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The purchase of Stellar Dynamics by GE Harris is a refreshing example of rational long-term thinking.

OCTOBER 1999

Distribution Automation at the

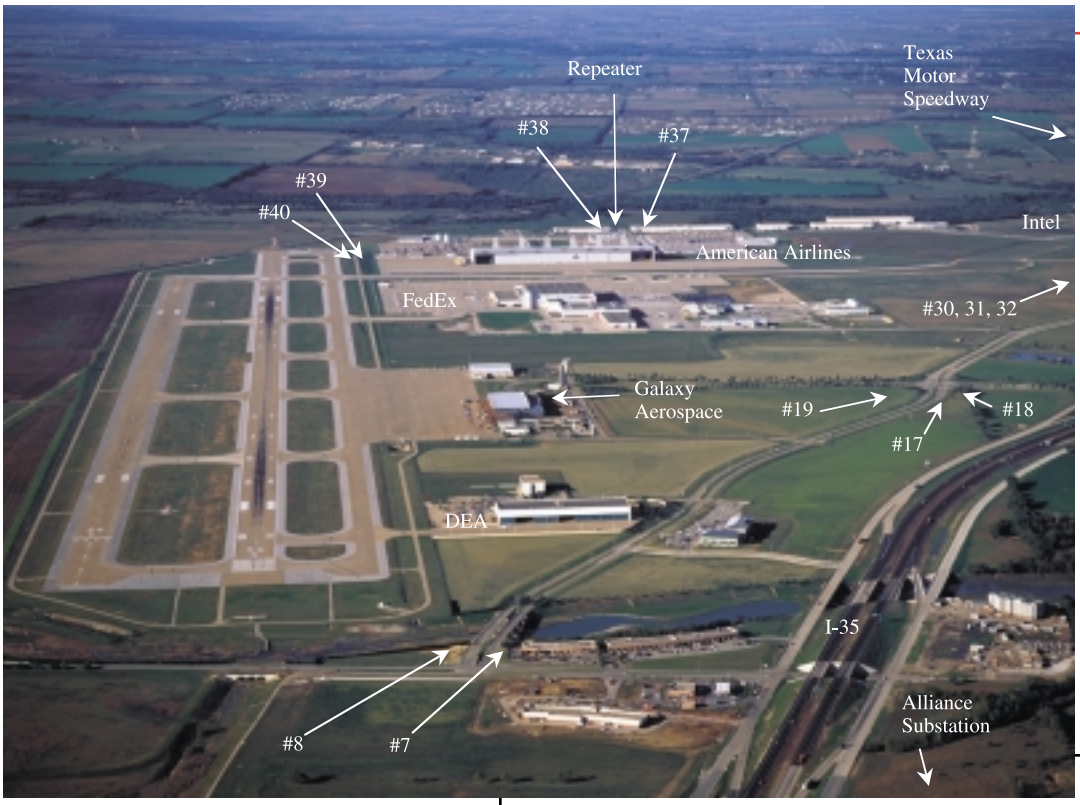

Figure 1. Alliance Airport.

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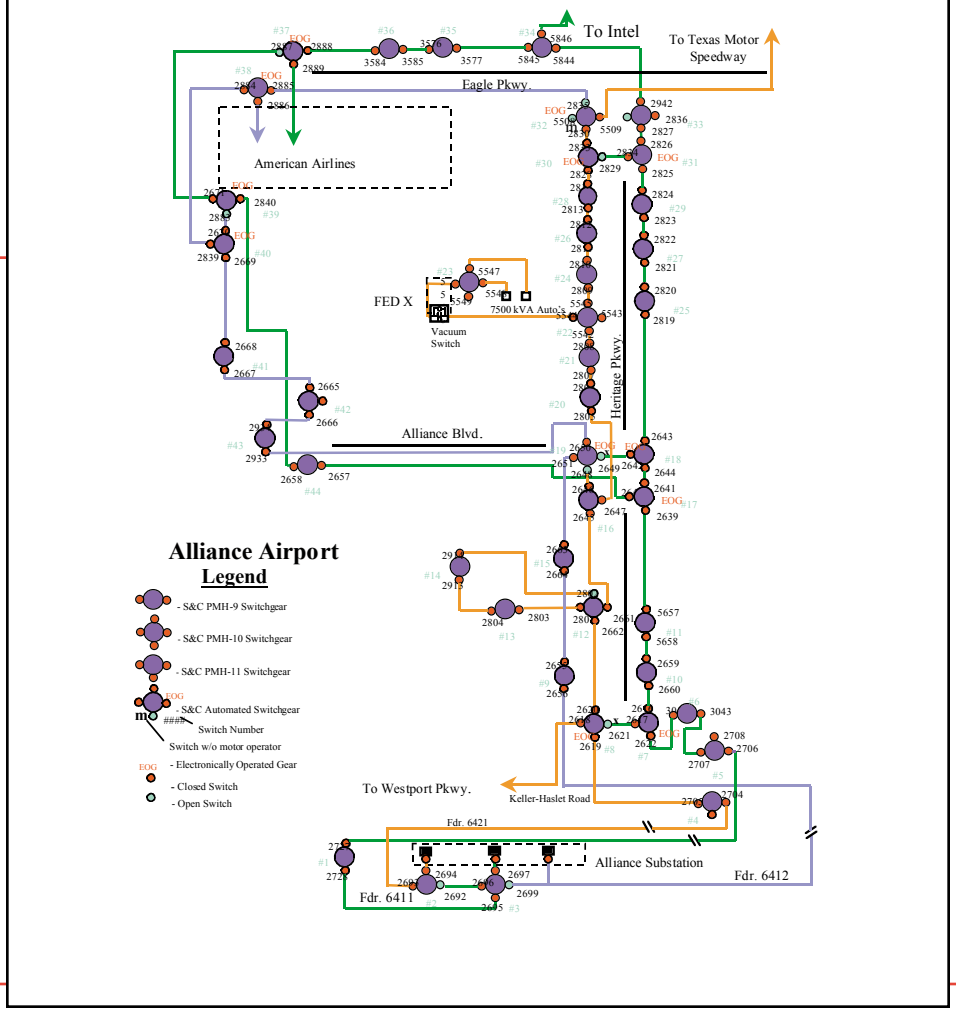


Alliance Airport Development

The Alliance Airport development is a master-planned international trade and logistics center in excess of 5,900 acres that features the world's first industrial airport. The airport opened in 1989 and has since become home to facilities for 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
- JCPenney
- Intel
- Kraft Foods
- Galaxy Aerospace

In addition, the Texas Motor Speedway is located just two miles north of the Alliance Airport complex.

The Alliance development is served from 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 of 3 phase 1000 kcmil Al. XLP cable, 12 miles of concrete encased duct bank, and 81 S&C PMH switchgear.

In the past, locating component failures in the underground electrical system at Alliance has taken up to several hours and frequently required closing the substation feeder breaker multiple times. This process is both time-consuming and potentially damaging to the underground cable. Three-phase fault currents can range up to 8700 amps in the system. With the growing number of critical customers that are served by the Alliance Substation, this method of fault location was no longer acceptable. The profile of the tenants at Alliance Airport and their reliability requirements have 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 DFW Airport, it was decided to pursue the installation of a similar system at Alliance.

DFW Airport

The automation system at DFW Airport consists of 171 automated switchgear. The switchgear is a combination of S&C PMH pad mounted units and Powell-ESCO SF-6 Arcwhippers. The switchgear uses GE Harris' DARTs as its remote terminal units (RTUs). The system is controlled using both fiberoptic 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 fiberoptics 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 uniquely 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 minutes. Five minutes of that time is spent waiting for the automation system to analyze and locate the fault.

Alliance Project

Unlike DFW Airport, it was decided it was not necessary to automate every switchgear at Alliance Airport. 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 significantly decreased. As a result, 12 existing S&C PMH-10 and PMH-11 manual switchgear were changed out to automated units. The physical locations of these automated switchgear are shown on Figure 1.

The major components comprising the Alliance Automation System are:

- GE Harris D20 RTU
- 900 MHz Spread-spectrum Radio System
- Graphical User Interface (GUI)

D20

The Alliance automation 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 1024K of EPROM program storage, 512K of RAM temporary storage, and 512K of NVRAM data storage. It is expandable through the use of additional cards. It has seven serial communication ports, two Westmaint monitoring serial ports, and two D.20 serial ports for connection to local I/O modules. The unit mounts in a standard 19-inch 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 56kbps 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 & Host 2). Host 1 is configured to communicate directly with the ten 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. (See Figure 2).

Graphical User Interface (GUI)

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 with a 21-inch monitor. It uses the Windows® NT 4.0 operating system. The main screen is divided into three main sections (See Figure 3):

- One-line Diagram – a basic schematic of the automated portion of the Alliance distribution network.
- Control Bar – buttons that allow zooming, resetting the fault indicator boxes on the one-line diagram, and navigating through the various screens that comprise the GUI.
- Alarm Bar – displays the three newest unacknowledged alarms on the automation system.

Conclusion

The completion of the Alliance Automation Project required the cooperation of many groups and individuals both inside and outside TXU Electric. It is also planned to install local fault indicators on the non-automated switchgear at Alliance to aid in the location of faults between the automated units.

TXU Electric will be adding automated switchgear to the Alliance Automation System as the need and opportunity arises. The focus of these additions will continue to be on automating switchgear that are deemed critical to restoring service to large blocks of load and critical customers.

The Alliance project was used as a pilot program for the retrofit of the distribution automation system at DFW Airport. There is a project in progress to replace the hardware and software at DFW Airport with upgraded versions of the equipment and software used at Alliance Airport. The expected improvements from this upgrade are enhanced system performance, greater ease of operation, and expandability.

Figure 2. Communication Path.

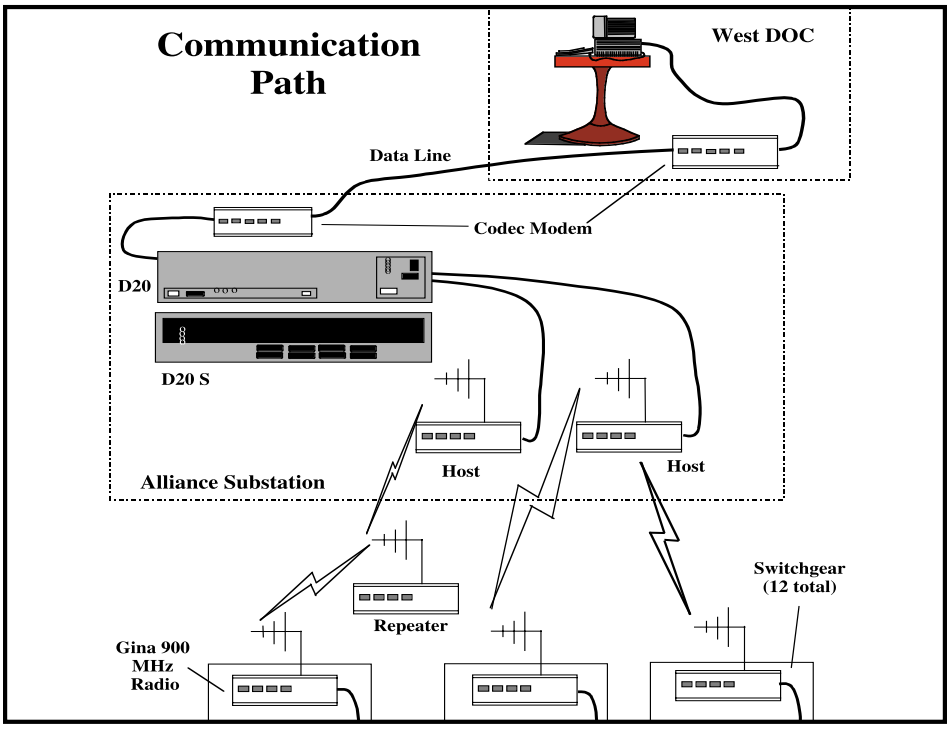
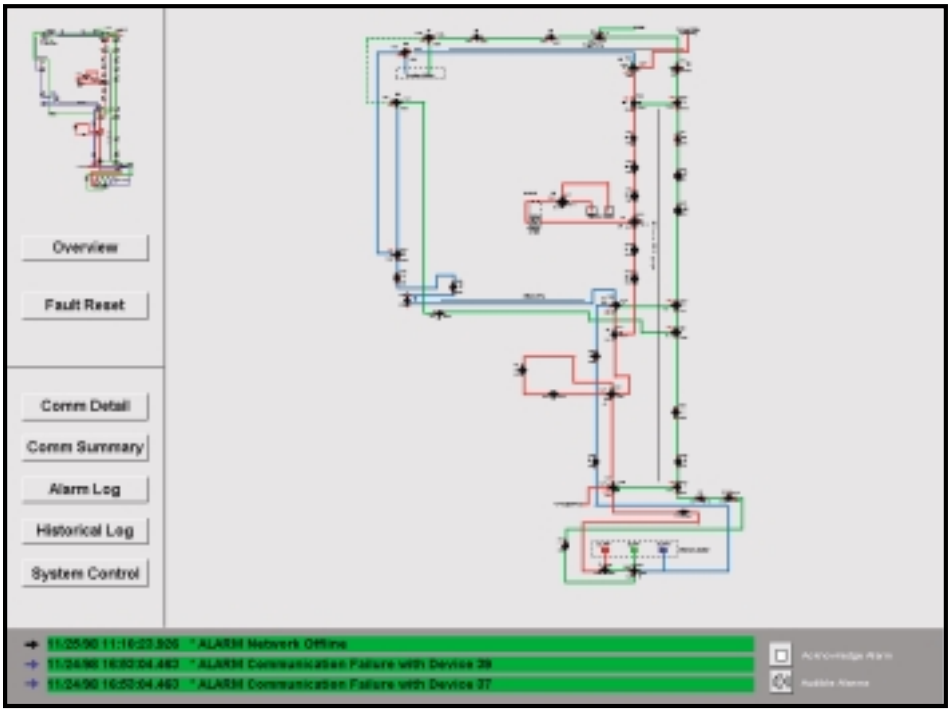


Figure 3. GUI.



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