



U.S. DEPARTMENT OF ENERGY
NATIONAL NUCLEAR SECURITY ADMINISTRATION

ARAC

ATMOSPHERIC RELEASE ADVISORY CAPABILITY (ARAC)



The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) has the world's leading scientists, engineers and technicians from over 50 years of managing the nation's nuclear weapons program. When the need arises, DOE is prepared to respond immediately to any type of radiological accident or incident anywhere in the world with the following seven radiological emergency response assets.

AMS (Aerial Measuring System) detects, measures and tracks radioactive material at an emergency to determine contamination levels. **ARAC (Atmospheric Release Advisory Capability)** develops predictive plots generated by sophisticated computer models. **ARG** (Accident Response Group) is deployed to manage or support the successful resolution of a U.S. nuclear weapons accident anywhere in the world. **FRMAC** (Federal Radiological Monitoring and Assessment Center) coordinates Federal radiological monitoring and assessment activities with those of state and local agencies. **NEST** (Nuclear Emergency Support Team) provides the nation's specialized technical expertise to the Federal response in resolving nuclear/radiological terrorist incidents. **RAP** (Radiological Assistance Program) is usually the first NNSA responder for assessing the emergency situation and deciding what further steps should be taken to minimize the hazards of a radiological emergency. **REAC/TS** (Radiation Emergency Assistance Center/Training Site) provides treatment and medical consultation for injuries resulting from radiation exposure and contamination, as well as serving as a training facility.

INTRODUCTION

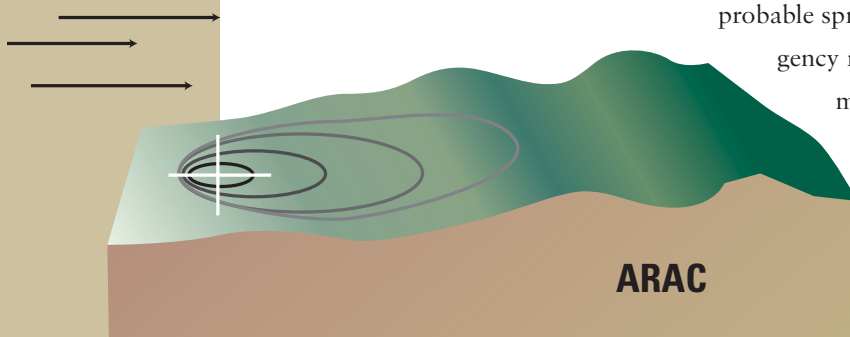
The Atmospheric Release Advisory Capability (ARAC) is one of the emergency response resources, or assets, administered by NNSA. ARAC's role in an emergency begins when a nuclear, chemical, or hazardous material is accidentally released into the atmosphere. ARAC, operated by the University of California's Lawrence Livermore National Laboratory, maps the

probable spread of the contamination to help emergency response officials decide what response

measures are needed. ARAC's main function

is to provide near real-time assessments of the consequences of accidental or potential radiation releases by modeling the movement of hazardous plumes.

This centralized, worldwide emergency response service provides emergency



PREDICT SIMULATE MODEL



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officials the vital immediate information they need to rapidly evaluate airborne and ground contamination projections and thus effectively protect people and the environment.

Since 1979, ARAC has responded to more than 150 alerts, accidents, and disasters, and has supported more than 800 emergency response exercises. In addition to accidental radiological releases, ARAC has assessed natural disasters such as volcanic ash cloud and earthquake-induced hazardous spills, smoke from wildfires, man-made disasters such as the Kuwaiti oil fires, and toxic chemical releases from a wide spectrum of accidents.

MISSION

The ARAC mission is to provide timely and accurate real-time assessment advisories to Emergency Managers from actual or potential hazardous, nuclear, or chemical material releases into the atmosphere. ARAC's computer-based system provides realistic plots, or maps, of potential radiation dose and exposure assessments, and estimates of the path of nuclear contaminants released into the atmosphere. For ARAC-supported sites — sites with computers and software for direct interactive service — the time to deliver these first plots can be as short as 5 to 10 minutes after the accident information is received. For non-supported sites, or sites without such computer equipment, the time to deliver these first plots would be no longer than one to two hours.

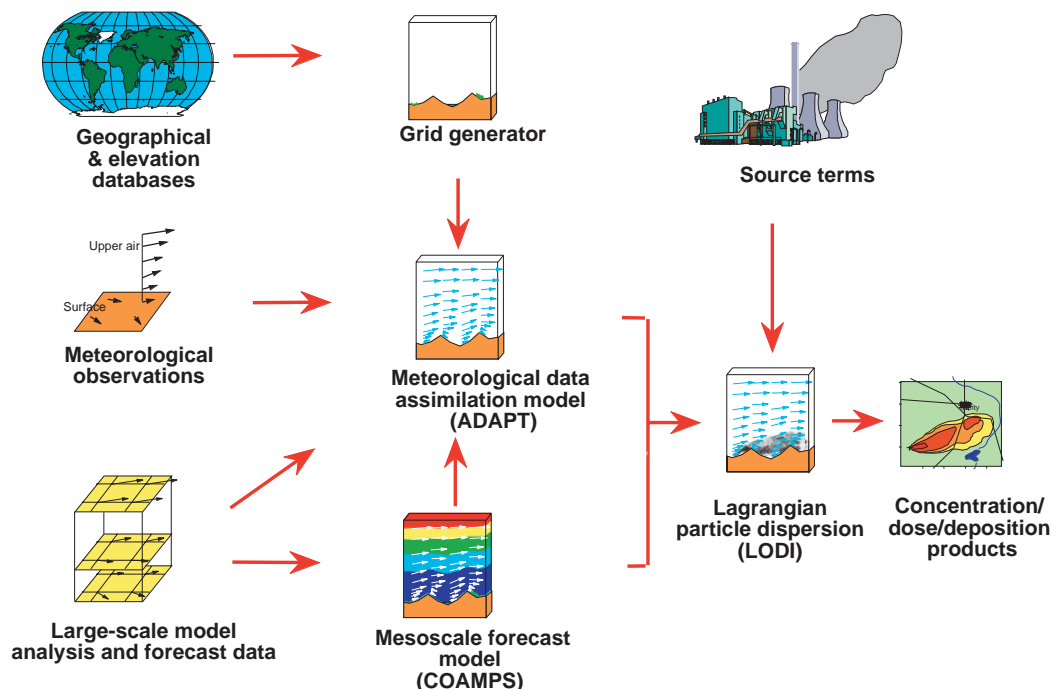
STEPS IN THE ARAC RESPONSE

Upon receiving a request for support, ARAC's staff begins downloading the most recent regional and site weather data for input into the model calculations. Information is automatically received from a link to the U.S. Air Force Global Weather Center and from the National Oceanic and Atmospheric Administration by satellite broadcast. This information is sent hourly for surface meteorological data and twice-daily for upper air data. Emergency scene officials provide critical information such as the time and exact location of the release and the type of accident or incident causing the emergency.

After ARAC team members have downloaded the regional weather information and received site input, computer codes simulate the release from the explosion, fire, vent or spill with dispersion models which show the spread of the material. These dispersion models take into consideration the effects from the local terrain or topography and complex meteorology. ARAC staff scientists prepare graphic contour plots of the contamination overlaid on the local maps; ARAC models also



Responders study an ARAC plot.



The steps in developing an ARAC plot.

include the actual or estimated amount and rate of release of the material. These plots can be widely distributed to emergency response officials and will be provided to the AMS, ARG, FRMAC, RAP, REAC/TS, NEST advance elements (frequently even prior to deployment) and on-scene leaders. ARAC continues to refine calculations as measurements are taken until all airborne releases have stopped and the hazardous threats are mapped and impacts assessed. This information is a valuable early aid to emergency managers in determining the scope and potential impact of accidents.

ARAC'S RESOURCES

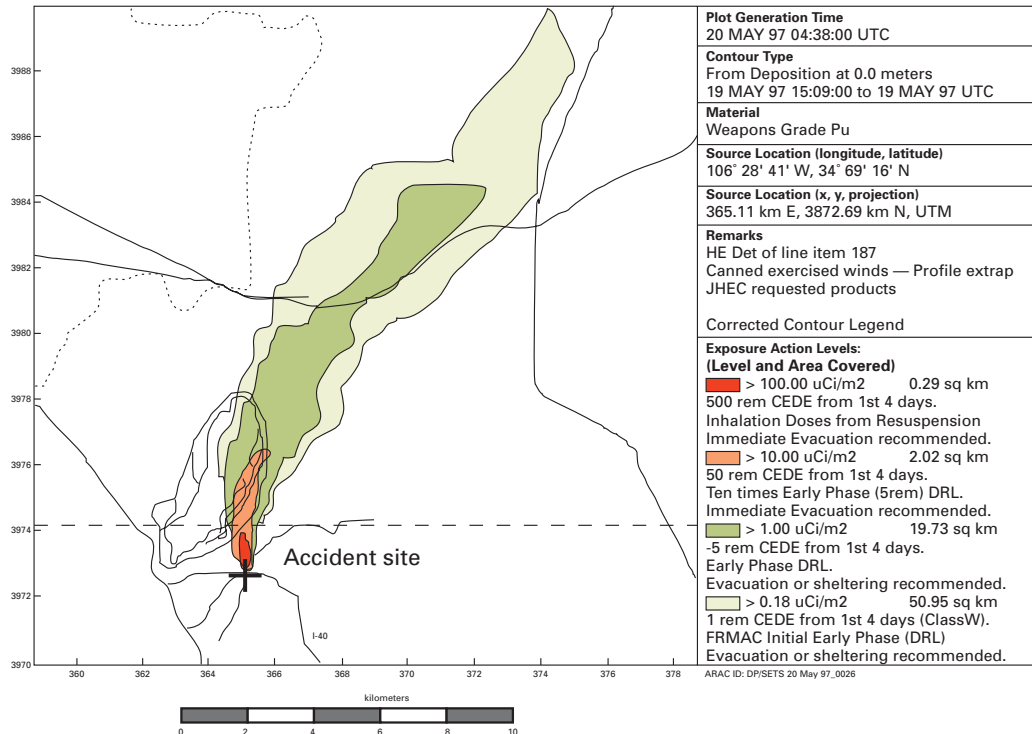
ARAC's specialists are trained in such areas as atmospheric science and modeling; computer science, operations and software development; electrical engineering; health physics; and industrial hygiene. In responding to the emergency, ARAC staff have vast databases at their fingertips. Database files are maintained for all ARAC-supported sites and a worldwide library of potential accident sites is available, including locations such as nuclear power plants and fuel-cycle facilities. A terrain database covers most of the world at a resolution of one-half kilometer. The geographic databases provide mapping information on scales ranging from site-specific buildings and streets to entire countries. ARAC's meteorological database and data services provide data for all standard weather data reporting locations of the world; computer-supported sites provide additional special local weather data for ARAC. ARAC staff can immediately analyze all of this available information and incorporate additional information received from the scene about the emergency event.

predict
simulate
model



SET 5: Total Deposition — Early/Arid

ARAC Notes for Exercise Digit Pace



A sample ARAC plot.

3-D MODELING

ARAC's transport and diffusion models simulate the release and predict the extent of the hazard. The 3-D modeling system ARAC uses has a continuous representation of terrain on a grid with greater resolution near the hazard release point. This grid can readily be selected anywhere in the world and easily scaled to the size of the problem. Mathematical calculations are used to arrive at wind representations which are adjusted over the grid to produce a mass-consistent flow in the terrain setting. Releases of hazardous material are simulated using thousands of "marker particles," each carrying the unique properties of its released material. These source "particles" are transported and dispersed in the atmosphere and deposited to the ground. The ARAC program provides state-of-the-art dispersion assessments and forecasts for a broad spectrum of complex accident situations.

PRODUCT REQUEST AND DELIVERY

ARAC products are delivered to an emergency manager via the Internet, intranet (e.g. DOE Emergency Communications Network), dial-up or wireless communication links using Internet and Web tools implemented by ARAC. Emergency managers at ARAC supported sites can request and display ARAC predictions using ARAC's iClient capability. Others participating in an event can view the predictions using the ARAC password protected Web site by using a standard Web browser run on standard desktop and laptop computers.

