Alliance Airport D/A Initiative

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The Alliance Airport development is a master-planned international trade and logistics center in excess of 5900 acres (2387.7 ha) that features the world's first industrial airport. The airport, located in north Fort Worth, Texas, U.S., opened in 1989 and has since become home to an impressive collection of government, national and international corporations. The current tenant list includes: * American Airlines-Maintenance and Engineering Base * FedEx-Southwest Regional Hub * Burlington Northern Santa Fe-Intermodal and Carload Transportation Center * U.S. Drug Enforcement Administration-National Aviation Support Headquarters * JC Penny * Intel * Kraft Foods * Galaxy Aerospace

In addition, the Texas Motor Speedway is located just 2 miles (3 km) north of the Alliance Airport complex.

The development is served by the Alliance Substation (2-94 MVA, 345-24.9-kV transformers) with three 24.9-kV distribution feeders. The main feeder routes of the distribution network are installed in a duct/manhole system and consist of 26.5 miles (42.6 km) of three-phase 1000-kcmil Al. XLP cable, 12 miles (19 km) of concrete-encased duct bank and 81 S&C PMH switchgear.

In the past, locating component failures in the underground electrical system at Alliance took up to several hours and required closing the substation feeder breaker multiple times. This process was time-consuming and potentially damaging to the underground cable. Three-phase fault currents can range up to 8700 A in the system. As the number of critical customers the Alliance Substation served continued to grow, this method of fault location was no longer acceptable. The profile of the tenants at Alliance Airport and their reliability requirements has created a need to give a higher level of service than can be offered by a manually switched distribution system. Based on the success of the distribution automation system at Dallas-Ft. Worth (DFW) International Airport, officials decided to install a similar system at Alliance.

The automation system at DFW Airport consists of 171 automated switchgear, which is a combination of S&C PMH pad-mounted units and Powell-ESCO SF6 Arcwhippers. The switchgear uses GE Harris Energy Control Systems’ DARTs as its remote terminal units.
(RTUs). The system is controlled using both fiber-optic and 900-MHz spread spectrum radio communications through H&L Instruments 542B fiber transceivers and GRE America's Gina 900-MHz radios. The communication protocol used to operate the system is Distribution Network Protocol (DNP) 2.99. This protocol, which is a version of DNP 2.0, was modified specifically for use at DFW Airport to allow the use of locally controlled fault indicator lights on the pad-mounted switchgear.

The DFW Airport automation software was written by the Flood Group and became operational in 1993. The software is written entirely in C and runs on a UNIX platform using Sun SPARC 20 workstations. The system displays were built using an object-oriented graphics package designed for real-time control systems. The interface allows the user to pan and zoom, open and close switches, retrieve database information and perform many other functions by pointing and clicking. All the user-interface displays were designed to look very similar to the wallboards the dispatchers normally use for switching.

The system continuously polls all the RTUs directly over a fiber-optic network and maintains a database of current and historical values of all monitored points. The system monitors current switch positions to maintain an accurate representation of each feeder segment's energy state. The system can distinguish between unenergized, normal, abnormal and parallel energization states and display them back to the operator. Both the distribution and the communications systems are continuously monitored for faults. If a fault is detected, then the system confirms the fault status on all affected grid segments. When the system has retrieved all available information, it analyzes the fault information together with the existing system status and isolates the fault to a specific segment or device. That information is then displayed to the operator, and the restoration effort can begin. With this system, the faulted cable or switchgear can be isolated and power restored to all available customers within 8 min. Of that time, 5 min is spent waiting for the automation system to analyze and locate the fault.

Unlike DFW Airport, Alliance Airport did not need every switchgear automated. By automating the switchgear at distribution feeder ties and where feeders split, the time needed to locate and isolate a fault and restore power to the remainder of the circuit could be decreased significantly. As a result, 12 existing S&C PMH-10 and PMH-11 manual switchgear were changed out to automated units.

The major components comprising the Alliance Automation System are: * GE Harris D20 RTU * 900-MHz Spread-spectrum * Radio System * Graphical User Interface (GUI).

The system is designed around the GE Harris D20M RTU. The D20 serves as the system data concentrator and the protocol gateway. The D20 is based on the VMF/Eurocard design and is controlled by a 32-bit 68020 microprocessor. It has 1024 k of EPROM program storage, 512 k of RAM temporary storage, and 512 k of NVRAM data storage. It is expandable through the use of additional cards. It has seven serial communication ports, two Westmait monitoring serial ports and two D.20 serial ports for connection to
local I/O modules. The unit mounts in a standard 19-inch (48-cm) rack.

All the data management, filtering and automation schemes used by the Alliance Automation System are contained in the D20. These routines were designed and constructed using the ladder logic contained in GE Harris' Prologic software. The D20 continuously monitors the status points of all the GE Harris DARTs, the status of the distribution feeder breakers and the status of all the devices in the automation system's communication path. Any system changes or abnormalities are processed by the D20 and forwarded to the GUI for display.

A D20 "S" board is connected to one of the D.20 serial ports. A set of "A" contacts have been tapped off the three distribution feeder breaker relays and connected to the "S" board. These contacts allow the automation system to monitor the status of the feeder breakers. The "S" board allows for a maximum of 64 external connections.

The D20 communicates to the GUI at the West Distribution Operations Center (West DOC) using a 56-kps digital data line through a pair of Codec modems. Communications from the D20 to the individual switchgear are handled by two GRE America GINA model 6000NV-5 900-MHz spread-spectrum radios (Host 1 and Host 2). Host 1 is configured to communicate directly with the 10 switchgear that have line of site to Alliance Substation. Host 2 communicates with a GINA radio configured as a repeater housed at American Airlines' Alliance Maintenance Center. The repeater is used to communicate with the two automated switchgear on the north side of American's complex.

The GUI provides all the information and access to control the automation system. It was built on the GE Harris PowerLink/USDATA Factory-Link software platform and resides on a Dell 266-MHz Pentium II computer. It uses the Windows NT 4.0 operating system. The main screen is divided into three sections: One-line Diagram—a basic schematic of the automated portion of the Alliance distribution network.