

# ASC Sequoia

## ADVANCING TECHNOLOGY FOR UNCERTAINTY QUANTIFICATION AND SCIENCE AT SCALE

Already ranked the world's most powerful computing system, the new-generation National Nuclear Security Administration (NNSA) supercomputer for the Advanced Simulation and Computing (ASC) Program—Sequoia—will deliver the required petascale capabilities necessary to ensure the continued safety and reliability of the nation's aging nuclear deterrent. As the latest system from the long-term partnership between Lawrence Livermore National Laboratory (LLNL) and IBM, Sequoia is a national asset and multi-national-laboratory resource.



The 20-petaFLOP/s Sequoia system has two main NNSA missions, both of which require “predictive simulation” of complex systems. Predictive simulation is not just computing the behavior of a complex system (the results), but also generating a precise quantification of the uncertainty associated with the results. This is analogous to the “margin of error” cited in scientific and technical papers or commonly used to qualify poll or survey results. Achieving predictive simulation is critical to resolving scientific problems when validation by physical

ASC SEQUOIA—THE 20 PETA FLOP/s (QUADRILLION FLOATING OPERATIONS PER SECOND), THIRD-GENERATION IBM BLUEGENE SYSTEM—IS NOW UNDERGOING ACCEPTANCE TESTING AT LAWRENCE LIVERMORE NATIONAL LABORATORY.

experiment (for example, underground nuclear testing) is impossible, impractical, or prohibited by law or treaty. Predictive simulation is necessary to sustain the nation's shrinking nuclear deterrent into the future as the deterrent continues to age. Sequoia's two missions are:

- To quantify the uncertainties in numerical simulations of nuclear weapons performance. This will require the execution of vast suites of simulations not possible on current systems.

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- To perform the advanced weapons science calculations needed to develop the accurate physics-based models for weapons codes.



Sequoia is primarily water cooled. Though orders of magnitude more powerful than such predecessor systems as ASC Purple and BlueGene/L, Sequoia will be roughly 90 times more power efficient than Purple and about eight times more than BlueGene/L relative to the peak speeds of these systems. For systems of this scale, energy efficiency is of central importance and absolutely essential to drive down operating costs.

Sequoia statistics:

- 20 PF/s target
- Memory of 1.5 PB, 4 PB/s bandwidth
- 1.5 M cores
- 3 PB/s link bandwidth
- 60 TB/s bisection bandwidth
- 0.5–1.0 TB/s Lustre bandwidth
- 55-PB disk
- 9.6 MW power, 4,000 ft<sup>2</sup>

For more information about Sequoia, see the ASC at Lawrence Livermore Web site: <https://asc.llnl.gov/>.



ABOVE: THE PETASCALE HEAT EXCHANGER, WHICH IS PART OF THE COOLING SYSTEM FOR SEQUOIA.  
BELOW: A MEMBER FROM THE IBM INSTALL TEAM WORKS ON THE ASC SEQUOIA COMPUTER.