

***Performance Information Management Through Wide  
Area Networking***

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***Santee Cooper***

# **Performance Information Management Through Wide Area Networking**

by

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## **Abstract**

In today's competitive utility market accurate and timely information about the performance of our generation units can make the difference between financial success and failure. Performance Services was given the goal to provide the means of obtaining and distributing both real time and historical performance data not only to the station, but to Management at the corporate office. This paper reviews the development of Santee Cooper's Performance Information Management System and the supporting Wide Area Network.

## **Introduction**

Prior to 1991, Santee Cooper's performance services program was typical of the industry. Performance tests were conducted on the turbines on an annual basis and tests on the boilers, major cycle components and cooling towers were conducted as needed. Test

schedules were highly effected by unit availability, scheduled outages, and demands for other services. Performance information was limited to test reports, monthly station progress reports and studies. In 1991, Santee Cooper began development of a comprehensive performance information management system to provide detailed, accurate performance information on the generating units in a timely manner. The goal of the system was to provide performance data both to the generating stations and at the Corporate offices in Moncks Corner. Information provided at the generating stations would be used to support optimizing unit performance, maintaining station instrumentation, and monitoring components. Information available at the Corporate office would be used to verify efficient unit operation and assist in maintenance planning, economic dispatching, power pricing, system planning, fuel accounting and fuel budgeting.

Data would be available in two basic formats. Actual instrument readings along with controllable loss information and certain other calculated performance indicators would be available on a real time basis. Historical data (both measured data and calculated results) would be recorded for later analysis at five minute intervals. Both formats would be available at either the generating station or the Corporate office.

### **Design Approach**

In order to accomplish the goals of the system, custom unit specific performance monitoring systems needed to be developed and then linked through Local Area Network (LAN) and Wide Area Network (WAN) technology to complete the total performance information management system.

The system is designed to maximize accuracy, provide unit specific design, networking capability, instrument redundancy and isolation from station controls.

**Accuracy** - Instrument accuracy is achieved through the support of the Performance Services Calibration Lab. This in-house lab facility maintains NIST certification. Accuracy of performance information received from the system is maintained by unit

specific in-house developed verification software for each scan read. Engineering calculations/software is traceable to the ASME codes.

**Unit Specific Design** - Operating software is designed specifically for each unit. Performance targets were established based upon the unit's design parameters and detailed modeling studies using PEPSE.

**Networking** - The system provides real-time and historical performance data to users at the generating stations using a dedicated LAN. WAN communications to the Corporate offices for the system are accomplished over a dedicated T1 line. The majority of Santee Cooper's power generation comes from coal fired units at four generation stations situated in four widely separated locations along the northern section of the South Carolina coast. Three of the four stations were included in the performance information management system design based on annual run hours. The Cross, Winyah and Jefferies stations included in the system make up over 80 percent of Santee Cooper's generation. The farthest of these locations is Winyah Station located approximately fifty-five miles from the Corporate office and the nearest is Jefferies Station just five miles from the Moncks Corner offices.

**Isolation** - The system was designed to avoid chances of interference with the operation of the unit. Since the system was designed to use test grade instrumentation, we needed the flexibility to change equipment when needed not when the unit operation would allow it. Complete isolation also provides assurance that no maintenance nor any spurious signals generated by the OLS or associated computer networks would adversely effect the unit's operation.

**Redundancy** - Redundant instrumentation provides a second source of information to the unit operators for comparison.

## **Implementation**

The system was designed and implemented in three phases beginning in 1991. Phase I and Phase II were completed in early 1995. Phase III is scheduled to be completed in late 1996.

**Phase I, Initial Construction/Controllable Losses** - dedicated instrument connections were permanently installed on each unit. Additional instruments were purchased and installed. A dedicated data acquisition system was developed and installed in permanent cabinets in each unit's relay room. Unit Specific software was developed to support monitoring of operator's controllable losses at the stations.

**Phase II - Expanded Applications/Local Area Network** - Additional instrumentation was installed to support turbine efficiency calculations and component performance monitoring. Data logging and archiving capability were initiated. Local Area Networks (LAN's) were installed to allow central processing and provide information to station Management. Asynchronous data processing is accomplished using the OS/2 operating system. A typical OLS LAN arrangement for each station is shown in figure 1.

**Phase III - Wide Area Network Communications** - Station OLS LAN's were connected to the Corporate offices in Moncks Corner. The centralized performance information database was established and a graphical user interface was developed. A diagram of the entire system is provided in figure 2.

## **Features**

Santee Cooper's performance information management system has been designed to maximize accuracy, speed, fault tolerance and flexibility. These features are designed into the system software and were the basis for hardware selection and construction.

## **Performance Monitoring Software**

Performance Services uses sophisticated in house developed software to glue the dedicated test quality instrumentation, data acquisition equipment and PC based local area network communication technology into a robust and stable performance monitoring system. This software is subdivided into 4 classifications which describes the tasks accomplished by each component.

### **Data Acquisition System Interfacing and Real Time Calculations**

Data acquisition system interfacing and real time calculation software provides the system with instrument measurements and performance analysis while the power unit is on-line. This information is continually updated and indicates the resulting performance impact due to operational changes made to the unit. This software is custom designed for the data acquisition system and each unit's individual thermal design model.

### **Information Retrieval and Display**

Information Retrieval and Display Software groups data together in many different easy to read and understand screens. Specific packages have been designed for plant operators, engineers and management. These programs are available for both OS/2 and MSDOS.

### **Historical Storage of Information**

Historical storage software provides both long and short term storage. This software utilizes a .DBF file format and a Paradox data base product. Short term storage software allows various tests to be performed on the unit. These programs are available for both OS/2 and MSDOS.

### **Engineering Analysis and Reporting**

Engineering analysis and reporting software utilizes long term storage data to produce various regular reports. These reports include weekly operational net unit heat rates,

monthly controllable loss summaries and monthly station performance reports. These programs are available for OS/2 and MSDOS.

### **Performance Monitoring Hardware**

Performance Services uses dedicated test quality instrumentation throughout the system. Specific calibration limits are employed for each instrument location. Performance services technicians monitor instruments daily in real time to detect system problems. FLUKE Helios data loggers provide fast, accurate data acquisition. These units scan approximately 180 channels per unit continuously at five second intervals. Performance data processing is accomplished on a dedicated industrial CPU located in the instrument cabinet in each relay room. All engineering analysis is performed on these CPU's at five second intervals. For each station a dedicated network server CPU provides traffic control for the asynchronous processing of data throughout the OLS LAN at each station. Each unit operator is equipped with a dedicated diskless work station for the OLS providing the operator's interface to the network.

### **Performance Information Network**

The Santee Cooper performance Information Network is a sophisticated Wide Area Network uniting three OS/2 LAN Server based local area networks at remote locations with a Novell NetWare based Local Area Network at the Corporate offices in Moncks Corner. Routers at each station and in Moncks Corner allow the station OLS LAN Servers to communicate over T1 lines directly to a dedicated OLS communications computer in Moncks Corner. That computer forms the link from the OS/2 networks operating in the field with the Novell network supported by the Production Server. The Production server provides access to real time performance data from the stations and performance information archived in the performance database. The database is stored on the production server. Thus data that was previously only available on a limited basis is now accessible to anyone using the Production Server.

## **Benefits**

Benefits of networking performance data have been realized both in increased availability of performance data and in a number of programs that have been initiated as a result.

**Optimized Performance Testing** - Use of the OLS and its network capabilities has reduced labor and equipment costs per test by approximately 80 percent.

**Enhanced Management Decision Support** - The ability to quickly access archived data using the performance database at the Corporate office has been useful in providing information to Management. Engineering analysis that would have required scheduling specific tests are now performed quickly using historical data from the database. Recently, data collected by the OLS over several years was successfully used to support Santee Cooper's position in a multi-million dollar claim.

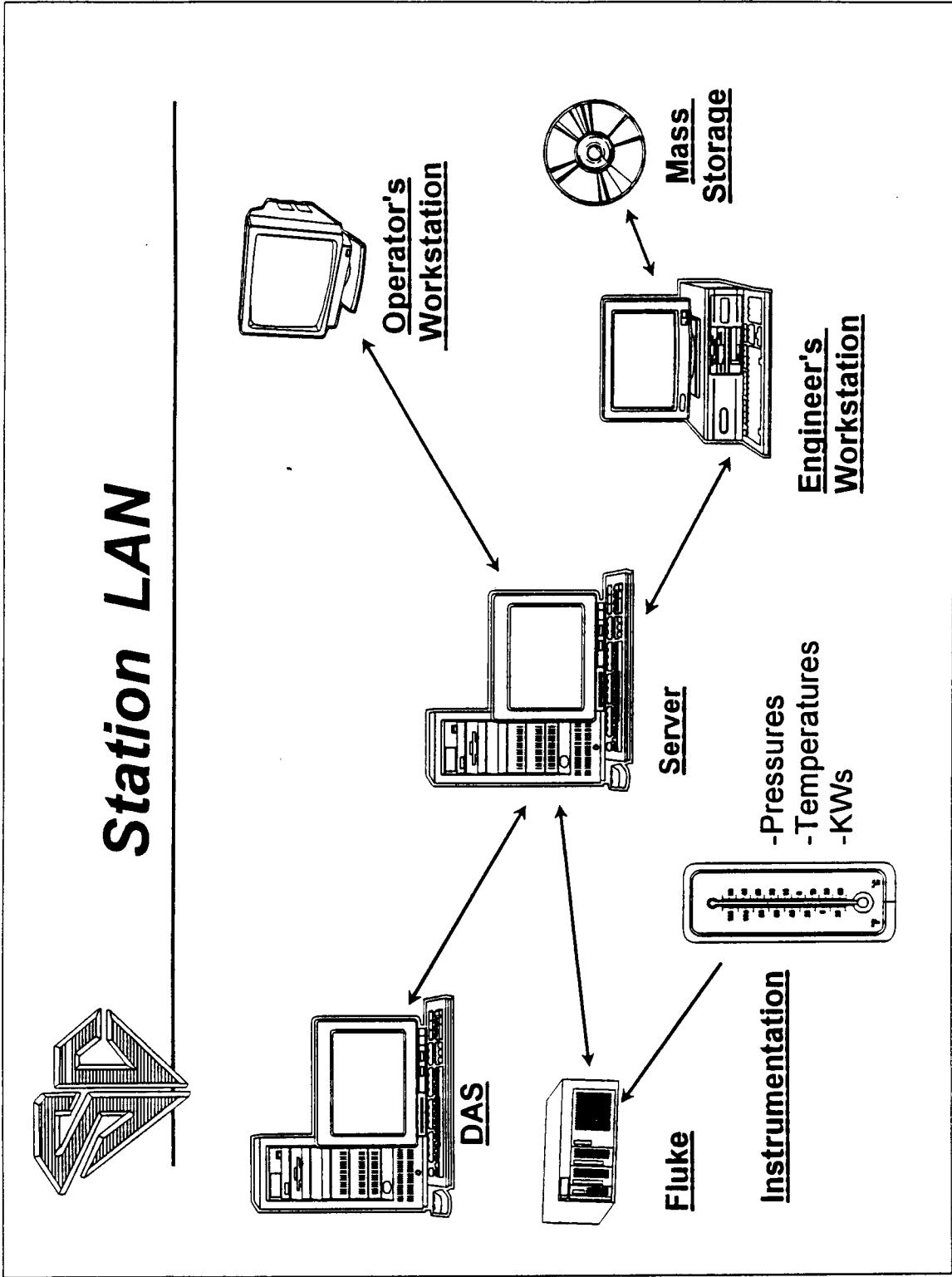
**Component Performance Trending** - Efficiencies of HP and IP turbines are monitored daily to identify abrupt changes in performance. Bi-weekly enthalpy drop tests are conducted on all seven OLS equipped units directly from the Corporate Offices in Moncks Corner. Results of these tests are used to quantify performance degradation rates and identify gradual changes in operating conditions. This facility was recently used to identify a minor control valve adjustment problem that, when corrected, resulted in recovering 3 MW output for the unit.

**Enhanced Performance reporting** - Station Monthly performance reports are now produced using the OLS. Performance trends derived from archived performance data for the month and inputs from station engineers are reviewed in monthly performance meetings at the stations. Monthly reports are produced detailing performance trends and planned action items.



**Support of Economic Dispatching** - Heat rate data supplied to the Moncks Corner network is used to produce heat rates each week for all seven OLS equipped units. Incremental heat input curves are produced and provided to Power Supply for use in the SCADA system. Availability of this data on a weekly basis ensures quick response to changes in unit performance.

**Controllable Loss Information** - In 1995, Generation instituted a competition between unit operating crews based on biweekly controllable loss reports provided by the OLS. The competition is part of a controllable loss reduction program and was facilitated by the OLS.



# Santee Cooper On-line Monitoring System

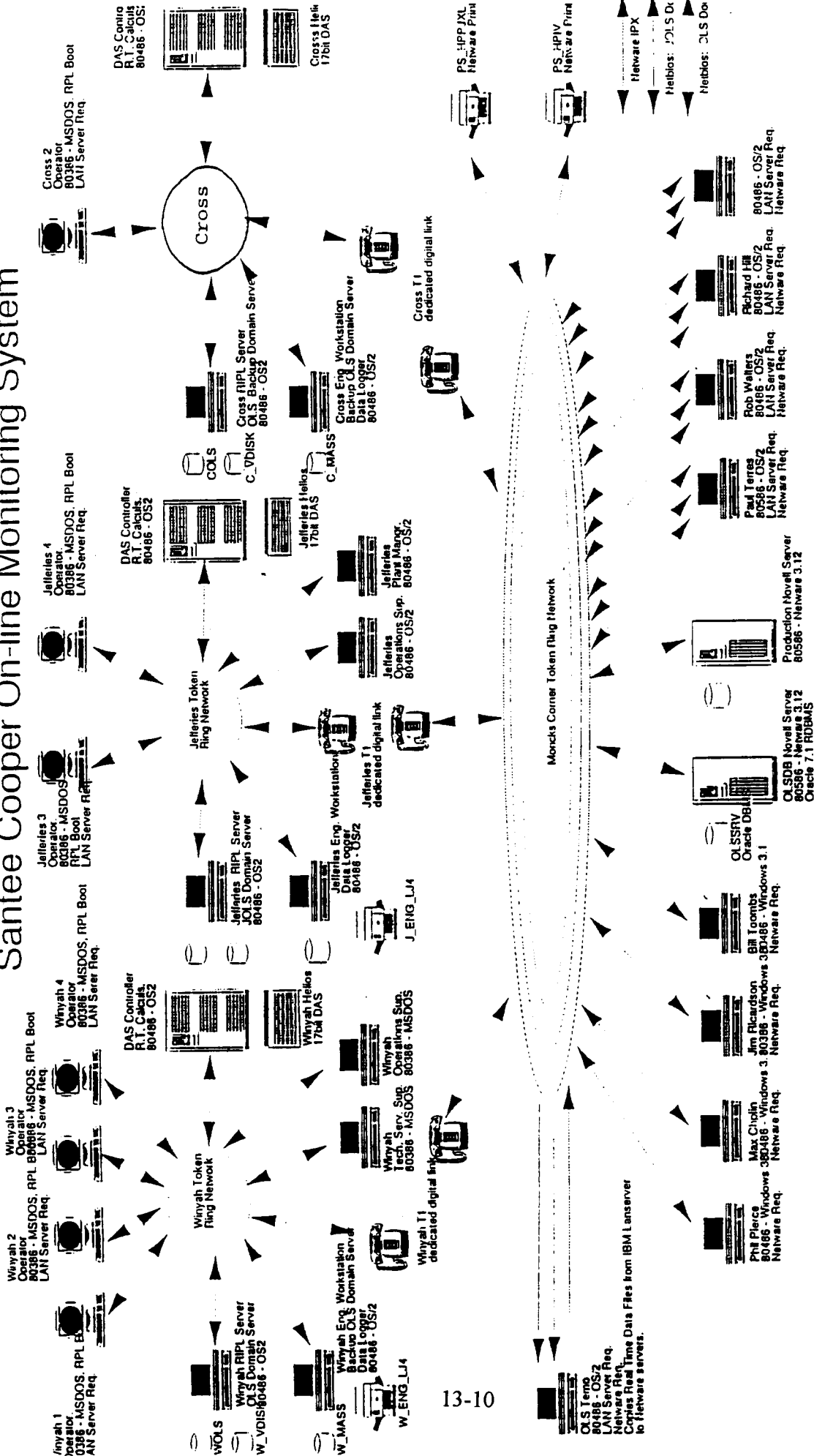


figure 2