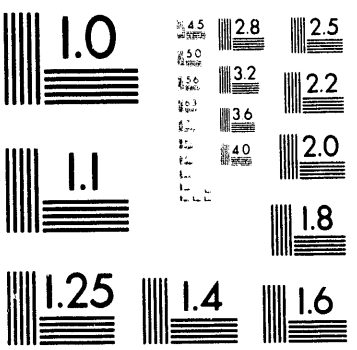
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DATA ACQUISITION AND CONTROL SYSTEM FOR THE HIGH-LEVEL WASTE TANK FARM AT HANFORD, WASHINGTON*

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ABSTRACT

The High-Level Nuclear Waste Storage Tank 241-SY-101 periodically releases flammable gasses. Mitigation experiments to release the gasses continuously to avoid a catastrophic build-up are planned for FY93 and beyond. Los Alamos has provided a data acquisition and control system (DACS) to monitor and control mitigation experiments on SY-101. The DACS consists of a data acquisition trailer to house the electronic components and computers in a friendly environment, a computer system running process control software for monitoring and controlling the tests, signal conditioners to convert the instrument signals to a usable form for the DACS, programmable logic controllers to process sensor signals and take action quickly, a fast data acquisition system for recording transient data, and a remote monitoring system to monitor the progress of the experiment. Equipment to monitor the release of the gasses was also provided. The first experiment involves a mixer pump to mix the waste and allow the gasses to be released at the surface of the liquid as the gas is being formed. The initial tests are scheduled for July 1993.

INTRODUCTION

Los Alamos National Laboratory (LANL) and EG&G/EM have developed a data acquisition and control system (DACS) for monitoring and controlling tests for the Hydrogen Mitigation program to mitigate the gases released from the High-Level Nuclear Waste Storage Tank 241-SY-101 (SY-101) located at the Hanford Site, Richland, Washington. The tank experiences episodic releases of toxic and explosive hydrogen gases. The DOE mandated the Emergency Hydrogen Mitigation program to mitigate the gases released from HLNWST 241-SY-101.

The DACS consists of a computer system running GENESIS process control software, a programmable logic controller for input/output (I/O) devices, a Nicolet digital transient recording system, and separate data collection and analysis systems for other data. A total of 18 IBM/PC compatible computers are used. The system is self-contained in an environmentally controlled 10-ft x 52-ft trailer. The trailer is supplied with heating, ventilation, and air conditioning as well as an uninterruptible power supply for critical equipment and is powered from a Hanford Site substation. A remote monitoring site has been established to monitor the test progress without interfering in the operation.

The DACS is used to monitor physical waste parameters such as the tank waste level, temperature, and gas characteristics including pressure flow and percent hydrogen. DACS is also used to monitor and control mitigation equipment such as a 150 hp pump used to circulate the waste. Automatic alarms and aborts are provided to alert the operator of possible unsafe conditions and will automatically stop the mitigation experiments if abort parameters are exceeded.

*This work supported by the US Department of Energy, Hanford Program Office in the Office of Environmental Restoration/Waste Management and the Office of Safeguards and Security.

The design incorporated the requirements of monitoring the tests, controlling and monitoring the mixer pump, and operating safely.

TANK 101-SY AT HANFORD, WA

Tank 101-SY (Fig. 1) in the Hanford High-Level Waste Tank Farm (Fig. 2) currently releases gas every 100 to 160 days, producing up to 10 500 cubic feet of gas

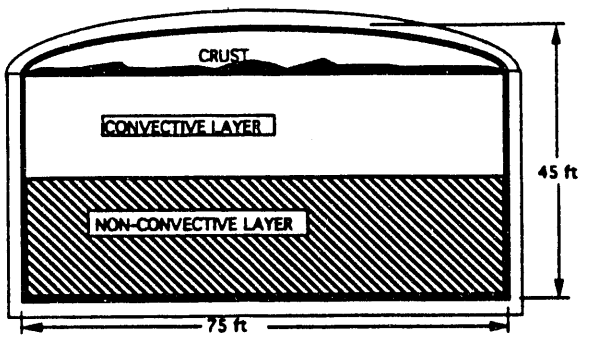


Fig. 1. Dimension of Tank 101-SY and qualitative structure of the waste.

Fig. 2. Aerial view of the SY Tank Farm. The center of Tank 101-SY is beneath the tent.

consisting of approximately equal parts of hydrogen, nitrous oxide, and nitrogen. The gas release event (GRE) takes a few minutes. During this time, the tank contains a potentially explosive mixture of gases and is considered a safety hazard. Because of the potential for contamination release, the tank will be mitigated. In the first experiment, a 150 hp submersible pump (Fig. 3) will be tested to

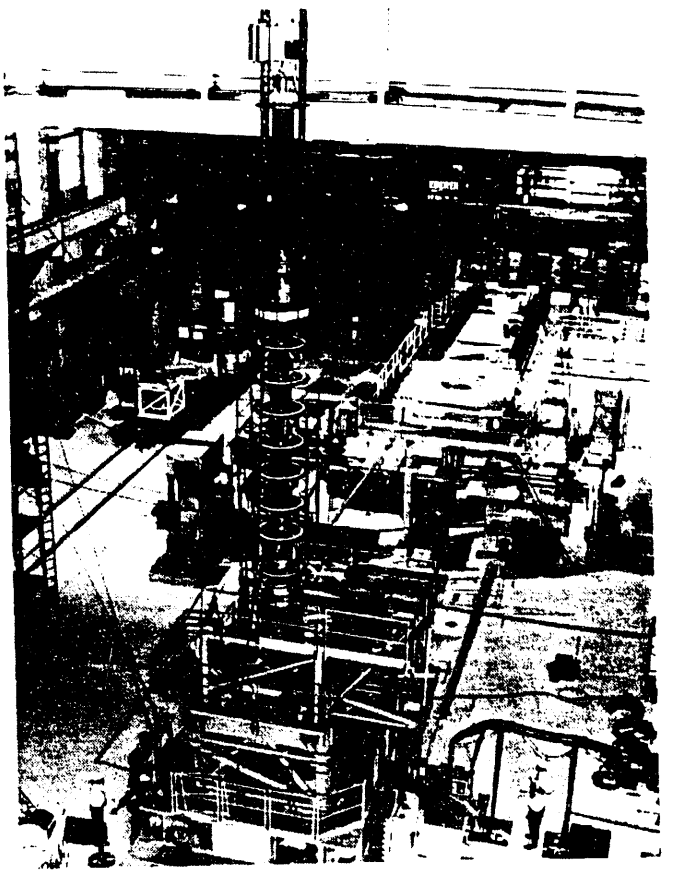


Fig. 3. Photograph of the mixer pump prior to testing.

assess its efficacy in mitigating the GRE. The mixer pump will mix the liquid from the convective layer with the slurry in the nonconvective layer and will be tested in July or August 1993. The goal is to make a gas burn impossible by forcing a continuous release of the gas as it is generated. This will limit the hydrogen and nitrous oxide build-up and will limit the gas concentration in the dome gas space to far below 25% of the lower flammability limit.

THE DATA ACQUISITION AND CONTROL SYSTEM (DACS)

The DACS is being developed to control and monitor the 101-SY mitigation experiments at Hanford. The data is generated from instruments as shown in Figs. 4 and 5. The DACS system is housed in a trailer for portability. Figure 6 shows the essential features of the system. The trailer (Fig. 7) is 10 ft x 52 ft and is customized by EG&G/Las Vegas to provide a suitable environment for the DACS. The trailer is supplied with heating, ventilation, and air conditioning as well as an uninterruptible power supply for critical equipment. GENESIS process

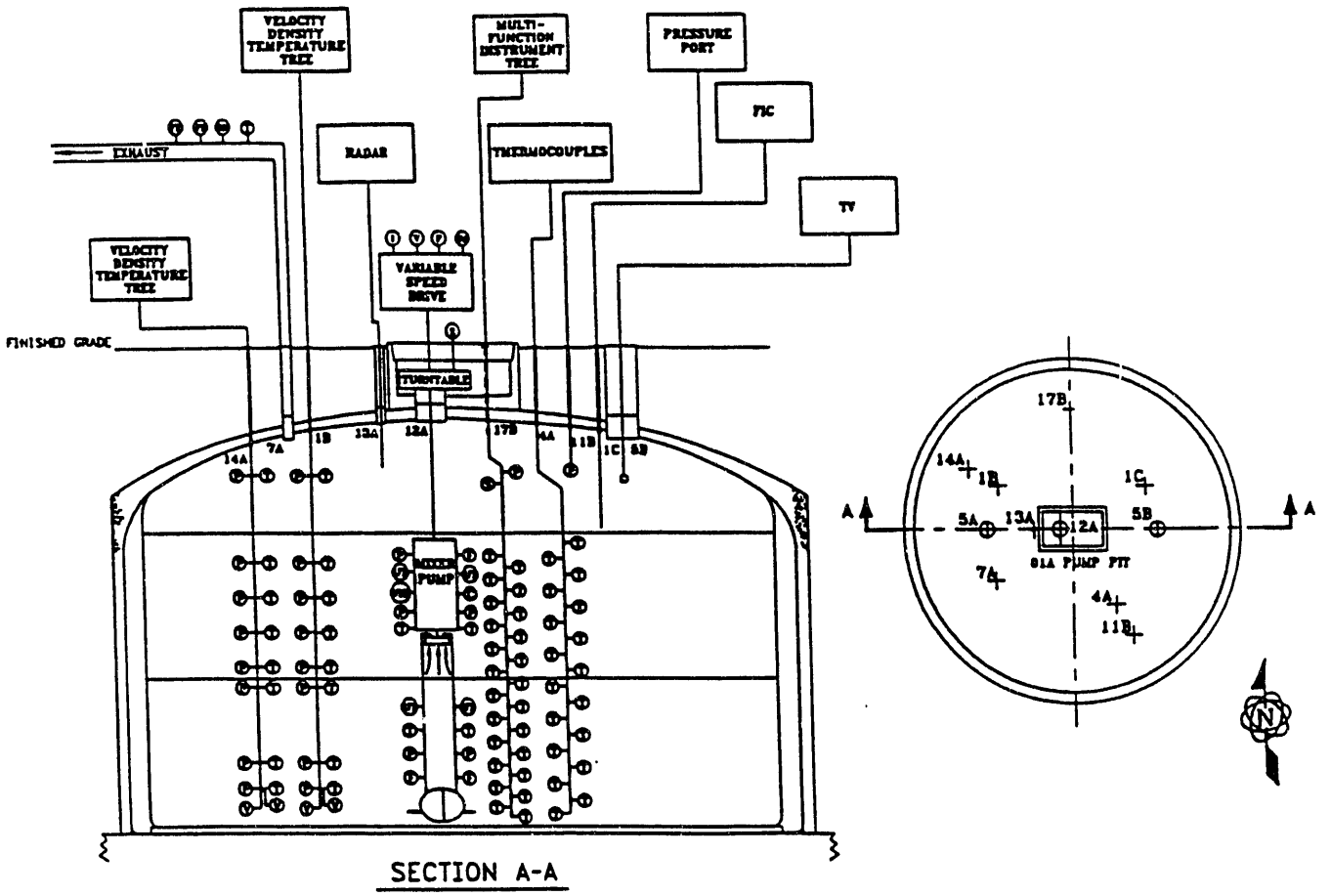


Fig. 4. Mixing test instruments.

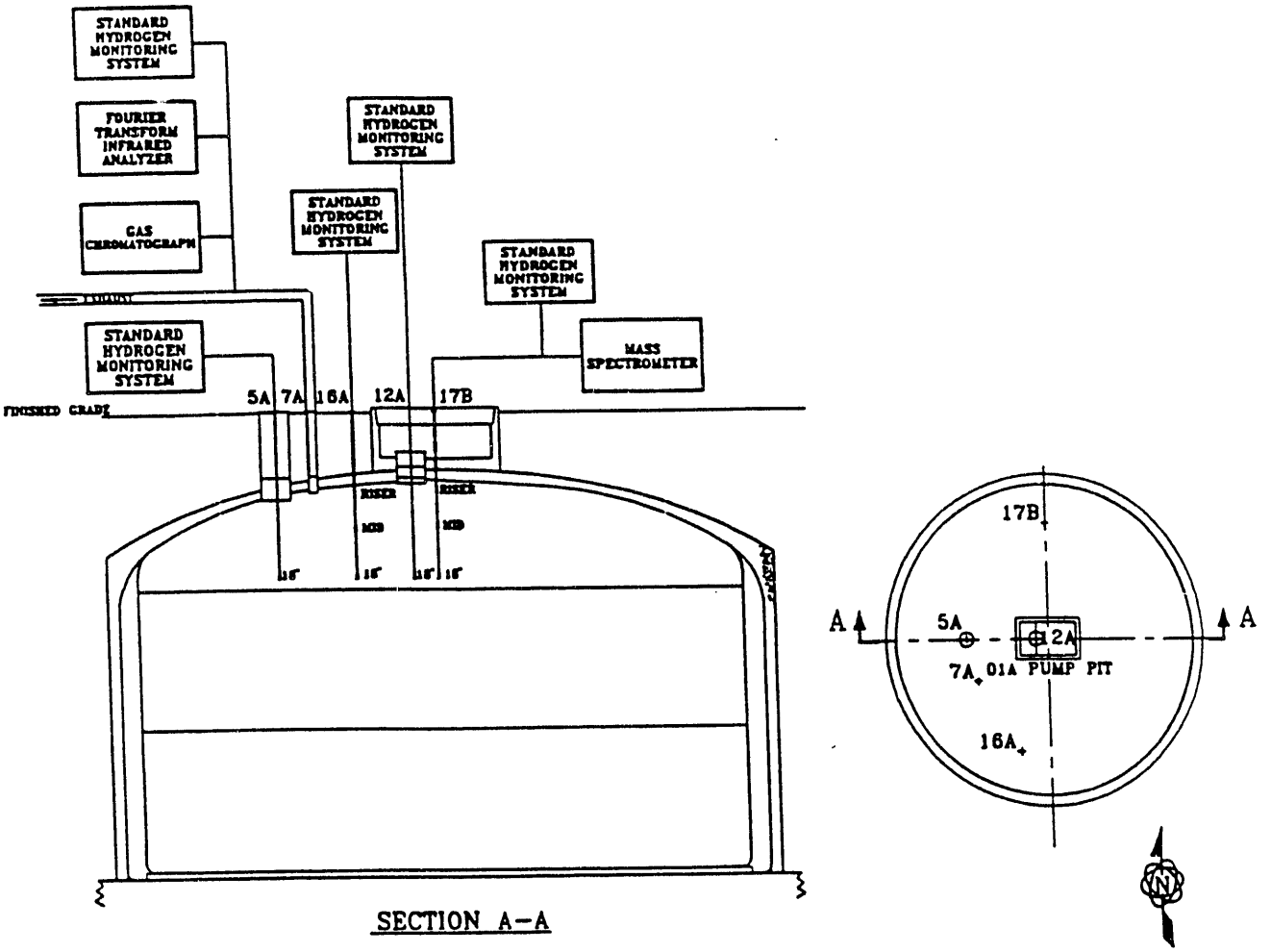


Fig. 5. Gas monitoring instruments.

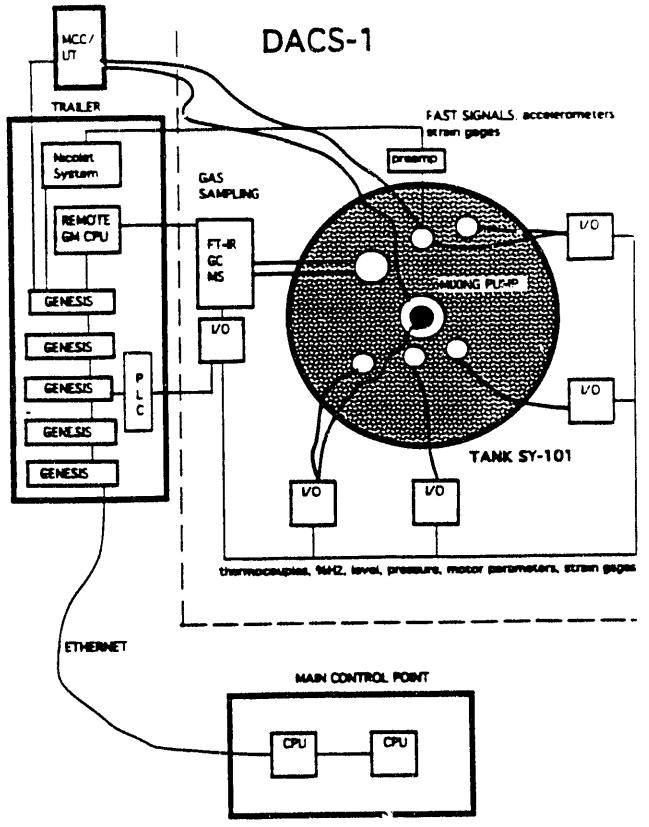


Fig. 6. Cartoon of the essential features of the DACS.

Fig. 7. Photograph of the DACS trailer power supply, heating, ventilation, air conditioning, and backup.

control software was selected to be the core of the DACS and Modicon hardware was selected for the I/O. The GENESIS/Modicon arrangement is shown in Fig. 8. Figure 9 is a photo of the control station in the trailer. This configuration is one of many possibilities and is optimized for this experiment. The real-time operating system has multiple-user and multi-function capability. The node-to-node communication is performed over a LAN. Communication with the Modicon I/O is done by an RS232 connection; the PLC communicates with the drops by ModSoft, a 1.544 Mbaud LAN. Critical monitoring requiring quick action is performed in the PLC; the actions are recorded by GENESIS. Figure 10 shows the Remote Monitoring Site, located 5 miles away, established to monitor progress in the tests and operations in the trailer without impeding progress. The Nicolet system is designed to be a stand-alone system for fast data. We configured the system with 1-MHz transient digitizers and either 32 channels of 250 kS/s or 8 channels of 1 MS/s. The system is fully programmable from the computer. The gas monitoring system consists of three computers: one to acquire data from the mass spectrometer, another to acquire data and control the gas chromatographs, and a third to analyze and format data received by ethernet to ship to the DACS.

GENESIS CAPABILITIES

In addition to the configuration described above, the GENESIS software has a number of other attributes:

- The system is icon-based and mouse-driven.
- The DACS is designed to operate on a LAN for the multi-user PC-PC communications.
- Communication to the I/O is done with RS232, RS422, or RS485. Another option that was not implemented is to use the Modbus Plus provided by Modicon for 1-MHz communication.
- The DACS is also capable of interfacing to a wide variety of process control hardware. These include programmable logic controllers as well as I/O modules. This hardware can be used to monitor the immediate environment, monitor equipment status, and control equipment. Proportional, integral, differential (PID) loops can also be used.
- GENESIS consists of three basic programs: strategy builder, display builder, and run time.
- The run time is real-time, multitasking, and DOS compatible.
- There are many types of function blocks available for strategy programming.
- The software support is good, and the documentation is adequate.

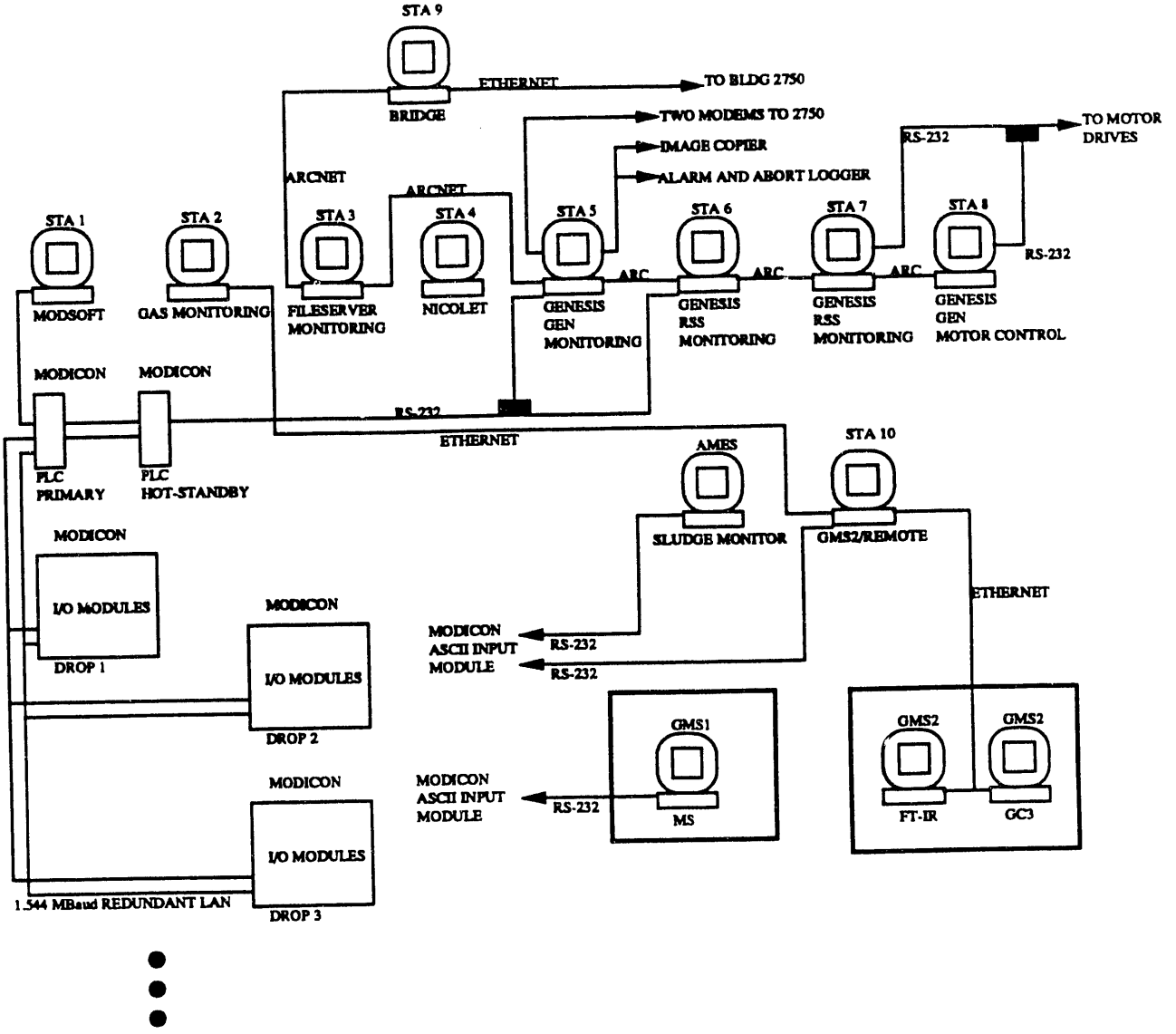


Fig. 8. One-line drawing of the DACS computer system.

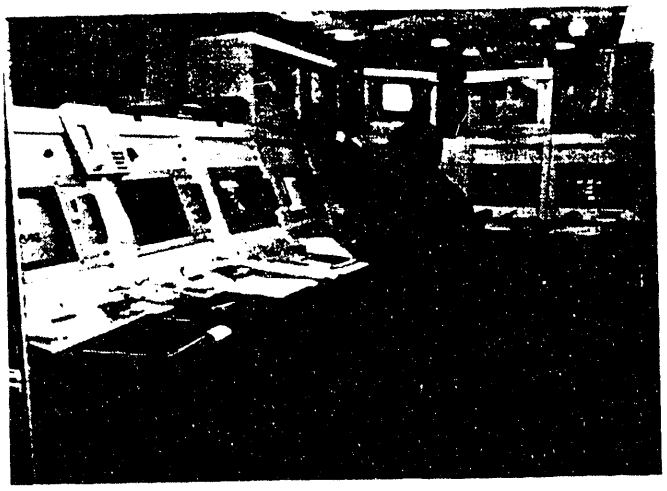
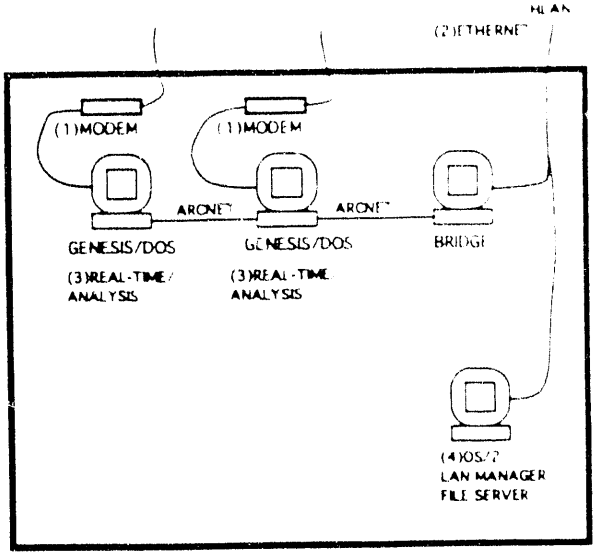


Fig. 9. Photograph of the control console within the DACS trailer.



(1)Initially modem for real-time displays. Wide band radio or ethernet possible later
(2)Ethernet
(3)Real-time display during tests or when monitoring. These computers can also be used for looking at data or analysis.
(4)Quick look at the data. Data transferred to PNL or others for analysis.

Fig. 10. One-line drawing of the remote monitoring site computer system.

SUMMARY

Los Alamos and EG&G/EM have developed a data acquisition and control system for the High-Level Waste Tank Farm at Hanford, Washington. This system, in its current configuration, is specifically designed to monitor and control hydrogen mitigation experiments on tank 101-SY. The DACS will monitor and control tests involving mixer pump operation. The mixer pump is designed to mix the convective liquids with the nonconvective layer and force the gradual release of the hydrogen as the gases are generated. The DACS is housed in an environmentally controlled trailer for portability, ruggedness, and versatility. This system can also be modified to monitor and control other experiments on 241-SY-101 or on other tanks.

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