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THE SAVANNAH RIVER RELEASE: TEST OF THE NEW ARAC CAPABILITY

M. H. Dickerson

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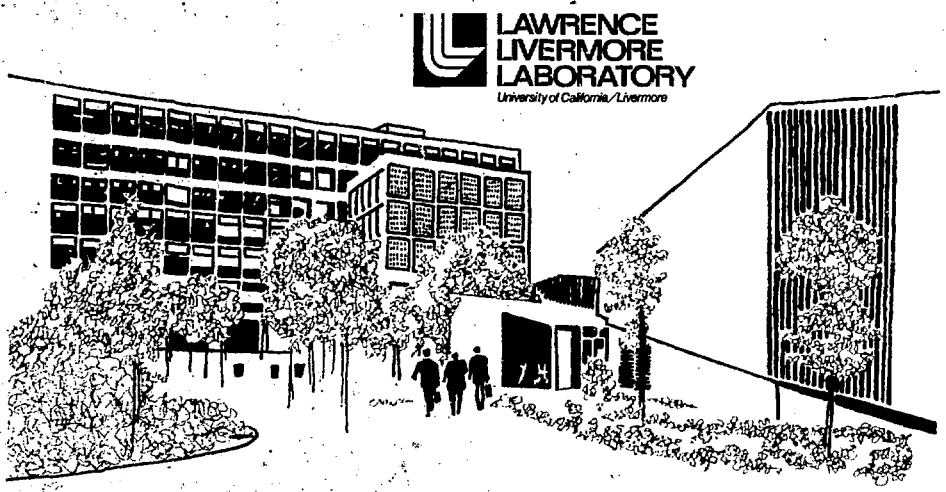

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THE SAVANNAH RIVER RELEASE: TEST OF THE NEW ARAC CAPABILITY

Introduction

Working jointly from opposite sides of the nation, LLL and the Savannah River Laboratory (SRL) quickly assessed the consequences of an early-morning tritium release in May 1974 from the Savannah River Plant, in South Carolina. Measurements confirmed the accuracy of the LLL predictions. Due to the small quantity involved and to the release location (well within the plant confines), the release was not dangerous to the public. The emergency provided a dramatic test of procedures and capabilities of the new Atmospheric Release Advisory Capability (ARAC) center at Livermore, which was not yet operational, demonstrating the capacity for quick response and the feasibility of real-time data acquisition and transmittal across the continent.

In FY 1973, the AEC's Division of Biomedical and Environmental Research decided to focus results of their atmospheric research program on the real-time (as events occur) prediction of individual and population doses from any massive release of radioactive or other toxic materials. LLL was funded to begin developing numerical models of the regional air pollution that might arise from multiple nuclear sources. We were funded, also, to develop the concept for an ARAC center capable of providing real-time predictions of maximum individual and population doses, with a response time of the order of several minutes for early advisory information and about 30 minutes for predictive regional advisory guidance. We estimated that the ARAC center could be operational within about two years of specific funding to create the center.

The work progressed rapidly. We advanced our modeling capabilities and established procedures for the ARAC center. The AEC was fully apprised of LLL progress. Thus, on May 2, when tritium was released about 1150Z (0750 EDT) from the Savannah River Plant, Aiken, South Carolina, officials sought advisory guidance from Livermore, although the ARAC center was not yet operational. The source term, release location (the H separation area — see Fig. 1), and the time of release were communicated during the initial telephone contact, about two hours after the release. Livermore was advised that, due to the small quantity involved and to the release location

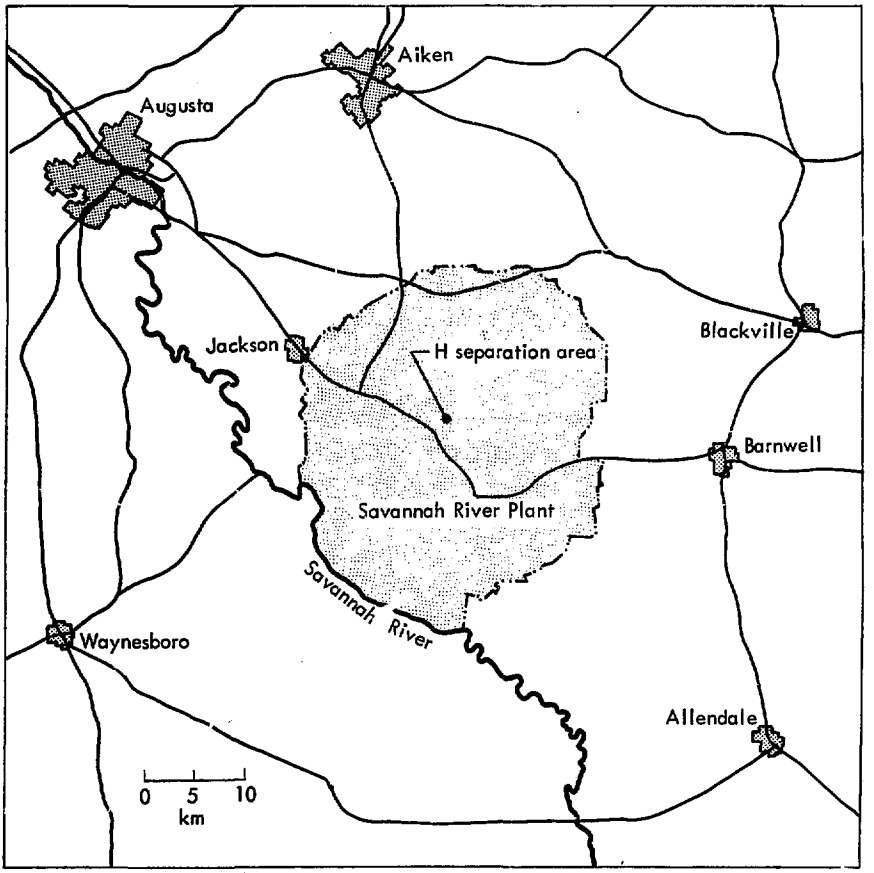

Fig. 1. The H separation area, where the tritium was released, is well within the confines of the Savannah River Plant, as shown in this area map.

(well within the plant confines), the release was not believed dangerous to the public. LLL ARAC personnel responded promptly to provide confirmatory data.

ARAC Status

On that date, meteorological-data communication facilities were operational between SRL and LLL. The new seven-tower meso-network at the

Savannah River Plant was not on line, but the nine levels (heights) of meteorological instrumentation on the TV tower were functioning. LLL was capable of receiving, selectively averaging, printing, storing, and graphically displaying the input data in real time. SRL commenced sending such information as temperatures, wind speeds, wind directions, and sigma (standard-deviation) readings, keyed to the locations of the TV-tower instrumentation. The input data were at 5-s intervals; LLL converted these to 5-min averages.

Major LLL computer codes such as MATHEW, a mass-consistent windfield model,[1] and ADPIC, a transport and diffusion model,[2] were not then interfaced with the Laboratory's CDC-7600 computers (this was not accomplished until about two weeks later). However, the real-time operational aspects of the ARAC had been formulated; it was on this basis that we implemented service to SRL.

Service to SRL

The LLL analog data center, a prototype for the ARAC center facility, began receiving data at approximately 1445Z (0745 PDT). Because the regional transport and diffusion models were not available, we implemented simple Gaussian normalized concentration calculations, which were readied for facsimile transmission to SRL by 1500Z. Atmospheric conditions over Savannah River were stable, so our first transmission was the Gaussian solution to the diffusion equation for "E" and "F" stabilities; this transmission was completed by 1530Z. Then we sent the solution for the "D" stability, representing the slightly more turbulent atmosphere to be expected as the day progressed. Next, based on our first transmission and results from a similar, earlier tritium release at LLL,[3] we sent our estimate of the likely tritium concentration in water extracted from vegetation in the cloud path. Figure 2 shows examples of these early transmissions, plus typical data we forwarded later.

We now commenced a series of Gaussian calculations, using our CPS[4] (continuous point source) code, to prepare plots of the normalized ground deposition and the cloud-center, sector-average, and surface normalized concentrations for the "D" and "E" stabilities. An example is shown in Fig. 2. We preferred the CPS code to the IPS (instantaneous point source) code because of difficulties with the latter during some earlier calculations; although CPS often underestimates the

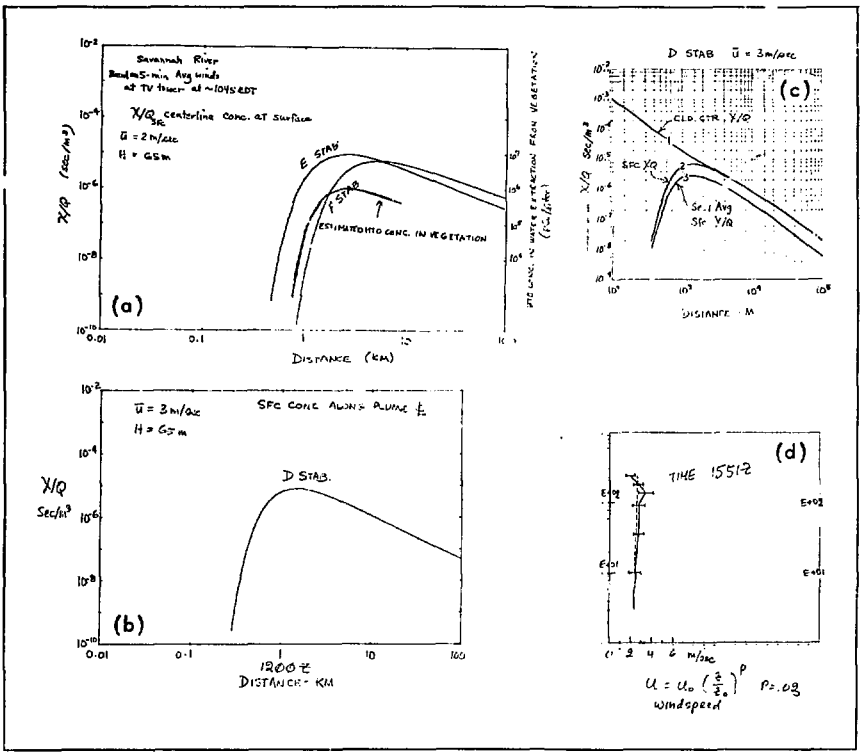

Fig. 2. Typical data plots transmitted to Savannah River Laboratory by the LLL ARAC group: (a) Gaussian solution to the diffusion equation for "E" and "F" stabilities, with an estimate of the likely tritium concentration in water extracted from vegetation in the cloud path; (b) Gaussian solution to the diffusion equation for "D" stability; (c) cloud-center, sector-average, and surface normalized concentrations for "D" stability; (d) wind profile, in which the solid curve represents measured windspeed values over a 5-min averaging period and the dashed curve represents the least-squares profile for the wind speed based on the calculated value of p (derived from a fit of the measurements to a power-law profile in the least-squares sense). The sector-average concentration is that expected over a 22° sector.

concentrations in a puff, we felt it was adequate for the release in question. All these plots were transmitted to SRL.

We also provided vertical profiles of the approximate potential temperature and wind speed as computed from information supplied by the TV-tower

instrumentation. These plots were transmitted at frequent intervals. The curve for approximate potential temperature (not shown) was the sum of the measured temperature plus the product of the measurement altitude and the dry adiabatic lapse rate. In the wind profiles (see Fig. 2), the solid curve represented measured wind-speed values adjusted by the standard deviation over the 5-min averaging period. These measurements were fitted to a power-law profile in a least-squares sense, from which the calculated power (p) shown on the profile was derived; the dashed curve was the least-squares profile for the wind speed based on this calculated power value.

Our facsimile transmissions and telephone reports on the TV-tower meteorological measurements (we were also relaying these to SRL) continued until about 1800Z — approximately six hours after the release. At this time, the laboratories concurred that all required data had been taken and no further calculations were needed. LLL agreed to perform a more detailed calculation of the regional effects of the release based on comprehensive meteorological data provided by SRL. This followup service is consistent with the proposed ARAC post-emergency capability to assist with any required cleanup.

Summary

SRL's only point measurement was taken approximately 40 km from the release site. A later calculation with the MATHEW/ADDIC computer codes was within 20% of the measured concentration.

In the three years following this test, ERDA decided to implement ARAC service for about 15 locations over the U.S.[5] Three ERDA facilities are currently receiving ARAC service and a fourth is scheduled for inclusion later this year. Research and development on the communications and data acquisition system, which was begun in 1975, is scheduled for completion in 1979, at which time ARAC will offer full 24-hr advisory service to on-line facilities. ARAC has been tested on approximately 25 separate occasions, either through planned tracer releases or simulated releases, and experience gained from these tests provides much of the basis for its present development.

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