

**National Oceanic and Atmospheric Administration  
National Weather Service  
Weather and Climate Operational Supercomputer System (WCOSS)  
Contract Number DG133-02-CN-0013**

**Annual Operational Analysis - Calendar 2006**

This annual operational analysis report is a status review of the Weather and Climate Operational Supercomputer System (WCOSS) program in terms of financial performance, customer results and performance measures. It details financial and technical performance against established baselines/requirements and evaluates customer results. The program continues to meet established cost, schedule and performance parameters and directly facilitates NOAA's strategic goals to "Serve Society's Needs for Weather and Water Information," to "Support the Nation's Commerce with Information for Safe, Efficient, and Environmentally Sound Transportation," and to "Provide Critical Support for NOAA's Mission."

## **1.0 Financial Performance**

The WCOSS financial performance for 2006 shows no variance, lease costs followed the contractual baseline exactly. The WCOSS lease packages hardware, software, maintenance, support (including on-site personnel, training and travel) costs under a single invoice.

Performance for the months January through September was tracked against the base period of performance as defined in the contract. Performance for the months October through December was tracked against Contract Modification 21 which extended the Period of Performance by five years (2007 through 2011).

In addition to lease costs, NCEP spent an additional \$2,388,000.00 with IBM to augment the system's computational power, increase its storage capabilities, increase the scope of security services and to increase expert software engineering support. All funds were derived from NCEP's PAC fund budget.

## **2.0 Customer Results**

The WCOSS program is fully meeting the customer's needs and the program is delivering the services intended. As described under Performance Measures, this project is exceeding the terms of the contract by substantial margins. Our customers demand on-time product generation and the WCOSS has consistently exceeded NWS requirements while simultaneously support improvements in model accuracy. This contract is a model of Government/Industry partnership in which industry steps up to a contractual requirement for on-time product generation that is wholly dependent on Government supplied weather and climate forecasting codes. During 2006 the WCOSS program directly contributed to the NOAA/NWS mission and was critical in supporting the issuance of weather watches and warnings that protect both life and property. The value of this program in terms of lives saved and property protected as well as service to the Public mandates a continued need for this investment.

### **3.0 Strategic and Business Results**

During 2006 significant improvements were made to the following models that run only on WCOSS assets. These models are mission critical and directly contribute to the achievement of NOAA strategic goals. Furthermore, these models are intrinsic to the NCEP business plan.

- ✓ Global Forecast System (improved science, improved data assimilation, improved database)
- ✓ North American Mesoscale (improved science, improved database)
- ✓ Real-Time Mesoscale Analysis (improved resolution)
- ✓ Short-Range Ensemble Forecast (improved science, improved timeliness)
- ✓ North American Ensemble Forecast System (improved science, improved database)
- ✓ Air Quality Forecast (expanded domain to CONUS)
- ✓ Rapid Update Cycle (improved resolution)
- ✓ Marine Wave Model (improved science, expanded domain to include Great Lakes)

NOAA/NWS/NCEP exercised a contract option to extend the current contract with IBM for five years (FY 2007 – FY 2011). This option includes language specific to security enhancements and increased levels of computational performance.

In February 2006 work began on an upgrade to the Fairmont facility power and cooling systems in anticipation of a WCOSS upgrade scheduled for July –November 2006. Extensive facility infrastructure work was completed on schedule and on budget allowing the planned hardware installation to proceed on schedule. New WCOSS hardware (IBM Power5+ clusters) is expected to become operational in January 2007 and to provide a 320% increase in computational performance over the current WCOSS. [The Primary system (located in Gaithersburg, MD) was Accepted in October and the Backup System (located in Fairmont, WV) was Accepted in December.]

### **3.2 Problems Experienced**

No significant problems were experienced during calendar year 2006.

### **3.3 Adjustments of Plans**

The WCOSS is the cornerstone of NWS numerical weather prediction and particular attention is paid to program execution. Therefore, no significant adjustment of plans was required during 2006 but a critical change in new system installation order was supported by the contractor, IBM. To provide the most flexibility during facility work at the Backup System site in Fairmont, WV, the contractor delivered the new primary system to Gaithersburg in July rather than October and the Fairmont delivery was done in October.

In addition, to benefit NCEP's research and development activities, supported under the NOAA R&D HPCS program, IBM delivered significant computational components to the Gaithersburg facility, well ahead of the scheduled R&D HPCS delivery. Once the R&D HPCS system was delivered, these "loaner" components were removed and used to complete the Backup System

delivered to Fairmont in October. The actions by the contractor preserved NCEP's R&D computational resources that were at risk due to delays in the NOAA R&D HPCS program.

### 3.4 Performance Measures

The current performance of the system is documented in the table below

**Performance Measures**

| <b>Indicator</b>                | <b>2006 Baseline</b> | <b>Calendar Year 2006</b> | <b>Comments</b>                     |
|---------------------------------|----------------------|---------------------------|-------------------------------------|
| On-Time Product Generation      | 99%                  | 99.48%                    |                                     |
| System Availability             | 99%                  | 99.86%                    |                                     |
| Time to Switch to Backup System | 30 min.              | 12.75 min                 | No switch required for four months. |

A separate set of Performance Measures were used to evaluate the option to extend the period of performance. The key performance measures were Computational Capability (2.5 times current performance), Computational Capacity (3.7 times current performance) and Input/Output speed (5 times current performance). All these measures were verified by Government personnel. Computational performance was validated using Government provided computational codes.

### 4. Innovation

During 2006 NCEP received an upgraded supercomputing system from its contractor, IBM. This new Power5+ system provided NCEP staff with three times the computational performance of the preceding system, an IBM Power4+ system, propelling NCEP from numbers 167 and 168 to numbers 36 and 37 on the Top 500 Supercomputers (<http://www.top500.org/list/2006/11/100>). In quantitative terms, NCEP systems went from supplying 4.4 Tflops each to 14 Tflops each (where Tflop is trillion of operations/second). Along with the increase in computational performance the contractor delivered a balanced system with increased memory, I/O bandwidth and disk storage. This upgrade positions NCEP to meet the needs of the next generation models with increased spatial and temporal resolution and to increase the number of ensemble members. These improvements are designed to provide our customers with improved weather forecast products (including enhanced precipitation and Air Quality forecasts) on a daily basis.