EMERGENCY PREPAREDNESS AND RESPONSE: A METEOROLOGICAL PERSPECTIVE

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ABSTRACT

The implementation of emergency planning drills at a nuclear facility are useful tools in the development and maintenance of a successful response. However, these drills never completely test the site's capability of handling the large responsibilities of evacuation and public protection. The ultimate goal of any nuclear facility is to minimize the potential for a non-routine release of radioactivity. External phenomena can often work against the safeguards of a nuclear facility. Some of these hazards are a direct result or are influenced by meteorology. Hurricanes and ice storms can severely hamper communications and cause large electrical power disruptions. Other external problems are caused by chemical spills and fires, where dispersion of toxic gases and smoke pose a major threat to everyone. When a non-routine event occurs initiating a forced plant shutdown, small releases to the environment are possible. All effluent releases are dictated by meteorological conditions. Each facility must consider its specific setting and potential releases to create an adequate model for atmospheric dispersion.

INTRODUCTION

The Oyster Creek Nuclear Generating Station (OCNGS), located in central New Jersey, is owned and operated by General Public Utilities Nuclear Corporation. This Boiling Water Reactor (BWR) utilizes water from the adjacent Barnegat Bay estuary and Atlantic Ocean to provide the necessary cooling. The site's emergency plan contains several procedures that deal directly with meteorological conditions. The classification of emergency action levels are found in a procedure that contains a section devoted to natural hazards such as severe weather and high winds. The Environmental Assessment Command Center (EACC) procedure provides a more technical explanation of meteorological concerns. This procedure includes a qualitative checklist for the determination of the ocean breeze, directions for obtaining National Weather Service forecast maps and alternate data sources for supplemental meteorological data. A trained meteorologist is an active participant on the emergency plan at OCNGS as well as at Three Mile Island, the other nuclear facility owned and operated by GPU. Upon activation of the EACC at the "Alert" stage, the meteorologist must make an assessment of the ocean breeze potential. This is done using the aforementioned EACC procedure and several supplemental meteorological towers situated along the coast and inland. Data such as wind direction, wind speed, delta temperature and temperature trends from all towers are used.

METEOROLOGICAL DATA COLLECTION AND REDUCTION

The hub of meteorological data analysis at GPU is the extensive computerized data acquisition system (Figure 1). Data collection software utilized at GPU samples wind speed, wind direction and temperature every 10 seconds. These 10-second values are averaged every 15 minutes and stored on the PC diskette as a circular file. The diskette file contains the most recent 7 days' worth of 15-minute averages. The three field PC's can be interrogated at any time via telephone. Fifteen minute

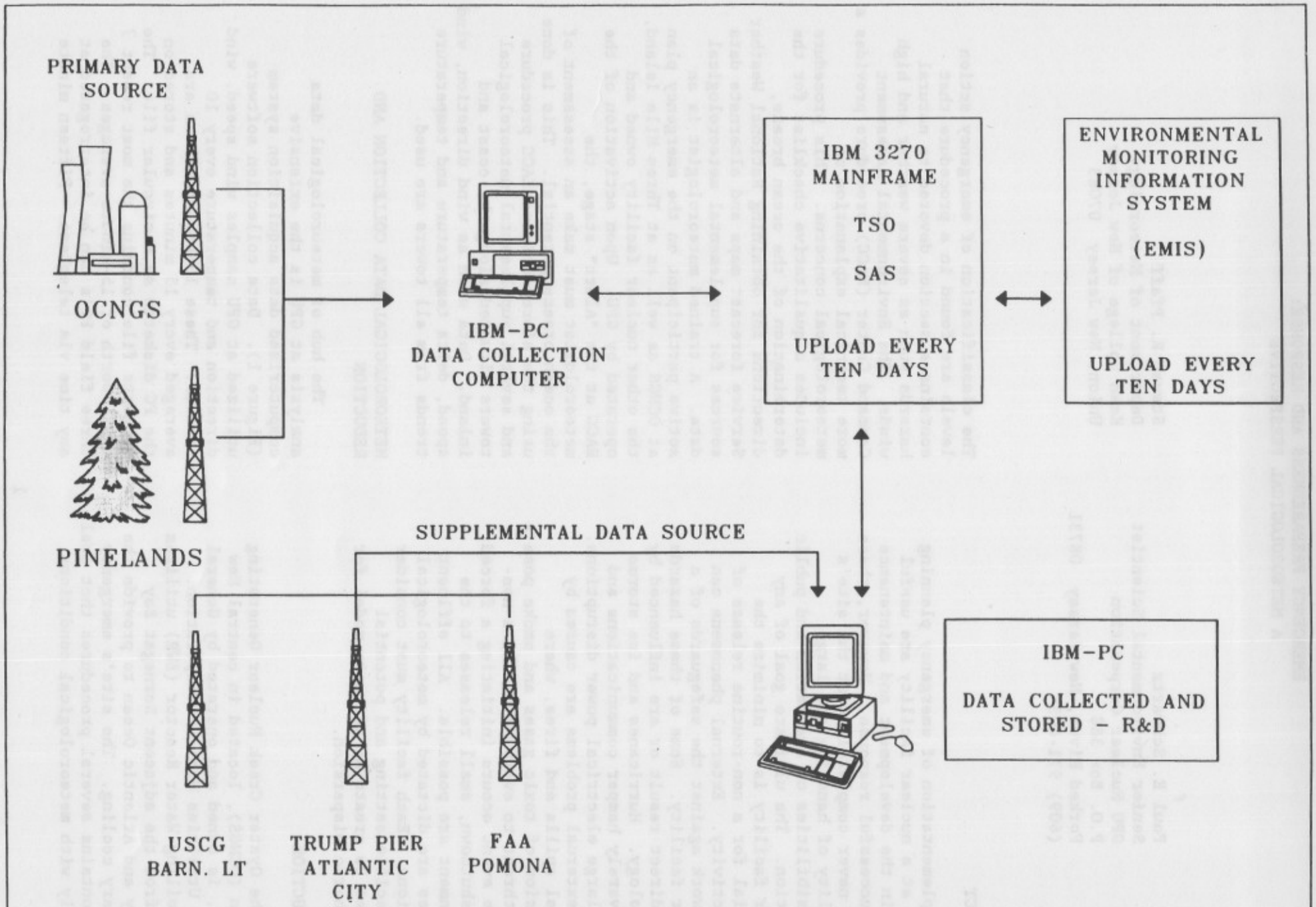

Figure 1: GPU Nuclear Corporation - Oyster Creek NGS
Meteorological Data Acquisition System

averages for any block of time during the last seven days can be accessed and displayed. As part of the emergency dose assessment for OCNGS, the participating meteorologist at the EOF can execute a program on his or her PC which automatically interrogates both ocean breeze sites successfully. The 15-minute averages can be displayed by site. The data appear as a tabular time series for the most recent 3-4 hours at one site. If the averages are displayed by parameter, the data will appear as a table showing values for both sites simultaneously but only for the requested parameter. In addition to the real-time interrogation feature of the ocean breeze monitoring network, data archival is another feature. Data archival is needed for storing and retrieving data for future analysis. The electronic center for data archiving of meteorological data is a PC, located at the OCNGS administrative building. Every six hours, this PC interrogates via telephone each of the PC's in the field (including one located at the Three Mile Island tower) and transfers the 15-minute averages to a removable hard disk (Bernoulli cartridge). Every ten days the averages on the hard disk are uploaded to the environmental database on the GPU mainframe computer. From this point, meteorological data can be accessed for any reason. Over the years the development of this automated meteorological data system has made data retrieval from past years as well as historical data analysis for meteorological, radiological or licensing activities much easier with reduced chance for human input error. All meteorological data must pass a rigid quality assurance program on both a daily and monthly basis.

OCEAN BREEZE ANALYSIS AND VERIFICATION

The verification of the mesoscale ocean breeze is qualitatively done using the knowledge of cloud cover, synoptic conditions such as the 500 millibar flow pattern, prevailing wind direction and the time of day and year. For this particular study, ocean breeze days were selected during 1992. Data were selected from April 15 through October 30, typically the time of year that conditions would exist for ocean breeze development. Meteorological data for this study were taken from the main tower located on-site, an inland site (Pinelands) located approximately 7 miles to the northwest of the site, the United States Coast Guard (USCG) station located at Barnegat Light, NJ, approximately 7 miles to the southeast, the FAA Technical Center at Pomona, New Jersey, located approximately 35 miles to the south-southwest of OCNGS and instrumentation located at the Trump Casino Pier in Atlantic City, located approximately 30 miles to the south. Results from the database revealed 18 separate cases of ocean breeze days. Ocean breeze events were marked at most locations by a distinct shift of winds (approximately 0900 LST) from the southwest to the east-southeast with little or no temperature change (instead of rising toward early afternoon). Onshore winds at Oyster Creek were determined to be any wind flow from 22 degrees (NNE) through 200 degrees (SSW). These onshore winds were seen on a regular basis at the eastern sampling locations and occasionally at the more inland sites, indicating that some of the ocean breeze cases were not particularly strong enough to penetrate more than several miles. Analysis of the National Weather Service 500-mb weather maps indicated weak gradient flow for most of the ocean breeze events. This is paramount since a strong synopic flow along the east coast, thus northwest winds, would act to inhibit ocean breeze formation. From the quality assurance program for the GPU meteorological network during the summer months, strong mixing was consistent on cloudless mornings at approximately 0700 local standard time, indicating that strong heating and the breaking of the overnight inversion layer were occurring. It was commonplace to see stability class changes of 5 Pasquill categories in a 1-hour span. This signaled the development of a well-mixed layer and the strong possibility of an ocean breeze situation, which, on average, developed by 0900 local standard time at the eastern-most locales.

METEOROLOGICAL FORECASTING FOR THE EMERGENCY PLAN

If an ocean breeze is positively identified, updated qualitative plume scenarios are determined from an EACC procedure. After the identification of the ocean breeze is made, the forecasting of large scale meteorological events are

done using National Weather Service tabular and predictive maps. The data are made available through the company's Local Area Network (LAN), which is directly connected to a satellite earth station located at GPU headquarters building in northern New Jersey. The staff meteorologist will make a 24-hour forecast and provide a recommendation to the emergency support director for protective action. The forecast will be updated every 12 hours, similar to that which is done by the National Weather Service.

ASSESSMENT OF NON-ROUTINE EMERGENCY PLAN ACTIONS

On May 3, 1992, a series of large scale brush fires raged out of control in the environmentally-sensitive region of central New Jersey known as the Pinelands. Not only were the lives of many residents threatened in the region, the OCNGS was in the direct path of the advanced flames. Not since Hurricane Gloria back in 1985 has a natural hazard impact the region. What made the situation most tenuous was the activation of the emergency plan on a Sunday with above-normal temperatures and near summer-like conditions. It was probably the first weekend of good weather in the past two months. The fires were a threat to the external acquisition of offsite power, thus causing the plant to SCRAM and placing the facility in the "Alert" emergency classification stage. From a meteorological standpoint, there were several items of concern. As previously mentioned, the ocean breeze effect was a distinct possibility given the insolation potential and time of year. Also, synoptic-scale wind shifts from an approaching upper-level trough predicted late in the day were expected and an accurate forecast was important. The meteorological events would play a major role in the progression of the conflagration, civilian evacuation and life saving, and, most important, the possible impact to OCNGS and the potential for a radiological release to the environment by either a controlled shutdown or other equipment failure.

PRESENTATION

The accurate assessment of meteorological information and its implementation in an emergency plan starts with a good data reduction and quality assurance plan. The network information flow through the GPU system will show the ease at which meteorological data can be disseminated from one emergency facility to another. Since radioactive plume movement is directly affected by meteorology, its importance is self-explanatory.

Assessing the potential effect of any mesoscale meteorological process for the purpose of public protection is usually unique to each site. The effect of the inland penetration will be discussed and how it relates to shoreline and estuary structure. The shallowness of the estuary and its effect on inland penetration will be explained through a series of historical plots of daily water temperatures at remote monitoring sites.

All of the information that will be presented will help to provide the emergency planning personnel with examples of how a meteorological network can best be incorporated into one's nuclear emergency plan and best serve to protect the public.

CONCLUSIONS

Through the analysis of the meteorological data during the event an accurate assessment of the brush fire and its impact was made to the state, county and general public. It is hopeful that others can utilize this presentation to update and improve their weather forecasting skills and techniques and provide better support to their nuclear emergency plan.

REFERENCES

1. P. SCHWARTZ, "Identifying and Tracking Plumes Affected by an Ocean Breeze in Support of Emergency Preparedness", American Nuclear Society Annual Meeting, Atlanta, Georgia (1989).