National Nuclear Security Administration

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NNSA Computers Lead Global List

Supercomputer Investment Paying Dividends for the Nation's Stockpile Stewardship Program at the Nuclear Weapons Laboratories

WASHINGTON, DC -- Four of the six fastest supercomputers in the world are in use at laboratories operated for the U.S. Department of Energy's National Nuclear Security Administration (DOE/NNSA) according to a recent rating by the University of Tennessee and the University of Mannheim, Germany.

TOP500, the computer performance list published twice a year by the two universities, rated NNSA's Lawrence Livermore National Laboratory in California number one and number four with Accelerated Strategic Computer Initiative (ASCI) White and Blue Pacific computers, both manufactured by IBM. The ASCI Red supercomputer at Sandia National Laboratories in New Mexico, manufactured by Intel, placed number three; and the ASCI Blue Mountain supercomputer at Los Alamos National Laboratory, also in New Mexico, manufactured by SGI, ranked number six.

The goal of ASCI is to meet the science-based simulation requirements of the Stockpile Stewardship Program, which encompasses all Energy Department efforts to meet its nuclear weapons responsibilities. ASCI is developing the high-fidelity numerical simulation tools required by the scientists and engineers charged with ensuring the safety, reliability and credibility of the nuclear deterrent without underground testing. A 10-year goal of the program is to deploy an integrated weapons simulation capability running on a computer capable of 100-trillion calculations per second. That speed is necessary to simulate the complex three-dimensional (3D) physics that occur in nuclear weapons.

"The Accelerated Strategic Computing Initiative, or ASCI, is the backbone of our stockpile stewardship program," said Secretary of Energy Spencer Abraham, "This independent ranking confirms our technology leadership to support our nuclear stockpile. Many skeptics labeled this technology advancement 'impossible' just five years ago."

In 1999, the first-ever 3D simulation of a nuclear weapon primary explosion was successfully completed by Lawrence Livermore National Laboratory on the IBM Blue Pacific supercomputer. This simulation required about 0.3 terabytes of memory and ran for 20 days. Soon thereafter,

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Sandia National Laboratories successfully completed the first-ever, 3D computer simulations of a weapon system exposed to hostile nuclear radiation and blast environments on the Intel Red supercomputer. In April 2000, Los Alamos National Laboratory completed a 3D prototype secondary burn simulation on the SGI Blue Mountain supercomputer. The simulation required over 2000 processors, generated nearly 15 terabytes of data, and ran for over a month. The top-rated ASCI White machine is currently being used to simulate full-system nuclear weapon performance, the largest calculations ever performed for stockpile stewardship.

"This three-dimensional simulation capability is a key advance in our science-based work" said NNSA Administrator John Gordon. "Only with 3D full physics simulation capability, which incorporates the complex physics required to model weapon performance, aging, and safety, can we ensure the nation's nuclear deterrent in the absence of underground testing."

Before ASCI supercomputers, none of the world's computers had been able to meet the speed and memory required for 3D simulations, nor did they have the capacity for the transfer and storage of large terabyte data files. NNSA joined with computer manufacturing companies to develop computers with unprecedented speed and capacity. With the help of U.S. computer industry partners IBM, SGI, Intel, and Compaq, NNSA's Lawrence Livermore, Los Alamos, and Sandia national laboratories are now doing stockpile stewardship simulations that would have been impossible with previous computing capabilities. Next year Los Alamos, in partnership with Compaq, will deploy a 30 trillion operations per second computer for nuclear weapons simulations, nearly three times faster than the current world's fastest computer at Lawrence Livermore.

Both ASCI White and Blue Pacific machines use thousands of IBM RS/6000 processors - commercial, off-the-shelf technology. And both machines were deployed on time, within budget, and both exceeded contract specifications for performance. Just one year ago, 28 moving vans delivered the top-ranked ASCI White machine to its home in Livermore, California, in a climate-controlled room the size of two basketball courts. The machine computes at 12.3 trillion operations per second, which is approaching four times Blue Pacific's speed of 3.9 trillion operations per second. Although it more than doubled the total computing capacity at the three laboratories, the ASCI White machine is now fully utilized by weapon physicists and engineers performing simulations for Stockpile Stewardship. At the same time the three other ASCI supercomputers continue to perform at full capacity.

The supercomputing technology being developed for complex nuclear weapons simulations will also allow for important advances in fields critical to our national interests, ranging from medical and pharmaceutical research to aerospace, combustion and global climate modeling. For example, the Celera Corporation and Sandia National Laboratories recently announced a partnership to apply NNSA supercomputer expertise to develop new systems and architectures for biological simulations of the human genome.

The Linpack timing code is the benchmark used in ranking the computers. The TOP500 list has been updated twice yearly since June 1993. The full list can be viewed at www.top500.org.

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