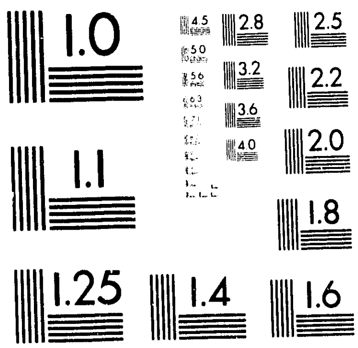

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Title: THE DEPARTMENT OF ENERGY NEVADA TEST SITE REMOTE AREA MONITORING SYSTEM

Author(s): Larry D. Sanders
Orval F. Hart

Submitted to: 17th Annual Army Environmental R&D Symposium
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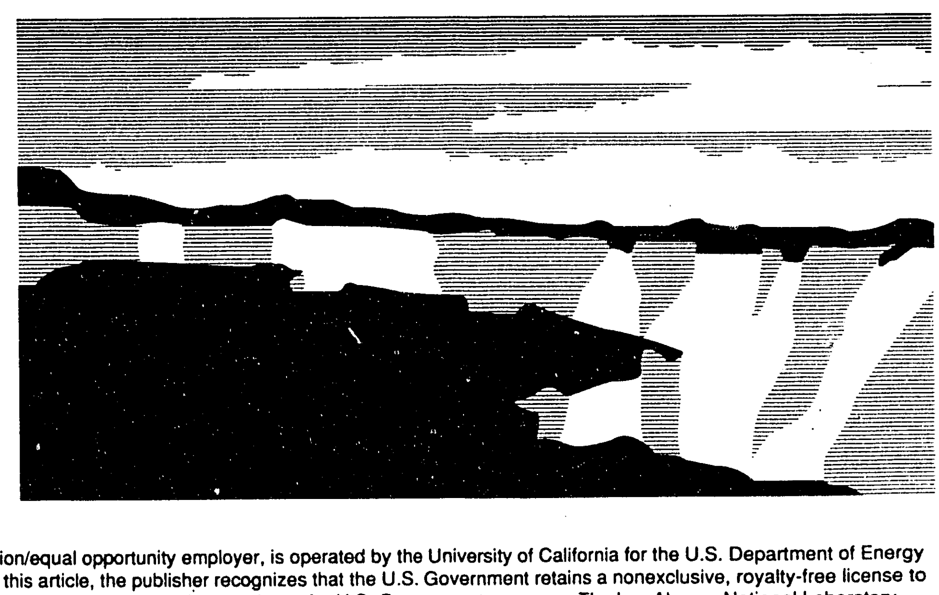

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ABSTRACT SUBMITTAL FORM

THE DEPARTMENT OF ENERGY
NEVADA TEST SITE
REMOTE AREA MONITORING SYSTEM

Larry D. Sanders
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ABSTRACT

The Department of Energy (DOE), Nevada Test Site Remote Area Monitoring System was developed by Los Alamos National Laboratory (LANL) for DOE test directors at the Nevada Test Site (NTS) to verify radiological conditions are safe after a nuclear test. In the unlikely event of a venting as a result of a nuclear test, this system provides radiological and meteorological data to Weather Service Nuclear Support Office (WSNSO) computers where mesoscale models are used predict downwind exposure rates. The system uses a combination of hardwired radiation sensors and satellite based data acquisition units with their own radiation sensors to measure exposure rates in remote areas of the NTS. The satellite based data acquisition units are available as small, Portable Remote Area Monitors (RAMs) for rapid deployment, and larger, Semipermanent RAMs that can have meteorological towers. The satellite based stations measure exposure rates and transmit measurements to the GOES (Geostationary Operational Environmental Satellite) where they are relayed to Direct Readout Ground Stations (DRGS) at the NTS and Los Alamos. Computers process the data and display results in the NTS Operations Coordination Center. The computers archive radiological and meteorological data and other measurements made by the system, print reports, and provide the system operators with diagnostic information. Similarly, computers at Los Alamos collect backup data. Los Alamos computers and NTS computers are linked together through a wide area network, providing remote redundant system capability. Recently, LANL, in collaboration with the Environmental Protection Agency Environmental Monitoring Sciences Laboratory in Las Vegas, Nevada expanded the system to take radiological and meteorological measurements in communities in the western United States. The system was also expanded to acquire data from Remote Automatic Weather Stations (RAWS) that transmit through GOES. The system provides a "Common Data Pool" containing RAMs data, RAWS data, and data reported from radiation safety personnel in the field. Data from the Common Data Pool are automatically transferred to WSNSO, EPA, and Reynolds Electrical and Engineering Company (REECo) radiation safety computers. The addition of Portable and Semipermanent RAMs to the system has vastly expanded monitoring capabilities at NTS and can be used to take measurements anywhere in this hemisphere. The satellite based RAMs can be easily adapted to make additional measurements to support other environmental monitoring and emergency response applications.

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DEPARTMENT OF ENERGY

NEVADA TEST SITE

REMOTE AREA MONITORING SYSTEM

(DOE NTS RAMS)

Los Alamos National Laboratory

DSAC

Larry Sanders, Orval Hart

June 9,1993

FIGURES

THE DEPARTMENT OF ENERGY NEVADA TEST SITE REMOTE AREA MONITORING SYSTEM

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The Department of Energy (DOE), Nevada Test Site Remote Area Monitoring System was developed by the Los Alamos National Laboratory (LANL) for DOE test directors at the Nevada Test Site (NTS) to verify radiological conditions are safe after a nuclear test. In the unlikely event of a venting as a result of a nuclear test, this system provides radiological and meteorological data to Weather Service Nuclear Support Office (WSNSO) computers where mesoscale models are used to predict downwind exposure rates. The system uses a combination of hardwired radiation sensors and satellite-based data acquisition units with their own radiation sensors to measure exposure rates in remote areas of the NTS. The satellite-based data acquisition units are available as small, portable Remote Area Monitors (RAMs) for rapid deployment, and larger, semipermanent RAMs that can have meteorological towers. The satellite-based stations measure exposure rates and transmit measurements to the GOES (Geostationary Operational Environmental Satellite) where they are relayed to Direct Readout Ground Stations (DRGS) at the NTS and Los Alamos.

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Recently, LANL, in collaboration with the Environmental Protection Agency Environmental Monitoring Sciences Laboratory (EPA/EMSL) in Las Vegas, Nevada expanded the system to take radiological and meteorological measurements in communities in the western United States. The system was also expanded to acquire data from Remote Automatic Weather Stations (RAWS) that transmit through GOES. The system provides a "Common Data Pool" containing RAMs data, RAWS data, and data reported from radiation safety personnel in the field. Data from the Common Data Pool are automatically transferred to WSNSO, EPA, and Reynolds Electrical and Engineering Company (REECo) radiation safety computers.

The addition of portable and semipermanent RAMs to the system has vastly expanded monitoring capabilities at NTS and can be used to take measurements anywhere in this hemisphere. The satellite-based RAMs can be easily adapted to make additional measurements to support other environmental monitoring and emergency response applications.

System Description

Radiological data for the Department of Energy Nevada Test Site Remote Area Monitoring System (DOE NTS RAMS) are collected routinely from four types of Remote Area Monitoring (RAM) stations. These are called permanent RAMs, semipermanent RAMs, portable RAMs, and EPA RAMs.

Presently, there are 40 permanent RAMs connected to the DOE NTS RAMS. Permanent RAMs consist of Neher-White pressurized ionization chambers with associated electronics cased in an aluminum container. Permanent RAMs are connected to a two-wire line that is routed to computer hardware located at the NTS Control Point (CP). Telephone lines are typically used to carry these analog signals. Permanent RAM stations at NTS are located up to 50 miles away from the CP. The detectors used in these stations have a calibrated range of 1 mR/hr to 1 kR/hr.

Semipermanent RAMs, portable RAMs, and EPA RAMs use microprocessor-based Data Collection Platforms (DCPs) that transmit readings through the Geostationary Operational Environmental Satellite (GOES) to earth stations at NTS and Los Alamos. Because of the many common aspects of these stations, they are generically called satellite RAMs. Semipermanent RAMs and portable RAMs are maintained and operated by Reynolds Electrical and Engineering Company (REECo). These stations are located on the NTS and the Nellis Bombing and Gunnery Range. The EPA supports the maintenance and operation of the EPA RAMs through its Community Monitoring Program. Most EPA RAMs are located off the NTS near communities in downwind trajectories from NTS. Some EPA RAMs are located in upwind trajectories to provide reference points.

GOES and its associated facilities are owned and operated by the National Earth Satellite, Data Information Service (NESDIS) of the National Oceanic and Atmospheric Administration (NOAA). NESDIS facilities that are used to monitor and control the GOES are located on Wallops Island, Virginia. All satellite RAMs are operated under a Memorandum of Understanding (MOU) between the Department of Energy, Nevada Operations Office (DOE/NV) and NESDIS. Los Alamos National Laboratory maintains the MOU for DOE/NV.

Meteorological data are acquired by the DOE NTS RAMS from other types of GOES-supported satellite stations called Remote Automatic Weather Stations (RAWS). RAWS are owned and operated by the Bureau of Land Management (BLM) and U.S. Forest Service and are maintained by the Boise Interagency Fire Center (BIFC). RAWS transmit meteorological data to GOES in a similar manner as satellite RAMs. GOES retransmits the data to the DRGS at NTS and Los Alamos.

The main purpose of the semipermanent RAMs and portable RAMs is to measure gamma radiation using the same detectors incorporated in the permanent RAMs; but, instead of using hardwired lines, they transmit data through GOES to the CP. The primary difference between these two RAMs is that portable RAMs have

Fig. 1. DOE portable RAM.

omni-directional antennas, more powerful transmitters and are contained in a relatively small box that can be carried by one person. A portable RAM station is shown in Fig. 1. Portable RAMs are self contained and are intended for emergency radiological monitoring support. Portable RAMs can be set up and operating in a few minutes. Semipermanent RAMs can take a half day to set up. Semipermanent RAMs are intended for long term radiological monitoring in remote areas. They incorporate the same basic electronics as portable RAMs. Semipermanent RAMs are

Fig. 2. DOE semipermanent RAM

typically mounted on a tripod arrangement as shown in Fig. 2. These stations can support the hardware to mount an anemometer and wind vane on a 20-ft or 30-ft mast.

An EPA RAM is shown in Fig. 3. These stations consist of an EPA Community Monitoring Station with output from a Reuter-Stokes Pressurized Ion Chamber (PIC) providing input to a DCP. The DCP collects sensor data and transmits the data to GOES. PICs used in these stations have a calibrated range from approximately 10^{-6}R/Hr to 0.1R/Hr. PICs cover this range by switching between two linear ranges. The low range is 10^{-6}R/Hr to $5x10^{-4}$R/Hr. The high range is $5x10^{-4}$R/hr to 0.1R/hr. Each PIC has two signal outputs. One output provides an analog voltage corresponding to the exposure rate. The other provides a digital voltage to indicate the range multiplier for the measurement. DCP software used in EPA RAMs is identical to that used in other DCPs. However, since PICs operate differently than Neher-White chambers, some considerations must be made for the EPA RAMs. The DCP monitors the PIC range indicator in EPA RAMs. If the exposure rate exceeds the PIC's low range, the monitored analog voltage will drop to a low value appropriate to the high range and the high range output will change levels. The DCP will multiply the measured output from the PIC and transmit correct radiological measurements. Data processing for EPA RAMs is slightly different than other satellite RAMs since EPA RAMs use different data conversions and alarm thresholds.

Satellite RAMs consist of a "smart" data acquisition unit capable of monitoring radiological and meteorological parameters, preprocessing, and then transmitting the data to GOES at regularly scheduled intervals. In this mode, the station transmits measurements of meteorological conditions (if equipped with appropriate sensors) and radiological conditions. The station also transmits health information about itself. The health information is useful in confirming the quality of the measurements and aids diagnosis of station problems. If the station detects exposure rates above programmed thresholds, it enters an emergency mode. In this mode, the station transmits raw radiological measurements on a different frequency. This frequency is used for emergency reporting and is a common channel shared by many GOES stations with emergency reporting capability. NESDIS requires that all transmissions on the emergency channel occur at random intervals to achieve maximum utilization of the system by all users. For this reason, the channel has been designated the Random Reporting Channel by NESDIS. The emergency transmission interval for stations used with the DOE NTS RAMS typically varies between 2 and 15 minutes. The average transmission rate is calculated to be approximately once every three minutes. Calculations indicate that, with 10 satellite RAMs on a dedicated random reporting channel in the emergency mode, there is a 94% probability of successful reception of every given data sample.

Figure 4 shows communications for satellite RAMs. There are normally three GOES satellites in operation: the East, West, and Standby satellites. The standard locations

Fig. 3. EPA Community Monitoring Station with DCP (Indian Springs, NV).

of these satellites and their footprints are shown in Fig. 5. The DOE NTS Permanent RAMS uses the West satellite for communications. The Standby satellite is available if a problem occurs in the West satellite. The DRGS has antenna-positioning capability to allow switching between GOES satellites. Presently, this capability is a manual operation through a controller located at each DRGS site. However, the controller can be interfaced to a computer that will track a satellite or automatically move to another satellite, should signal loss occur with the current satellite.

Satellite wobble is a natural tendency for GOES (and all spin-synchronized satellites). It occurs when the satellite's axis of rotation with respect to a perpendicular plane to the earth (the angle of inclination) is more than 0°. Inclination angle is controlled by NESDIS firing small jets on the satellite. The GOES carries enough fuel on board to last for years of inclination angle adjustments. However, circumstances may require moving a satellite to a new location. When the satellite gets low on fuel, NESDIS typically makes fewer inclination adjustments to conserve fuel and the satellite will begin to wobble. As far as the DRGS is concerned, satellite wobble exhibits itself by the satellite moving in a "figure 8" pattern around the equator. If the wobble is bad enough, the satellite will move out of the viewing angle of the

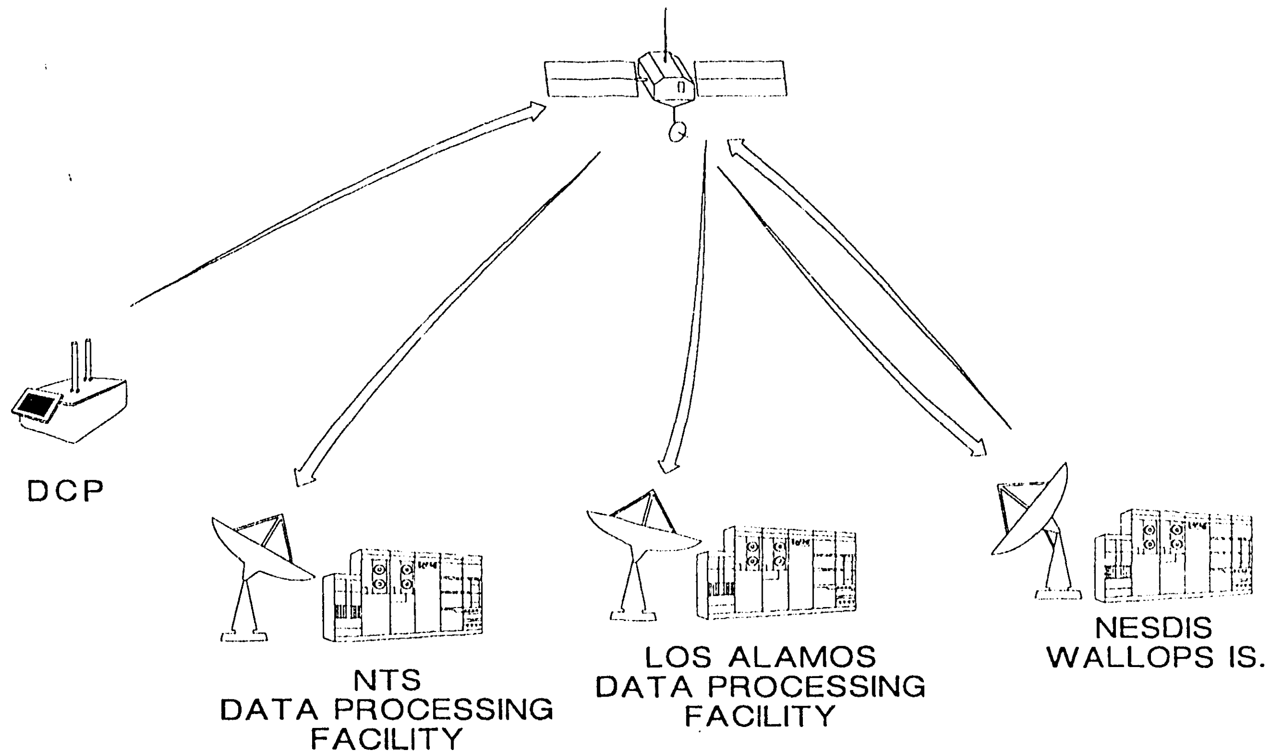

Fig. 4. Communications for satellite stations.

DRGS dish. As the satellite moves closer to the edge of the DRGS dish's viewing angle, a lower signal indication will be observed on the receiver. Transmission errors will increase as the signal level decreases until the satellite is completely out of the viewing angle. The speed and distance at which a satellite traverses the figure 8 depends on the angle of inclination. As a rough guide, inclination angles greater than 1° will cause the satellite to move in and out of the viewing angle of the 5m dish used by each DRGS for the DOE NTS RAMS.

The DOE NTS RAMS hardware at the CP is show in Fig. 6. The system is a near real time, multi-tasking radiation monitoring system. It provides both hard copy and computer disk storage of ambient exposure rate measurements for hardwired stations at variable, pre-selected rates. Hardwired data are automatically acquired at a rate of once/minute when station exposure rates exceed preset alert levels. Data are also stored and printed for satellite stations; however, they do not have acquisition rate control, since each station's microprocessor determines this function. The system stores detector calibration data and incorporates a calibration system for analog

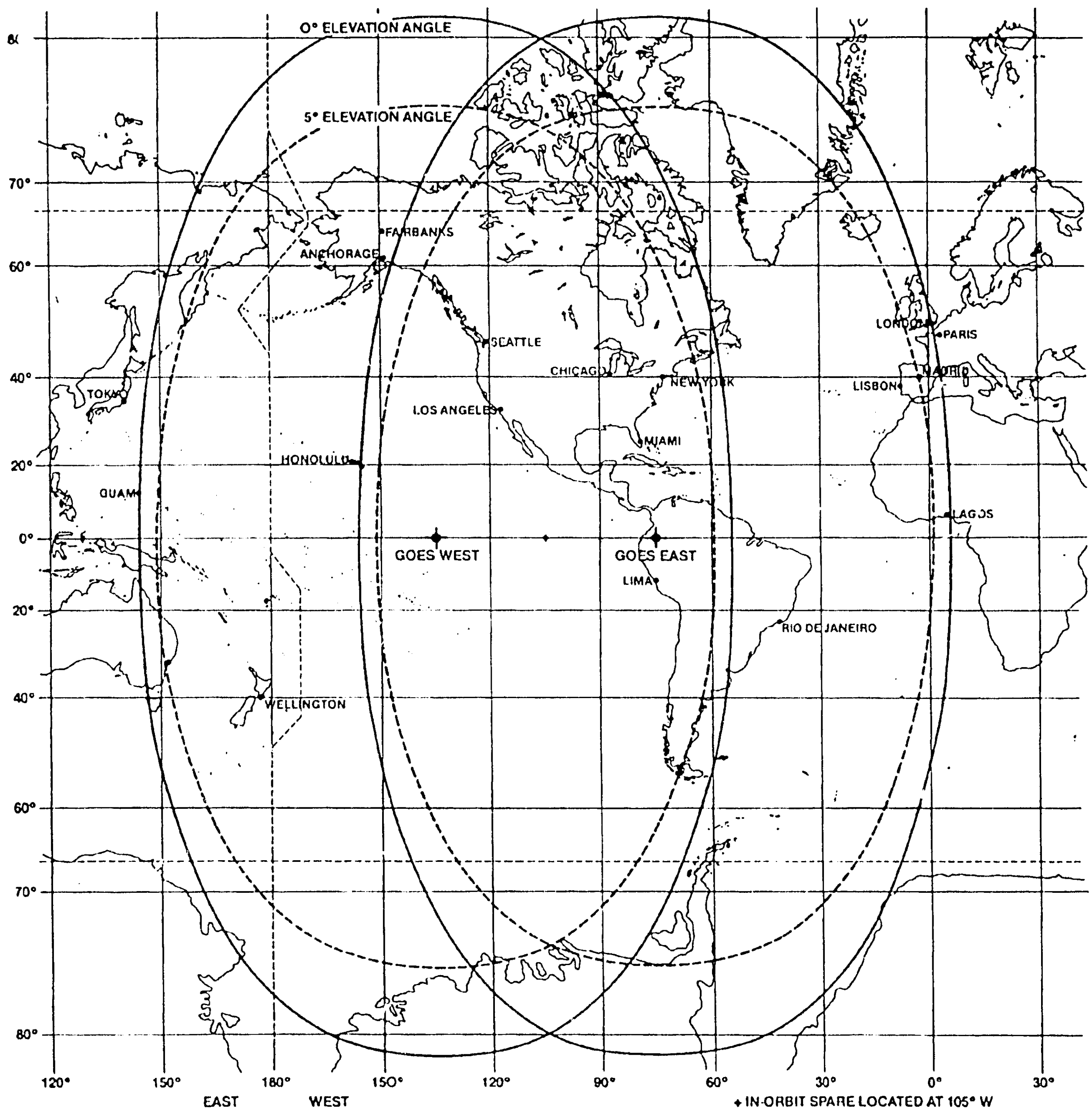

Fig. 5. Standard locations and footprints for GOES.

front-end tests.

The system uses three computers to collect and process data. Data are transferred from acquisition computers to the primary computer through a Local Area Network (LAN) using Ethernet communications. The primary computer is a DEC VAX 4300 computer. The VAX 4300 is part of a cluster containing a MicroVAX II. The VAX 4300 contains the majority of applications software including the Common Data Pool. The VAX 4300 also contains system support software and applications software. The MicroVAX II contains INGRES database software and corresponding databases.

Fig. 6. DOE NTS RAMS hardware at NTS, CP-2.

The computer used to collect data from hardwired Permanent RAMs is a DEC PDP 11/24 computer. Signal conditioners and an analog-to-digital converter (ADC) are used for acquiring data from the Permanent RAMS over telephone lines. Digital-to-analog converters (DAC) and digital I/O provide for computerized calibration of the ADC and signal conditioners.

The DRGS is a Synergetics Model 100, manufactured by Synergetics International in Boulder, CO. It consists of an electrically moveable 5m dish, downconverter, receiver, four demodulators, and a Data General S-20 computer. The DRGS is a stand-alone system; that is, its operation is independent of other DOE NTS RAMS computers. The S-20 computer in the DRGS is programmed to read all semipermanent and portable stations and hold the data for those stations in its database. The VAX 4300 reads data processed by the DRGS and places it in real-time databases with data acquired from permanent RAM stations. The DRGS also incorporates a satellite-synchronized clock that keeps current Greenwich Mean Time (GMT) time. GMT time and Julian date are used for time tags on all data in real-time data bases.

The system utilizes the LAN heavily to communicate with terminals, printers, and other computers. Application displays and printers are supported through terminal servers on the LAN. Displays include alphanumeric terminals to provide local and remote displays of stations in alarm, a color terminal provides local and remote displays of station status with their approximate geographic location on the NTS, and another alphanumeric terminal provides a local display of equipment status. Printers provide on-line printing of logged station measurements, system error messages, and reports. The system also utilizes a voice synthesizer through a terminal server to annunciate system messages.

The VAX 4300 application software for the DOE NTS RAMS reads permanent RAM station data at operator-selected rates, and reads data from satellite RAMs as they are received by the DRGS. It handles alarms, keeps displays updated, manages the data base, and logs data to the printer. Operator functions are available to perform the following functions:

update RAM station data acquisition parameters,
maintain probe calibrations,
control displays,
perform field tests,
locate ground zero,
calibrate the analog front end,
select log print rate,
obtain reports, and
maintair the data base.

The system provides three different data presentations that are displayed. The first display, called the "Map Display" is the most commonly used and is shown in Fig. 7. The Map Display uses a graphic representation of the NTS with a colored spot at the location of each RAM station. Colors are used to indicate the station status. Green indicates the station is reading below the alarm level set by the operator in the CP. A flashing red spot is used to indicate the station is reading above this level or to indicate an anomaly. Station anomalies are instances where the station is generating a voltage outside the normal ranges. If a station is generating an anomalous reading, the operator has capability to disable that station's data presentation. The station will then be considered off-line and its status will be indicated on the map with an

Fig. 7. DOE NTS RAMS Map Display.

orange spot. The operator's actions will also be recorded in the Logged Ram Locations database.

Colored spots can be either dots or squares to distinguish between different types of RAMs. Dots are used to represent permanent RAMs and squares are used to represent satellite stations. A white dot can be added to any location on the screen to indicate a GZ (Ground Zero) location. The starburst in the upper right-hand corner is a clock indicator. The clock indicator generates a sweep roughly once per minute to indicate the system is still functioning. As each sweep is completed, a new color will begin.

The Map Display can be replaced with a Histogram Display as shown in Fig. 8. Up to six stations can be presented on the Histogram Display. One could look at each histogram as a small 30-minute window over a strip chart recorder monitoring that station. Eight decades of measurement are shown on the display. Each decade is

Fig. 8. DOE NTS RAMS Histogram Display.

spaced according to its importance, with the low ranges occupying more screen area than the upper ranges. The station number is displayed at the top of each histogram while the description is shown at the bottom. A starburst is located in the top right-hand corner and functions the same as the clock indicator on the map display.

An alphanumeric terminal is used by the system to generate a black-and-white Alphanumeric Display of data from stations in alarm. A representation of this display is shown in Fig. 9. This display will give the station number, description, and measured exposure rate for each station that is flashing red on the Map Display. Station anomalies are shown with an asterisk.

Figure 10 is a simplified block diagram of the system. Since analog data are input to the system from each permanent RAM station over telephone lines, equipment must be protected against high voltage. Therefore, lightning protection circuits are

REMOTE AREA MONITORS

AREA	NO.	LOCATION	EXPOSURE RATE
23	1	MERCURY	192 MR
5	7	STAKE M 57	******
16	13	U16A TUNNEL	******
6	9	311 COMPOUND	1 R
11	11	TWEEZER FAC	498 MR

Fig. 9. DOE NTS RAMS Alphanumeric Display.

used to clip all signals above 10 V with less than 500 J energy. Signals from the lightning protection circuits are routed to signal conditioners that filter frequency components above 1 Hz. After signals are filtered, they are ready for acquisition by the PDP 11/24.

Computer acquisition is accomplished through an ADC and its expansion chassis. Data are transferred to the VAX 4300 through the LAN.

The system has ADC and signal-conditioner-calibration verification capability under computer control. This feature allows quick functional testing of analog front-end equipment and provides a rapid calibration capability. The system is calibrated by the DAC module indicated in Fig. 10. The DAC provides calibration voltages that are measured by the ADC during the front-end calibration process. This scheme is very dependent upon the accuracy of the DAC. Therefore, the DAC must be checked for drift before checking ADC and signal-conditioner calibration.

Transmissions from satellite RAMs are collected by the DRGS and made available through asynchronous communications ports on the DRGS. DRGS ports are connected to a terminal server. These port addresses are programmed in the system software. One port is selected by the system as the port through which it will acquire

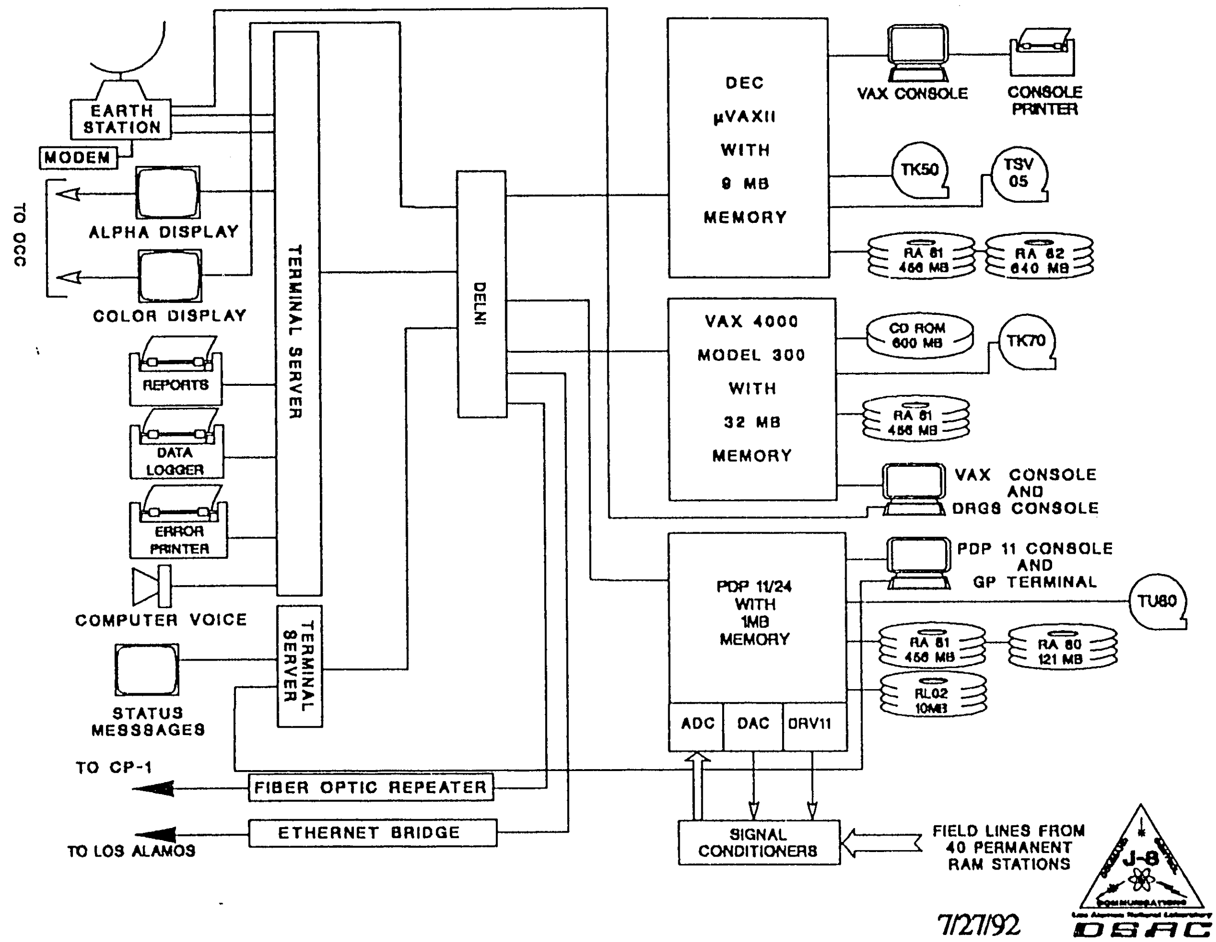

Fig. 10. DOE NTS RAMS block diagram.

satellite data while the application software is running. Data are output from the VAX 4300 through the terminal server to printers and terminals.

RAM radiation data are saved on disk. At the operator's discretion, data may be written to tape for archival purposes and old data on the disk may be erased. Data are archived periodically to reduce time for queries and data storage. When old data are erased, the system will continue writing new data to the disk. RAM location and probe historical data are kept on the data disk and may be similarly re-initiated at any time by the operator. Location data occupies very little of the data disk and is rarely re-initialized. Reports of the available data on disk can be obtained by the operator at any time.

DOE NTS RAMS Communications

The DOE NTS RAMS relies heavily on the use of a Local Area Network that has been named RAD-LAN. RAD-LAN provides the communications "nerve" between each of the DOE NTS RAMS computers and devices. A block diagram of the computers and hardware used to support RAD-LAN is given in Fig. 11. This figure shows the DOE NTS RAMS discussed in the previous section. It also shows the LANL development and backup system at Los Alamos. The system at Los Alamos is very similar to the NTS system. Los Alamos does not have an 11/24 collecting hardwired station data

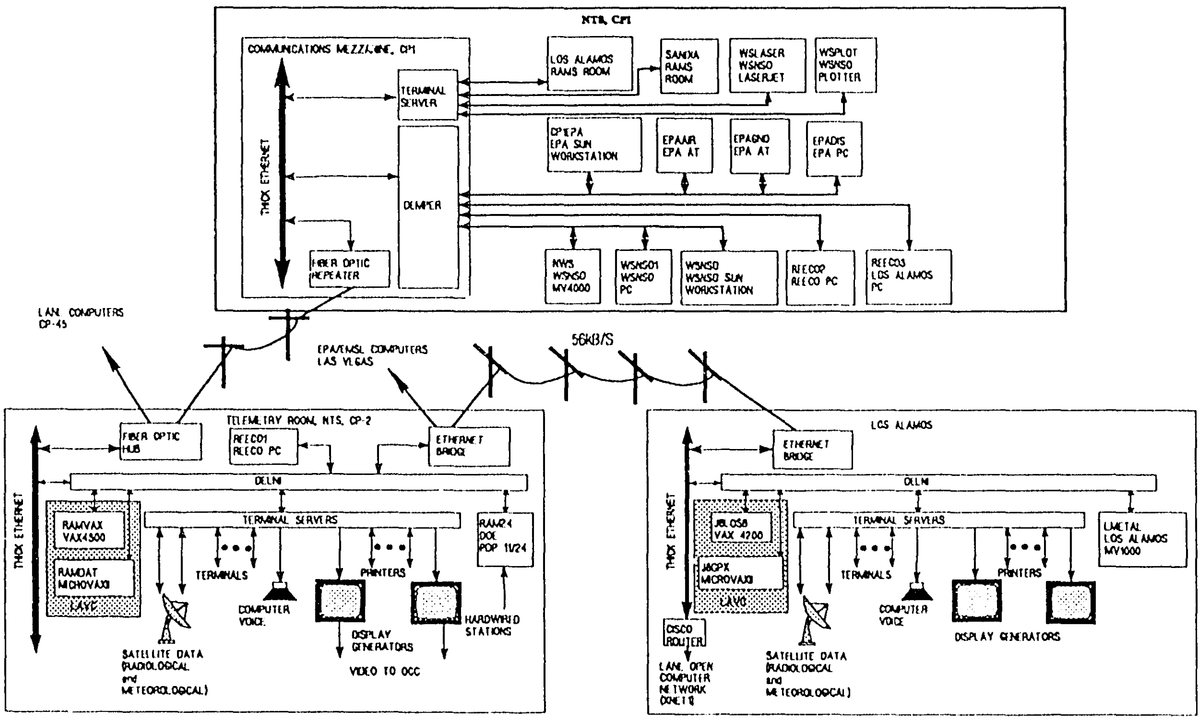

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Fig. 11. RAD-LAN block diagram.

and there are no remote display requirements at Los Alamos. Since Ethernet bridges are used to connect the two LANs, the VAX 4200 at LANL can communicate with all the equipment on the LAN at NTS, including the terminal servers. In the same fashion, all equipment on the LAN at NTS can communicate with equipment at Los Alamos. This is an important feature that was exploited when the system was developed. Through a simple batch file, the system at Los Alamos can connect to the DRGS at NTS and drive all terminal equipment at NTS. This allows each system to back the other up. This capability has been used in both directions. The DRGS at

Los Alamos has failed and was down for a couple of weeks until faulty equipment could be replaced. By simply changing the batch file that defines connections for the system, the LANL system stayed in operation by allowing it to connect to the spare port for the DRGS at NTS. The LANL system was used once when the NTS VAX failed. The configuration was changed so the LANL VAX read data from the NTS DRGS and drove all the displays and printers at NTS. There are several preprogrammed configurations available in each system, allowing for a number of scenarios.

The fiber optic hub at the NTS is used to extend RAD-LAN to additional buildings. Ethernet "thin-net" segments are installed to provide buffered communications to WSNSO, REECo, and EPA computers. These segments support medium sized computers and Personal Computers (PCs) for data viewing and monitoring.

Also indicated in Fig. 11 are connections to the Environmental Protection Agency Environmental Monitoring Sciences Laboratory (EPA/EMSL) in Las Vegas. The EPA/EMSL connection was implemented to give EPA in Las Vegas ability to monitor data from EPA RAMS. Los Alamos implemented the system for EPA. It has similar equipment to the NTS and Los Alamos systems, except that it does not have a DRGS located on site. Instead, it uses the Wide Area Network (WAN) to access the DRGS at NTS. The EPA system is programmed to display only EPA stations. Their Map Display shows several states surrounding Nevada and the locations of their stations in these states. Otherwise the operation of their system is the same as the DOE NTS RAMS.

The LAN at Los Alamos is also connected to "XNET1". This is an open DECNET network at Los Alamos that allows other DECNET machines to connect to RAD-LAN machines. Although there are liabilities associated with allowing this connection to exist, the advantages outweigh them. This connection has been used to allow other programming and system management personnel at Los Alamos who are not located near the computers to help solve problems.

RAD-LAN Data Flow

A diagram depicting RAD-LAN data flow is given in Fig. 12. There are many programs or "processes" running on the VAXes supporting the system. Figure 12 depicts the major ones. The box in the center of the figure relates to processes running on the VAX Cluster. The process PTSCAN communicates with the 11/24 and acquires permanent RAM data for the system. These data are transferred to the real-time databases, if they meet exception criteria. They are also transferred to directories for retrieval by PCs and the WSNSO Data General MV4000. The process DRGACQ takes care of logging on to the DRGS and retrieving data from it. These data are also transferred to real-time databases and directories so that PCs and the WSNSO computer may access them. The EPA Ground and Air computers transfer

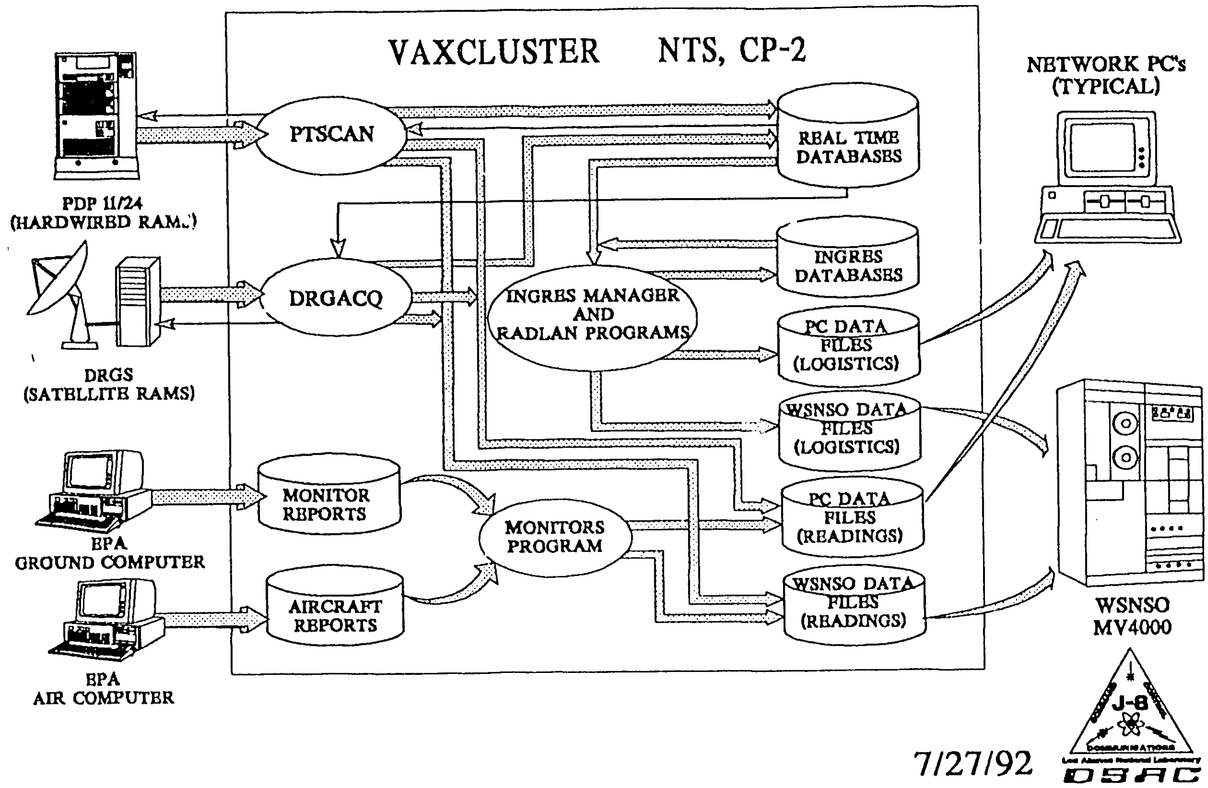

Fig. 12. RAD-LAN data flow.

data to special directories on the VAX. These data are reports transmitted over a voice communications network and transcribed by EPA. The transcribed reports are incorporated into the EPA computers and results are displayed by the EPA computers. The MONITORS program periodically picks up the data in these special directories and rewrites the data in a slightly different format in the directories for retrieval by the WSNSO computer and the PCs.

The system also uses INGRES, a relational database manager. Originally, the system was designed to use INGRES heavily. This allowed considerable flexibility and powerful retrieval capability. However, system performance was not acceptable to users who wanted faster response. Today, INGRES is primarily used to maintain a logistics data base. Before each event at the NTS, a batch job is run that allows INGRES to retrieve current acquisition parameters and station locations from the real-time databases and its own database. The data are combined, formatted, and written to directories on the VAX for retrieval by any of the PCs or the WSNSO computer on the network. Once INGRES accomplishes the data transfer, it is turned off.

Future System Expansion

Due to the flexibility of the system, it is being continually expanded. The DCPs are ideal to place around facilities with which the public has concern (i.e., what might be considered hazardous facilities). The units are relatively easily deployed, self-sustaining (without the additional community monitoring hardware), and relatively low maintenance (depending on the environment, of course). The PIC can very easily be replaced by other sensors for particular circumstances, e.g., pollutants. With these capabilities, facilities can prove that they are in compliance with whatever controlling regulations are in place, and can act as an alert should something fail that requires notification and mobilization of surrounding populations.

LANL is in the process of adding DCPs to the Community Monitoring Stations surrounding the Rocky Flats Plant in Colorado, installing them at strategic locations around facilities in Los Alamos, and even negotiating to install stations in Alaska.

The five at Rocky Flats are patterned after the EPA Community Monitoring Platforms, with our DCPs being added to provide them with similar capability. The intent is to use Internet to route the data back to them for site characterization and for off-normal conditions (data from the emergency reporting mode).

LANL has recently upgraded the DCPs to provided additional radiological and meteorological information (e.g., barometric pressure, ambient air temperature, and enhanced wind vector information). In addition, the data format was changed to make it easier for "customers" to import the information.

ACRONYMS

ADC	Analog to Digital Converter
BIFC	Boise Interagency Fire Center
BLM	Bureau of Land Management
CP	Control Point
CP-2	Control Point, Building 2
DAC	Digital to Analog Converter
DCP	Data Collection Platform
DEC	Digital Equipment Corporation
DOE	Department of Energy
DOE/NV	Department of Energy, Nevada Operations Office
DOE NTS RAMS	Department of Energy Nevada Test Site Remote Area Monitoring System
DRGS	Direct Readout Ground Station
EPA	Environmental Protection Agency
GMT	Greenwich Mean Time
GOES	Geostationary Operational Environmental Satellite
GZ	Ground Zero
LAN	Local Area Network
LANL	Los Alamos National Laboratory
MOU	Memorandum of Understanding

OCC	Operations Coordination Center
PC	Personal Computer
PIC	Pressurized Ion Chamber
NESDIS	National Earth Satellite Data Information Service
NOAA	National Oceanic and Atmospheric Administration
NTS	Nevada Test Site
RAD-LAN	Radiation Local Area Network
RAM	Remote Area Monitor
RAMS	Remote Area Monitoring System
RAWS	Remote Automatic Weather Station
REECo	Reynolds Electrical and Engineering Company
WAN	Wide Area Network
WSNSO	Weather Service Nuclear Support Office

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