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Advanced Simulation and Computing FY13 Implementation Plan, Volume 2

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Disclaimer

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Advanced Simulation and Computing

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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 FY13–FY16

Milestone Title	Level	FY	Completion Date	Site(s)	Participating Program Offices
Assessment of weapon surety status	1	FY13	TBD	SNL	ASC Campaign Engineering Campaigns
Demonstrate predictive capability for weapon system response to 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

ASC Level 2 Milestones for FY13

Table V-2. Quick Look: Level 2 Milestone Dependencies for FY13[1]

Milestone ID	Milestone Title	FY	Complete Date	Sub-Program	Site
TBD	Demonstrate Erosion with Auto-Contact Capability	FY13	12/31/12	IC	LLNL
TBD	Apply ASC Tools to Ignition-Relevant Experiments	FY13	6/30/13	IC	LLNL
TBD	Deliver Laser Ray Tracing Simulation Capability Required to Model Stockpile-Relevant Aboveground Experiments	FY13	9/30/13	IC	LLNL
TBD	Computation and Inter-Comparison of Four Distinct Equation of State Theory Predictions for the Lithium Deuteride Equation of State in an Interesting Regime	FY13	9/30/13	PEM	LLNL
TBD	Predictive Capability Assessment Project Results	FY13	9/30/13	V&V	LLNL
TBD	Report on Investigation of Input/Output Forwarding for Linux Clusters, as Part of Systems-Level Software at Scale	FY13	12/31/12	CSSE	LLNL
TBD	Sequoia File System Deployed to Classified Network	FY13	9/30/13	CSSE	LLNL
TBD	Early Users on Classified Sequoia Hardware	FY13	6/30/13	FOUS	LLNL
TBD	User Release in the Eulerian Application Project Codes of an Alternative Hydrodynamics Option	FY13	9/30/13	IC	LANL

[1] Factors such as FY13 Congressional Appropriations, NNSA/DP directives, and National Security considerations may necessitate a change in the current milestone set.

Milestone ID	Milestone Title	FY	Complete Date	Sub-Program	Site
TBD	Implement Improvements in the Lagrangian Application Codes for the FY14 Boost Initiation Peg Post	FY13	9/30/13	IC	LANL
TBD	Initial Multi-Phase Strength Model for a Single Phase Change	FY13	6/30/13	PEM	LANL
TBD	Development and Implementation of Initial Condition Models in Support of the FY14 Boost Initiation Peg Post	FY13	9/30/13	PEM	LANL
TBD	Quantification of Uncertainty Due to Numerical Errors and Approximations in Physics Calculations	FY13	6/30/13	V&V	LANL
TBD	Case Study of In Situ Data Analysis in ASC Integrated Codes	FY13	9/30/13	CSSE	LANL
TBD	Expanded Frequency Capability in EIGER for Electromagnetic Response Coupling	FY13	6/30/13	IC	SNL
TBD	New TRILINOS Solver Stack with Next-Generation High Performance Computing Platform Support Deployed for SIERRA/ThermalFluid	FY13	6/30/13	IC	SNL
TBD	Demonstration of Combined SIERRA/SolidMechanics and SIERRA/StructuralDynamics Code Capabilities with a Common Toolkit Underpinning	FY13	9/30/13	IC	SNL
TBD	Physics-Based Model for Lightning Arrestor Connector Performance	FY13	9/30/13	PEM	SNL

Milestone ID	Milestone Title	FY	Complete Date	Sub-Program	Site
TBD	Capability for Incorporating Micro-Scale Variability into Design and Analysis Models of 304L Stainless Steel Laser Welds	FY13	9/30/13	PEM	SNL
TBD	Predict the Aerodynamic Performance of a Full-Scale Stockpile Gravity Bomb with SIERRA Gas Dynamics Code	FY13	9/30/13	V&V	SNL
TBD	ASC V&V Project Credibility Assessment Using PCMM Methodology	FY13	9/30/13	V&V	SNL
TBD	Data Co-Processing for Extreme Scale Analysis	FY13	3/31/13	CSSE	SNL
TBD	SIROCCO File System Performance	FY13	6/30/13	CSSE	SNL
TBD	Study of Key Performance Issues of ASC Applications Executing on Emerging Technologies	FY13	9/30/13	CSSE	SNL
TBD	Demonstrate Effective SNL Access and Use of Sequoia System	FY13	3/31/13	FOUS	SNL
TBD	Deploy SNL Computing Resources onto the Inter-Site High Performance Computing Network	FY13	9/30/13	FOUS	SNL
TBD	Lustre File System Production on Cielo	FY13	3/31/13	CSSE	LANL SNL

Milestone (ID#): Report on Investigation of Input/Output Forwarding for Linux Clusters, as Part of Systems-Level Software at Scale		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 12/31/12		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: This milestone investigates I/O forwarding services for commodity Linux clusters to improve job launch scalability, reduce O/S jitter, and simplify system management. The investigation will discuss the motivation and requirements, review I/O forwarding architectures and implementations, and consider possible ways to deploy I/O forwarding on TLCC clusters as an alternative to direct-mounted NFS and Lustre file systems.		
Completion Criteria: Report to include results from investigation of I/O forwarding services for commodity Linux clusters.		
Customer: ASC/LLNL		
Milestone Certification Method: Professional report and hand-off to ASC program.		
Supporting Resources: Systems software expertise, test bed resources		

Milestone (ID#): Sequoia File System Deployed to Classified Network		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 9/30/13		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: This milestone represents the culmination of the procurement, development, integration, testing, and deployment of the 55-petabyte Sequoia file system (known as Grove. Grove is a Lustre file system that will serve as the primary parallel file system for the Sequoia platform, but will also be accessible from other LC machines. Completion of this milestone will require extensive integration and testing of Grove hardware and software components in the unclassified environment. The milestone will be complete when the Grove file system has been migrated to the classified environment and is available for use by production applications.		
Completion Criteria: Sequoia file system production operation in classified environment.		
Customer: ASC/LLNL		
Milestone Certification Method: Professional report and handoff to ASC program.		
Supporting Resources: Sequoia, systems, and file systems expertise		

Milestone (ID#): Early Users on Classified Sequoia Hardware		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 6/30/13		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: The Sequoia system will provide approximately 20 peak petaFLOP/s of compute cycles to the center. The system is scheduled to be integrated from January through June 2012, with system acceptance scheduled for September 30, 2012. Unclassified science runs are scheduled to take place through January 2013. The system is expected to be moved to the classified network in mid-February 2013. The goal of this milestone is to have early users running their codes on Sequoia on the classified network.		
Completion Criteria: Racks have been assembled in the TSF, the system has been moved to the classified network, and at least one user has ported their code. A user will write a memo certifying that their code has run on Sequoia.		
Customer: ASC/LLNL		
Milestone Certification Method: Professional report and handoff to ASC program.		
Supporting Resources: Sequoia, code team participation		

Milestone (ID#): Case Study of In Situ Data Analysis in ASC Integrated Codes		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 9/30/13		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: The massive, complex datasets generated by scientific simulations on next-generation computer architectures at extreme scale pose new challenges for data management and scientific understanding. A critical element in meeting these new challenges is in situ data analysis where information is reduced and analyzed as close to the point of generation as possible, for example, at run time or as the data stream to longer term storage. This milestone will demonstrate in situ data analysis in xRAGE, an ASC Eulerian Radiation Hydrodynamics code. We will work with the Eulerian Applications Project to identify target problems that will exercise physics of interest to the program, and we will work closely with users to maximize the achieved usability and productivity improvements. We will investigate enhancements to the in situ process that enable and improve techniques of data reduction and data triage in addition to improving in situ performance by using portable acceleration technology. We will report on their viability and performance in xRAGE or another ASC code. These products will provide ASC integrated code developers with reference codes and tools that will benefit DSW by advancing the technology for predictive science at extreme scales.		
Completion Criteria: Demonstration of our in-situ visualization and analysis capability applied to xRAGE and/or other ASC codes with performance impacts documented.		
Customer: ASC integrated code development teams and DSW		
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: System resources and participation of code teams and code users.		

Milestone (ID#): Data Co-Processing for Extreme Scale Analysis		
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: ASC calculations produce complex datasets 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 evaluates two approaches for providing such a coupling: • In-situ processing provides "tightly-coupled" analysis capabilities through libraries linked directly with the simulation. SNL has collaborated on developing an in-situ capability designed for this purpose. • In-transit processing provides "loosely coupled" analysis capabilities by performing the analysis on separate processing resources. SNL provides this capability through a "data services" capability designed for this purpose.		
Completion Criteria: SNL will engineer, test, and evaluate 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 made available to the ASC community.		
Customer: ASC platform design team members and application developers.		
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: Platform facilities, such as Cielo and associated test beds.		

Milestone (ID#): SIROCCO File System Performance		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 6/30/13		
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.		
Completion Criteria: Completion of the Sirocco performance analysis.		
Customer: ASC platform design team members and application developers.		
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: Cielo and associated test beds		

Milestone (ID#): Study of Key Performance Issues of ASC Applications Executing on Emerging Technologies		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 9/30/13		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Next generation computing platforms are expected to present significantly different architectural designs from the previous several generations. In preparation for these changes, we will explore the potential computing environments from processor core, to node, to inter-node. Our tools include a set of application proxies (called mini-apps), a set of test beds, simulation capabilities provided by the Structural Simulation Toolkit, abstract machine models, and analytic performance models. The outcome will be a better understanding of the characteristics and capabilities within the context of the computational science and engineering simulations of interest to the ASC program on emerging and future architectures and will inform hardware and software requirements.		
Completion Criteria: Completion of program review and a final document.		
Customer: ASC platform design team members and application developers.		
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: ASC advanced architecture systems.		

Milestone (ID#): Demonstrate Effective SNL Access and Use of Sequoia System		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 03/31/13		
ASC nWBS Subprogram: FOUS		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Determine, document, and publish the recommended access methods for SNL HPC customers (and local user support personnel) to the Sequoia computer system hosted at LLNL. Prepare guidelines for job submission, data transfer to and from LLNL, trouble ticket generation, and coordination with LLNL Help Desk personnel. Assist in debugging code or scripting as necessary to ensure success for the initial SNL users, especially those requesting CCC access.		
Completion Criteria: Report or presentation providing evidence of proper accounting processes, job submission, data transfer, visualization of input and/or output for production-type jobs.		
Customer: ASC and DSW		
Milestone Certification Method: Testimony (email, presentations, graphics results) of success on Sequoia runs for SNL users.		
Supporting Resources: Long-haul communication lines between labs.		

Milestone (ID#): Deploy SNL Computing Resources onto the Inter-Site High Performance Computing Network		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 9/30/13		
ASC nWBS Subprogram: FOUS		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Identify cluster systems and additional hardware that can move from the SRN address space into the iHPC address space to provide enhanced resources and broader access for SNL external and internal customers. Likely candidates are the Glory TLCC1 HPC cluster and some Lustre file system servers. Prepare the iHPC environment for these systems and move them no later than June 30, 2013.		
Completion Criteria: The candidate equipment will be operational and effective use, including external to SNL, shall be demonstrated.		
Customer: ASC environment customers, including external partners/collaborators.		
Milestone Certification Method: Final documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion. The "handoff" of the developed capability (product) to a customer is documented.		
Supporting Resources: SNL FOUS operations teams and CCE iHPC project.		

Milestone (ID#): Lustre File System Production on Cielo		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 3/31/13		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL, SNL		
Participating Programs/Campaigns: ASC		
Description: The Lustre file system on Cielo is providing reliability and performance needed for full production of the Cielo platform. Application users can get their work done on Cielo without major file system issues. Requirements include: file system deployment is complete, acceptance testing has been completed, reliability and performance of the file system has been demonstrated by application program, all hardware for I/O is in operation, and Lustre is effectively deployed into the full Cielo environment, including purging, file transfer agent access, external node access, and monitoring and management. A milestone review has been completed and the results documented.		
Completion Criteria: Follows the ASC Level 2 Milestone criteria for capability platforms but specifically with regards to the Lustre file system on Cielo: that the file system has been successfully demonstrated for production capability-class simulations. The file system requirements are specifically listed in the usage model for Cielo, which defines that the Cielo file system has demonstrated an acceptable production user environment with all the associated support, testing, reliability, performance, and applications use of the system.		
Customer: NNSA/ASC HQ, ASC program managers responsible for CCCs, SSP, and ASC tri-lab CCC users.		
Milestone Certification Method: A program review is conducted, requiring all three laboratories to participate in the completion of the review. The review panel will include a mix of systems personnel and end users. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: ACES personnel, Cielo, and associated hardware test beds		

ASC Level 2 Milestones for FY14

Table V-3. Quick Look: Level 2 Milestone Dependencies for FY14[2]

Milestone ID	Milestone Title	FY	Complete Date	Sub-Program	Site
TBD	Assess Scalability and Demonstrate Performance of Nuclear Performance Code System on Sequoia	FY14	3/31/14	IC	LLNL
TBD	Demonstrate the Ability to Simulate X-Ray Output Effects on a Nuclear Warhead for the Purpose of Assessing Vulnerability	FY14	9/30/14	IC	LLNL
TBD	Deliver within the Nuclear Performance Code System an Initial Capability for the Simulation of Output	FY14	9/30/14	IC	LLNL
TBD	Implement Prompt Diagnostic Simulation Capability (Integrated/RIF PINEX, TENEX, NUEX) and Correlate with Radiochemical Diagnostics	FY14	9/30/14	PEM	LLNL
TBD	Predictive Capability Assessment Project Results	FY14	9/30/14	V&V	LLNL
TBD	Documentation of Current Approaches and Investigation of New Techniques for Uncertainty Quantification Analysis	FY14	9/30/14	V&V	LLNL
TBD	Post-Petascale Plan for Software (Programming Model, Code Correctness, Tasking, Performance Tools)	FY14	9/30/14	CSSE	LLNL

[2] Factors such as FY14 Congressional Appropriations, NNSA/DP directives, and National Security considerations may necessitate a change in the current milestone set.

Milestone ID	Milestone Title	FY	Complete Date	Sub-Program	Site
TBD	TLCC 3 Contract Awarded	FY14	9/30/14	CSSE	LLNL
TBD	Plan for Cluster Systems Software in a Tens of Thousands of Nodes/Cores Environment	FY14	9/30/14	FOUS	LLNL
TBD	Improved Physics Models in the Eulerian Applications Project Codes for Predictive Capability Framework Energy Balance II Peg Post	FY14	9/30/14	IC	LANL
TBD	User Release by the Transport Project of a Production Quality Version of the High Order/Low Order Transport Package	FY14	9/30/14	IC	LANL
TBD	Assessments and Improvements of Material Models Supporting the Pit Reuse Strategy	FY14	9/30/14	PEM	LANL
TBD	Assessment of New Robustness Techniques to Develop Confidence in Performance Predictions for Future Stockpile Systems	FY14	9/30/14	V&V	LANL
TBD	Programming Environments for Next-Generation Computing Platforms	FY14	9/30/14	CSSE	LANL
TBD	Strategic Computing Complex Facility Upgrades for Trinity Complete	FY14	9/30/14	FOUS	LANL
TBD	Implementation of Atomistic Model for Carrier Recombination in CHARON	FY14	9/30/14	IC	SNL
TBD	Improved Verification and Validation through Integrated Sensitivity Analysis Workflow	FY14	6/30/14	IC	SNL
TBD	Improved SIERRA Performance Via Toolkit Integration	FY14	9/30/14	IC	SNL
TBD	Simulation of Critical Ion Source Behavior in 2D	FY14	3/31/14	PEM	SNL

Milestone ID	Milestone Title	FY	Complete Date	Sub-Program	Site
TBD	Predictive multi-physics simulations for re-entry random vibration	FY14	9/30/14	PEM	SNL
TBD	Execute Complete Quantities of Margins and Uncertainties Assessment of the B83 in Thermal/Mechanical Environments	FY14	9/30/14	V&V	SNL
TBD	Validation Studies to Assess Cavity System-Generated Electromagnetic Pulse Models	FY14	9/30/14	V&V	SNL
TBD	Application-Level Resiliency Using a Persistent Data Object Store for Local Checkpoint/Restart	FY14	9/30/14	CSSE	SNL
TBD	ASC Workload Energy Efficiency: System and Application Interfaces for Measurement and Control	FY14	9/30/14	CSSE	SNL
TBD	Apply Heterogeneous Programming Models to Address Key Performance Issues of ASC Applications Executing on Heterogeneous Parallel Systems	FY14	9/30/14	CSSE	SNL
TBD	ACES Trinity System Selection	FY14	9/30/14	CSSE	LANL SNL
TBD	Deployment of a Common Capacity Computing Environment	FY14	9/30/14	CSSE	LLNL LANL SNL
TBD	Evaluate Proxy Application Performance on Current Hardware Test Beds or Sequoia	FY14	9/30/14	CSSE	LLNL LANL SNL

Milestone (ID#): Post-Petascale Plan for Software (Programming Model, Code Correctness, Tasking, Performance Tools)		
Level: 2	**Fiscal Year**: FY14	**DOE Area/Campaign**: ASC
Completion Date: 9/30/14		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: This milestone is a planning and scoping activity in preparation for the 2017 advanced technology system to be sited at LLNL. This milestone addresses plans for the post-petascale software environment, including the programming models, performance tools, and issues of code correctness and tasking		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): TLCC3 Contract Awarded		
Level: 2	**Fiscal Year**: FY14	**DOE Area/Campaign**: ASC
Completion Date: 9/30/15		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: Based on tri-lab process and review, LLNL successfully awards the contract for the next-generation Tri-Lab Linux Commodity Clusters (TLCC3).		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): Plan for Cluster Systems Software in a Tens of Thousands of Nodes/Cores Environment		
Level: 2	**Fiscal Year**: FY14	**DOE Area/Campaign**: ASC
Completion Date: Q4 FY14		
ASC nWBS Subprogram: FOUS		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: This milestone is a planning and scoping activity to determine gaps in current cluster systems software and identify development areas required to scale to a cluster with tens of thousands of nodes/cores.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): Programming Environments for Next-Generation Computing Platforms		
Level: 2	**Fiscal Year**: FY14	**DOE Area/Campaign**: ASC
Completion Date: 9/30/14		
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 programming models and supporting tools that allow for effective expression of large-scale concurrency while providing flexibility in mapping to the underlying architecture as a step towards enabling productivity and performance at exascale.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): Strategic Computing Complex Facility Upgrades for Trinity Complete		
Level: 2	**Fiscal Year**: FY14	**DOE Area/Campaign**: ASC
Completion Date: 9/30/14		
ASC nWBS Subprogram: FOUS		
Participating Sites: LANL		
Participating Programs/Campaigns: ASC		
Description: The SCC facility cooling infrastructure has been upgraded to support the Trinity and CTS-1 water-cooled systems.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): Application-Level Resiliency Using a Persistent Data Object Store for Local Checkpoint/Restart		
Level: 2	**Fiscal Year**: FY14	**DOE Area/Campaign**: ASC
Completion Date: 9/30/14		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Resilience is a crosscutting issue that spans the entire software stack as well as the hardware, and it is not expected to be solved with a silver bullet solution but rather a comprehensive approach involving changes over many elements over time. However, there are elements of the problem that can be addressed early on and in so doing, provide a path toward the final, long-term solution. The notion of a persistent data object store is such an element, and it is key for providing a means to application-level resilience somewhat independent of future solutions. Specifically, we intend to develop an API for a persistent data object store, implement this functionality per that API, and demonstrate how it can be used at scale to provide scalable, local checkpoint/restart capability. The objective is to provide the core 'persistence' capability and demonstrate how it can be used to avoid system-wide checkpoint/restart in favor of application-driven local checkpoint/restart.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: TBD		

Milestone (ID#): ASC Workload Energy Efficiency: System and Application Interfaces for Measurement and Control		
Level: 2	**Fiscal Year**: FY14	**DOE Area/Campaign**: ASC
Completion Date: TBD		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Addressing anticipated ASC computational needs within reasonable power constraints requires great advances in hardware power efficiency. To achieve the greatest efficiency from next-generation hardware at scale, software, at many levels, will be required to coordinate and optimize the underlying hardware. While commodity pressures will drive useful innovations in this area that can be leveraged, our efforts are distinguished by our requirements at scale. This milestone will first identify the critical multi-level measurement requirements needed for next-generation platforms. Given a measurement set, a power application programming interface (API) will be defined at all necessary levels; operating system; reliability, availability, and serviceability (RAS) system; run-time; and application level. These APIs will be implemented and evaluated using real ASC applications (or their mini-app stand-ins) for trade-offs between energy and runtime performance. This milestone is in preparation for Trinity, which is targeted to be the first ASC advanced architecture platform with an integrated power measurement and component tuning capability that can demonstrate real impact to ASC application energy efficiency.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: TBD		

Milestone (ID#): Apply Heterogeneous Programming Models to Address Key Performance Issues of ASC Applications Executing on Heterogeneous Parallel Systems		
Level: 2	**Fiscal Year**: FY14	**DOE Area/Campaign**: ASC
Completion Date: 9/30/14		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: Assess results of the CSSE FY13 milestone, *Study of Key Performance Issues of ASC Applications Executing on Emerging Technologies*, for performance issues that could be addressed with heterogeneous parallel programming models (also known as MPI+X). Apply this programming model to one or more mini-apps to demonstrate how the programming model can improve identified performance issues on heterogeneous parallel systems.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: TBD		

Milestone (ID#): ACES Trinity System Selection		
Level: 2	**Fiscal Year**: FY14	**DOE Area/Campaign**: ASC
Completion Date: 9/30/14		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL, SNL		
Participating Programs/Campaigns: ASC		
Description: The Trinity RFP has been completed and distributed to all potential vendors, vendor proposals have been submitted, proposals have been evaluated, negotiations with selected vendor are complete, and a contract award has been executed with the selected vendor.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): Deployment of a Common Capacity Computing Environment		
Level: 2	**Fiscal Year**: FY14	**DOE Area/Campaign**: ASC
Completion Date: 9/30/14		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL, LANL, SNL		
Participating Programs/Campaigns: ASC		
Description: Deploy Common Computing Environment (CCE) capabilities developed during FY13, including the next major release of common operating system and software stack. Prepare for deployment of the next generation of ASC Tri-Lab Linux Capacity Clusters-3 (TLCC3) systems. 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.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): Evaluate Proxy Application Performance on Current Hardware Test Beds or Sequoia		
Level: 2	**Fiscal Year**: FY14	**DOE Area/Campaign**: ASC
Completion Date: 9/30/14		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL, LANL, SNL		
Participating Programs/Campaigns: ASC		
Description: Each lab will identify two proxy applications that have been validated as a proxy for a key performance aspect of our integrated codes. These proxy applications will be exercised on current hardware test beds at the labs as well as Sequoia to analyze both performance and scalability aspects. A tri-lab report will be completed detailing key performance indicators related to hardware such as memory bandwidth, caching, and data movement.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: TBD		

ASC Level 2 Milestones for FY15

Table V-4. Quick Look: Level 2 Milestone Dependencies for FY15[3]

Milestone ID	Milestone Title	FY	Complete Date	Sub-Program	Site
TBD	Release New Deterministic Neutronics Package that Is More Amenable to Scaling on Advanced Architectures	FY15	6/30/15	IC	LLNL
TBD	Enhance Modeling and Simulation Capabilities for Nuclear Explosives Package Engineering Assessment	FY15	6/30/15	IC	LLNL
TBD	Evaluate Capabilities of Nuclear Performance Code System to Simulate with High Geometric Fidelity	FY15	9/30/15	IC	LLNL
TBD	Deliver and Perform Initial Validation on New Multi-Phase Equation of State Based on Advanced Calculational Techniques and New Experimental Data	FY15	9/30/15	PEM	LLNL
TBD	Predictive Capability Assessment Project Results	FY15	9/30/15	V&V	LLNL
TBD	Planning for Systems Software Environment and Applications Preparation for 2017 Hardware Platform	FY15	9/30/15	CSSE	LLNL
TBD	Contract Awarded for 2017 Advanced Technology System	FY15	9/30/15	CSSE	LLNL
TBD	Early Users on LLNL TLCC3 Machine	FY15	6/30/15	FOUS	LLNL

[3] Factors such as FY15 Congressional Appropriations, NNSA/DP directives, and National Security considerations may necessitate a change in the current milestone set.

Milestone ID	Milestone Title	FY	Complete Date	Sub-Program	Site
TBD	Production Release of the Eolus Diagnostics Codes for the Predictive Capability Framework Boost and Secondary Peg Posts	FY15	9/30/15	IC	LANL
TBD	Prepare ASC Applications for Trinity System	FY15	9/30/15	IC, CSSE	LANL
TBD	Replacement of the Legacy Opacity Code LEDCOP with the ATOMIC Opacity Code for Production of New Opacities	FY15	9/30/15	PEM	LANL
TBD	Delivery of Improved Physics Capabilities Supporting FY16 Initial Conditions 2 Peg Post	FY15	9/30/15	PEM	LANL
TBD	Deliver Enhancements to the Primary Validation Suite to Perform an Initial Benchmark Evaluation of Predictive Capability through Late Time Implosion and Early Explosion	FY15	9/30/15	V&V	LANL
TBD	Two-Way Coupled Aero-Structural Capability	FY15	9/30/15	IC, PEM	SNL
TBD	3D Particle Radiation Transport Calculations for Box Internal Electromagnetic Pulse	FY15	9/30/15	IC	SNL
TBD	New TRILINOS Solver Stack with Support for Threading and Accelerator-Based Architectures in Production Solvers	FY15	6/30/15	IC	SNL
TBD	Direct Simulation Monte Carlo Simulation of a Massively Parallel, Chemically Reacting, 3D Re-Entry Flow	FY15	9/30/15	PEM	SNL
TBD	First Release of DAKOTA Adaptive Sampling Methods for Refinement of Krieging and LHS Sampling	FY15	9/30/15	V&V	SNL

Milestone ID	Milestone Title	FY	Complete Date	Sub-Program	Site
TBD	Propagate Uncertainties in Reentry Coupled Simulations to Component (Gas Transfer System or NG or Stronglink) Response Metric	FY15	9/30/15	V&V	SNL
TBD	Using Performance Modeling & Simulation Tools and Techniques to Gauge Key Application Performance Characteristics of the Trinity Platform	FY15	9/30/15	CSSE	SNL
TBD	Demonstration of Fault-Tolerant Programming Model at Extreme Scale	FY15	9/30/15	CSSE	SNL
TBD	Integrate the Tri-Lab Linux Capacity Cluster-3 Clusters into SNL Environment	FY15	9/30/15	FOUS	SNL
TBD	ACES Initial Trinity Delivery	FY15	9/30/15	CSSE	LANL SNL
TBD	Feedback to Vendors Key Bottlenecks in Performance and Demonstrate an Initial Set of Performance Improvements for the Architectures Represented by Hardware Test Beds	FY15	9/30/15	CSSE	LLNL LANL SNL

Milestone (ID#): Planning for Systems Software Environment and Applications Preparation for 2017 Hardware Platform		
Level: 2	**Fiscal Year**: FY15	**DOE Area/Campaign**: ASC
Completion Date: 9/30/15		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: This milestone addresses hardware and software plans for the 2017 system at LLNL. It includes the completion of the Request for Proposals for the 2017 platform, including systems software and development environment. A code migration and application preparation strategy, including expected programming model and tools support, will also be developed.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): Contract Awarded for 2017 Advanced Technology System		
Level: 2	**Fiscal Year**: FY15	**DOE Area/Campaign**: ASC
Completion Date: 9/30/15		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: LLNL successfully awards the contract for the 2017 Advanced Technology System.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): Early Users on TLCC 3 System at LLNL		
Level: 2	**Fiscal Year**: FY13	**DOE Area/Campaign**: ASC
Completion Date: 6/30/13		
ASC nWBS Subprogram: FOUS		
Participating Sites: LLNL		
Participating Programs/Campaigns: ASC		
Description: Early users will be on the TLCC3 machines at LLNL.		
Completion Criteria: Racks have been assembled in the TSF, the system is on the network, and at least one user has ported his/her code. A user will write a memo certifying that his/her code has run on a TLCC3 machine.		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): Using Performance Modeling & Simulation Tools and Techniques to Gauge Key Application Performance Characteristics of the Trinity Platform		
Level: 2	**Fiscal Year**: FY15	**DOE Area/Campaign**: ASC
Completion Date: 9/30/15		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: This milestone has several important goals. We want to develop the SST simulator for Trinity in advance of the actual physical system deployment for two key reasons: 1) to provide the application development teams a head start on analyzing the behavior of their codes on Trinity (before it is actually available), and 2) to set a baseline for predictive performance for the SST for the Trinity system. These are obviously interconnected, and both rely on our core ability to model an application's performance on SST prior to Trinity's full deployment. The first key deliverable is hence the development of a SST simulator of Trinity, and the verification and validation of that simulator, recognizing that the completion of that V&V may only be possible after Trinity is deployed and comparative performance data is collected and reconciled with the SST Trinity simulator. We will select one or more ASC applications or mini-apps to focus the work, and data will be collected on the SST simulator and documented such that we can later (when the actual Trinity data is available) do a rigorous comparison and analysis of SST's predictive capability in this context. The work is expected to focus on the macro-scale components of SST but may not be restricted to that; final determination will be done closer to the milestone date. Once the application performance analysis is done and the SST simulator 'calibrated' via V&V processes, we expect to subsequently improve the SST Trinity simulator as needed so that it can be used for a wide variety of application performance analysis work.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: TBD		

Milestone (ID#): Demonstration of Fault-Tolerant Programming Model at Extreme Scale		
Level: 2	**Fiscal Year**: FY15	**DOE Area/Campaign**: ASC
Completion Date: 9/30/15		
ASC nWBS Subprogram: CSSE		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: There is a general consensus that despite best efforts on all parts, the application will still be required to account for faults 'below' it. That is, we do not anticipate that the system comprised of the software stack and hardware (minus the application) will be (or appear to be) entirely stable from the application's perspective. New program models are being explored now, including task-DAG approaches, combined with algorithmic changes that induce better fault tolerance. Currently, these are being done at small scale on what amount to semi-realistic test problems. However, the results indicate that these approaches may have significant promise for scalable, fault-tolerant applications programming models, and we anticipate developing realistic-scale applications in the next two years as proof of concept for the approach. This milestone will include a demonstration of one or more novel approaches to fault-tolerant programming models, on a realistic application, at scale, on a capability-class system as well as analysis of its performance on the SST performance simulator. For the latter, we will analyze the response to faults in the system and characterize the scalability and performance based on at least one realistic-scale application and system configuration. The intent is to use the SST simulator for Trinity, if it is available in the right time frame for these experiments.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: TBD		

Milestone (ID#): Integrate the Tri-Lab Linux Capacity Cluster-3 Clusters into SNL Environment		
Level: 2	**Fiscal Year**: FY15	**DOE Area/Campaign**: ASC
Completion Date: 9/30/15		
ASC nWBS Subprogram: FOUS		
Participating Sites: SNL		
Participating Programs/Campaigns: ASC		
Description: TLCC3 resources will be installed, accepted from the provider, integrated into the network environment, and ready for General Use within two calendar quarters following delivery to SNL facilities.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): ACES Initial Trinity Delivery		
Level: 2	**Fiscal Year**: FY15	**DOE Area/Campaign**: ASC
Completion Date: 9/30/15		
ASC nWBS Subprogram: CSSE		
Participating Sites: LANL, SNL		
Participating Programs/Campaigns: ASC		
Description: A substantial portion of the Trinity platform hardware has been delivered. Pre-delivery testing of the hardware at the vendor site has been completed as well as post-delivery testing at the site in Los Alamos. These tests include some application codes that are used to find system problems. The system portions delivered are ready to be connected together as one system.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: TBD		
Supporting Resources: TBD		

Milestone (ID#): Feedback to Vendors Key Bottlenecks in Performance and Demonstrate an Initial Set of Performance Improvements for the Architectures Represented by Our Hardware Test Beds		
Level: 2	**Fiscal Year**: FY15	**DOE Area/Campaign**: ASC
Completion Date: 9/30/15		
ASC nWBS Subprogram: CSSE		
Participating Sites: LLNL, LANL, SNL		
Participating Programs/Campaigns: ASC		
Description: For two hardware test bed architectures, the key performance bottlenecks will be identified for our proxy applications and these will be communicated to the vendors. Algorithmic improvements will be explored for that combination of proxy applications and hardware, and a report on successful and unsuccessful attempts to increase performance will be completed as lessons learned.		
Completion Criteria: TBD		
Customer: TBD		
Milestone Certification Method: A program review is conducted and its results are documented. Professional documentation, such as a report or a set of viewgraphs with a written summary, is prepared as a record of milestone completion.		
Supporting Resources: TBD		