



U.S. DEPARTMENT OF  
**ENERGY**

Office of Science



## Fact Sheet:

### **Collaboration of Oak Ridge, Argonne, and Livermore (CORAL)**

The Collaboration of Oak Ridge, Argonne, and Livermore (CORAL) is a joint procurement activity among three of the Department of Energy's National Laboratories launched in 2014 to build state-of-the-art high-performance computing technologies that are essential for supporting U.S. national nuclear security and are key tools used for technology advancement and scientific discovery.

CORAL is jointly led by the Office of Science's two Leadership Computing Facility centers at Oak Ridge National Laboratory (ORNL) and Argonne National Laboratory (ANL), and The National Nuclear Security Administration's facility at Lawrence Livermore National Laboratory (LLNL). The collaboration will procure leadership computing systems for the three National Labs and is part of a national strategic computing effort that would align strategies and resources across the federal enterprise.

#### *The Need for Supercomputing for the 21<sup>st</sup> Century*

High-performance computing (HPC) is essential for supporting the national nuclear deterrent and is a key tool used for technology advancement and scientific discovery. The computers being procured under this announcement deliver both much greater capabilities and energy efficiency, providing a key milestone in capacity and efficiency toward exascale. Extreme scale computing aims to deliver 20-40x the capabilities of today's computers with a similar size and power footprint.

DOE supercomputers run the most complex energy, science, and security mission applications and our investments advance HPC technologies to assure continued U.S. leadership in the field. DOE uses high performance computing in a number of wide-ranging fields, including:

- Assuring the viability of our nation's nuclear deterrent and supporting U.S. policy in nonproliferation and counterterrorism
- Developing scientific advances crucial for the development of new and renewable energy sources
- Designing and discovering new materials
- Improving the precision and accuracy of climate models
- Advancing the study of astrophysics, biology, chemistry, and other fields

Advances in HPC technology research, development, and deployment are needed to ensure that our Nation can continue to meet critical HPC-relevant national security needs, fully leverage HPC for economic competitiveness and scientific discovery, and position our country for sustained technical leadership. Collaboration with other Agencies and industry is essential to the success of high-performance computing.

### DOE Collaboration to Advance Supercomputing

CORAL was established in early 2014 to leverage supercomputing investments, streamline the procurement process, and reduce costs to develop supercomputers that will be more than five to seven times more powerful when deployed than today's U.S. fastest systems.

The three CORAL labs developed a single Request for Proposal (RFP) that specified the requirements and desired features of a system to meet the mission needs of DOE's Office of Science and the National Nuclear Security Administration. One requirement was that ORNL and ANL would have architecturally diverse computers to manage risk during a period of rapid technological evolution. Collaboration between DOE, NNSA, the National Labs and the private sector helped to:

- Strengthen technical requirement inputs from a larger group of experts
- Provide additional technical expertise with a wide range of experience for review processes
- Streamline the RFP process so that vendors only have to respond to one solicitation

### Procuring CORAL

DOE's Office of Science and the National Nuclear Security Administration signed a memorandum of understanding (MOU) to increase coordination in high performance computing research and development and HPC acquisitions. The CORAL RFP was released on January 6, 2014 and proposals were received on February 18, 2014.

The proposals were evaluated in accordance with the terms of the RFP and evaluations were performed by a collaborative team of more than 100 experts from the three CORAL labs. Two different computer architectures were selected by the three laboratories, working together.

### Technical Details of CORAL

The Argonne CORAL award announced today leverages Intel's HPC scalable system framework to advance key research initiatives for scientific discovery and technology advancement. Argonne's new system, Aurora, is expected to be at least eighteen times more powerful than ANL's current leadership system, Mira but only use 2.7 times more energy.

- Aurora will be 180 petaflops
  - 3<sup>rd</sup> Generation Intel® Xeon Phi™ processors
  - 2<sup>nd</sup> Generation Intel® Omni-Path Architecture with silicon photonics interconnect integrated on the package
  - Intel® SSDs burst buffer
  - Intel Lustre\* File System
  - Maximum projected power envelope of 13MW

Previously announced CORAL awards will be built on the IBM Power Architecture, NVIDIA's Volta GPU and Mellanox's Interconnected technologies. Oak Ridge's new system, Summit, is expected to provide at least five times the performance of ORNL's current leadership system, Titan. Livermore's new supercomputer, Sierra, is expected to be at least seven times more powerful than LLNL's current machine, Sequoia.

- Both Summit and Sierra systems will be 150 petaFLOPS<sup>1</sup> each:
  - IBM POWER processors and NVIDIA Volta GPUs (graphics processing units)
  - Mellanox InfiniBand Interconnection Network
  - IBM Elastic Storage
  - Maximum projected power envelope of 10 MW

### Supercomputing Legacy

The DOE Office of Science and the NNSA provide a portfolio of national high-performance computing facilities housing some of the world's most advanced supercomputers. These leadership computing facilities enable world-class research for significant advances in science.

- The Oak Ridge Leadership Computing Facility (OLCF) was established at ORNL in 2004 with the mission of accelerating scientific discovery and engineering progress by providing outstanding computing and data management resources to high-priority research and development projects.
- The Argonne Leadership Computing Facility (ALCF) provides the computational science community with a world-class computing capability dedicated to breakthrough science and engineering. It began operation in 2006 with its team providing expertise and assistance to support user projects to achieve top performance of applications and to maximize benefits from the use of ALCF resources.
- The NNSA Advanced Simulation and Computing (ASC) program grew out of the Advanced Strategic Computing Initiative (ASCI), which launched in the mid-1990s to make possible the continued effectiveness and safety of the nuclear stockpile in the absence of underground testing. In short, the computers have become the virtual nuclear testing platform, the integrating element of the Stockpile Stewardship Program. The technologies developed for ASC have wide application in related areas of national security as well as in supporting the advancement of science and technology in the U.S. The three national nuclear security laboratories -- Lawrence Livermore, Los Alamos, and Sandia -- have a rich history dating from the early 1950s in the development of high performance computing platforms and technology.

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<sup>1</sup> 1 petaFLOP is 1,000,000,000,000,000 operations per second