UTILIZATION OF INTERNET AND OTHER NON-TRADITIONAL DATA SOURCES FOR METEOROLOGICAL SUPPORT WITHIN THE EMERGENCY OPERATIONS FACILITY (EOF)

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ABSTRACT

Nuclear power stations are required by the NRC to maintain an on-site meteorological measurement program. These on-site data represent the primary source of meteorological data utilized in dose assessment modeling and Protective Action Zone (PAZ) selection. Many nuclear power stations have installed redundant monitoring systems to provide a backup source of data. Some nuclear power stations have identified representative National Weather Service (NWS) sites as backup sources of meteorological data. With the advances in computer technologies and high speed communications, other non-traditional sources of meteorological data/information are now available to nuclear power stations and their emergency operation facilities (EOFs). These data may include network connected file servers feeding weather graphics and text data to end user PCs, or the data may be pulled directly off Internet where there is a proliferation of "weather" servers that make available anything from simple hourly surface observations of temperatures, winds, clouds and pressure, to images of numerical weather forecast products, satellite imagery, and NWS local forecasts. Utilities should review their meteorological support requirements to their EOF's and take advantage of the current revolution in communications, computers, and graphics to supplement their meteorological database.

INTRODUCTION

Requirements for measuring on-site meteorological data at commercial nuclear power stations are outlined in several Nuclear Regulatory Commission (NRC) regulatory guides. The first of which is Regulatory Guide 1.23 (1) which simply states that in determining the acceptability of a site for nuclear power, the licensee must take into consideration meteorological conditions at the site location and surrounding area. This required nuclear power stations to develop on-site measurement plans for meteorological data to support dose assessment and define protective action zones (PAZs) based on the emergency action level (EAL) and site meteorology. These specific requirements were spelled out in NUREG 0654 (2) along with specifications for dose assessment dispersion modeling. The end result of these guidelines has seen nuclear power stations develop sophisticated meteorological monitoring systems which support dispersion modeling requirements and provide a basis for making decisions for determining PAZs. While this has helped define the proper procedures for utilizing the on-site data within the EOF, the question remains how does one "forecast" future changes in meteorological patterns that may possibly affect plume transport processes such as dispersion conditions, deposition patterns, and selection of PAZs.

The intent of this paper is to present the availability of other non-traditional sources of meteorological data that can supplement the on-site measurements during EOF activation, their uses, and how they are integrated operationally within the EOF framework at Duke Power Company. These data sources can provide the basis for making forecasts of changing meteorological conditions that may impact dispersion processes and other management decisions during EOF activation.

THE DUKE POWER APPROACH

Duke Power Company has developed a Meteorological Forecast Center which is located at the company's centralized Customer Service Center (CSC) located about 15 miles northeast of Charlotte and approximately 20 miles due east of the McGuire Nuclear Station (Figure 1). The purpose of this in-house weather forecast center was originally to provide short term and medium range weather forecasts supporting customer operations, hydroelectric operations, and power delivery. With the recent advances in computer technologies in the area of LAN-Server networks, the role of the forecast center has expanded to include providing forecast support services to the nuclear stations and the EOF's. These services include site specific forecasts of winds, temperatures, precipitation, stability and mixing heights that provide a backup for the on-site measurements data, which is the primary source of meteorological data used for dose assessments.

The capabilities of the forecast center in making site specific meteorological forecasts during rapidly changing synoptic conditions are centered on the varied data sources available to the in-house meteorological staff and each meteorologists' forecasting expertise. Within the forecast center, there are three independent sources of meteorological data/information available to the meteorologist. These are:

1. Winds, temperature, stability, and precipitation data collected from Duke's monitoring network including the tower data from Oconee, McGuire, and Catawba Nuclear Stations.

2. NIDs data which include satellite imagery, NEXRAD radar, surface observations, numerical modeling guidance, upper air data, and severe weather statements issued by the NWS.

3. "Other" data are available through high speed Internet connections to the World Wide Web (WWW). These data include forecast model graphics, surface streamline analysis, surface observations, satellite images, upper air soundings, NWS area discussions and forecasts, and much more!

Each of these independent data sources are available through Duke Power's communication network to computers at each Nuclear Power Station and to the station Operational Support Centers (OSCs) and EOFs. Data collected by the on-site measurements programs at the stations are available through the "All Points Data" (APD) servers at the stations and are accessible through the network using either netbios commands or TCP/IP protocols. Data points such as wind speed are updated every two minutes and are fifteen minute running averages. These data are the primary source for making dose assessments from dispersion models. The NIDs data are provided through a contract with a private vendor authorized by the NWS to resale gridded model data, alpha numeric text data which include surface observations, weather radar and satellite imagery along with other "value" added weather related products produced by the vendor. The data are received by the forecast center through a 280 kbs satellite downlink system

and fed to several file servers within the forecast center which serve as work stations and are network connected using TCP/IP protocol. The forecast center has developed several packages to analyze, display, and provide forecasts, observations, and graphics using standard Internet TCP protocol throughout the Duke Power LAN network. For the EOF, these internally produced weather graphics and forecasts address the issue of backup redundancy for the primary on-site meteorological data. The data provides the meteorologist with the ability to forecast changing meteorological conditions that could play a role in positioning off site field monitoring crews during EOF activation and creating input files based on regional wind patterns and meteorological conditions during loss of on-site station data. The meteorologist has the tools at hand to classify atmospheric stability, project transport wind direction and speed, and estimate downwind deposition patterns due to real-time precipitation events. Without this additional source of meteorological data it is virtually impossible to address these issues in the context of the meteorologist's role to the EOF. Relying on on-site tower data alone is inadequate in addressing projections of dose patterns during actual events when one has to forecast what the synoptic conditions are going to be two hours or two days out, depending on the duration of the emergency.

During EOF activation, the role of the meteorologist is to assist the Dose Assessment Coordinator and work closely with the Field Monitoring Coordinator in positioning field monitoring teams. When making determination of where to send the individual field monitoring teams, the meteorologists have at their disposal, tower data from the APD server updated every two minutes which is available on a network connected workstation on the meteorologist's desk located in the EOF. Also available with the same workstation is access through the network to several "meteorological" servers located at the CSC forecast center. Accessing the "meteorological" servers allows the meteorologist to display both national and regional images of current weather conditions, forecast maps of projected weather conditions, surface observations from nearby NWS stations, and current radar images available every six minutes. The meteorologist can then integrate these data with the on-site tower data and construct regional wind fields which project the future transport direction and speed of the plume. The advantage is to forecast changes in transport direction, speed, precipitation patterns, and stability that will impact plume dispersion and deposition processes. This ability to project future changes in weather conditions has been demonstrated on numerous occasions during station emergency exercises. Even though simulated meteorological data is used during emergency drills, one of the objectives of the meteorologist is to forecast out to several hours any changes in weather conditions. The ability to access the continuously updated data base from network connected "meteorological" file servers meets this objective.

Another role that this non-traditional meteorological data provides to the EOF meteorologist is the ability to construct meteorological input files from current regional conditions to support dispersion modeling requirements and PAZ selection in lieu of losing the ability to access the on-site tower data. The data available through the forecast centers "meteorological' servers provides this backup data source. The alternative of not having this additional data source as backup would be to establish communications to the area NWS forecast office by phone. This is becoming an impractical option in this age of NWS modernization since the local NWS office will be closing and forecast responsibilities will be shifted over 60 miles from the nearest nuclear station on the Duke Power system. The final alternative, which some utilities have done, is install a redundant on-site meteorological tower with instrumentation for backup purposes. The estimated cost of installation and maintenance of such a system for two years is over $235,000 (3). The data

delivered over the network file servers meets the needs of a backup source of meteorological data.

SOURCES OF METEOROLOGICAL DATA FROM THE "INTERNET"

The Internet was developed back in the 1970s by the US Defense Department to provide a global communications network to installations and government research labs. In the 1980s Internet usage expanded to the university research communities. By the mid 90s browse software such as Gopher, Mosaic, and Netscape were developed that made it easier to move around the Internet, view graphics, send mail, and search for content. The result was an explosion of on-line information servers of all types.

Duke Power Company made a commitment several years ago to expand Internet access to its employees and subsidiaries, some of which operate worldwide. Internet access benefits a wide range of job functions throughout the company. These benefits range from conducting financial investment activities, legal/environmental/engineering research and power marketing, to accessing weather forecasting information and graphics. The availability of a diverse database of current meteorological information has enabled companies such as Duke Power to utilize these services in their daily operations.

In 1994 we began developing a meteorological file server that would serve clients with weather graphics from our downlink system using standard Internet protocol. This internal "gopher" and later "Web" server has been continually updated with graphic images from our NIDs vendor system. Several external Internet sites at universities such as Purdue, N. C. State, and UNC Charlotte, were included to supplement our database with updated hourly surface observations, NWS forecast products, McIDAS products, and numerical model forecasts from NMC models such as the ETA, NGM, and AVN (see Figure 2). This allowed access to forecast imagery and information across the company communications network, making forecast graphics available for the first time to the stations and EOFs. Since then we have continuously improved on our network file servers by offering internally produced model graphics, radar, satellite, surface plots, and forecasts along with backup sources from other external Internet sites. The goal is to become self sufficient in producing forecast graphics internally rather than relying solely on external sites for the data.

The availability of meteorological data from Internet sites has been demonstrated at the Duke Power EOFs. The meteorologists can access data that will enable them to provide forecasts and projections of regional and local weather, and demonstrate this ability to local, state, and federal representatives during annual station exercises. Internet access to meteorological data is considered a backup source to internally produced data. Since a wide range of Internet weather sites are available on the World Wide Web (WWW), utilities that currently have access to the Internet should consider incorporating these data sources into their emergency plans as a backup source of meteorological data.

Other advantages of this non-traditional data source is the ability to utilize off the shelf software such as PCGRIDDS and SHARP. PCGRIDDS is a DOS based program that allows the user to perform detailed analysis on the gridded numerical model fields. The gridded data is available through government FTP servers on Internet. SHARP is a program that uses station upper air soundings to plot SKEW T graphs. This enables the meteorologist to determine mixing heights and stability indices and modify the soundings based on advection patterns determined from the

numerical guidance. Both PCGRIDDS and SHARP were produced within the NWS and are available at no cost from anonymous FTP servers through Internet.

The utilization of the Internet as another source of meteorological data can provide a valuable additional source of input data for dose calculations and forecast of changing synoptic conditions that affect plume transport processes. Meteorologists and other emergency response managers should incorporate Internet access into their EOF data streams. However, the Internet alone should not be considered a stand alone backup source for meteorological data. Utilities should look at contracting to a private vendor to insure availability of regional/local data. Internet access should be considered a supplement and an additional backup source but not the primary backup source for meteorological data.

SUMMARY

Currently, nuclear utilities utilize on-site measurements of meteorological data as their primary source of data. However, there is little consistency within the industry of what data sources are considered backup or supplemental to the primary on-site data. Some utilities rely on redundant on-site systems while others utilize nearby NWS stations for backup. Duke Power Company has incorporated non-traditional data sources such as development of in-house meteorological servers that feed real-time meteorological data that is received from a private vendor through satellite downlink. This insures a steady stream of data will be available of meteorological conditions affecting plume transport during EOF activation. The data not only meets the need of providing a backup source for dispersion modeling but is necessary for the meteorologist to provide forecast support during emergency activation of the EOF. Without this additional source of meteorological data it would be impossible to forecast future changes in synoptic conditions affecting plume transport.

With the advances in computers and high speed communications utilities should investigate incorporating additional sources of meteorological data as backup to their primary data source. Internet access is utilized by Duke Power Company within the EOF as another source of meteorological data. WWW/Gopher Internet servers provide a valuable source of meteorological data. This data can be used for meeting drill objectives. It is recommended that nuclear utilities review their backup meteorological data sources and the role these sources play in their emergency response plans.

REFERENCES

1. U.S. Nuclear Regulatory Commission, "Meteorological Measurement Program for Nuclear Power Plants", Regulatory Guide 1.23, Revision 2, April 1986.

2. U.S. Nuclear Regulatory Commission, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants", NUREG 0654, Revision 1, November 1980.

3. U.S. Environmental Protection Agency, "Quality Assurance Handbook for Air Pollution Measurement Systems", EPA-600/R-94, Office of Research and Development, RTP, Rev-March 1995.

Figure 1. Duke Power Service Area

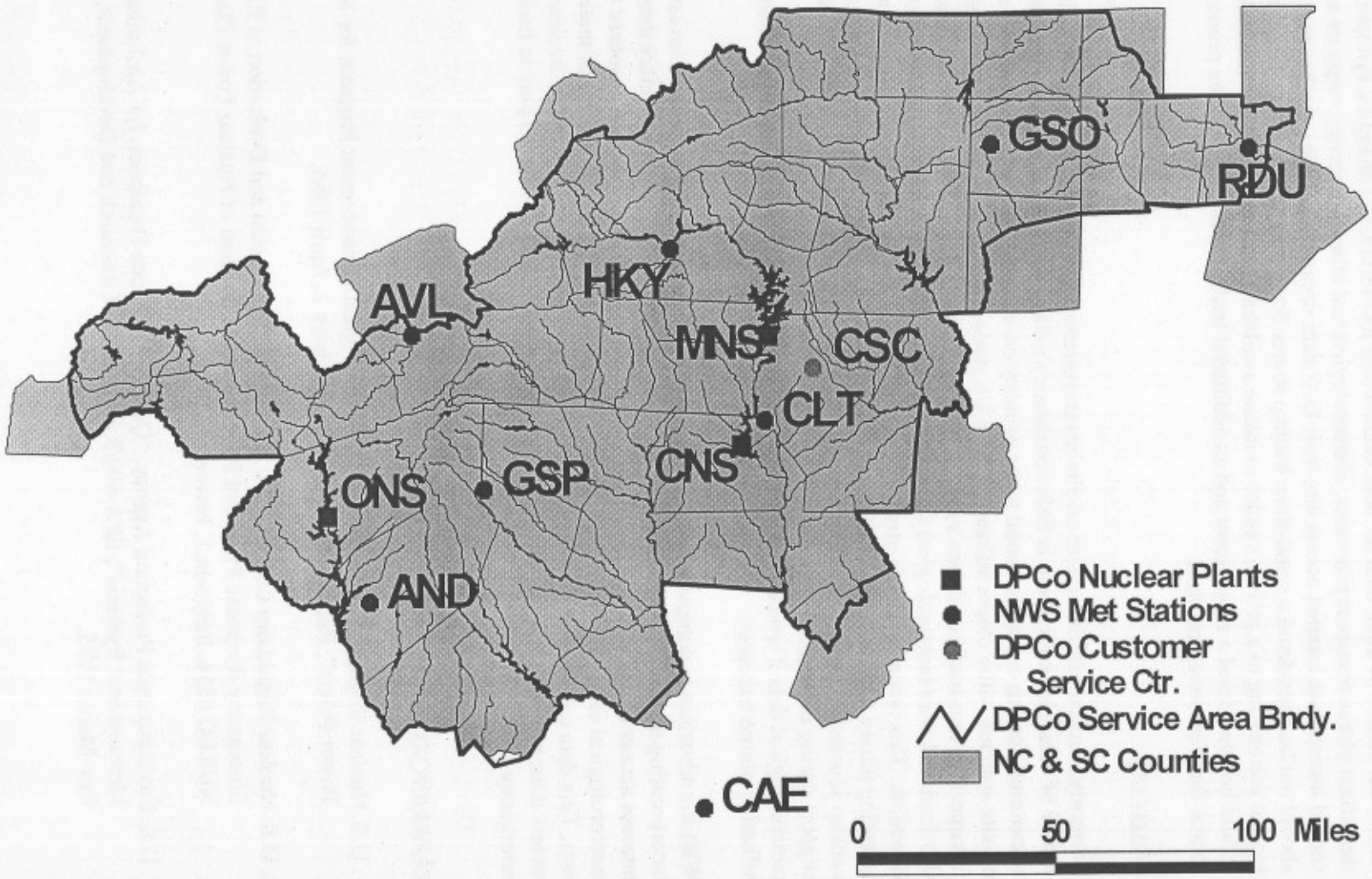

FIGURE 2

LISTING OF SOME USEFUL INTERNET SITES FOR MET SUPPORT

<URL: http://meaxl.nrrc.ncsu.edu/

NCSU Meteorology. This server provides regional surface and satellite data as well as forecast model output from the MASS regional mesoscale model.

<URL: http://aspl.sbs.ohio-state.edu

The Ohio State University Atmospheric Science Home Page. This server provides forecast products for US, Canada and the Caribbean; NWS forecasts and discussions , severe weather products with WXP; tropical forecasts and observations, marine and aviation products, surface and upper air analysis, satellite images and much more. Excellent source for weather information with easy to access menus and up to date images.

<URL:http//cirrus.sprl.umich.edu/wxnet/

Weathernet. This server provides both international and domestic forecast and analysis products, NWS forecasts and discussions, Nexrad products, tropical forecast and observations, marine and aviation products, surface and upper air analysis, satellite images, forecast model output and DIFAX products.

<URL:gopher://thunder.atms.purdue.edu/11/

The Purdue WXP Weather Gopher. This server provides surface and upper air observations and analysis products, forecast model output using WXP graphics package. Very good source of numerical forecast guidance. This server also provides archived hurricane and surface data.

<URL:gopher//wx.atmos.uiuc.edu

The University of Illinois Weather Machine. This server is an excellent provider of GOES8 satellite data. The server also provides easily accessed surface data listed by states.

<URL:http//www.cdc.noaa.gov/

The Climate Diagnostics Center. This server provides climatic and forecast model output product. Good source for comparing numerical model output.

<URL: http://ws321.uncc.edu/

The UNC-Charlotte Weather Web Server. This server provides regional radar and satellite images as well as domestic forecast and analysis products, forecast model output, upper air products, and McIDAS products. Excellent source for forecast model data.