,

ASCR Facilities Program Manager (**PM**):

- Provides high-level oversight of the facility Upgrades, Transitions to Operations, and Operations, including Program Management of the ALCC and NERSC ERCAP allocations.
- Participates in Upgrade Reviews (e.g., IPRs), ASCR ESAABs, annual Budget Reviews, OAs, on Integrated Project/Program Teams (IPTs), CD Dry Runs, and Needs and Best Practices Workshops,
- Conducts Site Visits and quarterly IPT Reviews, where applicable.
- Arranges for the peer reviews of ALCC proposals.
- Prepares annual OMB Exhibit 300s, **monthly Financial Plans**, **monthly Dashboards**, and monthly CPIC reports.
- Approves Transition to Operations plans.
- Assesses monthly PARS reports.
- Has peer reviews performed on ALCC proposals, where applicable.
- Provides input to annual Budgets, annual OA Guidance and annual Budget Review Guidance.
- Comments on scientific accomplishments documents, Mission Need Statements, Acquisition Strategies, PEPs, CD documents, Performance Baselines (PBs), Baseline Change Proposals, Upgrade Funding Profiles, monthly Upgrade Watch List input (if appropriate), monthly operations reports, Alternative Analyses, Risk Management Plans, Key Performance Parameters (KPPs), and Upgrade Completion (Acceptance) Criteria,

SC PMSO (SC Office of Project Assessment, **SC-28**)

- Conducts SC ESAABs and Independent Project Reviews.

Federal Project Director (**FPD**)/ASCR Program Liaison (where applicable):

- Attains and maintains certification in concert with the requirements outlined in DOE Order 361.1B before they are delegated the authority to serve as FPD and/or within one year of appointment, achieve the appropriate level of certification.
- Serves as the single point of contact between Federal and contractor staff for all matters relating to an Upgrade and its performance.
- Establishes PBs, reflective of identified and assessed risks and uncertainties, to include Total Project Costs (TPCs), CD-4 dates, and minimum KPPs. The key project milestones and completion dates shall be stated no less specifically than month and year. The scope will be

stated in quantity, size and other parameters that give shape and form to the project. The funding assumptions upon which the PB is predicated will be clearly documented and approved.
- Chairs Integrated Project/Program Team, including periodic conference calls, and prepares and maintains the IPT Charter and operating guidance with IPT support and ensures that the IPT is properly staffed. Defines and oversees the roles and responsibilities of each IPT member. Provides broad project guidance. Delegates appropriate decision-making authority to the IPT members.
- Ensure the timely, reliable and accurate integration of contractor performance data into the Upgrade's scheduling, accounting, and performance measurement systems.
- Evaluates and verifies reported progress; make projections of progress and identify trends.
- Participates on Upgrade Reviews (e.g., IPRs), ASCR ESAABs, annual Budget Reviews, OAs, CD Dry Runs, NEPA reviews (where applicable), and Operational Readiness Reviews (to determine the facility or area can be occupied from both a regulatory and a work function standpoint).
- Establishes Beneficial Occupancy Dates for the facilities and/or equipment.
- Approves IPT charter and Baseline Change Proposals (as delineated in the PEPs).
- Verifies achievement of KPPs and Project Completion (Acceptance) Criteria and that mission requirements have been achieved. The FPD will verify and document the scope accomplished, TPC, KPPs met, and the completion date as it relates to the original CD-2 performance baseline and the latest approved baseline change.
- Prepares PEPs, CDs documentation, the monthly PARS reports, Upgrade performance measures, (which include Tailoring Strategy), Project Closeout Report, and Lessons Learned reports (which can be part of the Project Closeout Report).
- Provides input to annual Budgets, annual OMB Exhibits 300s, monthly Dashboards, and monthly CPIC reports.
- Comments on Missions Need Statements, Acquisition Strategies, Baseline Change Proposals, Upgrade Funding Profiles, monthly Upgrade Watch List input (if appropriate), Transition to Operations plans, monthly operations reports, Alternative Analyses, Risk Management Plans, Request For Proposals, Contracts, and scientific accomplishments documents.
- Provides oversight of subcontracts; e.g., LTOs.

Laboratory Facility/Center Director (or designees):

- Exercises full financial authority and accountability for the Upgrades, Transitions to Operations, and operations; e.g., manages all procurements and human resources and ensures that safety and security are fully integrated throughout the facility.
- Appointed as the Lab Contracting Officer's Technical Representative, as determined by the Lab Contracting Officer.
- Defines Upgrade cost, schedule, performance, and scope baselines.
- Oversees the Upgrade line management organization and ensure the line Upgrade teams have the necessary experience, expertise, and training in design engineering, safety and security analysis, construction, and testing.
- Ensures the development and implementation of key Upgrade documentation; that design, construction, environmental, sustainability, safety, security, health and quality efforts performed comply with the contract, public law, regulations and EOs and DOE O 413.3B Appendix B 11-29-2010 B-7.
- Participates in annual Budget Reviews, OAs, Needs and Best Practices Workshops, Upgrade Reviews (e.g., IPRs), IPTs, CD Dry Runs, and NEPA reviews (where applicable)
- Prepares scientific accomplishments documents, Mission Need Statements, Acquisition Strategies, Baseline Change Proposals, Transition to Operations plans, monthly operations reports, Alternative Analyses, Risk Management Plans, KPPs, Project Completion (Acceptance) Criteria, Request For Proposals, draft Contracts, Hazard Analysis Reports, Construction Upgrade Safety and Health Plans, NEPA documentation, Security Vulnerability Assessments, and Integrated Safety Management Plans.
- Approves Baseline Change Proposals (as delineated in the PEPs)

- Provides input to annual Budgets, annual OMB Exhibit 300s, PEPs, CD documentation, PBs, Upgrade Funding Profiles, monthly Dashboards, monthly Upgrade Watch List (if appropriate), monthly CPIC reports, monthly PARS reports, Project Closeout Report, Lessons Learned reports.
- Conducts independent review to verify the conditions for CD4 have been met.
- Documents High Performance and Sustainable Building provisions per EO 13423, Section 2(f), EO 13514, Section 2, and Sustainable Environmental Stewardship considerations per DOE O 450.1A, as amended, in Acquisition Strategies, and/or PEPs, as appropriate.