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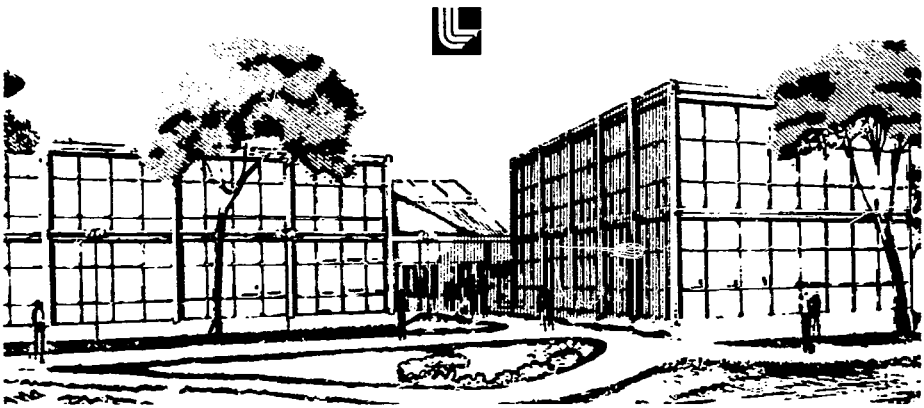

ATMOSPHERIC RELEASE ADVISORY CAPABILITY (ARAC): UPDATE 1977

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Abstract

The Atmospheric Release Advisory Capability (ARAC) is a service to facilities requiring a means of real-time prediction of the extent of health hazards that may result from a release of radionuclides or other toxic materials. The ARAC system, sponsored by the Department of Energy (DOE), consists of a network of serviced facilities and a central facility at the University of California, Lawrence Livermore Laboratory (LLL). Since 1973, when the concept was initiated, a joint feasibility study of the ARAC system has been conducted by LLL and the Savannah River Laboratory (SRL) and research and development was initiated to implement this service for DOE nuclear facilities. The present system of three sites (LLL, Savannah River Plant and the Rocky Flats Plant) is now being tested and evaluated with the Mound Laboratory scheduled to join the network in the fall of 1977. Plans are presently being formulated to implement the ARAC service for additional DOE sites during the next several years. This article briefly describes the ARAC concept, discusses progress to date and outlines future plans for completing the system's development and operating the service.

Introduction

The nuclear, as well as the non-nuclear industry, face a challenge in minimizing damage that could result from toxic emissions during accidents or incidents. Continuation of a favorable safety record depends not only on strict adherence to standards and regulations but also on extensive effort at the local level to foresee potential occurrences and to plan productive emergency action guides. Although the energy industry on the whole is engaged in this problem, the Department of Energy (DOE) nuclear sites (research and production facilities) have a special responsibility to assume the lead role in this regard. In the execution of this responsibility, the DOE nuclear sites are typically faced with a number of questions such as:

1. What health hazards to operating personnel and the public would result in the event of an accident or incident?

2. More specifically, how fast and to what extent will a release of hazardous material diffuse under a particular set of circumstances and conditions?

3. What kind of predictive information can be derived to permit adequate decisions in an emergency?

4. How can routine releases of toxic emissions be planned so as to minimize potential impact on the surrounding environment?

5. What is the impact of normal operating releases on the environment?

DOE is sponsoring a means of assisting the management at DOE nuclear sites in responding to these types of questions. Under the cognizance of the Division of Biomedical and Environmental Research (DBER) program, the University of California, Lawrence Livermore Laboratory (LLL) has developed and is operating a centralized service to provide sites with real-time predictions of the consequences of an atmospheric release of toxic material. This system is also designed to assist DOE in case of a nuclear weapons accident or other incidents involving nuclear materials. This service is called the Atmospheric Release Advisory Capability (ARAC).[1] Recently FAA requested that DOE augment this capability to be called Stratospheric Environmental Assessment Capability (SEAC)[2] to assist in the assessment of in-cabin dose to airline passengers resulting from foreign nuclear tests. This article updates the status of ARAC reported at the 1975 IEEE meeting in San Francisco[3] with the primary focus on service for the DOE nuclear facilities.

Purpose of ARAC

The chief purpose of ARAC is to provide responsible site officials with estimates of the effects of accidental or routine atmospheric releases of hazardous materials as rapidly and as accurately as possible. To do this, ARAC develops a series of advisories containing projections based on monitored environmental and other input data from the site. Central to the ARAC concept are the numerical models that provide real-time regional assessments of release consequences using the localized site data. These models vary in complexity from a simple-trajectory model to an interfaced set of advanced regional transport and diffusion models covering distances of ~ 10 to 100 km. The models, combined with other technologies for dose conversion, data handling, and communication, permit a means for predicting the effects of release of most toxic materials.

Although the primary purpose for development of the ARAC service was to assist a site in emergency response, another, and perhaps a more effective use has emerged: that of providing the sites with periodic assessments based on their normal operating releases. This service is feasible and cost effective since the necessary data are collected and archived in the ARAC center. In addition the archival data can be used to perform sensitivity studies to ascertain changes in the environment impact possible from changes in site operations, e.g., an expansion of the facilities.

Component Parts of ARAC

The ARAC concept is built upon a communication and data acquisition network that allows each user to have rapid access to the central advisory products, which in turn are based on environmental data from the local site. Figure 1 shows the component parts of the ARAC system. A number of nuclear or chemical facilities or sites within the United States can be serviced within the network. The meteorological service, provided by the National Weather Service (NWS) and the Air Force Global Weather Central (AFGWC), supplies the meteorological data (observational data, analyses, and forecasts) used in each assessment. The ARAC central facility (ACF), through data and voice telecommunication links, provides the sites with the regional assessments calculated on the CDC 7600 class computers. Dashed lines in the figure indicate components that are not yet installed.

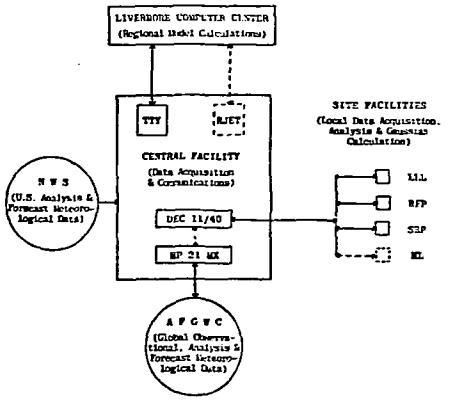

FIGURE 1. Component parts of the ARAC system.

Site Facility

Each ARAC-serviced site has a minicomputer, referred to as a site facility, which furnishes local data-acquisition, assessment, and communication capabilities. Some specific functions of the site facility are:

1. It multiplexes the environmental sensors.

2. It provides local data quality control.

3. It calculates and displays Gaussian diffusion estimates for close-in distances (out to approximately 5 km) using the latest local meteorological data.

4. It transmits local environmental monitor measurements to the central facility.

5. It receives and displays regional calculations from the central facility.

In 1976, site facilities were installed at LLL, Rocky Flats Plant (RFP) in Golden, Colorado, and the Savannah River Plant (SRP) in Aiken, South Carolina. These facilities began sending 15 minute averaged meteorological data to the ACF late in 1976. Mound Laboratory (ML) in Miamisburg, Ohio will join the ARAC network during the fall of this year. At the present time software development for the site facility minicomputer is 95 percent complete and is constructed so that changes from one DOE facility to another requires a minimum amount of effort.

Central Facility

The central facility serves as the focal point for data acquisition, assessments, and communications for the ARAC service. During normal operating conditions, environmental data from the sites, together with any site messages, are transmitted to the central facility on a scheduled 4 hour basis.

Meteorological data from the NWS and the AFGWC are received by the central facility minicomputer on a routine and special-request basis. These data are stored for analysis; certain data such as airport surface data and upper air data are selected and formatted as input data for the regional models. The design of the AFGWC meteorological data network is such that a minicomputer can receive, analyze, display, and store the meteorological data. This feature improves the efficiency of manipulating and using large amounts of weather data.

Dashed lines in Fig. 1 indicate that data communication links are not yet developed, or that software for the operating systems is not yet complete. Hardware for the Remote Job Entry Terminal (RJET) will be installed early in 1978. By the fall of 1978 development of the ACF will be 80% complete and ready to provide around-the-clock service assuming the personnel are available to operate the center.

Transport and Diffusion Models

The MATHEW[4]/ADPIC[5] transport and diffusion models are continually being modified and verified against field tracer studies to provide the ARAC users with useful products in a timely manner. In addition, the ADPIC model has been modified to calculate long-term assessments (on the order of a year) due to normal operating releases. This relatively new version of ADPIC is called PATRIC[5] (PArticle-TRajectory-In-Cell) and is presently being tested against long-term measurements of ^{85}Kr taken around the Savannah River Plant. In the near future PATRIC will become part of the ARAC transport and diffusion model options.

Summary

During the past three years, while the service has been under development and available to selected users, ARAC has been tested on approximately 30 separate occasions. These activities have included the following: real-time tracer tests in cooperation with the Savannah River Plant; simulation of creditable accidents at ARAC serviced DOE facilities; simulation of releases in different parts of the world. On a few occasions ARAC was activated for accidents or potential accidents involving radioactive material. One was in May 1974 when the Savannah River Plant (SRP) experienced a relatively small release of tritium.[7] Another was a railroad accident in North Carolina involving a carload of uranium hexafloride. Neither of these accidents resulted in any danger to the public but each was a test of the ARAC system.

By the end of 1978, the research and development will be 80% complete so that ARAC can begin to offer an around-the-clock service to DOE nuclear facilities. During 1978 we will be initiating studies directed toward investigating the applicability of the ARAC service to the nuclear power industry.

Acknowledgments

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