NA-ASC-119R-08-Vol.2-Rev 0-IP
LLNL-TR-413758

Advanced Simulation and Computing

FY10–11 Implementation Plan

Volume 2, Rev. 0

June 11, 2009

By B. Carnes

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

Advanced Simulation and Computing

FY10–11 IMPLEMENTATION PLAN
Volume 2, Rev. 0

June 11, 2009

Approved by:

Robert Meisner, NNSA ASC Program Director (acting)	Signature	Date
James Peery, SNL ASC Executive	Signature	Date
Michel McCoy, LLNL ASC Executive	Signature	Date
John Hopson, LANL ASC Executive	Signature	Date

ASC Focal Point
Robert Meisner
NA 121.2
Tele.: 202-586-1800
FAX: 202-586-0405
bob.meisner @nnsa.doe.gov

IP Focal Point
Njema Frazier
NA 121.2
Tele.: 202-586-5789
FAX: 202-586-7754
njema.frazier@nnsa.doe.gov

Implementation Plan Contents at a Glance

Section No./Title		Vol. 1	Vol. 2
I.	Executive Summary		
II.	Introduction		
III.	Accomplishments		
IV.	Product Descriptions		
V.	ASC Level 1 and 2 Milestones		
VI.	ASC Roadmap Drivers for FY10–FY11		
VII.	ASC Risk Management		
VIII.	Performance Measures and Data		
IX.	Budget		
Appendix A.	Glossary		
Appendix B.	Codes		
Appendix C.	Points of Contact		
Appendix D.	1.5.1.4-TRI-001 Academic Alliance Centers		
Appendix E.	ASC Obligation/Cost Plan		

Contents

List of Tables

List of Figures

I. Executive Summary

The Stockpile Stewardship Program (SSP) is a single, highly integrated technical program for maintaining the surety and reliability of the U.S. nuclear stockpile. The SSP uses past nuclear test data along with current and future non-nuclear test data, computational modeling and simulation, and experimental facilities to advance understanding of nuclear weapons. It includes stockpile surveillance, experimental research, development and engineering programs, and an appropriately scaled production capability to support stockpile requirements. This integrated national program requires the continued use of current facilities and programs along with new experimental facilities and computational enhancements to support these programs.

The Advanced Simulation and Computing Program (ASC)[1] is a cornerstone of the SSP, providing simulation capabilities and computational resources to support the annual stockpile assessment and certification, to study advanced nuclear weapons design and manufacturing processes, to analyze accident scenarios and weapons aging, and to provide the tools to enable stockpile Life Extension Programs (LEPs) and the resolution of Significant Finding Investigations (SFIs). This requires a balanced resource, including technical staff, hardware, simulation software, and computer science solutions.

In its first decade, the ASC strategy focused on demonstrating simulation capabilities of unprecedented scale in three spatial dimensions. In its second decade, ASC is focused on increasing its predictive capabilities in a three-dimensional simulation environment while maintaining support to the SSP. The program continues to improve its unique tools for solving progressively more difficult stockpile problems (focused on sufficient resolution, dimensionality and scientific details); to quantify critical margins and uncertainties (QMU); and to resolve increasingly difficult analyses needed for the SSP. Moreover, ASC has restructured its business model from one that was very successful in delivering an initial capability to one that is integrated and focused on requirements-driven products that address long-standing technical questions related to enhanced predictive capability in the simulation tools.

ASC must continue to meet three objectives:

- **Objective 1. Robust Tools.** Develop robust models, codes, and computational techniques to support stockpile needs such as refurbishments, SFIs, LEPs, annual assessments, and evolving future requirements.
- **Objective 2. Prediction through Simulation.** Deliver validated physics and engineering tools to enable simulations of nuclear weapons performance in a variety of operational environments and physical regimes and to enable risk-informed decisions about the performance, safety, and reliability of the stockpile.
- **Objective 3. Balanced Operational Infrastructure.** Implement a balanced computing platform acquisition strategy and operational infrastructure to meet Directed Stockpile Work (DSW) and SSP needs for capacity and high-end simulation capabilities.

[1] In FY02 the Advanced Simulation and Computing (ASC) Program evolved from the Accelerated Strategic Computing Initiative (ASCI).

II. Introduction

The ASC Program supports the National Nuclear Security Administration's (NNSA's) overarching goal of Nuclear Weapons Stewardship: *"We continue to advance the Stockpile Stewardship Program to push the scientific and engineering boundaries needed to maintain our nuclear arsenal. It also means maintaining the basic science and engineering that is the foundation of the weapons program."*[2]

In 1996, ASCI—the Accelerated Strategic Computing Initiative—was established as an essential element of the SSP to provide nuclear weapons simulation and modeling capabilities.

In 2000, the NNSA was established to carry out the national security responsibilities of the Department of Energy, including maintenance of a safe, secure, and reliable stockpile of nuclear weapons and associated materials capabilities and technologies.

Shortly thereafter, in 2002, ASCI matured from an initiative to a recognized program and was renamed the Advanced Simulation and Computing (ASC) Program.

Prior to the start of the nuclear testing moratorium in October 1992, the nuclear weapons stockpile was maintained through (1) underground nuclear testing and surveillance activities and (2) "modernization" (i.e., development of new weapons systems). A consequence of the nuclear test ban is that the safety, performance, and reliability of U.S. nuclear weapons must be ensured by other means for systems far beyond the lifetimes originally envisioned when the weapons were designed.

NNSA will carry out its responsibilities through the twenty-first century in accordance with the current Administration's vision and the Nuclear Posture Review (NPR) guidance. NNSA Administrator Thomas P. D'Agostino summarized[3] the NNSA objectives for SSP as follows:

"Our fundamental national security responsibilities for the United States include:

- *Assuring the safety, security and reliability of the U.S. nuclear weapons stockpile while at the same time transforming the stockpile and the infrastructure that supports it;*
- *Reducing the threat posed by nuclear proliferation; and,*
- *Providing reliable and safe nuclear reactor propulsion systems for the U.S. Navy."*

"Throughout the past decade, the Stockpile Stewardship Program (SSP) has proven its ability to successfully sustain the safety, security and reliability of the nuclear arsenal without resorting to underground nuclear testing. The SSP also enables the U.S. to provide a credible strategic deterrent capability with a stockpile that is significantly smaller. To assure our ability to maintain essential military capabilities over the long-term, however, and to enable significant reductions in reserve warheads, we must make progress towards a truly responsive nuclear weapons infrastructure as called for in the Nuclear Posture Review (NPR). The NPR called for a transition from a threat-based nuclear deterrent, with large numbers of deployed and reserve weapons, to a deterrent that is based on capabilities, with a smaller nuclear weapons stockpile and

[2] NNSA Strategic Planning Guidance for FY2010–2014, April 2008, page 17.

[3] Testimony on the *FY 2008 National Defense Authorization Budget Request for the Department of Energy's NNSA* before the House Armed Services Subcommittee, March 20, 2007.

greater reliance on the capability and responsiveness of the Department of Defense (DoD) and NNSA infrastructure to adapt to emerging threats."

A truly responsive infrastructure will allow us to address and resolve any stockpile problems uncovered in our surveillance program; to adapt weapons (achieve a capability to modify or repackage existing warheads within 18 months of a decision to enter engineering development); to be able to design, develop, and initially produce a new warhead within three to four years of a decision to do so;[4] to restore production capacity to produce new warheads in sufficient quantities to meet any defense needs that arise without disrupting ongoing refurbishments; to ensure that services such as warhead transportation, tritium support, and other ongoing support efforts are capable of being carried out on a time scale consistent with the Department of Defense's ability to deploy weapons; and to improve test readiness (an 18-month test readiness posture) in order to be able to diagnose a problem and design a test that could confirm the problem or certify the solution (without assuming any resumption of nuclear testing).

Additionally, the NPR guidance has directed that NNSA maintain a research and development and manufacturing base that ensures the long-term effectiveness of the nation's stockpile and begin a modest effort to examine concepts (for example, Advanced Concepts Initiatives) that could be deployed to further enhance the deterrent capabilities of the stockpile in response to the national security challenges of the twenty-first century.

The ASC Program plays a vital role in the NNSA infrastructure and its ability to respond to the NPR guidance. The program focuses on development of modern simulation tools that can provide insights into stockpile problems, provide tools with which designers and analysts can certify nuclear weapons, and guide any necessary modifications in nuclear warheads and the underpinning manufacturing processes. Additionally, ASC is enhancing the predictive capability necessary to evaluate weapons effects, design experiments, and ensure test readiness.

ASC continues to improve its unique tools to solve progressively more difficult stockpile problems, with a focus on sufficient resolution, dimensionality, and scientific details, to enable QMU and to resolve the increasingly difficult analyses needed for stockpile stewardship. The DSW provides requirements for simulation, including planned LEPs, stockpile support activities that may be ongoing or require short-term urgent response, and requirements for future capabilities to meet longer-term stockpile needs. Thus, ASC's advancing, leading-edge technology in high-performance computing (HPC) and predictive simulation meets these short- and long-term needs, including the annual assessments and certifications and SFIs. The following section lists past, present, and planned ASC contributions to meet these needs.

ASC Contributions to the Stockpile Stewardship Program

In FY96, ASCI Red was delivered. Red, the world's first teraFLOPS supercomputer, was upgraded to more than 3 teraFLOPS in FY99 and was retired from service in September 2005.

In FY98, ASCI Blue Pacific and ASCI Blue Mountain were delivered. These platforms were the first 3-teraFLOPS systems in the world and have both since been decommissioned.

[4] While there are no plans to develop new weapons, acquiring such capability is an important prerequisite to deep reductions in the nuclear stockpile.

In FY00, ASCI successfully demonstrated the first-ever three dimensional (3D) simulation of a nuclear weapon primary explosion and the visualization capability to analyze the results; ASCI successfully demonstrated the first-ever 3D hostile-environment simulation; and ASCI accepted delivery of ASCI White, a 12.3-teraFLOPS supercomputer, which has since been retired from service.

In FY01, ASCI successfully demonstrated simulation of a 3D nuclear weapon secondary explosion; ASCI delivered a fully functional Problem Solving Environment for ASCI White; ASCI demonstrated high-bandwidth distance computing between the three national laboratories; and ASCI demonstrated the initial validation methodology for early primary behavior. Lastly, ASCI completed the 3D analysis for a stockpile-to-target sequence (STS) for normal environments.

In FY02, ASCI demonstrated 3D system simulation of a full-system (primary and secondary) thermonuclear weapon explosion, and ASCI completed the 3D analysis for an STS abnormal-environment crash-and-burn accident involving a nuclear weapon.

In FY03, ASCI delivered a nuclear safety simulation of a complex, abnormal, explosive initiation scenario; ASCI demonstrated the capability of computing electrical responses of a weapons system in a hostile (nuclear) environment; and ASCI delivered an operational 20-teraFLOPS platform on the ASCI Q machine, which has been retired from service.

In FY04, ASC provided simulation codes with focused model validation to support the annual certification of the stockpile and to assess manufacturing options. ASC supported the life-extension refurbishments of the W76 and W80, in addition to the W88 pit certification. In addition, ASC provided the simulation capabilities to design various non-nuclear experiments and diagnostics.

In FY05, ASC identified and documented SSP requirements to move beyond a 100-teraFLOPS computing platform to a petaFLOPS-class system; ASC delivered a metallurgical structural model for aging to support pit-lifetime estimations, including spiked-plutonium alloy. In addition, ASC provided the necessary simulation codes to support test readiness as part of NNSA's national priorities.

In FY06, ASC delivered the capability to perform nuclear performance simulations and engineering simulations related to the W76/W80 LEPs to assess performance over relevant operational ranges, with assessments of uncertainty levels for selected sets of simulations. The deliverables of this milestone were demonstrated through 2D and 3D physics and engineering simulations. The engineering simulations analyzed system behavior in abnormal thermal environments and mechanical response of systems to hostile blasts. Additionally, confidence measures and methods for uncertainty quantification (UQ) were developed to support weapons certification and QMU Level 1 milestones.

In FY07, ASC supported the completion of the W76-1 and W88 warhead certification, using quantified design margins and uncertainties; ASC also provided two robust 100-teraFLOPS-platform production environments by IBM and CRAY, supporting DSW and Campaign simulation requirements, respectively. One of the original ASCI program Level 1 milestones was completed when the ASC Purple system was formally declared "generally available." This was augmented by the 360-teraFLOPS ASC BlueGene/L system, which provided additional capability for science campaigns. The ASC-funded partnerships between SNL/Cray and LLNL/IBM have transformed the supercomputer industry. There are currently at least 34 "Blue Gene Solution" systems on the Top 500 list and 38 Cray sales based on the SNL Red Storm architecture.

In FY08, ASC delivered the codes for experiment and diagnostic design to support the CD-4 approval on the National Ignition Facility (NIF). An advanced architecture platform capable of sustaining a 1-petaFLOPS benchmark, named Roadrunner, was sited at LANL. SNL and LANL established the collaborative Alliance for Computing at Extreme Scale (ACES) for the purpose of providing a user facility for production capability computing to the Complex. Plans were made for machine Zia, the first machine to be hosted through ACES, to be procured and sited at LANL.

By FY09, a suite of physics-based models and high-fidelity databases will be developed and implemented. ASC is being brought to bear on critical simulations in support of secure transportation and NWC infrastructure.

In FY10 and beyond, ASC will continue to deliver codes to address the next generation of LEPs and for experiment and diagnostic design to support the indirect-drive ignition experiments on the NIF and will continue to improve confidence and response time for predictive capabilities to answer questions of vital importance to the SSP. In addition, ASC will continue to provide national leadership in HPC and deploy capability and capacity platforms in support of Defense Programs campaigns.

III. Accomplishments for FY08–FY09

ASC accomplishments from Quarter 4, fiscal year 2008, through quarter 3, fiscal year 2009, are reflected below for the Computational Systems and Software Environment (CSSE) and Facility Operations and User Support (FOUS) sub-programs.

HQ is pleased to highlight the outstanding achievements of the Defense Programs Contractors.

Computational Systems and Software Environment

LLNL Accomplishments for Computational Systems and Software Environment

Accomplishments will be added in Rev. 0.1 of this document.

LANL Accomplishments for Computational Systems and Software Environment

Accomplishments will be added in Rev. 0.1 of this document.

SNL Accomplishments for Computational Systems and Software Environment

Accomplishments will be added in Rev. 0.1 of this document.

Facility Operations and User Support

LLNL Accomplishments for Facility Operations and User Support

Accomplishments will be added in Rev. 0.1 of this document.

LANL Accomplishments for Facility Operations and User Support

Accomplishments will be added in Rev. 0.1 of this document.

SNL Accomplishments for Facility Operations and User Support

Accomplishments will be added in Rev. 0.1 of this document.

Academic Alliances

University of Chicago Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

University of Illinois at Urbana-Champaign Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

University of Utah Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

California Institute of Technology (Caltech) Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

Purdue University Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

Stanford University Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

University of Michigan Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

University of Texas, at Austin, Accomplishments

Accomplishments will be added in Rev. 0.1 of this document.

IV. Product Descriptions by the National Work Breakdown Structure

WBS 1.5.4: Computational Systems and Software Environment

The mission of this national sub-program is to build integrated, balanced, and scalable computational capabilities to meet the predictive simulation requirements of NNSA. It strives to provide users of ASC computing resources a stable and seamless computing environment for all ASC-deployed platforms, which include capability, capacity, and advanced systems. Along with these powerful systems that ASC will maintain and continue to field, the supporting software infrastructure that CSSE is responsible for deploying on these platforms includes many critical components, from system software and tools, to I/O, storage and networking, to post-processing visualization and data analysis tools, and to a common computing environment. Achieving this deployment objective requires sustained investment in applied research and development activities to create technologies that address ASC's unique mission-driven need for scalability, parallelism, performance, and reliability.

WBS 1.5.4.1: Capability Systems

This level 4 product provides capability production platforms and integrated planning for the overall system architecture commensurate with projected user workloads. The scope of this product includes strategic planning, research, development, procurement, hardware maintenance, testing, integration and deployment, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include strategic planning, performance modeling, benchmarking, and procurement and integration coordination. This product also provides market research for future systems.

Capability Systems Deliverables for FY10

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.2: Capacity Systems

This level 4 product provides capacity production platforms commensurate with projected user workloads. The scope of this product includes planning, research, development, procurement, hardware maintenance, testing, integration and deployment, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include the procurement and installation of capacity platforms.

Capacity Systems Deliverables for FY10

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.3: Advanced Systems

This level 4 product provides advanced architectures in response to programmatic, computing needs. The scope of this product includes strategic planning, research, development, procurement, testing, integration and deployment, as well as industrial and academic collaborations. Projects and technologies include strategic planning, performance modeling, benchmarking, and procurement and integration coordination. This product also provides market research, and the investigation of advanced architectural concepts and hardware (including node interconnects and machine area networks) via prototype development, deployment and test bed activities. Also included in this product are cost-effective computers designed to achieve extreme speeds in addressing specific, stockpile-relevant issues through development of enhanced performance codes especially suited to run on the systems.

Advanced Systems Deliverables for FY10

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.4: System Software and Tools

This level 4 product provides the system software infrastructure, including the supporting operating system environments and the integrated tools to enable the development, optimization and efficient execution of application codes. The scope of this product includes planning, research, development, integration and initial deployment, continuing product support, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include system-level software addressing optimal delivery of system resources to end-users, such as schedulers, custom device drivers, resource allocation, optimized kernels, system management tools, compilers, debuggers, performance tuning tools, run-time libraries, math libraries, component frameworks, other emerging programming paradigms of importance to scientific code development and application performance analysis.

System Software and Tools Deliverables for FY10

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.5: Input/Output, Storage Systems, and Networking

This level 4 product provides I/O (data transfer) storage infrastructure in balance with all platforms and consistent with integrated system architecture plans. The procurement of all supporting subsystems, and data transfer, storage systems and infrastructures occurs through this product. The scope of this product includes planning, research, development, procurement, hardware maintenance, integration and deployment, continuing product support, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include high-performance parallel file systems, hierarchical storage management systems, storage-area-networks, network-attached storage (NAS), and HPSS or future hierarchical storage management system disks, tape, robotics, servers, and media. This product also includes relevant prototype deployment and test bed activities. Projects and technologies in the advanced networking and interconnect areas shall include networking and interconnect architectures, emerging networking hardware technologies and communication

protocols, network performance/security monitoring/analysis tools, and high performance encryption and security technologies.

Input/Output, Storage Systems, and Networking Deliverables for FY10

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.6: Post-Processing Environments

This level 4 product provides integrated post-processing environments to support end-user visualization, data analysis, and data management. The scope of this product includes planning, research, development, integration and deployment, continuing customer/product support, and quality and reliability activities, as well as industrial and academic collaborations. Projects and technologies include tools for metadata and scientific data management, and general-purpose and application-specific visualization, analysis, and comparison. Research includes innovative data access methods and visualization of massive, complex data—the use of open-source foundations will continue to be an important strategy for development of shareable advanced techniques. The product must develop solutions to address interactivity, scaling and tri-lab access for petascale platforms, and data analysis techniques needed to support effective V&V and comparative analysis. Solutions for emerging platform architectures may in turn require customization and/or re-architecting of software to leverage hardware features. A continuing emphasis will be placed on tools for improving end-user productivity. The product also provides and supports infrastructure including office and collaborative space visualization displays, mechanisms for image data delivery, and graphics rendering hardware.

Post-Processing Environments Deliverables for FY10

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.4.7: Common Computing Environment

The goal of the Common Computing Environment (CCE) product is to enable such an environment across the tri-labs that will initially be deployed on the TLCC systems. The scope of this product includes funded R&D projects to address gap areas identified by the tri-lab technical Working Groups.

The CCE working groups and projects focus on a common software stack to include, but not be limited to, operating system software; application development tools; resource management; HPC monitoring and metrics; and common tri-lab environment issues of configuration management, licenses, WAN access, and multi-realm security, to name a few.

Common Computing Environment Deliverables for FY10

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.5: Facility Operations and User Support

This sub-program provides both necessary physical facility and operational support for reliable production computing and storage environments as well as a suite of user services for effective use of ASC tri-lab computing resources. The scope of the facility operations includes planning, integration and deployment, continuing product support, software license and maintenance fees, procurement of operational equipment and media, quality and reliability activities, and collaborations. FOUS also covers physical space, power and other utility infrastructure, and LAN/WAN networking for local and remote access, as well as requisite system administration, cyber-security, and operations services for ongoing support and addressing system problems. Industrial and academic collaborations are an important part of this sub-program.

WBS 1.5.5.1: Facilities, Operations, and Communications

This level 4 product provides necessary physical facility and operational support for reliable production computing and storage environments. The scope of this product includes planning, integration and deployment, continuing product support, software license and maintenance fees, procurement of operational equipment and media, quality and reliability activities and collaborations. This product also covers physical space, power and other utility infrastructure, and LAN/WAN networking for local and remote access, as well as requisite system administration, cyber-security and operations services for ongoing support and addressing system problems.

Facilities, Operations, and Communications Deliverables for FY10

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.5.2: User Support Services

This level 4 product provides users with a suite of services enabling effective use of ASC tri-lab computing resources. The scope of this product includes planning, development, integration and deployment, continuing product support, and quality and reliability activities collaborations. Projects and technologies include computer center hotline and help-desk services, account management, web-based system documentation, system status information tools, user training, trouble-ticketing systems, and application analyst support.

User Support Services Deliverables for FY10:

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

WBS 1.5.5.3: Collaborations

This level 4 product provides collaboration with external agencies on specific HPC projects. The scope of this product includes planning, development, integration and deployment, continuing product support, and quality and reliability activities collaborations. This product also includes any programmatic support across the entire

ASC program and studies, either by internal or external groups that enable the program to improve its planning and execution of its mission.

Collaborations Deliverables for FY10

Deliverables will be added in Rev. 0.1 of this document.

Projects will be added in Rev. 0.1 of this document.

V. ASC Level 1 and 2 Milestones

Table V-1. Quick Look: *Proposed* Level 1 Milestone Dependencies

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram(s)	Site(s)	ASC Category
3	Baseline demonstration of UQ aggregation methodology for full-system weapon performance prediction	1	FY10	Q4	ASC	HQ, LLNL, LANL, SNL	C11, C1, C4, DSW
4	Develop, implement, and apply a suite of physics-based models and high-fidelity databases to enable predictive simulation of the initial conditions for primary boost.	1	FY12	Q4	ASC	HQ, LLNL, LANL	C11, C1, C2
5	Capabilities for SFI response improvements	1	FY13	Q4	ASC	HQ, LLNL, LANL, SNL	C11, DSW
6	Develop, implement, and apply a suite of physics-based models and high-fidelity databases to enable predictive simulation of primary boost	1	FY15	Q4	ASC	HQ, LLNL, LANL	C11, C1, C2, C10
7	Develop predictive capability for full-system integrated weapon safety assessment	1	FY16	Q4	ASC	HQ, LLNL, LANL, SNL	C11, C1, C2, DSW
8	Develop, implement, and apply a suite of physics-based models and high-fidelity databases to enable predictive simulation of secondary performance	1	FY20	Q4	ASC	HQ, LLNL, LANL, SNL	C11, C4, C2, C10

Table V-2. Quick Look: Level 2 Milestone Dependencies for FY10[5]

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram(s)	Site(s)
TBD	Demonstrate ALE-AMR capability	2	FY10	Sep-10	IC	LLNL
TBD	Implement additional physics module sharing in nuclear performance code system	2	FY10	Sep-10	IC	LLNL
TBD	Deliver improved implicit and explicit schemes for both thermal and solid mechanics	2	FY10	Sep-10	IC	LLNL
TBD	Advanced hydrogen EOS delivered for QMU	2	FY10	Jun-10	PEM	LLNL
TBD	Development of a novel NIF target capsule design	2	FY10	Sep-10	PEM	LLNL
TBD	Develop and deploy the next-generation multiphase material strength model	2	FY10	Sep-10	PEM	LLNL
TBD	Assess performance of advanced high explosive burn models	2	FY10	Jun-10	PEM	LLNL
TBD	Assess sensitivity of weapon performance to key nuclear physics uncertainties	2	FY10	Jun-10	PEM	LLNL
TBD	Apply Purgatorio and advanced analytic models to assessment of plasma properties and compare to results from molecular dynamics simulations	2	FY10	Sep-10	PEM	LLNL
TBD	Uncertainty Quantification of Selected SCAMP Events	2	FY10	Sep-10	V&V	LLNL
TBD	Uncertainty Quantification of Selected PMP Events	2	FY10	Sep-10	V&V	LLNL
TBD	Scalable Applications Preparations and Outreach for Dawn	2	FY10	Jun-10	CSSE	LLNL
TBD	TSF 7.5 MW Power Upgrade; Phase 1 of 15 MW Upgrade	2	FY10	Sep-10	FOUS	LLNL
TBD	Deploy FrontRange Incident Management Module	2	FY10	Jun-10	FOUS	LLNL
TBD	Certify and Accredit LC to NAPS 14.2c	2	FY10	Sep-10	FOUS	LLNL
TBD	Improved Mix Models	2	FY10	Sep-10	IC	LANL
TBD	High Rate Improvements to Strength Models	2	FY10	Sep-10	IC	LANL
TBD	Improved Pu EOS	2	FY10	Sep-10	IC	LANL

[5] Factors such as FY10 Congressional Appropriations, NNSA/DP directives, and National Security considerations may necessitate a change in the current milestone set.

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram(s)	Site(s)
TBD	Enhance code suite physics and optimization in support of the National Technical Nuclear Forensics Program and High Energy Density Physics experimental program	2	FY10	Mar-10	IC	LANL
TBD	Enhance code suite physics and optimization in support of Directed Stockpile Work (DSW) and the National Code Strategy	2	FY10	Sep-10	IC	LANL
TBD	3D hydro capabilities to support Directed Stockpile Work (DSW)	2	FY10	Jun-10	IC	LANL
TBD	2D burn capabilities to support Directed Stockpile Work (DSW)	2	FY10	Sep-10	IC	LANL
TBD	Advanced Reactive Flow Model for Insensitive High Explosives	2	FY10	Sep-10	PEM	LANL
TBD	Assessment of primary burn in an ASC code	2	FY10	Sep-10	V&V	LANL
TBD	Thermonuclear Applications V&V Assessment of Physics Modeling Capabilities in an ASC Code	2	FY10	Sep-10	V&V	LANL
TBD	Engineering V&V Assessment of a High-Explosive Assembly Stress-State Characterization (HATCH)	2	FY10	Sep-10	V&V	LANL
TBD	Roadrunner Phase 3 transition to operational status	2	FY10	Jun-10	CSSE	LANL
TBD	Visualization-On-Platform technology	2	FY10	Sep-10	CSSE	LANL
TBD	Infrastructure Equipment Upgrades Project	2	FY10	Mar-10	FOUS	LANL
TBD	Coupled thermal and quasistatic failure capabilities for assured safety applications	2	FY10	Sep-10	IC	SNL
TBD	Time-dependent NWM21 Radiation Environment	2	FY10	Sep-10	IC	SNL
TBD	Trilinos/Sierra ToolKit Integration	2	FY10	Sep-10	IC	SNL
TBD	Develop a physics-based model of neutron-damage effects in radiation-hard GaAs-based HBTs and validate against reactor data	2	FY10	Sep-10	PEM	SNL
TBD	Utilize experimentally validated constitutive model for lead-free solder to simulate aging and reliability of solder joints in stockpile components	2	FY10	Sep-10	PEM	SNL
TBD	Implement the Conformal Decomposition Finite Element Method (CDFEM) interface tracking technology with full 3D, parallel, transient capabilities in SIERRA Mechanics and demonstrate application of CDFEM to transient exclusion region melting and flow	2	FY10	Sep-10	PEM	SNL

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram(s)	Site(s)
TBD	Abnormal thermal safety response QMU baseline for B61/3,4,10	2	FY10	Sep-10	V&V	SNL
TBD	Cavity SGEMP V&V	2	FY10	Sep-10	V&V	SNL
TBD	Deliver Visualization-based analysis tools that help quantify margins and uncertainties for SIERRA ensemble runs in support of V&V PE's Full System Safety Milestone in FY12	2	FY10	Sep-10	CSSE	SNL
TBD	Evaluate advanced memory subsystems	2	FY10	Sep-10	CSSE	SNL
TBD	Initial operational assessment of linked implicit and explicit codes for simulating NEP mechanical response to a hostile environment	2	FY10	Sep-10	IC, V&V	LLNL, LANL
TBD	Zia platform system integration readiness	2	FY10	Jun-10	CSSE	LANL, SNL
TBD	Deployment of a common capacity computing environment	2	FY1-	Sep-10	CSSE	LLNL, LANL, SNL

Table V-3. Quick Look: *Preliminary* Level 2 Milestone Dependencies for FY11

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram(s)	Site(s)
TBD	Investigate boost physics issues	2	FY11	Sep-11	IC	LLNL
TBD	Implement algorithms for improved loading on structures	2	FY11	Sep-11	IC	LLNL
TBD	Multiphase Pu EOS variations delivered for QMU	2	FY11	Sep-11	PEM	LLNL
TBD	Assess sensitivity of material properties models to advanced high explosive burn models	2	FY11	Jun-11	PEM	LLNL
TBD	Apply new simulation and modeling capability	2	FY11	Sep-11	PEM	LLNL
TBD	Scalable Applications Preparations and Outreach for Sequoia	2	FY11	Jun-11	CSSE	LLNL
TBD	Data Analysis Plan for Sequoia	2	FY11	Mar-11	CSSE	LLNL
TBD	Develop TOSS 2.0	2	FY11	Sep-11	CSSE	LLNL, LANL, SNL
TBD	Deploy TLCC10 Clusters	2	FY11	Sep-11	FOUS	LLNL
TBD	TSF 7.5 MW Power Upgrade; Phase 2 of 15 MW Upgrade	2	FY11	Sep-11	FOUS	LLNL
TBD	Enhance the code suite physics in support of the Thermonuclear Burn Initiative and the Predictive Capabilities Framework – Initial Conditions for Boost I	2	FY11	Mar-11	IC	LANL
TBD	2D Primary design capability in support of Directed Stockpile Work (DSW)	2	FY11	Jun-11	IC	LANL
TBD	Enhance the code suite physics in support of the National Code Strategy and robustness through improved testing	2	FY11	Sep-11	IC	LANL
TBD	Explore algorithmic diversity in transport methods	2	FY11	Sep-11	IC	LANL
TBD	Explore algorithmic diversity in transport methods	2	FY11	Sep-11	IC	LANL
TBD	Initial Implementation of In-Line NLTE Capability	2	FY11	Mar-11	PEM	LANL
TBD	Subgrid damage model for fragmentation problems	2	FY11	Sep-11	PEM	LANL
TBD	Next Generation of Charged-Particle Data Capabilities	2	FY11	Jun-11	PEM	LANL
TBD	Verification Toolbox	2	FY11	Sep-11	V&V	LANL
TBD	Benchmark evaluation of Predictive Capability for Boost using LANL Boost Validation Suite (BVS)	2	FY11	Sep-11	V&V	LANL

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram(s)	Site(s)
TBD	Engineering V&V Assessment of a Simplified Weapon Subassembly Subjected to Shock Loading	2	FY11	Sep-11	V&V	LANL
TBD	Zia system production readiness	2	FY11	Jun-11	CSSE	LANL
TBD	VIZ cluster upgrade project	2	FY11	Sep-11	CSSE	LANL
TBD	W80 Abnormal Mechanical QMU	2	FY11	Sep-11	V&V	SNL
TBD	Zia Platform Production Capability Readiness	2	FY11	Sep-11	CSSE	SNL

Detailed Milestone Descriptions for FY10

Further milestone descriptions will be added in Rev. 0.1 of this document.

Milestone (ID#): Scalable Applications Preparations and Outreach for Dawn		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: June 30, 2010		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns:		
Description: The Scalable Applications Preparation effort will develop the knowledge base, documentation, and training to provide ASC code teams with support for utilization of the Dawn initial delivery system for Sequoia. SAP will actively engage tri-lab code teams to address their needs in porting codes to Dawn, exploring options for multi-core utilization, characterizing performance issues for the codes. For FY10, tri-lab code teams will be surveyed for needs. One or more multi-physics codes will be engaged to characterize Dawn performance, analyze bottlenecks and load balance issues, and to develop strategies for improving performance targeting the Sequoia system.		

Milestone (ID#): TSF 7.5 MW Power Upgrade; Phase 1 of 15 MW Upgrade		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: 4QFY10		
ASC nWBS Subprogram: 1.5.5.1.4		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: Complete distribution of 7.5 MW computational power upgrade to the TSF West Computer Room.		

Milestone (ID#): Deploy FrontRange Incident Management Module	
Fiscal Year: FY10	**DOE Area/Campaign**: ASC
Completion Date: Q3FY10	
ASC nWBS Subprogram: FOUS 1.5.5.2.1 (Hotlines and User Support)	
Participating Sites: LLNL	
Participating Programs/Campaigns: XXXX	
Description: Livermore Computing's current trouble tracking system, Remedy, will be replaced with the FrontRange IT Service Management product. FrontRange is a product based on industry best practices, the Information Technology Infrastructure Library (ITIL) processes. We will use FrontRange's Incident Management module to provide core service desk functionality to efficiently identify, respond to, and track issues and service requests needing resolution. This Milestone is complete when all LC incidents are managed via the FrontRange system and service level agreement metrics reports are available.	

Milestone (ID#): Certify and Accredit LC to NAPS 14.2c		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: Q4FY10		
ASC nWBS Subprogram: FOUS 1.5.5.1.3		
Participating Sites: LLNL		
Participating Programs/Campaigns: XXXX		
Description: Livermore Computing's cyber security plan accreditation expires March 31, 2010. A new plan must be written to be compliant with the NNSA's NAPS 14.2c cyber security policy. This new policy requires a complete overhaul of LLNL's classified security plans. LC will be a major contributor in the effort to create a Site Security Component Library which will be used as a basis for LC's NAPS compliant plan. All new security test and evaluation (ST&E) plans will be developed to demonstrate NAPS compliance. Ultimately, the LC Information System Security Plan (ISSP) will be developed and delivered. This milestone is complete when the ISSP and the ST&E plans have been submitted and LC has received interim approval to test.		

Milestone (ID#): Roadrunner Phase 3 transition to operational status		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: Apr-10		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: FOUS		
Description: This effort will culminate in the formal transition of the machine and associated infrastructure to production computing. It will also mark the completion of CD-4 in the Roadrunner CD process. The Roadrunner final system is scheduled to deliver a significantly advanced architecture system that should provide compute power of over a petaFLOPS of computing cycles to the weapons program. The advanced architecture hardware will consist of a hybrid computing architecture that has the potential for significant improvements to the price/performance curve to help meet the computing requirements in the future.		

Milestone (ID#): Visualization-On-Platform technology		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: Sep-10		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: The crux of the petascale visualization performance problem is interactive rendering, since it is the most computationally intensive portion of the visualization process. For terascale platforms, commodity clusters with graphics processors (GPUs) have been used for interactive rendering. For petascale platforms, visualization and rendering may be able to run efficiently on the supercomputer platform itself. This milestone will evaluate the visualization and rendering performance of current and next-generation supercomputers in contrast to GPU-based visualization clusters. This milestone will explore and evaluate the maturity level of this technology and it's applicability to applications of interest to the ASC program.		

Milestone (ID#): Infrastructure Equipment Upgrades Project		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: Mar-10		
ASC nWBS Subprogram: FOUS		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: In preparation for the next phase of Supercomputing in 2010 it is necessary to upgrade the existing mechanical and electrical infrastructure in the SCC Facility. The upgrades consists of the procurement and installation of major mechanical equipment (cooling towers, chillers, water cooling skids and air handling units) and major electrical equipment (switchboards and 3000 amp breakers). This milestone will provide the necessary power projected for the Zia Machine in 2010.		

Milestone (ID#): Deliver Visualization-based analysis tools that help quantify margins and uncertainties for SIERRA ensemble runs in support of V&V PE's Full System Safety Milestone in FY12.		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: Sep-10		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: The Full System Safety Milestone requires analysis of complex ensembles of runs, but current tools do not support rich analysis of this data, Instead, analysts rely on summarized analysis of the data. Sandia's Data Analysis and Visualization team, in partnership with Tony Giunta and staff of his recommendation, are targeting ensemble analysis tools to solve analysis problems in support of their FY12 Full System Safety Milestone. It is critical to have ensemble analysis tools in place in FY10, so that those tools can directly support the analysis needed to accomplish the V&V Milestone that will occur in FY11 and FY12. A PCMM evaluation shall be made for this capability.		

Milestone (ID#): Evaluate advanced memory subsystems		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: Sep-10		
ASC nWBS Subprogram: Computational Systems and Software Environment		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Develop a next-generation memory system architecture to increase performance of SNL applications in partnership with industry and academia. Sandia is providing simulation capabilities, performing architectural analysis, and supplying application expertise. Simulation of this system shall show order of magnitude improvements in memory system performance. Simulation shall also be used to design new memory access protocols, evaluate the power/performance tradeoffs of different memory system topologies, and determine how overall system balance (processor core count and capabilities, interconnect bandwidths, and memory hierarchy sizes) should be altered to take advantage of the new memory system. Additionally, the performance impact of "Smart" memory operations including atomic memory operations, flexible data movement offload, and in-memory synchronization, shall be quantified in simulation and in an FPGA prototype. The architecture shall be defined with an industrial partner who will develop a concept prototype.		

Milestone (ID#): Zia Platform System Integration Readiness		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: Sep-10		
ASC nWBS Subprogram: Computational Systems and Software Environment		
Participating Sites: SNL, LANL		
Participating Programs/Campaigns: ASC		
Description: Zia will achieve System Integration Readiness as defined by the Capability Platform Level 2 Milestones Working Group. In summary, this includes all hardware delivered, installed and contractual acceptance has been substantially completed. System software needed for basic operation has been delivered, tested and demonstrated to be operational. The vendor has demonstrated capability scaling functionality and the system is ready to begin on-site integration. The Zia platform is ready for integration into the LANL computer center, and prepared for operation in support of tri-lab computing, through the ACES partnership.		

Milestone (ID#): Deployment of a common capacity computing environment		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: Sep-11		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL, LANL, SNL		
Participating Programs/Campaigns: XXXX		
Description: Deploy Common Computing Environment (CCE) capabilities developed during FY09 including: major upgrades to the common operating system (TOSS); Open|SpeedShop; Workload Characterization; Application Monitoring; and Gazebo Test and Analysis Suite. Demonstrate the tri-lab CCE software stack on the production ASC Tri-Lab Linux Capacity Clusters (TLCC) systems. Develop new capabilities in the continuing FY10 CCE projects. The tri-labs will continue to do gap and risk analysis of the CCE software stack and add new projects, as needed, to address high-priority gaps.		

Milestone Descriptions for Preliminary FY11

Milestone (ID#): Scalable Applications Preparations and Outreach for Sequoia		
Level: 2	**Fiscal Year**: FY11	**DOE Area/Campaign**: ASC
Completion Date: June 30, 2011		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: XXXX		
Description: Building on the FY10 milestone, the Scalable Applications Preparation (SAP) effort will extend the knowledge base, documentation, and training for Dawn. SAP will engage tri-lab code teams to address their needs in porting codes to Dawn, and preparing for arrival of Sequoia in FY12. For FY11, additional multi-physics codes will be engaged to characterize Dawn performance, analyze bottlenecks and load balance issues, and to develop strategies for improving performance targeting the Sequoia system. Additional refinements to understanding and performance enhancements will be achieved for the codes previously targeted.		

Milestone (ID#): Data Analysis Plan for Sequoia		
Level: 2	**Fiscal Year**: FY11	**DOE Area/Campaign**: ASC
Completion Date: Dec 31, 2011		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns:		
Description: This plan defines LLNL's site strategy for Tri-lab large-scale data analysis on Sequoia and its related infrastructure environment. It is a Sequoia-specific follow-on to the FY08 Level 2 Milestone "Infrastructure Plan for ASC Petascale Environments" (LLNL Technical Report 402112), and addresses Phase 2 (i.e., FY11-FY13) petascale data analysis on Sequoia. The plan will provide detailed description of tools and capabilities for data movement, data analysis, visualization, and mass store archiving that will be deployed to support petascale data tasks for Sequoia users. While this plan primarily will describe LLNL site-specific development, deployment and operational support for Sequoia, the objective is for the described data capabilities to be used by the broad Tri-lab user community in support of Sequoia UQ and weapon science simulations.		

Milestone (ID#): Develop TOSS 2.0	
Fiscal Year: FY11	**DOE Area/Campaign**: ASC
Completion Date: Q4FY11	
ASC nWBS Subprogram: CSSE – 1.5.4.1.1 and CSSE – 1.5.4.x.x (CCE)	
Participating Sites: LLNL, SNL, LANL	
Participating Programs/Campaigns: XXXX	
Description: In FY11, deploy Common Computing Environment (CCE) capabilities developed during FY10 and FY11, including the next major release of common operating system (TOSS 2.0) and software stack. Prepare for deployment of the next generation of the ASC Tri-Lab Linux Capacity Clusters (TLCC) systems, which may include hardware and software integration and testing for the tri-lab environment.	

Milestone (ID#): Deploy TLCC10 Clusters	
Fiscal Year: FY11	**DOE Area/Campaign**: ASC
Completion Date: Q4FY11	
ASC nWBS Subprogram: **FOUS 1.5.5.1.1**	
Participating Sites: LLNL, SNL, LANL	
Participating Programs/Campaigns: XXXX	
Description: Deploy next generation ASC Tri-Lab Linux Capacity Clusters (TLCC) systems into production computing environments.	

Milestone (ID#): TSF 7.5 MW Power Upgrade; Phase 2 of 15 MW Upgrade		
Level: 2	**Fiscal Year**: FY11	**DOE Area/Campaign**: ASC
Completion Date: 4QFY11		
ASC nWBS Subprogram: 1.5.5.1.4		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: Complete distribution of 7.5 MW computational power upgrade to the TSF East Computer Room.		

Milestone (ID#): Zia Platform Production Capability Readiness		
Level: 2	**Fiscal Year**: FY11	**DOE Area/Campaign**: ASC
Completion Date: Jun-11		
ASC nWBS Subprogram: Computational Systems and Software Environment (CSSE)		
Participating Sites: SNL, LANL		
Participating Programs/Campaigns: ASC		
Description: Zia shall achieve Production Capability Readiness as defined by the Capability Platform Level 2 Milestones Working Group. In summary, this includes the platform is made available for capability-class projects; all system software, tools, utilities and user support processes are available and fully functional; ASC applications targeted for the platform are ported and made available to designers, analysts, and engineers; the platform has demonstrated acceptable reliability performance targets.		

Milestone (ID#): VIZ cluster upgrade project		
Level: 2	**Fiscal Year**: FY11	**DOE Area/Campaign**: ASC
Completion Date: Sep-11		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: The focus of this milestone will be to provide the necessary resources to visualize output generated on peta-scale clusters. Requirements will be developed, equipment will be purchased, and the cluster will be integrated into the LANL computer center. The milestone will be complete when the cluster is ready for production work.		

Milestone (ID#): Zia Platform Production Capability Readiness		
Level: 2	**Fiscal Year**: FY11	**DOE Area/Campaign**: ASC
Completion Date: Jun-11		
ASC nWBS Subprogram: Computational Systems and Software Environment (CSSE)		
Participating Sites: SNL, LANL		
Participating Programs/Campaigns: ASC		
Description: Zia shall achieve Production Capability Readiness as defined by the Capability Platform Level 2 Milestones Working Group. In summary, this includes the platform is made available for capability-class projects; all system software, tools, utilities and user support processes are available and fully functional; ASC applications targeted for the platform are ported and made available to designers, analysts, and engineers; the platform has demonstrated acceptable reliability performance targets.		

VI. ASC Roadmap Drivers for FY10–FY11

Table VI-1. ASC Roadmap Drivers for FY10-11[6]

To be added in Rev. 0.1.

[6] The ASC Top Ten Risks table was originally published in the *ASC Program Plan FY05*.

VII. ASC Risk Management

Risk management is a process for identifying and analyzing risks, executing mitigation and contingency planning to minimize potential consequences of identified risks, and monitoring and communicating up-to-date information about risk issues. Risk management is about identifying opportunities and avoiding losses. A "risk" is defined as (1) a future event, action, or condition that might prevent the successful execution of strategies or achievement of technical or business objectives, and (2) the risk exposure level, defined by the likelihood or probability that an event, action, or condition will occur, and the consequences, if that event, action, or condition does occur. Table VII-1 summarizes ASC's top ten risks, which are managed and tracked.

Table VII-1. ASC's Top Ten Risks[7]

No	Risk Description	Risk Assessment			Mitigation Approach
		Consequence	Likelihood	Risk Exposure	
1	Compute resources are insufficient to meet capacity and capability needs of designers, analysts, DSW, or other Campaigns.	High	High	HIGH	Integrate program planning with DSW and other Campaigns, to ensure requirements for computing are understood and appropriately set; maintain emphasis on platform strategy as a central element of the program; pursue plans for additional and cost-effective capacity platforms.
2	Designers, analysts, DSW, or other Campaign programs lack confidence in ASC codes or models for application to certification /qualification.	Very High	Low	MEDIUM	Maintain program emphasis on V&V; Integrate program planning with DSW and other Campaign programs to assure requirements needed for certification/qualification are properly set and met.

[7] The ASC Top Ten Risks table was originally published in the *ASC Program Plan FY05*.

No	Risk Description	Risk Assessment			Mitigation Approach
		Consequence	Likelihood	Risk Exposure	
3	Inability to respond effectively with Modeling & Simulation (M&S) capability and expertise in support of stockpile requirements – near or long term, planned or unplanned (LEP, SFIs, etc.).	Very High	Low	MEDIUM	Integrate program planning, particularly technical investment priority, with DSW and other Campaign programs to ensure capability and expertise is developed in most appropriate areas; retain ability to apply legacy tools, codes, models.
4	Base of personnel with requisite skills, knowledge, and abilities erodes.	High	Low	MEDIUM	Maintain emphasis on "best and brightest" personnel base, with Institutes, Research Foundations, and University programs, as central feeder elements of the program.
5	Advanced material model development more difficult, takes longer than expected.	Moderate	High	MEDIUM	Increase support to physics research; pursue plans for additional computing capability for physics and engineering model development
6	Data not available for input to new physics models or for model validation.	High	Moderate	MEDIUM	Work with Science and Engineering Campaigns to obtain needed data; propose relevant experiments.
7	Infrastructure resources are insufficient to meet designer, analyst, DSW, or other Campaign program needs.	High	Low	MEDIUM	Integrate program planning with DSW and other Campaigns, to ensure requirements for computing are understood and appropriately set; maintain emphasis on system view of infrastructure and PSE strategy, as central elements of the program.
8	External regulatory requirements delay program deliverables by diverting resources to extensive compliance-related activities	Moderate	Low	MEDIUM	Work with external regulatory bodies to assure that they understand NNSA's mission, ASC's mission, and the processes to set and align requirements and deliverables, consistent with applicable regulations.

No	Risk Description	Risk Assessment			Mitigation Approach
		Consequence	Likelihood	Risk Exposure	
9	Inadequate computational environment impedes development and use of advanced applications on ASC platforms.	Moderate	Very Low	LOW	Integrated planning between program elements to anticipate application requirements and prioritize software tools development and implementation.
10	Fundamental flaws discovered in numerical algorithms used in advanced applications require major changes to application development.	Moderate	Very Low	LOW	Anticipate or resolve algorithm issues through technical interactions on algorithm research through the Institutes, ASC Centers, and academia, and focus on test problem comparisons as part of software development process.

VIII. Performance Measures

Table VIII-1. ASC Campaign Annual Performance Results and Targets

(R = Results; T = Target)

Performance Indicators	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Endpoint Target
Strategic Goal 2.1 (Nuclear Deterrent) GPRA Unit Program Goal 2.1.30.00, Advanced Simulation and Computing Campaign										
Adoption of ASC Modern Codes: The cumulative percentage of simulation runs that utilize modern ASC-developed codes on ASC computing platforms as measured against the total of legacy and ASC codes used for stockpile stewardship activities (Long-term Outcome)	N/A	R: 50%	R: 63%	T: 72%	T: 80%	T: 85%	T: 90%	T: 95%	T: 100%	By 2013, ASC-developed modern codes are used for all simulations on ASC platforms. Adoption of Modern ASC Codes will enable a responsive simulation capability for the nuclear weapons complex. This measure is meant to show how quickly ASC codes are being adopted by the user community in place of legacy codes.
Reduced Reliance on Calibration: The cumulative percentage reduction in the use of calibration "knobs" to successfully simulate nuclear weapons performance (Long-term Outcome)	N/A	R: 2%	R: 8%	T: 16%	T: 25%	T: 33%	T: 41%	T: 50%	T: 58%	By 2018, the four major calibration knobs affecting weapons performance simulation have been replaced by science-based, predictive phenomenological models. Reduced reliance on calibration will ensure the development of robust ASC simulation tools, These tools are intended to enable the understanding of the complex behaviors and effect of nuclear weapons, now and into the future, without nuclear testing.
ASC Impact on SFI Closure: The cumulative percentage of nuclear weapon Significant Finding Investigations (SFIs) resolved through the use of modern (non-legacy) ASC codes, measured against all codes used for SFI resolution (Long-term Outcome)	N/A	R: 10%	R: 25%	T: 37%	T: 50%	T: 62%	T: 75%	T: 87%	T: 100%	By 2013, ASC codes will be the principal tools for resolution of all SFIs. This demonstrates how valuable the ASC tools are for meeting the needs of the weapon designer's analysts by documenting the impact on closing SFIs.

Performance Indicators	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Endpoint Target
Code Efficiency: The cumulative percentage of simulation turnaround time reduced while using modern ASC codes (Efficiency)	N/A	R: 6%	R: 7%	T: 13%	T: 26%	T: 32%	T: 39%	T: 45%	T: 50%	By 2013, achieve a 50% reduction in turnaround time, as measured by a series of benchmark calculations, for the most heavily used ASC codes. To show code efficiency by demonstrating that simulation time decreases as the ASC codes mature.
NOTE: Performance measures were revised in 2007 to be consistent with new program roadmap.										

Table VIII-2. ASC Performance Measurement Data for FY10

Table will be included in Rev. 0.1.

IX. Budget

To be added in Rev. 0.5.

Appendix A. Glossary

The Glossary will be added in Rev. 0.5 of this document.

Appendix C. Points of Contact

The Points of Contact will be added in Rev. 0.1 of this document.

Appendix D.
WBS 1.5.1.4-TRI-001 Academic Alliance Centers

The Academic Alliance Centers project includes research activities at the eight funded academic centers as part of the ASAP and PSAAP, as listed below.

Academic Strategic Alliance Program:

- University of Chicago
- University of Illinois at Urbana-Champaign (UIUC)
- University of Utah

Predictive Science Academic Alliance Program:

- California Institute of Technology (Caltech)
- Purdue University
- Stanford University
- University of Michigan
- University of Texas, at Austin
- The Predictive Science Academic Alliance Program will be added in Rev. 0.1 of this document.

Appendix E.
ASC Obligation/Cost Plan

Graph will be included in Rev. 0.1.

Figure D-1. ASC obligation/cost plan for FY10.