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FY09–FY10 Implementation Plan

Volume 2, Rev. 0

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Advanced Simulation and Computing

FY09–10 IMPLEMENTATION PLAN
Volume 2, Rev. 0

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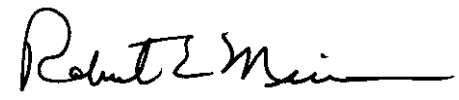
Approved by:

Robert Meisner, NNSA ASC Program Director (acting)		*7/8/2008*
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Implementation Plan Contents at a Glance

Section No./Title		Vol. 1	Vol. 2	Vol. 3
I.	Executive Summary			
II.	Introduction			
III.	Accomplishments			
IV.	Product Descriptions			
V.	ASC Level 1 and 2 Milestones			
VI.	ASC Roadmap Drivers for FY09–FY10			
VII.	ASC Risk Management			
VIII.	Performance Measures			
IX.	Budget			
Appendix A.	Glossary			
Appendix B.	Points of Contact			
Appendix C.	1.5.1.4-TRI-002 Predictive Science Academic Alliance Program			
Appendix D.	1.5.1.4-TRI-001 Alliance Support			
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 safety and reliability of the U.S. nuclear stockpile. The SSP uses past nuclear test data along with current and future nonnuclear 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 (SLEPs) 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 the 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 performances 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) long-term strategic goal of Nuclear Weapons Stewardship: *"ensure that our nuclear weapons continue to serve their essential deterrence role by maintaining and enhancing the safety, security, and reliability of the U.S. nuclear weapons stockpile."*[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 Acting 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 Plan, page 8.

[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, including the Robust Nuclear Earth Penetrator) 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 quantify critical margins and uncertainties (QMU), to resolve the increasingly difficult analyses needed for stockpile stewardship. The DSW provides requirements for simulation, including planned SLEPs, 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 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-teraops systems in the world and have both since been decommissioned.

[4] While there are no plans to develop new weapons, gaining the 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-teraops 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-teraops platform on the ASCI Q machine.

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 nonnuclear experiments and diagnostics.

In FY05, ASC identified and documented SSP requirements to move beyond a 100-teraops 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 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 a robust 100-teraFLOPS-platform production environment supporting DSW and Campaign simulation requirements. This was augmented by the 360-teraFLOPS ASC BlueGene/L system, which provided additional capability for science campaigns.

By FY08, ASC will deliver 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 will be sited at Los Alamos National Laboratory (LANL).

By FY09, a modern baseline of all enduring stockpile systems, using ASC codes, will be completed.

In FY10 and beyond, ASC will continue to deliver codes 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.

Table II-1. Defense Program Campaigns

Campaign Number	Campaign Title
C1	**Primary Assessment Technology and Test Readiness**
C2	**Dynamic Materials Properties**
C3	**Advanced Radiography**
C4	**Secondary Assessment Technology**
C5	**Enhanced Surety**
C6	**Weapon Systems Engineering Assessment Technology**
C7	**Nuclear Survivability**
C8	**Enhanced Surveillance**
C9	**Advanced Design & Production Technologies**
C10	**Inertial Confinement Fusion Ignition and High Yield Campaign**
C11	**Advanced Simulation and Computing**
C12	**Pit Manufacturing and Certification Campaign**
C15	**Nonnuclear Readiness**
C16	**Materials Readiness**
C18	**Engineering Campaigns Construction Activities**
C19	**Advanced Design & Production Technologies Readiness**

The National Work Breakdown Structure

ASC's program structure is based on the new national work breakdown structure (nWBS), described in the ASC Business Model (NA-ASC-104R-05-Vol.1-Rev.5).

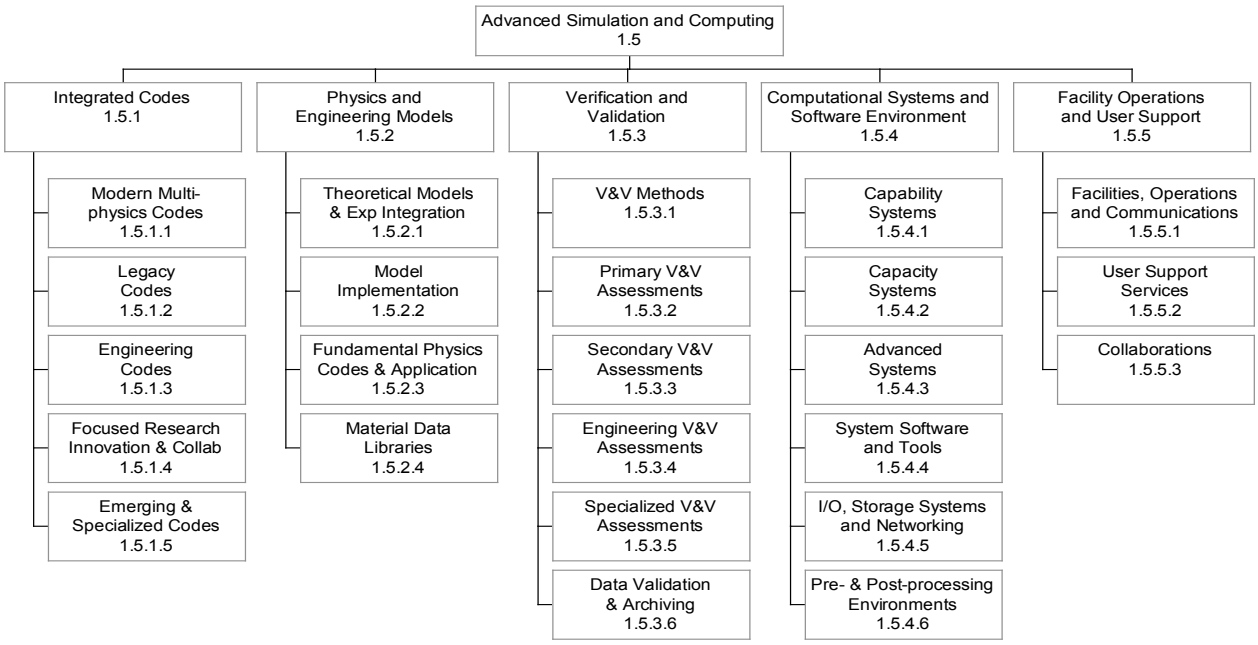

Figure II-1. The ASC program structure is based on the new national work breakdown structure.

Sub-Programs

As the chart visualizes, ASC is divided into five sub-programs:

- Integrated Codes
- Physics and Engineering Models
- Verification and Validation
- Computational Systems and Software Environment
- Facility Operations and User Support

The first three sub-programs focus on improved models in the modern codes, delivery of validated tools, and response to SSP issues (for example, SFIs, LEPs, annual assessments). Key drivers are to improve the confidence in prediction through simulations; to calculate, measure, and understand the uncertainty in the predictions; and to ensure rapid delivery of simulation capabilities to the SSP.

The fourth sub-program, Computational Systems and Software Environment, ensures the development and deployment of a computing environment needed for all ASC-deployed platforms: capability, capacity, and advanced systems.[5] Not only is this sub-

[5] The ASC Program is in transition for current platforms. Future platforms will follow the Capital Acquisition Management process identified in the NA-10 *Program Management Manual*.

program responsible for related research and technology development, but it is also responsible for planning, procurement, and quality control activities.

The fifth, and last, sub-program, Facility Operations and User Support, provides operational support for production computing and storage, user support services, and collaborative research opportunities with educational institutions, as well as programmatic support across the ASC program.

Product Deliverables

The Product deliverables are described at level 4 and span the full-scope of the program in the context of the nWBS. They describe what the Laboratories expect to provide to a given Product as a result of their activities.

Deliverables can, but do not necessarily, contribute to level 2 milestones chosen in a given fiscal year. Deliverables that do directly contribute to level 2 milestones for the fiscal year will be reviewed in the context of level 2 milestone reviews.

III. Accomplishments for FY07–FY08

ASC accomplishments from Quarter 4, fiscal year 2007, through quarter 3, fiscal year 2008, 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.

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 Input/Output (I/O), storage and networking, to pre- and post-processing visualization and data analysis tools. 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 FY09

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 FY09

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 testbed 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 FY09

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 FY09

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 (input/output, or 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 testbed 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 FY09

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: Pre- and Post-Processing Environments

This level 4 product provides integrated environments to support end-user simulation set up, and post-processing 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 optimized problem set-up and meshing, metadata and scientific data management, and application-specific and general-purpose visualization, analysis, and comparison. Research includes innovative data access methods and visualization of massive, complex data. Special focus will be placed on tools for improving end-user productivity. Also included are procurement, deployment, and support of office and collaborative space visualization displays, mechanisms for image data delivery, and custom graphics rendering hardware.

Pre- and Post-Processing Environments Deliverables for FY09

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 FY09

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 FY09

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 high-performance computing 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 FY09

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
359	Complete modern baseline of all enduring stockpile systems with ASC codes.	1	2009	Sep-09	ASC	HQ, LLNL, LANL, SNL	DSW Deliverables
1	Develop, implement, and apply a suite of physics-based models and high-fidelity databases to enable predictive simulation of the initial conditions for secondary performance.	1	FY09	Q4	ASC	HQ, LLNL, LANL, SNL	C11, C4
2	Develop, implement, and validate a suite of physics-based models and high-fidelity databases in support of Full Operational Capability in DTRA's National Technical Nuclear Forensics program.	1	FY09	Q4	ASC	HQ, LLNL, LANL	C11, C1, C4, NA-22, DTRA
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 FY09[6]

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram(s)	Site(s)	ASC Category
TBD	Explore impact of high-fidelity models on device performance	2	09	Sep-09	IC	LLNL	
TBD	Improve physics models, code usability, and nuclear databases in support of nuclear forensic full operational capability	2	09	Sep-09	IC	LLNL	
TBD	Improve HED AGES modeling capability in LLNL's ASC nuclear design code	2	09	Jun-09	IC	LLNL	
TBD	Establish initial high-fidelity full-device baseline capability	2	09	Dec-08	IC	LLNL	
TBD	New global EOS data library delivered for QMU, V&V, and other applications	2	09	Sep-09	PEM	LLNL	
TBD	High-resolution exploration of two key UGT events	2	09	Sep-09	PEM	LLNL	
TBD	Advanced detonation model for 3D simulations	2	09	Sep-09	PEM	LLNL	
TBD	Numerical convergence study of selected burn calculations	2	09	Jun-09	V&V	LLNL	
TBD	Top 20 uncertain parameters in a primary device calculation	2	09	Jun-09	V&V	LLNL	
TBD	Development of First Version of the Computational UQ Pipeline	2	09	Sep-09	V&V	LLNL	
TBD	First Demonstration of Secondary Computational Assessment Metric Project (SCAMP) Across Several UGT's using the Computational UQ Pipeline	2	09	Sep-09	V&V	LLNL	
TBD	TLCC hardware delivery and acceptance at LLNL TLCC clusters in production at LLNL	2	09	Jun-09	CSSE, FOUS	LLNL	
TBD	Deploy Dawn ID machine for limited availability use	2	09	Sep-09	CSSE, FOUS	LLNL	
TBD	Release of a Shavano project code to support X Program requirements, attribution, TBI and Science Campaigns	2	09	Mar-09	IC	LANL	
TBD	Release of a Shavano project code to support X Program requirements, attribution, TBI and Science Campaigns	2	09	Sep-09	IC	LANL	
TBD	Release of a Crestone project code to support threat reduction, mix validation studies, weapons systems baselines, TBI and NBI and X3 component framework	2	09	Mar-09	IC	LANL	

[6] Factors such as FY09 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)	ASC Category
TBD	Release of a Crestone project code to support threat reduction, mix validation studies, weapons systems baselines, TBI and NBI and X3 component framework	2	09	Sep-09	IC	LANL	
TBD	Verification of high resolution Thermonuclear Burn Initiative (TBI) hydrodynamic simulations	2	09	Jun-09	IC	LANL	
TBD	Initial Implementation of continuous-energy Monte Carlo neutron transport kernel from Monte Carlo Application Toolkit (MCATK) project	2	09	Jun-09	IC	LANL	
TBD	Release of merged MCNP5 and MCNPX code	2	09	Sep-09	IC	LANL	
TBD	Deliver software tools that will support urban particulate dispersal simulations and seismic detection/determination of proliferant events using detailed source region descriptions between ASC and other supporting codes	2	09	Sep-09	IC	LANL	
TBD	Roadrunner mission science simulations: ejecta and TN Burn	2	09	Sep-09	PEM	LANL	
TBD	Attribution – Deliver ASC capabilities for nuclear forensics	2	09	Sep-09	PEM	LANL	
TBD	Enhanced material model for damage and strength in ASC codes	2	09	Sep-09	PEM	LANL	
TBD	Plutonium fission – models for neutron spectra and UQ assessment	2	09	Sep-09	PEM	LANL	
TBD	Assessment of specific ASC code capabilities for Thermonuclear Applications	2	09	Jun-09	V&V	LANL	
TBD	Initial implementation of LANL Boost Validation Suite (BVS)	2	09	Sep-09	V&V	LANL	
TBD	Calculation verification of a full-system mechanical response simulation of a hostile blast environment	2	09	Sep-09	V&V	LANL	
TBD	Prototype full-system uncertainty quantification using ASC code capabilities	2	09	Sep-09	V&V	LANL	
TBD	Take delivery of Roadrunner Phase 3 system	2	09	Dec-08	CSSE	LANL	
TBD	Acceptance of Roadrunner Phase 3 System at scale	2	09	Mar-09	CSSE	LANL	
TBD	Performance assessment of the full Roadrunner System	2	09	Sep-09	CSSE	LANL	
TBD	SCC Infrastructure Upgrades Project	2	09	Sep-09	FOUS	LANL	
TBD	HPSS 7.1 deployment	2	09	Sep-09	FOUS	LANL	
TBD	Complete consolidation of thermal/fluid capabilities and consolidation of solid mechanics			Sep-09	IC	SNL	

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram(s)	Site(s)	ASC Category
	capabilities in SIERRA Mechanics						
TBD	Coupled thermal structural capability in SIERRA Mechanics to model structural collapse during a fire			Sep-09	IC	SNL	
TBD	Initial SIERRA Mechanics capability of coupled PREMO/CALORE ablation capability for reentry environments			Sep09	IC	SNL	
TBD	Improved energy dissipation models for predictive mechanical response			Sep-09	IC	SNL	
TBD	Algorithms for smart, adaptive uncertainty assessments			Sep-09	IC	SNL	
TBD	Demonstrate capability to build and manage massive meshes			Sep-09	IC	SNL	
TBD	Consolidated DART Workbench			Sep-09	IC	SNL	
TBD	Mixed Signal Electrical Setup/Modeling			Sep-09	IC	SNL	
TBD	Improved pressure fluctuation model for turbulent flow			Sep-09	IC	SNL	
TBD	Uncertainty analysis for the prediction of x-ray dose-rate environment in a weapon system			Sep-09	V&V	SNL	
TBD	Computational uncertainty quantification for the QASPR Silicon circuit prototype			Jun-09	V&V	SNL	
TBD	Deliver smart simulation/experimental petascale data comparison tools	2	09	Sep-09	CSSE	SNL	
TBD	Evaluation of the impact chip multiprocessors have on Sandia application performance	2	09	Sep-09	CSSE	SNL	
TBD	Red Storm 284 teraFLOPS upgrade	2	09	Dec-08	CSSE	SNL	
TBD	Deploy Tripod capabilities for capacity computing environment	2	09	Sep-09	CSSE, FOUS	LLNL, LANL, SNL	
TBD	Zia platform RFP requirements	2	09	Jun-09	CSSE	LANL, SNL	

Table V-3. Quick Look: *Preliminary* Level 2 Milestone Dependencies for FY10

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram(s)	Site(s)	ASC Category
TBD	Next generation multiphase, multiscale strength model	2	10	Jun-10	PEM	LLNL	
TBD	Standard calculation 2010 (SC10)	2	10	Sep-10	V&V	LLNL	
TBD	Continued Development of Computational Pipeline	2	10		V&V	LLNL	
TBD	Expansion of SCAMP Using the Computational Pipeline for High Fidelity Models	2	10		V&V	LLNL	
TBD	Multiphase EOS assessed in our codes	2	10	Sep-10	PEM	LANL	
TBD	Improved mix models in our codes assessed in universal model and in validation suite	2	10	Sep-10	PEM	LANL	
TBD	Upgraded PTW strength model for high strain rates	2	10	Sep-10	PEM	LANL	
TBD	Implement new non-LTE inline opacity capability in codes	2	10	Sep-10	PEM	LANL	
TBD	Advanced HE model for insensitive high explosive	2	10	Sep-10	PEM	LANL	
TBD	Assessment of ASC code capabilities for Thermonuclear Applications: Stockpile features and primary outputs	2	10	Jun-10	V&V	LANL	
TBD	Benchmark evaluation of Predictive Capability for Boost using LANL Boost Validation Suite	2	10	Sep-10	V&V	LANL	
TBD	Verification and validation assessment of coupled implicit/explicit codes for simulation of mechanical response in hostile environments	2	10	Sep-10	V&V	LANL	
TBD	Roadrunner Phase 3 Transition to Operational Status	2	10	Sep-10	CSSE	LANL	
TBD	Demonstration of advanced algorithms for predicting coupled flow and temperature of fuels in complex environments	2	10	Sep-10	IC	SNL	
TBD	Uncertainty analysis for the prediction of the effect of x-ray dose-rate on a circuit or subsystem	2	10	Sep-10	V&V	SNL	
TBD	Uncertainty analysis for prediction of cavity SGEMP effects in a reentry body	2	10	Sep-10	V&V	SNL	
TBD	Evaluate advanced memory subsystems	2	10	Mar-10	CSSE	SNL	
TBD	Zia platform delivery	2	10	Dec-09	CSSE	LANL, SNL	
TBD	Zia platform general availability	2	10	Jun-10	CSSE	LANL, SNL	

Detailed Milestone Descriptions for FY09

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

Milestone (ID#): TLCC clusters in production at LLNL		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: Dec-08		
ASC nWBS Subprogram: CSSE, FOUS		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: This milestone is the culmination of the TLCC platform procurement and will be satisfied when all classified scalable units are functioning properly on the classified network and science codes are running at scale on the classified side. This is the progression past the acceptance phase of the hardware and software stack on the unclassified side and encompasses running NIF and SSP science at scale on the classified network. Both the 8 Scalable Unit Juno system for weapons applications and the 2 Scalable Unit Eos system for NIF applications are part of this Milestone.		

Milestone (ID#): Deploy Dawn ID machine for limited availability use		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: Sep-09		
ASC nWBS Subprogram: CSSE, FOUS		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: This milestone will be a result of work started three years ago with the planning for a multi-petaFLOP UQ-focused platform (Sequoia) and will be satisfied when a smaller Initial Delivery (ID) version of the final system is delivered, installed, integrated, accepted, and deployed at LLNL for LA Tri-lab ASC use in support of SSP mission. The end product of this milestone will be a LA petascale computing system, code named Dawn, to be used for code development and scaling necessary to ensure effective use of a final Sequoia platform (expected in 2011-2012). The Dawn ID system will also be used for urgent nearer-term SSP program needs, in particular for UQ, National Boost Initiative (NBI) and energy balance PCF pegpost deliverables. The overall Sequoia platform strategy is based on availability, for at least two or three years, of a significant ID system upon which simulations can evolve and adapt to the architectural evolution inherent in Sequoia platform planning process. This approach enhances the probability of effective use of Sequoia during its lifecycle. Allocation and scheduling of Dawn as an LA system will likely be performed informally, similar to what has been used for BlueGene/L. However, provision will be made to allow for dedicated access times for application scaling studies across the entire Dawn resource.		

Milestone (ID#): Take delivery of Roadrunner Phase 3 system		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: Dec-08		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: The focus of this effort will be to provide the resources needed to deliver the Phase 3 system to LANL in FY08. 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#): Acceptance of Roadrunner Phase 3 System at scale		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: Mar-09		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: FOUS, IC, PEM		
Description: The focus of this effort will be to perform the necessary software testing and evaluation of the Phase 3 system to ensure the requirements for acceptance of the system are met in preparation for transitioning the system to the operations. Included in this effort will be industry-standard LINPAC evaluation and LANL specific scientific acceptance tests. 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#): Performance assessment of the full Roadrunner System		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: Sep-09		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: Assess the performance of the full system Roadrunner on a realistic application workload. The work will include analyzing the differences between the achieved/measured performance and the achievable/modeled performance on full applications and optimize the system to maximize performance.		

Milestone (ID#): SCC Infrastructure Upgrades Project		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: Sep-09		
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#): HPSS 7.1 deployment		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: September, 2009		
ASC nWBS Subprogram: FOUS		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: HPSS release 7.1 will be deployed on the unclassified network by 2Q09 and on the classified network by 4Q09. This release has major metadata performance improvements for small file inserts, tape aggregations for small files, and administrative improvements including real time monitoring of the system.		

Milestone (ID#): Deliver smart simulation/experimental petascale data comparison tools		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: Sep-09		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: We will extend our characterization and comparison tools to handle ensembles of large-scale simulation data, and associated experimental data, which might be described and characterized very differently.		

Milestone (ID#): Evaluation of the impact chip multiprocessors have on Sandia application performance		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: Sep-09		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: SNL will investigate the impact of Chip Multi-Processors (CMPs) on the performance of important SNL application codes and the impact of CMPs on the performance and applicability of SNL's system software. This investigation will make algorithmic and architectural recommendations for next generation platform acquisitions, which will be documented in a report.		

Milestone (ID#): Red Storm 284 teraFLOPS upgrade		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: Dec-08		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Sandia will complete the upgrade of the Red Storm computer system to a peak of ~284TF in FY09. The middle section, or 6240 of the 12,960 compute nodes, will be upgraded to 2.2 GHz quad-core Opteron processors. The memory on the entire system will be upgraded to 2 GB per core. The upgrade involves replacing 1560 compute node boards, 6240 compute node processors and all associated memory. The memory from the compute nodes boards that are being replaced will be reused to populate all remaining dual core nodes with 4GB of memory. The existing cabinets, backplanes, interconnect, cabling, and service and I/O nodes will be reused. The system will then have a 38,400 compute node cores with 75TB of compute node memory.		

Milestone (ID#): Deploy Tripod capabilities for capacity computing environment		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: Sep-09		
ASC nWBS Subprogram: CSSE, FOUS		
Participating Sites: LLNL, LANL, SNL		
Participating Programs/Campaigns: ASC		
Description: Deploy additional Tripod capabilities for capacity computing environment, working towards a responsive and more efficient infrastructure to support computing for QMU and predictivity.		

Milestone (ID#): Zia platform RFP requirements		
Level: 2	**Fiscal Year**: FY09	**DOE Area/Campaign**: ASC
Completion Date: Jun-2009		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL, SNL		
Participating Programs/Campaigns: CSSE		
Description: As a part of the Alliance for Computing at Extreme Scales (ACES) partnership with LANL, develop, issue and evaluate the RFP for the Zia platform and award a contract. (This milestone needs to be coordinated with LANL and is also dependent on the CD process, which should be reflected in another milestone.)		

Milestone Descriptions for Preliminary FY10

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

Milestone (ID#): Roadrunner Phase 3 transition to operational status		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date:		
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#): Evaluate advanced memory subsystems		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: Mar-10		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Develop, with industry and academia partnerships, an advanced memory subsystem to increase the effective performance of SNL application workloads on next generation microprocessors. Advanced functionality includes (but not limited to) the following operations: atomic memory operations, scatter/gather, in-memory copy/zero/fill/etc, and in-memory synchronization. The architecture will be defined, validated and documented with an industrial partner agreement to develop prototypes.		

Milestone (ID#): Zia platform delivery		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: Dec-09		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL, LANL		
Participating Programs/Campaigns: ASC		
Description: As a part of the ACES partnership with LANL, deliver the Zia platform. (This milestone needs to be coordinated with LANL and is also dependent on the CD process, which should be reflected in another milestone.)		

Milestone (ID#): Zia platform general availability		
Level: 2	**Fiscal Year**: FY10	**DOE Area/Campaign**: ASC
Completion Date: Jun-10		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL, LANL		
Participating Programs/Campaigns: ASC		
Description: As a part of the ACES partnership with LANL, deploy the Zia platform. (This milestone needs to be coordinated with LANL and is also dependent on the CD process, which should be reflected in another milestone.)		

VI. ASC Roadmap Drivers for FY09–FY10

Table VI-1. ASC Roadmap Drivers for FY09-10[7]

To be added in Rev. 0.1.

[7] 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[8]

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.

[8] 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 (SLEP, 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 model development
6	Data not available for input to new physics models or for model validation.	High	Moderate	MEDIUM	Work with Science 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 Annual Performance Results (R) and Targets (T)

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.										

Appendix A. Glossary

The Glossary will be added in Rev. 0.1 of this document.

Appendix B. Points of Contact

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

Appendix C. WBS 1.5.1.4-TRI-002
Predictive Science Academic Alliance Program

The Predictive Science Academic Alliance Program will be added in Rev. 0.1 of this document.

Appendix D.
WBS 1.5.1.4-TRI-001 Alliance Support

Alliance Support will be added in Rev. 0.1 of this document.

California Institute of Technology, Center for Simulating Dynamic Response of Materials

Stanford, ASC Alliance Center for Integrated Turbulence Simulations, CITS

University of Chicago, ASC Center for Astrophysical Thermonuclear Flashes

University of Illinois, Center for Simulation of Advanced Rockets

University of Utah, Center for Simulation of Accidental Fires and Explosions

Appendix E.
ASC Obligation/Cost Plan

Graph will be included in Rev. 0.1.

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

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