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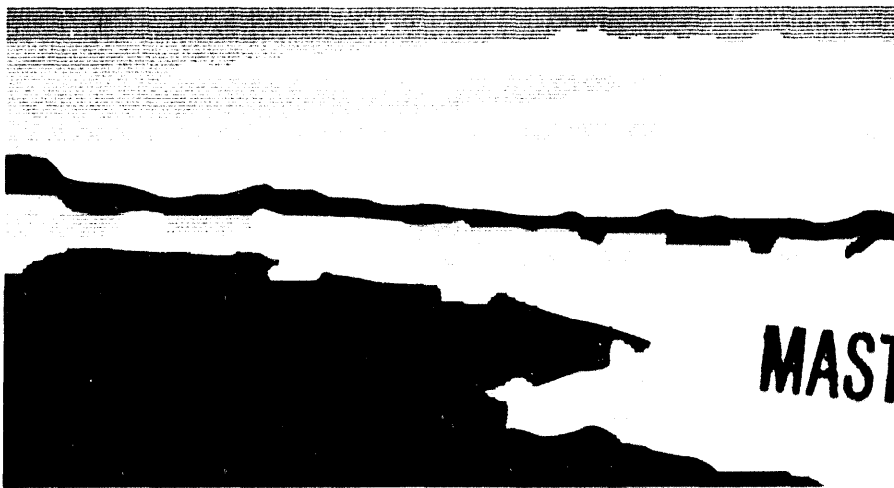
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## NEIGHBORHOOD ENVIRONMENTAL WATCH NETWORK

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### Abstract

The Neighborhood Environmental Watch Network (NEWNET) is a regional network of environmental monitoring stations and a data archival center that supports collaboration between communities, industry, and government agencies to solve environmental problems. The stations provide local displays of measurements for the public and transmit measurements via satellite to a central site for archival and analysis. Station managers are selected from the local community and trained to support the stations. Archived data and analysis tools are available to researchers, educational institutions, industrial collaborators, and the public across the nation through a communications network. Los Alamos National Laboratory and the Environmental Protection Agency have developed a NEWNET pilot program for the Department of Energy. The pilot program supports monitoring stations in Nevada, Arizona, Utah, Wyoming, and California. Additional stations are being placed in Colorado and New Mexico. Pilot stations take radiological and meteorological measurements. Other measurements are possible by exchanging sensors.

### INTRODUCTION

The quality and preservation of our environment is a major public issue. This was demonstrated in the last national election by all major candidates including environmental reforms in their platforms. There is more public concern about the environment and the impact of our lifestyles on the environment. This concern is reflected by a heightened awareness of environmental issues and by an increase in environmental legislation. Although the public has a strong voice in these matters, it is often starved for information on which to base decisions. The general public has limited direct knowledge of or experience in many of these areas and often the information simply does not exist. There is a strong need for the public to develop a better understanding of the environment so they can make more informed decisions. In addition, there is a strong need for improved and more complete environmental data and modelling. At minimum, a common basis of understanding is required so the public can better understand the need and relevance of environmental legislation as well as making decisions in their own personal lives, from the food they eat to the car they drive.

The Neighborhood Environmental Watch Network (NEWNET) is a program that addresses the need for environmental understanding. It helps the public become more involved in observing the environment and understanding the impact of agents on the environment. NEWNET also provides researchers with important data needed to better understand the environment. The cycle shown in Figure 1. indicates the

process by which we obtain better understanding. Collecting and analyzing data can help us understand the current conditions of our environment. These data and analyses can help us develop predictive models of what we think may happen as variables change in the environment. Models must be tested and verified through experimentation and improved observations. Experimentation and improved observation will require improved instrumentation to collect data. Each step in the cycle makes its own contribution to developing a better understanding of our environment. In the past, this cycle has revolved mostly around a relatively small group of specialists (when compared to the rest of the population).

NEWNET gives the general public an opportunity to participate in each of the processes shown in the cycle. Individuals in the community, students in the classroom, industrial researchers, and government researchers can all take part in the process. The results of such broad based participation will be a better understanding of the environment and a common ground on which everyone can base their reasoning. This understanding will promote better stewardship of our environment through better lifestyle choices, through collaborative community relations, and through better environmental legislation. It will help us weigh environmental impacts against economic factors and evaluate factors that will promote a healthier life style for ourselves and the generations that follow.

The markets for NEWNET include government (local, state, and federal), industry, and education. These markets are stimulated by local concerns about emissions from processes used by industry or the government to produce a product. Depending on the perceived danger to the public, these concerns will vary in size from local to national. For example, toxic chemicals used at a production facility may only generate concern in a nearby community. A nuclear accident such as Chernobyl will generate world-wide concern. In either case, public concern will have an impact on the entity using the process. This impact can be severe enough to require shutdown of the factory or process. Such drastic measures usually are taken when the public develops a lack of confidence in the institution's ability (or desire) to control the emissions. Confidence can be restored by the institution working with the public to implement collaborative programs for environmental monitoring and education. NEWNET can be used as the vehicle to implement this process.

## **METHODS**

NEWNET is based on a program supported by Los Alamos National Laboratory (LANL), the Environmental Protection Agency/Environmental Monitoring Sciences Laboratory (EPA/EMSL), and Desert Research Institute (DRI) for the Department of Energy/Nevada Operations Office (DOE/NV). The program implemented 19 stations in communities near the DOE Nevada Test Site (NTS) where nuclear weapons are tested.

DRI is funded to locate interested individuals in the community who may have some

scientific background. An example might be the local science teacher. These individuals are given the opportunity to become the station manager. Each potential station manager must then graduate from a DRI class that teaches them how all the station instruments operate. Once the station manager has been properly trained and the station is in operation, the station manager regularly checks the instrumentation, and keeps records of station operations. The station manager is also responsible for reporting any anomalies to EPA. Station managers participate in school presentations and arrange EPA presentations to local civic organizations. They represent EPA to the local community and provide outreach to the community. All station managers are compensated for their time by DRI.

An example of one of these stations is the Indian Springs Community Monitoring Station, shown in Figure 2. Community monitoring stations use a combination of air samplers and radiological instrumentation to measure radiation and particulate levels. The air samplers are configured to trap tritium, noble gases, and particulates that are most likely to be released if a venting from a nuclear test were to occur. Samples are collected manually by EPA on a weekly basis and are taken to an EPA laboratory for analysis. Sampling equipment used in these stations has its limitations. By the time samples are analyzed, it is too late to determine the cause of off normal readings.

Real time measurements at each station are accomplished by using a computerized data acquisition system that monitors radiological and meteorological instruments, preprocesses the measurements, and then transmits the data to a geostationary satellite at regularly scheduled intervals. Reuter-Stokes Pressurized Ion Chambers (PICs) are used for the radiological measurement. PICs in these stations have a calibrated range from  $10^{-6}$ R/hr to 0.5R/hr. Since the PICs are linear devices, this range must be covered by switching between two ranges. The low range is  $10^{-6}$ R/hr to  $5 \times 10^{-4}$ R/hr. The high range is  $5 \times 10^{-4}$ R/hr to 0.5R/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. The station computer makes a PIC measurement each minute. The system is also programmed to process and transmit meteorological measurements. Meteorological conditions that can be monitored include wind speed, wind direction, ambient air temperature, and barometric pressure. The community monitoring stations near NTS do not yet have the meteorological sensors installed. The meteorological instrumentation is planned for future stations. The meteorological measurements are useful in analyzing data from the station. They can be used to correlate changes in background radiation to changes in the weather, reducing the need to look for other sources of above normal readings. The station also transmits diagnostic information. This information is useful in confirming the quality of the measurements and aids diagnosis of station problems. The station has a local display of the current gamma radiation level measured by the PIC. This measurement allows anyone to observe current exposure levels. The EPA posts the previous week's averages for the station and all the other stations in the program on a bulletin board near the station. National averages are also listed so that observers may see how

current readings relate to the posted measurements.

The Geostationary Operational Environmental Satellite (GOES) is used to support communications between each of the stations and the central data collection facility. 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 Community Monitoring Stations are operated under a Memorandum of Understanding (MOU) between the Department of Energy, Nevada Operations Office and NESDIS. Los Alamos National Laboratory maintains the MOU for DOE/NV. Figure 3 shows the standard locations for GOES. There are normally three GOES satellites in operation; the East, West, and Stand-by satellites. The primary satellite to support this program is GOES West. However, since this satellite is very low on fuel, NESDIS is allowing it to drift in a figure eight pattern. The drift is large enough that five meter dishes will lose the satellite's signal. Since the standby satellite is more stable, all data is being picked up from GOES Standby.

If it detects exposure rates above programmed thresholds, the station 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. Since the channel is shared, there is a statistical probability that a transmission will be successful. 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 NEUNET is calculated to be approximately once every three minutes when exposure levels have exceeded alarm thresholds. Calculations indicate that, with 10 stations on a dedicated random reporting channel in the emergency mode, there is a 94% probability of successful reception of every given data sample.

Data transmitted to GOES is relayed to receiving stations in Los Alamos, New Mexico, and the NTS. Equipment at the Los Alamos receiving station is shown in Figure 4. Station measurements are processed and displayed at both locations simultaneously. The system utilizes a Local Area Network (LAN) to provide communications between terminals, printers, and computers. Satellite data are read by a Direct Readout Ground Station (DRGS). The DRGS consists of satellite receiving equipment and a computer. A Digital Equipment Corporation (DEC) VAX cluster is used to read data from the DRGS. The VAX computers contain application software that properly decodes station messages, performs engineering unit conversions, manages data bases, processes alarms, generates displays, and prints reports. A set of operator functions are available for changing and manipulating the system. They allow the operator to change data acquisition characteristics, input new probe calibration data, control displays, print reports, manage data bases, and shut the system down. All functions that change the way the system collects or processes data

are monitored by the system. If the operator changes any of these parameters, the changes are time stamped and stored in another data base. Application displays and printers are supported through terminal servers on the LAN. Displays include alphanumeric terminals to provide displays of stations in alarm, a color-graphic terminal to provide displays of station status with their approximate geographic location, and another alphanumeric terminal that provides a local display of equipment status. Networked printers provide on-line printing of logged station measurements, system error messages, and reports. The system also utilizes a voice synthesizer to annunciate system messages.

The system provides three different data presentations. The first display, called the "Map Display" is the most commonly used and is shown in Figure 5. The Map Display uses a graphic representation of the region of interest and shows the status of all the stations being monitored. A colored box indicates the status of each station. Green indicates the station is reading below the alarm level set by the operator. A flashing red box is used to indicate the station is reading above this level or an anomaly. Station anomalies are instances where the station is generating a voltage outside the normal ranges. Anomalies include: a negative voltage measurement from a gamma sensor, a voltage greater than 4 V, or a voltage outside the calibration range for the detector being used. If a station is generating an anomalous reading, the operator has capability to disable that station's data presentation. The station's data will not be recorded and the station will no longer indicate an alarm. The station will then be considered off-line and its status will be indicated on the map with an orange box. The operator's actions will also be recorded in the Logged Ram Locations data base. 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 clock will sweep through a cycle of eight different colors before repeating.

The current system monitors 120 satellite based monitoring stations in the western United States. These include the 19 monitoring stations used in the NEWNET pilot program, 21 remote stations for EPA, 20 remote radiological monitoring stations on the NTS, and 60 Remote Automatic Weather Stations. Data is stored in local files, then archived to optical disk for long term storage. The system has world-wide access through INTERNET and has dedicated communications circuits to the NTS and EPA in Las Vegas.

## **RESULTS**

The Community Monitoring Program has been successful in providing a vehicle for collaboration between the public in communities around the NTS and the DOE. Interviews with station managers indicate they strongly support the stations and believe in the program. Station managers have developed classroom activities and projects that are based on the monitoring stations. This program has provided the basis for a common understanding of the environment around the NTS and is ready to be implemented on a broader scale.

## CONCLUSIONS

Public concern for the environment is very high, but the general public needs a better understanding of the environment so it can make informed decisions about its lifestyles. The success of the program in Nevada has demonstrated that the NEWNET concept can be successful on a larger scale. The Nevada program demonstrated that proper training and active participation by community members will help educate the public about the reality of their environment. School teachers involved in the program are using the environmental monitoring stations in their classes to teach students more about the environment. Community support organizations are asking station managers and EPA administrators to give presentations on the program.

Data archiving and reporting implemented in the Nevada program is helping EPA maintain long term records to establish long term trends in the environment. NEWNET expands on this concept. NEWNET provides quality assured data, tools to study the data, and a means for sharing interpretation of the data between educational institutions, industry, government, and the public.

Archived data can be used as standard data sets to be applied to environmental models. Environmental models can vary in sophistication from simple models that might be used in the public school system to complex models using the massive computing resources at Los Alamos. Using NEWNET data in these models will promote deeper thought about the factors that determine our environment and will foster a greater understanding of the environment by the public.

Studying the data and applying it to models will lead to quests to develop experiments that will answer questions about the environment. Experimentation and analysis of data will help us refine environmental models and will help us understand the consequences of actions taken (or not taken) to preserve and protect our environment for future generations.

Wide area access to the public access data base gives the public, industry, and the government ability to compare measurements from stations across the nation. Schools and research facilities across the nation can retrieve data for analysis. Analysis of the data can lead to model development. Schools and industry alike can devise their own environmental experiments that provide additional data for analysis and model refinement. The result of this nation wide study will be a better understanding of the environment. The public access national environmental data base can provide a common basis of understanding for discussions about the environmental impact of planned activities.

LANL is investigating expanding the capabilities of environmental monitoring stations. More powerful computers and more sophisticated instrumentation are all expected to play an important role in the future of NEWNET. The first operational prototype of a NEWNET community monitoring station based on these concepts is

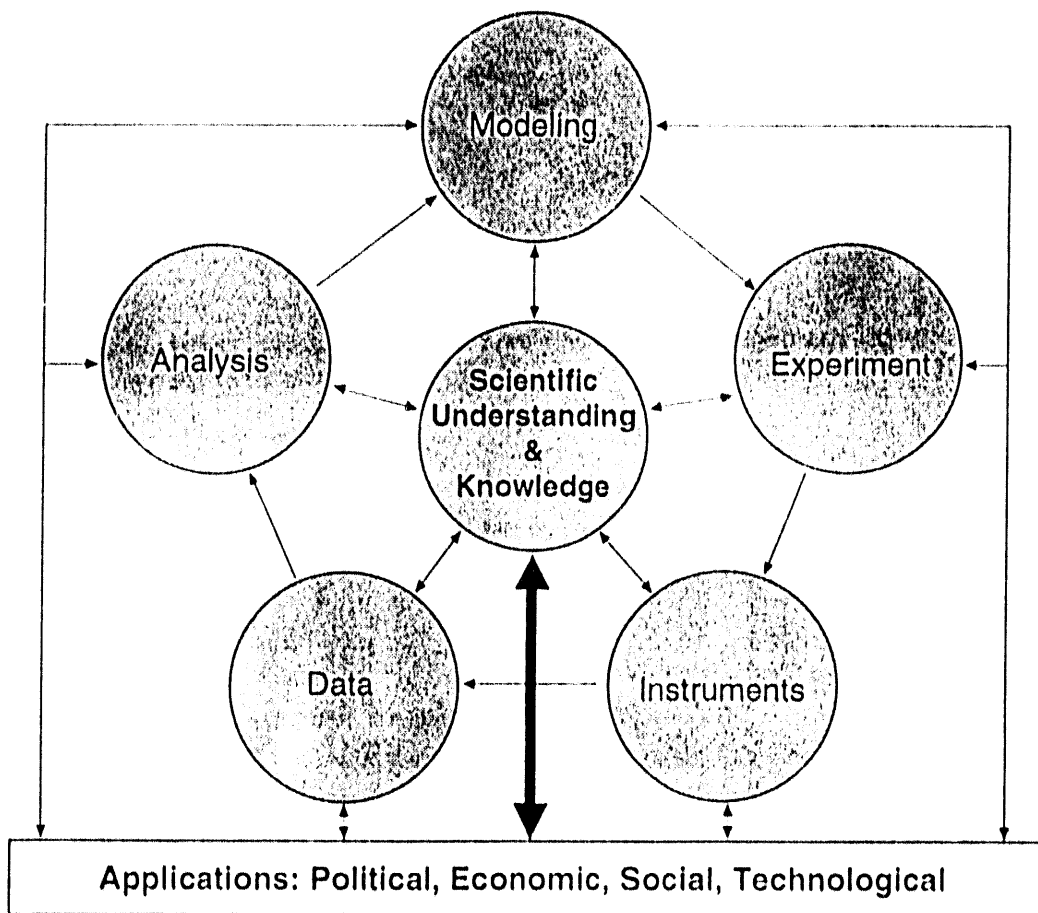
being implemented at Los Alamos, New Mexico. LANL is developing the first Environmental Telling Machine (ETM). The ETM will be a public access device that will interface with the public access national environmental data base. It will provide an easy to use, informative, interface that will allow users to query the data base about measurements made at their community monitoring station. The ETM will allow users to compare their local measurements with measurements made from other stations across the nation.

LANL is implementing additional infrastructure that will support NEWNET. LANL is implementing a team of engineers who will examine data acquired by the system. Engineers will examine data that does not pass automatic data checking filters. They will identify anomalies and be responsible for determining if the data is correct. The causes of incorrect data will be identified by LANL engineers who will document such findings. All quality assured data will be stored in the public access data base for access by users. LANL is developing a set of software tools that will perform preliminary checks on the data for normal patterns. This software will reduce the efforts required to perform manual checks on the data. Data that falls outside of the norms will be reviewed by the data quality assurance team. Data visualization tools are being developed to examine and correlate NEWNET data. Data visualization tools can be made available to remote access users of the system.

## NOTATION

DOE	Department of Energy
DOE/NV	Department of Energy, Nevada Operations Office
DRI	Desert Research Institute
DRGS	Direct Readout Ground Station
EPA	Environmental Protection Agency
EPA/EMSL	Environmental Protection Agency/Environmental Monitoring Sciences Laboratory
GOES	Geostationary Operational Environmental Satellite
LANL	Los Alamos National Laboratory
MOU	Memorandum of Understanding
NESDIS	National Earth Satellite, Data Information Service
NOAA	National Oceanic and Atmospheric Administration
NEUNET	Neighborhood Environmental Watch Network
NTS	Nevada Test Site
PAM	Portable Air Monitor
PIC	Pressurized Ion Chamber
WSNSO	Weather Service Nuclear Support Office

**FIGURES**



**Figure 1.** NEWNET Guiding Philosophy

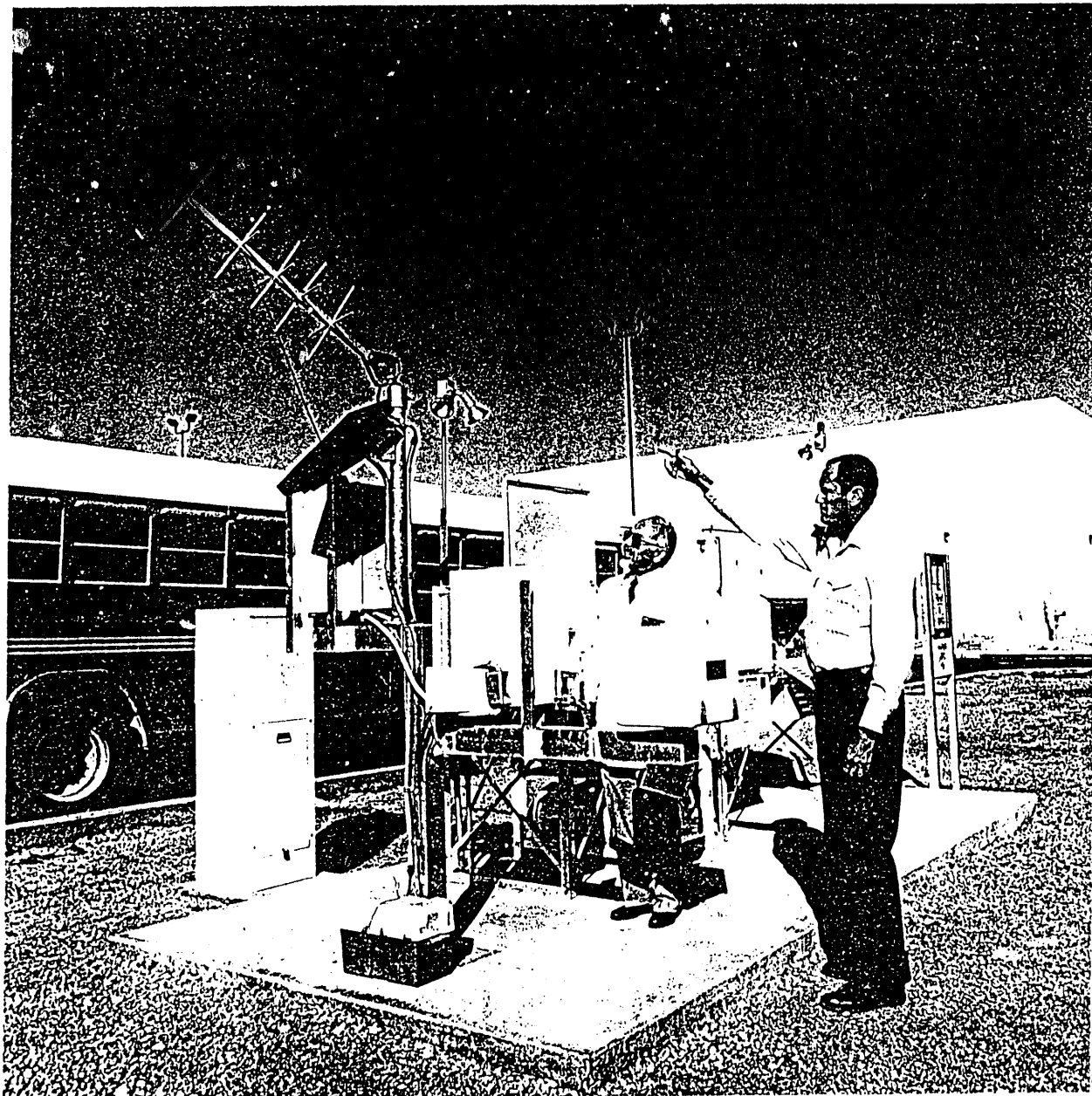


Figure 2. Community Monitoring Station at Indian Springs, Nevada

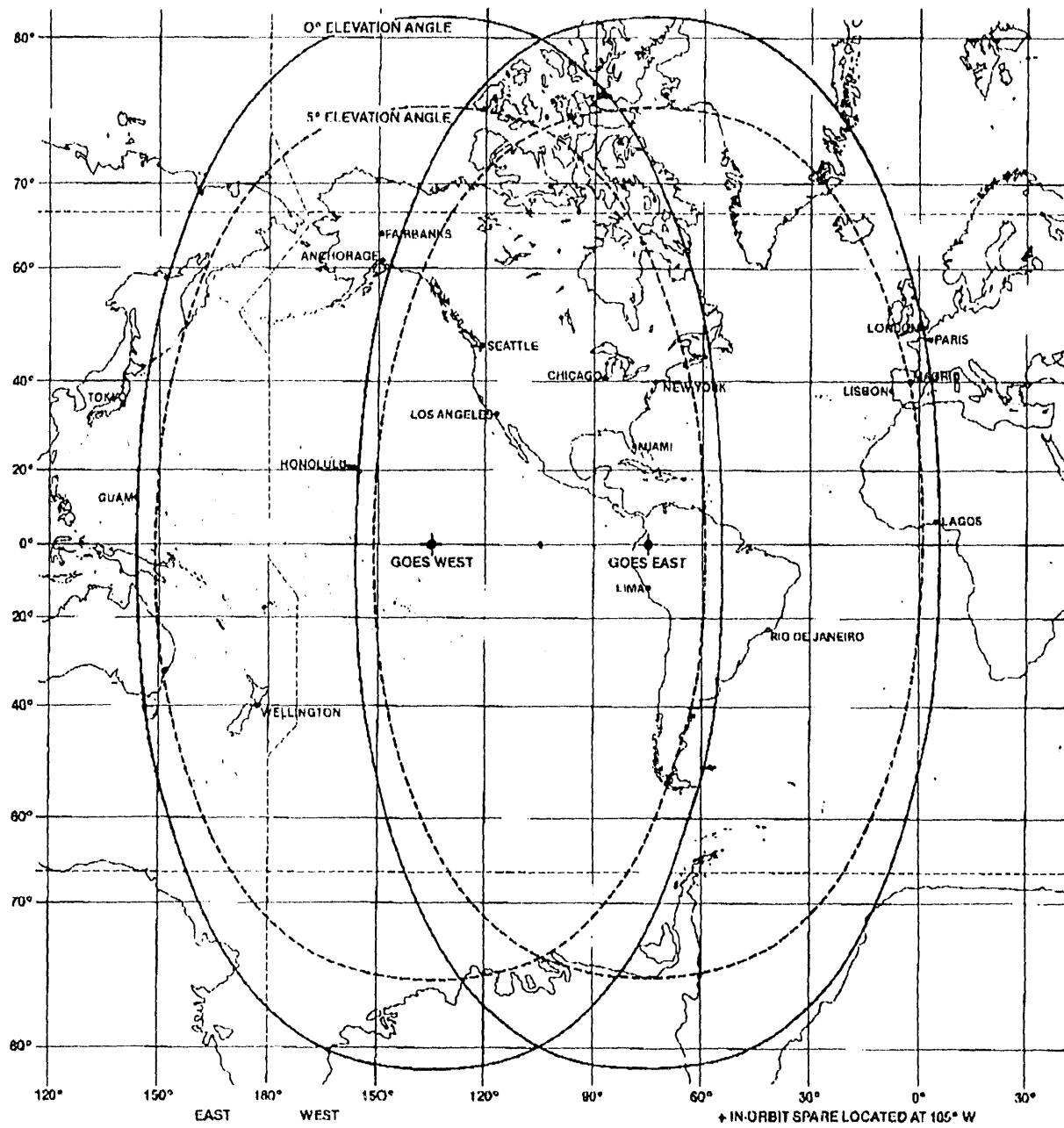


Figure 3. Standard Locations and Footprints for GOES



**Figure 4.** Los Alamos Data Receiving and Processing Facility

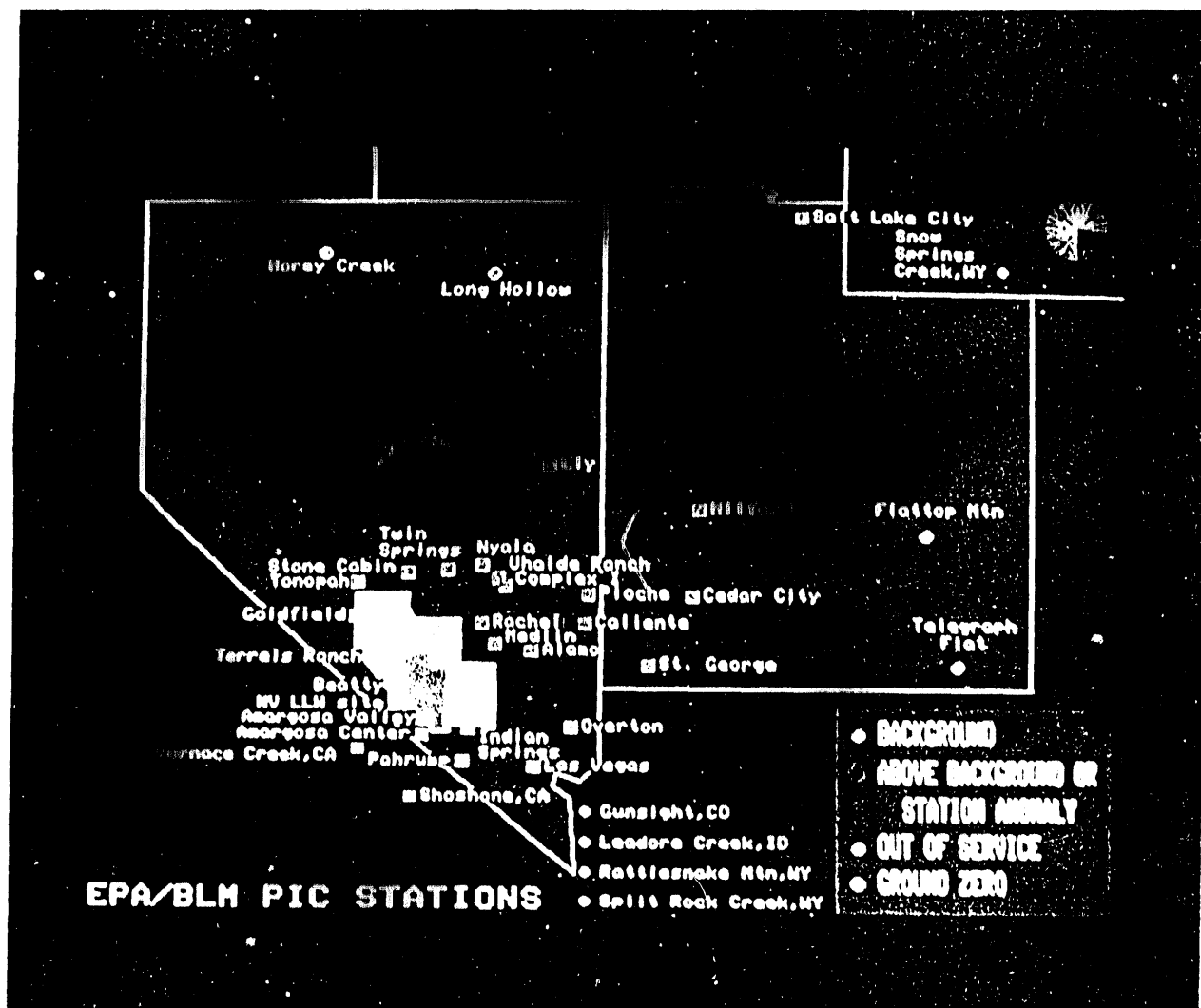


Figure 5. Map Display of Existing Community Monitoring Stations

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