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Advanced Simulation and Computing

FY12–13 Implementation Plan

Volume 2, Rev. 0

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Advanced Simulation and Computing

FY12–13 IMPLEMENTATION PLAN
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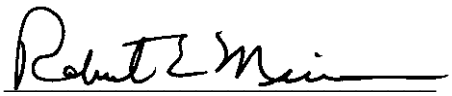

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V. ASC Level 1 and 2 Milestones

Table V-1. ASC Level 1 *Proposed* Milestones and Interfaces with Defense Programs Components from FY12–FY16

Milestone Title	Level	FY	Completion Date	Site(s)	Participating Program Offices
Develop, implement, and apply a suite of physics-based models and high-fidelity databases necessary for predictive simulation of the initial conditions for primary boost (initial conditions 1)	1	FY12	Q4	LANL, LLNL	Science Campaigns ASC Campaign
Assessment of weapon surety status	1	FY13	TBD	SNL	ASC Campaign Engineering Campaigns
Demonstrate predictive capability for weapon system response to short-pulsed neutrons in hostile radiation environment	1	FY13	TBD	SNL	ASC Campaign
Baseline demonstration of UQ aggregation methodology for full-system weapon performance prediction	1	FY14	TBD	LANL, LLNL, SNL	Science Campaigns ASC Campaign DSW
Full-system safety assessment	1	FY14	TBD	SNL	ASC Campaign Engineering Campaigns
Advanced models to support initial conditions for boost (initial conditions 2)	1	FY14	TBD	LANL, LLNL	Science Campaigns ASC Campaign

Table V-2. Quick Look: Level 2 Milestone Dependencies for FY12[1]

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram	Site
TBD	Improved Physics Fidelity Relevant to Nuclear Performance and Aboveground Experiment Simulations	2	FY12	9/30/12	IC	LLNL
TBD	Enhanced Multi-Physics Arbitrary Lagrangian-Eulerian Capability	2	FY12	9/30/12	IC	LLNL
TBD	Develop and Perform Prototype Simulations on Combined Low-High Pressure Plutonium Strength Model	2	FY12	9/30/12	PEM	LLNL
TBD	Predictive Capability Assessment Project Comparison of Suite Calibrated Event Calculations to Annual Assessment Review Events	2	FY12	9/30/12	V&V	LLNL
TBD	Early Users on Unclassified Sequoia Hardware	2	FY12	9/30/12	CSSE/FOUS	LLNL
TBD	Lorenz Dashboard Beta Release	2	FY12	12/31/11	FOUS	LLNL
TBD	TLCC2 Early Classified Use	2	FY12	6/30/12	FOUS	LLNL
TBD	Improve Eulerian Application Codes through Additional Physics and Algorithms to Allow Validation via High Energy Density Experiments	2	FY12	9/30/12	IC	LANL
TBD	Production Release of the Neutron Transport Monte Carlo Application Toolkit	2	FY12	9/20/12	IC	LANL
TBD	A Common Mix Model for Multi-Fluids	2	FY12	9/30/12	PEM	LANL
TBD	Benchmark Evaluation of Predictive Capability for Boost Using LANL Boost Validation Suite	2	FY12	6/30/12	V&V	LANL
TBD	Cielo Platform Production Capability Readiness	2	FY12	6/30/12	CSSE	LANL
TBD	Application Deployment of a Quick Parallel Log-Structured File System Capability	2	FY12	6/30/12	CSSE	LANL
TBD	TLCC2 System Integration and Production Readiness	2	FY12	6/30/12	FOUS	LANL
TBD	Cavity System-Generated Electromagnetic Pulse Predictive Capability for Realistic Re-Entry Body Geometry	2	FY12	9/30/12	IC	SNL
TBD	Large Eddy Simulation Capability for B61 Qualification Activities	2	FY12	6/30/12	IC	SNL

[1] Factors such as FY12 Congressional Appropriations, NNSA/DP directives, and National Security considerations may necessitate a change in the current milestone set.

TBD	Integrated Workflow and Problem Setup for SIERRA	2	FY12	3/31/12	IC	SNL
TBD	Coupled Large Eddy Simulation and Structural Dynamics (SALINAS) Capabilities for B61 Captive Carry	2	FY12	9/30/12	PEM	SNL
TBD	Density Functional Theory Assessment of Defects in Neutron-Irradiated III-V Materials	2	FY12	9/30/12	PEM	SNL
TBD	Failure Predictions for B61 Abnormal Mechanical Environments	2	FY12	9/30/12	V&V	SNL
TBD	Intrinsic Verification and Validation Enabled by SIERRA/DAKOTA Integration	2	FY12	9/30/12	V&V	SNL
TBD	Demonstration of a Legacy Application's Path to Exascale	2	FY12	3/31/12	CSSE	SNL
TBD	Characterize the Role of the Mini-Application in Predicting Key Performance Characteristics of Real Applications	2	FY12	6/30/12	CSSE	SNL
TBD	Deploy TLCC2 and a Common Capacity Computing Environment	2	FY12	9/30/12	CSSE	SNL
TBD	Integrate the TLCC2 Clusters Delivered in FY11 and FY12 into SNL Environment	2	FY12	6/30/12	FOUS	SNL
TBD	Cielo Capability Computing Platform Production Readiness	2	FY12	12/31/11	CSSE/FOUS	LLNL, LANL, SNL

Table V-3. Quick Look: *Preliminary* Level 2 Milestone Dependencies for FY13

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram(s)	Site(s)
TBD	Application of Nuclear Performance Codes to Inertial Confinement Fusion Relevant Problems	2	FY13	9/30/13	IC	LLNL
TBD	Demonstrate Erosion with Auto-Contact Capability	2	FY13	12/31/12	IC	LLNL
TBD	Upgrade to Plutonium Equation of State that Benefits from Equation of State Variations Study	2	FY13	9/30/13	PEM	LLNL
TBD	Predictive Capability Assessment Project Comparison of Suite Calibrated Event Calculations, Annual Assessment Review Event Calculations, and Best Physics Calculations	2	FY13	9/30/13	V&V	LLNL
TBD	Early Users on Classified Sequoia Hardware	2	FY13	3/31/13	FOUS	LLNL
TBD	Implement in Lagrangian Application Codes the Physics and Infrastructure Improvements Required for the Predictive Capability Framework FY14 Level 1 Milestone	2	FY13	9/30/13	IC	LANL
TBD	Production Release in the Eulerian Application Codes of an Alternative Hydrodynamics Option	2	FY13	6/30/13	IC	LANL
TBD	Development and Release of Improved Physics Required to Support 2014 Predictive Capability Framework Initial Conditions for Boost PegPost	2	FY13	6/30/13	PEM	LANL
TBD	Quantification of Uncertainty Due to Numerical Errors and Approximations in Multiphysics Calculations	2	FY13	6/30/13	V&V	LANL
TBD	Programming Models and Data Analysis Environments for Extreme-Scale Systems	2	FY13	6/30/13	CSSE	LANL
TBD	HPSS v8.x Integration and Production Deployment	2	FY13	6/30/13	FOUS	LANL
TBD	Fully Functioning Integrated SIERRA/Solid Mechanics-Structural Dynamics Application	2	FY13	9/30/13	IC	SNL
TBD	Coupled High/Low Mach Number Algorithms	2	FY13	9/30/13	IC	SNL
TBD	High-Frequency Electromagnetic Field Capabilities in EIGER for Re-Entry Body/Re-Entry Vehicle Simulations	2	FY13	9/30/12	IC	SNL
TBD	Exascale Capability for Solvers and Algorithms Software Stack	2	FY13	9/30/12	IC	SNL

Milestone ID	Milestone Title	Level	FY	Completion Date	DOE Program/ Subprogram(s)	Site(s)
TBD	Physics-Based Model for Lightning Arrestor Connector Performance	2	FY13	9/30/13	PEM	SNL
TBD	Realistic Material Variability with Mechanical Constitutive Models for Directed Stockpile Work Materials	2	FY13	9/30/13	PEM	SNL
TBD	Enhanced Solution Verification Capability in Precept	2	FY13	9/30/13	V&V	SNL
TBD	Computational Uncertainty Quantification for the QASPR Project	2	FY13	9/13/13	V&V	SNL
TBD	Data Co-Processing for Extreme Scale Analysis	2	FY13	12/31/12	CSSE	SNL
TBD	Peer-to-Peer File System Performance	2	FY13	3/31/13	CSSE	SNL
TBD	Cielo Phase III Upgrade	2	FY13	6/30/13	CSSE/FOUS	SNL

Detailed Milestone Descriptions for FY12

Milestone (ID#): Early Users on Unclassified Sequoia Hardware		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 9/31/12		
ASC nWBS Subprogram: CSSE/FOUS		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: Early users will be working on the Sequoia hardware.		

Milestone (ID#): Lorenz Dashboard Beta Release		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 12/31/11		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: Implement an HPC dashboard, or "My LC Portal," which gives the LC user a comprehensive, personalized view into the center.		

Milestone (ID#): HPC Enclave		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 9/31/12		
ASC nWBS Subprogram: FOUS		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: Complete security plan and network changes required to implement a collaboration zone and a restricted zone for LC resources. The collaboration zone allows foreign nationals access to LC resources while disabling access to restricted zone resources.		

Milestone (ID#): TLCC2 Early Classified Use		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 6/30/12		
ASC nWBS Subprogram: FOUS		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: Early users will be working on the classified TLCC2 resource.		

Milestone (ID#): Cielo Platform Production Capability Readiness		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 12/31/11		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: The ACES partnership between LANL and SNL is responsible for the deployment and integration of the Cielo platform, which will be sited at LANL. Cielo 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 CCC capability work; 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; and the platform has demonstrated acceptable reliability performance targets.		

Milestone (ID#): Application Deployment of a Quick Parallel Log-Structured File System Capability		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 6/30/12		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: Deployment and assessment of PLFS with HASH in multiple production ASC applications on a production machine.		

Milestone (ID#): TLCC2 System Integration and Production Readiness		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 6/30/12		
ASC nWBS Subprogram: FOUS		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: Deploy CCE capabilities developed during FY11, including the next major release of common operating system and software stack. Deploy the next generation of the ASC TLCC systems (TLCC2), which will include hardware and software integration and testing for the tri-lab environment.		

Milestone (ID#): Demonstration of a Legacy Application's Path to Exascale		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 3/31/12		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Cielo is expected to be the last capability system on which existing ASC codes can run without significant modifications. This assertion will be tested to determine where the breaking point is for an existing highly scalable application. The goal is to stretch the performance boundaries of the application by applying recent CSSE R&D in areas such as resilience, power, I/O, VIZ services, SMARTMAP, lightweight LWKs, virtualization, simulation, and feedback loops. Dedicated system time reservations and/or CCC allocations will be used to quantify the impact of system-level changes to extend the life and performance of the ASC code base. Finally, an exascale simulation will be performed to supplement the calculations at higher scales than are currently available.		

Milestone (ID#): Characterize the Role of the Mini-Application in Predicting Key Performance Characteristics of Real Applications		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 6/30/12		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: The Mantevo project includes a set of application proxies, referred to as "miniapps," and designed by code developers to represent key runtime performance characteristics of their applications. SNL will analyze two of these miniapps to determine how well they represent the full application programs. Specifically, SNL will profile the runtime performance of the miniapp and application, characterizing the relationship between the two on at least two HPC platforms (including Cielo).		

Milestone (ID#): Deploy TLCC2 and a Common Capacity Computing Environment		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 9/30/12		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Deploy CCE capabilities developed during FY11, including the next major release of common operating system and software stack. Deploy the next generation of the ASC TLCC systems (TLCC2), which will include hardware and software integration and testing for the tri-lab environment.		

Milestone (ID#): Integrate the TLCC2 Clusters Delivered in FY11 and FY12 into SNL Environment		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 6/30/12		
ASC nWBS Subprogram: FOUS		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: The ASC program is acquiring a second generation of tri-lab Linux capacity clusters (TLCC) beginning in Q4 FY11. All equipment will be delivered by the end of Q2 FY12. This milestone represents integration and deployment of the clusters delivered to SNL onto the SRN and SCN networks for production use.		

Milestone (ID#): Cielo Capability Computing Platform Production Readiness		
Level: 2	**Fiscal Year**: FY12	**DOE Area/Campaign**: ASC
Completion Date: 12/31/11		
ASC nWBS Subprogram: CSSE/FOUS		
Participating Sites: LLNL, LANL, SNL		
Participating Programs/Campaigns: ASC		
Description: The ACES partnership between LANL and SNL is responsible for the deployment and integration of the Cielo platform, which will be sited at LANL. Cielo 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 CCC capability work; 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; and the platform has demonstrated acceptable reliability performance targets.		

Milestone Descriptions for Preliminary FY13

Milestone (ID#): Early Users on Classified Sequoia Hardware		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 3/31/13		
ASC nWBS Subprogram: FOUS		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: Early users will be working on the classified Sequoia hardware.		

Milestone (ID#): Programming Models and Data Analysis Environments for Extreme-Scale Systems		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 6/30/12		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: Emerging computer architectures pose new challenges for scientific applications at extreme scales. This milestone will deliver 1) programming models and supporting tools that allow for effective expression of large-scale concurrency while providing flexibility in mapping to the underlying architecture, and 2) a data analysis environment that addresses the challenges of massive data, including *in situ* analysis and advanced data reduction techniques. These products will be a step towards enabling productivity and performance at exascale.		

Milestone (ID#): HPSS v8.x Integration and Production Deployment		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 6/30/12		
ASC nWBS Subprogram: FOUS		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: Implement HPSS version 8.x into the open and secure computing environments. This version provides the ability to run multiple core components of HPSS thus enabling archive scaling of meta-data processing.		

Milestone (ID#): Data Co-Processing for Extreme Scale Analysis		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 12/31/12		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		

Description: ASC calculations produce complex ensembles of data that are increasingly difficult to explore and understand using traditional post-processing workflows. To advance understanding of underlying physics, uncertainties, and results of ASC codes, SNL must gather as much relevant data as possible from large simulations. This drives SNL to couple data analysis and visualization capability with a running simulation, so that high fidelity data can be extracted and written to disk.

This milestone will work with ASC customers to engineer, compare, and evaluate two complimentary methods for analyzing extreme scale data:

- *In-situ* processing. One solution to providing analysis capabilities is to directly couple analysis libraries with the simulation. SNL has collaborated on developing the ParaView *in-situ* library, which has been demonstrated with a number of codes.
- In-transit processing. Another option for processing data at extreme scale is to loosely couple the running simulation with parallel data services that use separate processing resources to reliably perform a range of operations on the simulation data.

Within this milestone, SNL will engineer, test, and evaluate a set of customer-driven data operations on large-scale data created by a running simulation. The data operations will be performed by instrumented versions of both the *in-situ* and in-transit solutions, with the resulting performance data published and distributed to the ASC community.

Milestone (ID#): Peer-to-Peer File System Performance		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 3/31/13		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Exascale computing will likely require fundamental changes in the storage and management of persistent data. Incremental advances in current capabilities are likely inadequate. This milestone will provide performance analysis of a revolutionary approach to persistent storage—one that uses smart storage servers with access to a variety of different local and remote media (for example, disk, NVRAM, memory, and tape) and are pervasive throughout the computing platform. Storage servers have the ability to directly handle I/O requests, initiate third party transfers, or replicate the data as needed. Results will come from implementations for the Cielo system.		

Milestone (ID#): Cielo Phase III Upgrade		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 6/30/13		
ASC nWBS Subprogram: CSSE/FOUS		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Acquire and integrate the planned Phase III upgrade to Cielo, bringing the capability platform to its full scale and production target of X.XPF supporting the ASC program.		