PNNL-14043

User's Guide for the Air Pollutant Graphical Environmental Modeling System (APGEMS)

Clifford S. Glantz
K. Jerry Allwine
Mitchell A. Pelton
Kerrie J. Pattison

September 2002

Prepared for
The U.S. Department of Energy
Under Contract DE-AC06-76RLO 1830

Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

The Air Pollutant Graphical Environmental Monitoring System (***APGEMS***) Version 2.0 is a state-of-the-art atmospheric dispersion and dose assessment model developed for emergency planning, preparedness, and response applications. It is the primary atmospheric dispersion and dose assessment modeling tool at the Emergency Operation Center (EOC) at the U.S. Department of Energy's Hanford Site.

APGEMS can be used for areas with relatively uniform terrain or complex terrain environments. Source-to-receptor transport distances can range from as little as one hundred meters to a few hundred kilometers. ***APGEMS*** uses a three-dimensional diagnostic wind model to compute the vertical and horizontal spatial variation in winds at each time step in the simulation. The wind field is determined by applying a mass-conserving interpolation technique to the surface- and upper-air observations supplied to the model. The model accounts for flow channeling, blocking by major terrain features, and drainage flows. ***APGEMS*** employs a Gaussian puff formulation to mathematically describe the concentration distribution of the released materials as they move in the mean wind field. The model treats wet and dry deposition, radioactive decay, and first-order chemical transformations of the released material.

APGEMS is a PC-based software product. Its modular design allows its various components to be upgraded and replaced when appropriate. ***APGEMS*** generates screen, hardcopy, and Internet-shareable output products. The interface with the Internet allows information to be rapidly shared with emergency response personnel within the EOC and at other control centers.

APGEMS can be run in three different modes: the Standard, Exercise, and Exercise Generation modes. The Standard mode is used during an actual emergency or drills that involve using real-time data. The Exercise mode is used during drills that involve "canned" meteorological data. The Exercise Generation mode is used to create the comprehensive exercise data packages (including field team monitoring readings) that are used by exercise controllers to run a training event.

This user's guide is intended to assist in the training of new ***APGEMS*** users and to be a ready reference for experienced users. The focus of the user's guide is the computer program's user interface. This document explains how to efficiently and appropriately use the interface to prepare a model simulation, run a simulation, and access and disseminate model output products. One section provides "first-responder" instructions to assist non-technical staff members in running ***APGEMS*** during the earliest stage of an emergency response event. Other sections provide general operating instructions and comprehensive information on every ***APGEMS*** screen, menu option, and program function. These sections of the document make extensive use of labeled screen displays to guide the reader. A technical discussion of the ***APGEMS*** atmospheric dispersion (excerpted from Allwine and Bian 1995) is appended to the user's guide.

Acknowledgements

The authors wish to acknowledge the support of a number of Hanford Site staff members who have greatly contributed to our work in developing and implementing the ***APGEMS*** model. Our principal clients have been Larry Campbell, Gayla Aldridge, and Ted Morales with Flour Daniel Hanford. We appreciate their insight, patience, and dedication in working with our model team. We would also like to acknowledge the technical support provided by Russ Bechtol, Paul Rittman, Ralph Broz, Tom Froelich, and Rudy Prosser; the administrative support provided by Sheila Woody and Sandy Bauer; and the management support provided by Dan Connell, Mary Brown, and Gerry Griffin.

The authors would also like to thank Gene Shelar, Dick Thuillier, and Teri Mack of the Pacific Gas and Electric Company for their encouragement and suggestions during the creation of the ***PGEMS*** model from which ***APGEMS*** is derived.

Finally, the authors would like to thank Jo Lynn Draper for editing the document, Jennifer Kirk for providing text-processing services, and Phyllis Parker for general administrative support in publishing this document.

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1.0 INTRODUCTION

The Air Pollutant Graphical Environmental Monitoring System (***APGEMS***) Version 2.0 is a state-of-the-art atmospheric dispersion model developed for emergency planning, preparedness, and response applications. It is the primary atmospheric dispersion and dose assessment modeling tool at the Emergency Operation Center (EOC) at the U.S. Department of Energy's Hanford Site.

This user's guide is intended to assist in the training of new ***APGEMS*** users and to be a ready reference for experienced users. The focus of the user's guide is the computer program's user interface. This document explains how to efficiently and appropriately use the interface to prepare a model simulation, run a simulation, and access and disseminate model output products.

This user's guide consists of nine sections and two appendices. Section 1 provides an overview of ***APGEMS*** and the Hanford Site. Section 2 provides "first-responder" instructions for running ***APGEMS*** at the Hanford Site's EOC. First-responders are the initial staff members to arrive at the Hanford EOC during an event or exercise. These people may have very limited training in atmospheric dispersion modeling or the use of ***APGEMS*** (e.g., they may be administrative support, communications specialists, or computer programming specialists). To assist them in running the initial ***APGEMS*** simulation, this section provides simple step-by-step instructions for the earliest stages of an emergency response event.

Section 3 provides general instruction for running ***APGEMS***. These instructions cover all major areas of standard ***APGEMS*** operation, including the setting of release parameters, defining the source term, and accessing and sharing all model output products. Section 4 provides more comprehensive information on every ***APGEMS*** screen, menu option, and program function. This section expands on the general operating instructions to provide information on every aspect of the ***APGEMS*** user interface. Both Sections 3 and 4 make extensive use of labeled screen displays to guide the reader.

Section 5 discusses the content of the program's hardcopy output products. Examples of these hardcopy products are presented in Appendix A. Section 6 provides a general description of the ***APGEMS*** directory structure and key input files. Section 7 provides directions on how to set up ***APGEMS*** to operate in its Exercise and Exercise Generator modes. Section 8 reviews the structure and content of the meteorological data input files that are used for ***APGEMS*** operation at the Hanford Site. Section 9 presents the references cited in this document. Finally, Appendix B presents a technical discussion of the ***APGEMS*** atmospheric dispersion model (this appendix is excerpted from Allwine and Bian [1995]).

1.1 Overview of *APGEMS 2.0*

APGEMS 2.0 is the primary atmospheric dispersion and dose assessment modeling tool at the Hanford Site EOC. ***APGEMS*** assesses the atmospheric transport, diffusion, deposition, and dose impacts of air pollutants (both particles and gases). The model can be used for areas with relatively uniform terrain or complex terrain environments. Two nested grids are used to cover the modeling domain. A fine-resolution grid resolves the dispersion within a few kilometers of the release location and a course-resolution grid captures pollutant transport out to the limits of the modeling domain. Source-to-receptor transport distances can range from as little as one hundred meters to a few hundred kilometers.

APGEMS uses a three-dimensional diagnostic wind model to compute the vertical and horizontal spatial variation in winds at each time step in the simulation. The wind field is determined by applying a mass-conserving interpolation technique to the surface- and upper-air observations supplied to the model. Terrain data are used to refine the model's wind field. The model accounts for flow channeling, blocking by major terrain features, and drainage flows. The mixed layer height can change spatially and temporally just as all the other meteorological and release inputs.

APGEMS employs a Gaussian puff formulation to mathematically describe the concentration distribution of the released materials as they move in the mean wind field. Mathematical reflections of the concentration distribution from the ground and the top of a mixed layer modify the initial Gaussian distribution. The model treats wet and dry deposition, radioactive decay, and first-order chemical transformations of the released material.

Instructions for running an ***APGEMS*** simulation are provided using a user-friendly graphical interface. The model accesses data files that provide information on terrain, meteorology, pollutant characteristics, and other parameters. Output products are displayed using a graphical user interface. Among the products that can be displayed graphically or numerically are the distributions and cumulative exposures at ground level; time-averaged pollutant concentrations; deposition fields; total effective dose equivalent; and maximum organ dose. The values of key parameters can be viewed for each major time step in the simulation.

APGEMS can be run in three different modes: the Standard, Exercise, and Exercise Generation modes. The Standard mode is used during actual emergencies or drills and uses real-time data. Model results are analyzed by the hazard evaluation team and are forwarded, with explanation, to decision-makers. Output can then be used to establish the alert level of an event, position field teams and emergency response personnel, order protective actions, select evacuation routes, and support other decision-making activities.

The Exercise mode is used during drills that involve "canned" meteorological data. These are usually exercises in which historical meteorological data that fit the drill's

training criteria are re-dated to work during the training event. In this mode, data files are accessed from the appropriate exercise data directory rather than the real-time data directory. Exercise data are only accessible by the model at times when that data would be available if this were a real event (e.g., exercise meteorological data for 2 PM can only be utilized after 2 PM). In this way, the model's acquisition of exercise data accurately simulates the way it acquires data during a real event.

The Exercise Generation mode is used to create the comprehensive exercise data packages that are used by exercise controllers to run a training event. In addition to generating estimates of the affected area, plume position, and dose impacts throughout the exercise, the model also generates readings for each type of monitoring instrument used by field teams (e.g., PAM Air, GM-P11, CP, Micro Rem Meter). Graphical plots of all output products, including instrument readings, are produced at intervals as short as 15-minutes for the entire exercise.

APGEMS modular design allows its various components to be upgraded and replaced when appropriate. ***APGEMS*** generates screen, hardcopy, and Internet-shareable output products. The interface with the Internet is a new feature that allows the rapid sharing of information with technical specialists, decision makers, and other emergency response personnel within the EOC and at other control centers.

Instructions and illustrations presented in this document focus on program operation at the Hanford Site. To those using this user's guide to support applications at other locations, references to the Hanford Site may be a bit bewildering. To help understand the examples presented in this document, the remainder of this section provides background information on the Hanford Site and the real-time meteorological data available for Hanford Site applications.

1.2 Description of the Hanford Site

The Hanford Site lies within the semi-arid Pasco Basin of the Columbia Plateau in southeastern Washington State (Figure 1.1). The Hanford Site occupies an area of about 1,450 km^2 (about 560 mi^2). The Columbia River flows through the northern part of the Hanford Site and, turning south, forms part of the Site's eastern boundary. The Yakima River runs along a portion of the southern boundary of the Hanford Site. Rattlesnake Mountain, Yakima Ridge, and Umtanum Ridge form the southwestern and western boundaries. The Saddle Mountains form the northern boundary of the Hanford Site. Two small east-west ridges, Gable Butte and Gable Mountain, rise above the plateau of the central part of the Hanford Site. Adjoining lands to the west, north, and east are principally range and agricultural land. The cities of Kennewick, Pasco, and Richland (the Tri-Cities) constitute the nearest population centers and are located southeast of the Hanford Site.

Figure 1.1. The Hanford Site.

Beginning in the 1940's (with the creation of the site as part of the Manhattan Project), Hanford played a pivotal role in the nation's defense as a plutonium production complex. Currently, Hanford is engaged in the world's largest environmental cleanup project, with many challenges to be resolved in the face of overlapping technical, political, regulatory, and cultural interests. Hanford also has a mission to develop and deploy science and technology. The large size of the Hanford Site, coupled with restricted public access, provides a buffer for the smaller operational areas that are currently used for storage of nuclear materials, waste processing, waste disposal, and scientific research (Dirkes et al. 1999). Hanford's four major operational areas, which occupy only about 6% of the Site, are the 100, 200, 300, and 400 Areas.

- The 100 Areas. This consists of the 100-B/C, 100-D, 100-F, 100-H, 100-K, and 100-N Areas. These areas lie along the south shore of the Columbia River in the northern portion of the Hanford Site. These areas contain former plutonium production reactors and their support facilities. Spent nuclear fuel is stored underwater in 100-K Area basins. The removal of this fuel and its transition to dry storage in the 200 Area is one of the Site's highest priorities.

- The 200 Areas. The 200 East and 200 West Areas are in the center of the Hanford Site on the Central Plateau. Facilities in these areas were used for extracting plutonium from spent reactor fuel and processing the plutonium. Massive quantities of radioactive wastes are currently stored in these areas. The stabilization of plutonium-bearing materials, the retrieval and stabilization of highly radioactive wastes stored in underground storage tanks, and the safe storage and disposal of solid radioactive and mixed waste materials are some of the major clean-up activities being conducted in the 200 Areas.

- The 300 Area. This area is located near the southern border of the Hanford Site. It contains laboratories, support facilities, and former reactor fuel manufacturing facilities.

- The 400 Area. This area is located between the 200 and 300 Areas and contains the Fast Flux Test Facility and associated facilities.

On June 9, 2000, more than half of the original Hanford Site (~ 790 km^2 [305 mi^2]) was set aside as the Hanford Reach National Monument. The monument includes the 51-mile long ''Hanford Reach'' (the last free-flowing, non-tidal stretch of the Columbia River in the United States), Fitzner/Eberhardt Arid Land Ecology Reserve, Saddle Mountain Wildlife Refuge, Wahluke Slope Wildlife Area, and Hanford Dune Field. The monument is intended to preserve the unique ecological, scientific, historical, and cultural resources of the Hanford Site.

1.3 Meteorological Monitoring at the Hanford Site

The climate of the Hanford Site and the surrounding region is greatly influenced by the Pacific Ocean and Cascade Mountain Range to the west and the Rocky Mountains located to the north and east. The Pacific Ocean moderates temperatures throughout the Pacific Northwest and the Cascade Range generates a "rain shadow" that limits rain and snowfall in the eastern half of Washington State. The Cascade Range also serves as a source of cold air drainage, which has a considerable effect on the wind regime on the Hanford Site. Mountain ranges to the north and east of the region shield the area from the severe winter storms and frigid air masses that move southward across Canada (Hoitink et al. 2002).

The topography of the Hanford Site is quite complex. Along the western border of the Site, the broad length of Rattlesnake Mountain rises up from the Columbia Basin. The mountain reaches an elevation of about 1090 m (3600 ft), a 900 m (3000 ft) difference in elevation from the slightly rolling terrain of the Columbia Basin. The 200 Areas are located near the center of the Site, on a plateau that is at least 30 m (100 ft) higher than the neighboring terrain. Gable Mountain rises to a height of 330 m (1100 ft) elevation and is located between the 200 East and 100-F Areas. The Hanford Reach of the Columbia River passes through the Site and helps form its eastern border. In the eastern portion of the Site, bluffs and cliffs (some towering 150 m [500 ft] above the level of the river) are located on the river's northern and eastern shores.

The complex topography of the Hanford Site can give rise to substantial spatial variations in wind, precipitation, temperature, and other meteorological parameters. Complex diurnal circulation patterns are experienced on the Site. In the warm season, it is common to see upriver flow during the day and strongly northwesterly winds (flow toward the southeast) during the night, particularly in northwestern portion of the Site (this includes the 200 Areas). To accurately characterize meteorological differences across the Site and support dispersion modeling requirements, the Hanford Meteorological Service (HMS) operates a network of automated monitoring stations.

Meteorological data for the Hanford Site are collected and archived at the HMS. The HMS is located near the center of the Site, just outside the northeast corner of the 200 West Area. Meteorological measurements have been made at the HMS since late 1944. Prior to the establishment of the HMS, local meteorological observations were made at the old Hanford townsite (1912 - late 1943) and in Richland (1943-1944). A climatological summary for Hanford is provided in Hoitink et al. (2002)[1].

These stations, which currently number 30, are located throughout the Hanford Site and in neighboring areas (Figure1.2). A 125-m (410-ft) instrumented tower operates at the HMS. A 60-m (200-ft) instrumented tower operates at each of the 100-N, 300, and 400 Area monitoring sites. Most of the other network stations utilize instrumented towers

[1] Hanford climatological data summaries have been updated annually since 1995. Earlier climatological reports that have been extensively cited include Glantz et al. (1990) and Stone et al. (1983). A detailed report on Hanford's meteorological monitoring instrumentation is provided in Glantz and Islam (1988).

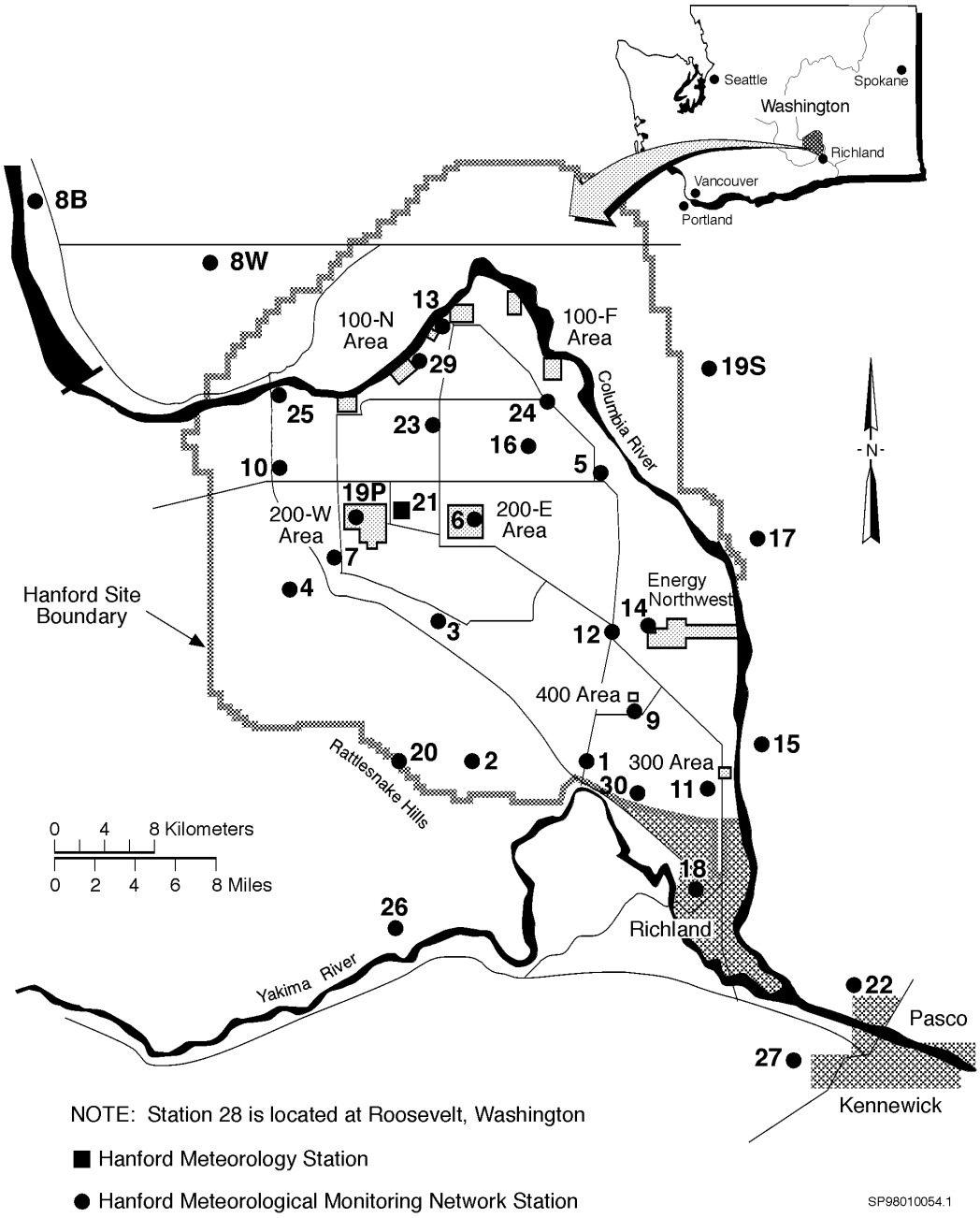


Figure 1.2. The Hanford Meteorology Monitoring Network.

with heights of ~10-m (33ft). All of the monitoring sites measure wind direction, wind speed, and temperature. A number of the sites also monitor precipitation and atmospheric pressure. The 125-m and 60-m tower sites measure winds and temperature at multiple elevations. Atmospheric humidity is also measured at these sites. The name of each monitoring site and a brief summary of what is measured is presented in Table 1.1.(Page 9.1) Doppler acoustic sodars are also deployed at the four tall-tower locations. These instruments use sound waves to remotely measure winds at heights from 120 m (400 ft) to ~600 m (2000 ft) above the surface.

Data are collected and processed at each monitoring site and key information is transmitted to the HMS every 15 minutes. The HMS begins acquiring data from its monitoring station at the top of the hour, a quarter after-the-hour, at the half-hour, and at a quarter to the hour. The station uses radio telemetry to sequentially poll each of its automated monitoring stations. Most data are provided in the form of 15-minute average values (precipitation is a notable exception – it is provided in the form of a 15-minute total accumulation) based on measurements made at 5-second intervals throughout the averaging period. The data are processed at the HMS and formatted into meteorology files that can be read by ***APGEMS***. Five meteorological data files, one each for near-surface telemetry, 200-ft tower, 400-ft tower, surface observations at the HMS, and sodar data are prepared for each 15-minute period. The naming convention and format of these files are described in detail in Section 5.

Once the data are processed at the HMS and posted on its server, the data are transmitted to other servers. This includes the server at the EOC and a server at Pacific Northwest National Laboratory (PNNL). At the EOC and PNNL server, data for a given time period are usually available within ten minutes of the end of the data averaging period. At the HMS, some files are available within a couple of minutes of the end of the averaging period while other files take a few minutes longer.

Table 1.1. Station Numbers, Names, and Instrumentation for each Hanford Meteorological Monitoring Network Site.

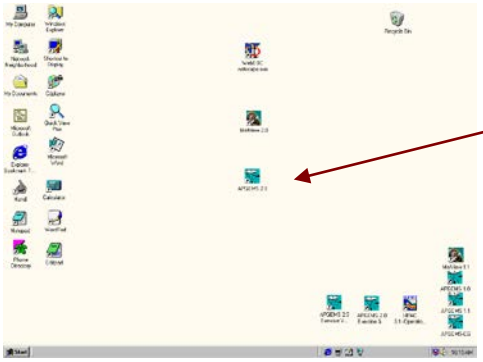
Site Number	Site Name	Instrumentation
1	Prosser Barricade	WS, WD, T, P
2	EOC	WS, WD, T, P
3	Army Loop Road	WS, WD, T, P
4	Rattlesnake Springs	WS, WD, T, P
5	Edna	WS, WD, T
6	200 East Area	WS, WD, T, P, AP
7	200 West Area	WS, WD, T, P
8B	Beverly	WS, WD, T, P
8W[a]	Wahluke Slope	WS, WD, T, P
9	FFTF (60 m)	WD, T, TD, DP, P, AP
10	Yakima Barricade	WS, WD, T, P, AP
11	300 Area (60 m)	WS, WD, T, TD, DP, P, AP
12	Wye Barricade	WS, WD, T, P
13	100-N Area (60 m)	WS, WD, T, TD, DP, P, AP
14	Energy Northwest (Supply System)	WS, WD, T, P
15	Franklin County	WS, WD, T
16	Gable Mountain	WS, WD, T
17	Ringold	WS, WD, T, P
18	Richland Airport	WS, WD, T, AP
19P	Plutonium Finishing Plant	WS, WD, T, AP
19S[b]	Sagehill	WS, WD, T
20	Rattlesnake Mountain	WS, WD, T, P
21	HMS (125 m)	WS, WD, T, P, AP
22	Tri-Cities Airport	WS, WD, T, P
23	Gable West	WS, WD, T
24	100-F Area	WS, WD, T, P
25	Vernita Bridge	WS, WD, T
26	Benton City	WS, WD, T, P
27	Vista	WS, WD, T, P
28[c]	Roosevelt, Washington	WS, WD, T, P, AP
29	100-K Area	WS, WD, T, P, AP
30	HAMMER	WS, WD, T

(a) Key: WS = wind speed, WD = wind direction, T = temperature, P = precipitation, AP= atmospheric pressure, DP = dew point (atmospheric moisture)
(b) Station no longer active.
(c) Roosevelt is located on the Columbia River west/southwest of the Site.

2.0 FIRST RESPONDER PROCEDURE FOR RUNNING APGEMS

If the Hanford Site's EOC is activated (for an exercise or a real event), the first staff members to arrive at the Unified Dose Assessment Center (UDAC) are responsible for performing "first-responder" activities. First-responder activities include running the ***APGEMS*** model and distributing output. This ***APGEMS*** assignment can be accomplished in a few easy steps.

Step 1. Double-click the *APGEMS* icon. Double-click on the shortcut icon to start the program. The APGEMS icon is usually positioned near the center of the desktop screen. While the model is loading, a message will appear on the screen "Loading default map data please wait…"

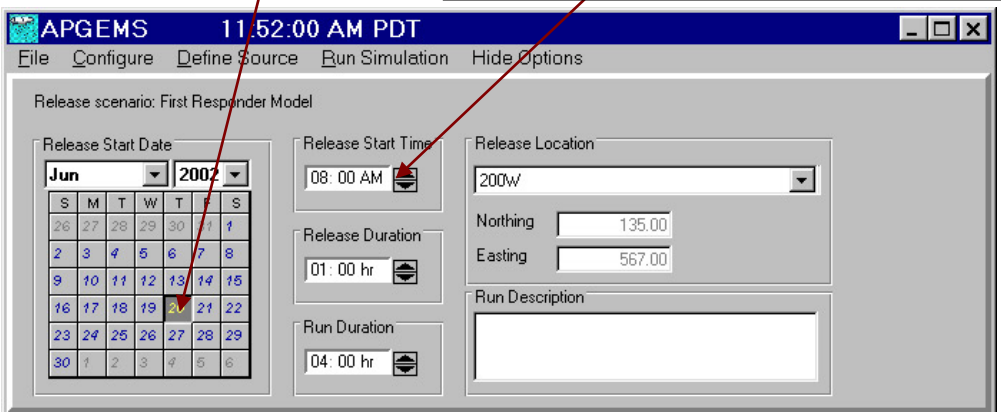


Step 1. Double-click the ***APGEMS*** icon on the desktop of the Meteorology workstation at UDAC. The icon is generally located near the center of the screen.

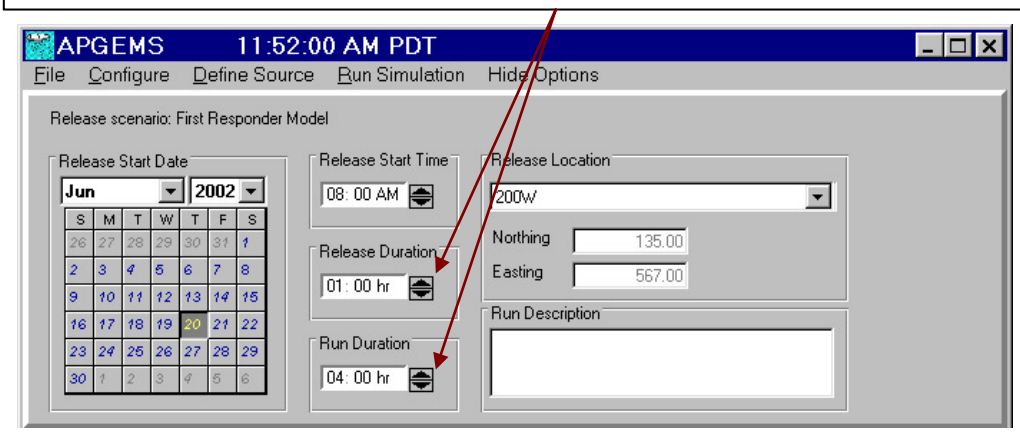
Step 2. Check Initial Settings and Adjust the Release Date and Time as Needed. The ***APGEMS*** Main Menu will appear with default settings in place for a first-responder model run. No source term information is needed – the model assumes a unit release of a generic contaminant.

Step 2a. Check the "Start Date". The default is today's date. If the start date needs to be changed, click the appropriate date on the calendar.

Step 2b. Check the "Release Start Time." The most recent quarter-hour is the default release start time (even if no release has occurred). If you have information that a release started at an earlier time, click the spinner buttons up or down to adjust this time.



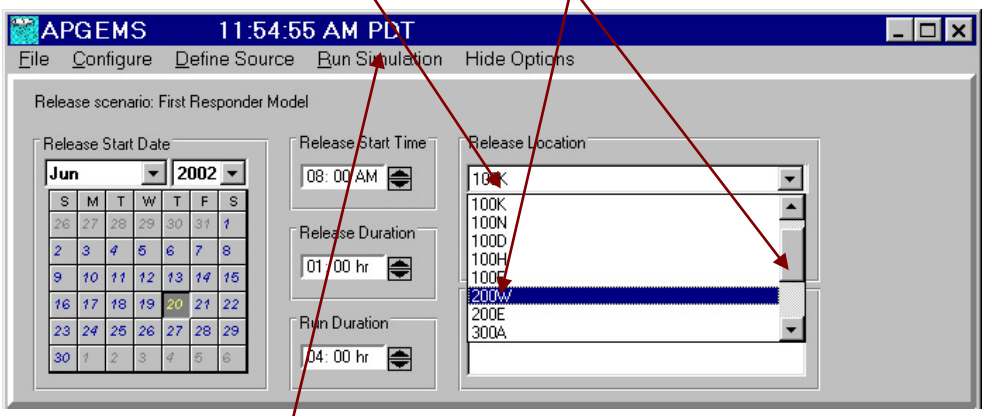
Step 2c. The "Release Duration and "Run Duration" are set to the default values that are generally used. You can click the spinner buttons to change these values.



Step 3. Set the Release Location. On the main screen, click the Release Location text box. A list of potential release sites will be displayed. Scroll down this list and click on the name of the area or facility that is most representative of the potential release site. *In the event that no suitable release location is available (such as a transportation accident outside of one of Hanford's operating areas), click "Other" and follow the instructions for selecting a new release location (see Section 3.3).*

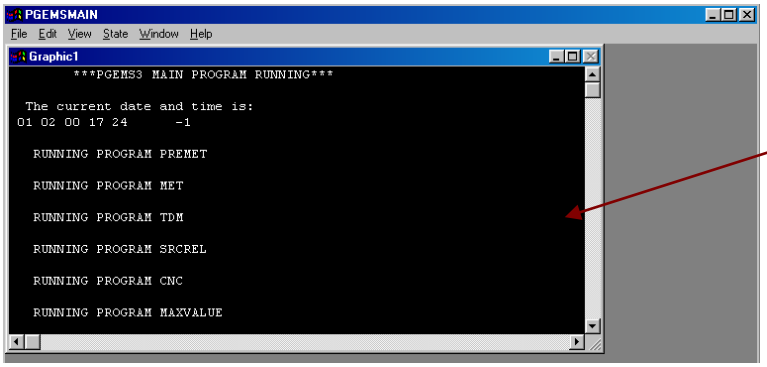
Step 3a. Click the Release Location text box to display a list of potential release locations.

Step 3b. Scroll down the list of release locations and click on the name of the area or facility that best represents the release location.



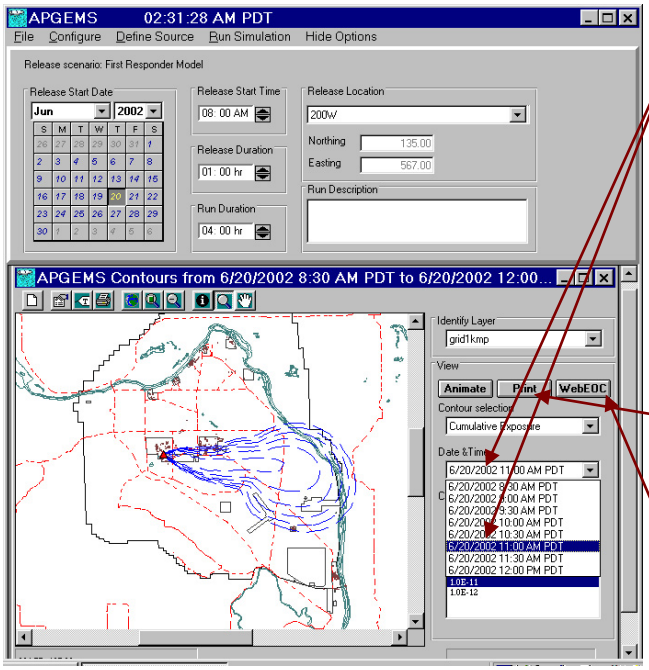
Step 4. Click *Run Simulation* to run the atmospheric dispersion model.

Step 4. Run the Simulation. You are now ready to run an ***APGEMS*** simulation. Click *Run Simulation* on the menu bar. A window will open and display the progress of the model as it runs through several different subroutines.



Once *Run Simulation* is clicked, a window opens to display the status of the model as it runs through each major component. A model run will generally take from 5 to 60 seconds.

Step 5. Examine the Output. An "APGEMS Contours…" window will appear, displaying a "Cumulative Exposure" (this is also called "Affected Area") plot for the first output interval in the simulation. Click on the "Date & Time" text box to display a list of output times. Click on the time period you wish to display. Initially, you probably want a projection for one hour past the current time.



Step 5. The initial Affected Area Plot (Cumulative Exposure) projection is displayed. Click on the *Date & Time* text box to display a list of all output times and then click on a date/time of interest.

Step 6a. Click *Print* to print a hardcopy of the displayed product.

Step 6b. Click *WebEOC* to transmit all of this simulation's output products to WebEOC.

Step 6. Print and Transmit Output Products. Click the *Print* button to generate a hardcopy of the cumulative exposure/affected area plot that is displayed on the screen. Click the *WebEOC* button to send output to the EOC's web system. All output products and time periods are displayed and transmitted when the *WebEOC* button is activated.

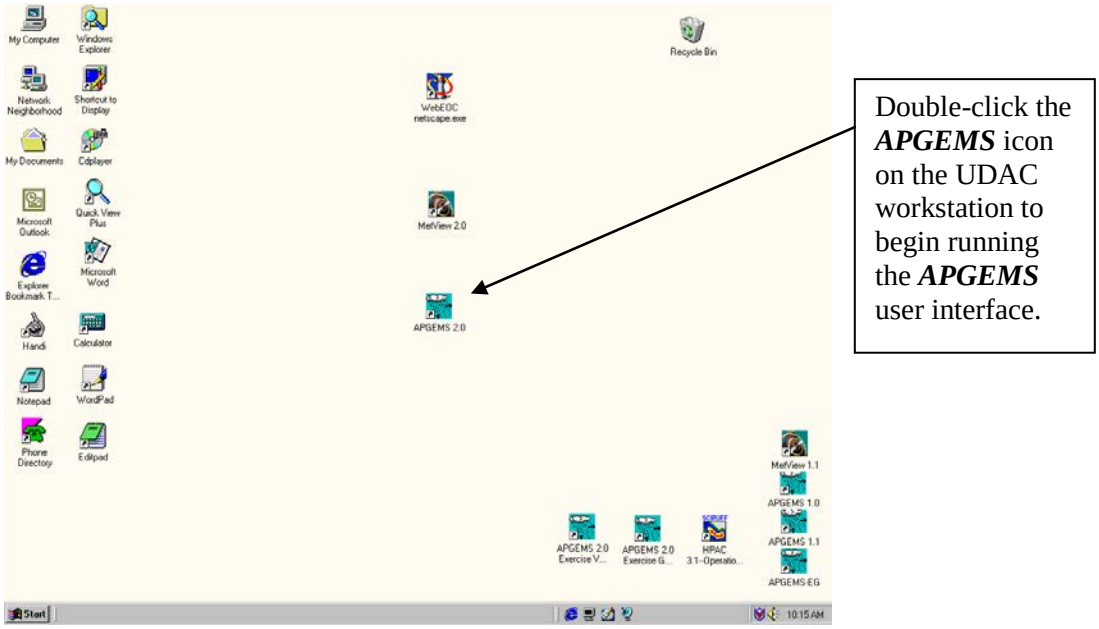
Step 7. Run a New Simulation. If new meteorological data become available, run a new simulation by clicking *Run Simulation* on the menu bar. Keep in mind that updated meteorological data automatically arrives every 15 minutes (at ~5 to 10 minutes past the quarter hour) and are automatically used in new simulations.

3.0 GENERAL PROCEDURE FOR RUNNING *APGEMS*

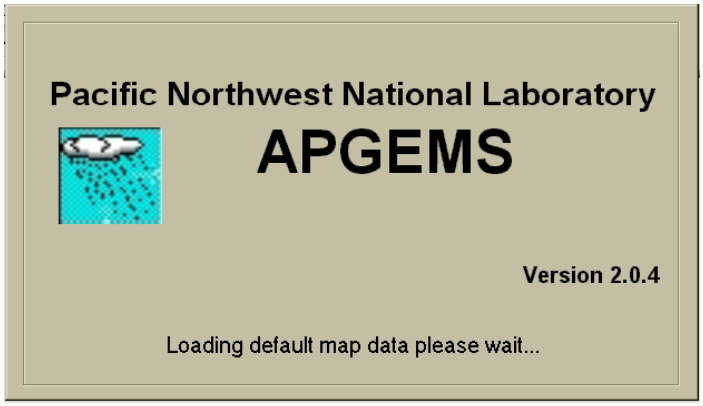
This section presents the general procedure for running ***APGEMS*** at the Hanford Site EOC. These procedures are generally applicable for running ***APGEMS*** at any user location.

3.1 Starting *APGEMS*

To run the ***APGEMS*** model, the first step is to double-click the ***APGEMS*** icon**.** The standard location for the ***APGEMS*** icon on the Meteorologist's EOC workstation is near the center of the screen.

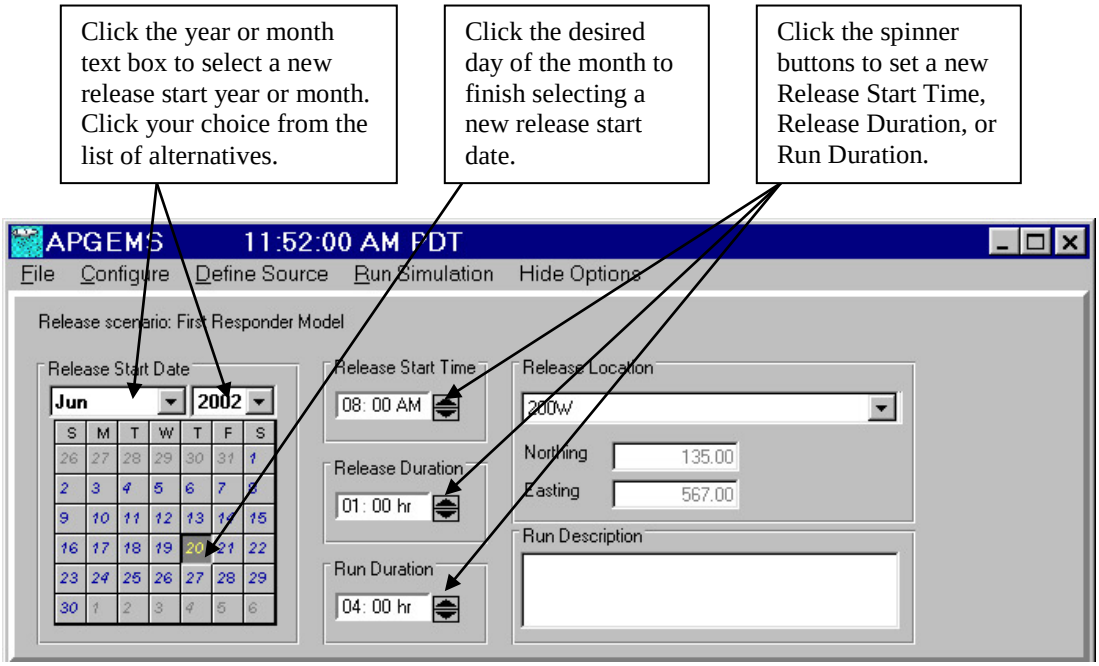


While the model is loading, a message will appear on the screen with the model name and version number. The message says "Loading default map data please wait…" A few seconds later, the ***APGEMS*** Main Menu will appear.



3.2 Setting the Release Start Date/Time, Release Duration, and Run Duration

The Main Menu is used to set the release starting date and time, release duration, run duration, and other key parameters.



The first functions performed on this menu involve setting the following parameters:

- "Release Start Date" and "Release Start Time." These are the starting date and time for the release of pollutants to the atmosphere and the simulation. On startup these parameters will default to the current date and time (as of the last quarter hour). If ***APGEMS*** is started at 11:59 PM on August 25, the release start date and time will be set to August 25 at 11:45 PM. If the model is started two minutes later, on August 26 at 12:01 AM, the release start date and time will be set to August 26 at 12:00 AM.

- "Release Duration." This is the length of time during which pollutants are continuously released (beginning at the start of the simulation). On startup, this parameter will default to "1:00 hr" indicating that the pollutant release will begin at the release start time and will halt exactly one hour later.

- "Run Duration." This is the amount of time covered by the model simulation. On startup, this parameter will default to "4:00 hr." The model will simulate atmospheric dispersion and computer impacts beginning at the release start date/time and continuing on through the entire run duration.

Adjust these parameters to fit the requirements of your simulation.

1. To reset the release year, click on the text box that displays the year. This generates a drop-down list box that presents all available years. Click on the desired year.

2. To reset the release month, click on the text box that displays the month. This generates a drop-down list box that lists all 12 months of the year. Click on the desired month. *Note: After changing the month or year, the calendar display will reset to reflect your changes.*

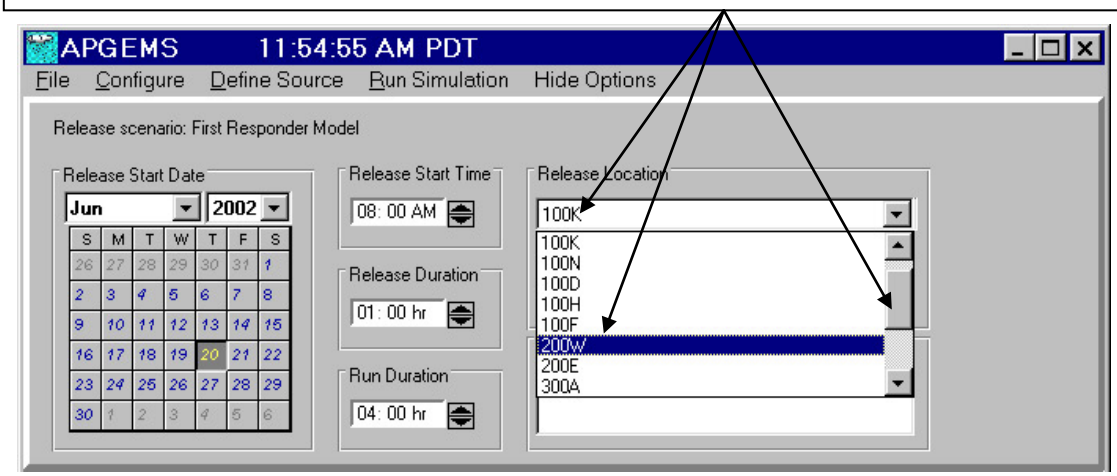
3. To reset the date of the month, click on the desired day on the calendar. The selected day will be highlighted so that it looks "pushed-in" when compared to the other days on the calendar.

The release start time, release duration, and run duration can be reset using their associated spinner buttons. Each click on the up or down spinner button moves the time forward or back by 15 minutes. When adjusting the release start time, spinning the time forward or backward through midnight will automatically change the date. *Note: The program operates on "real" clock time, automatically accounting for the transition between standard and daylight savings time.*

3.3 Setting the Release Location

The one parameter the user almost always has to adjust before running a simulation is the release location. On the Main Menu, select the release location from one of the existing set of release locations, or define a new release location by selecting "Other." Click the release location text box and a drop-down list box of potential release locations will appear. You can scroll through this list and click the name of the location to use for the site of the pollutant release.

Click the release location text box and then click the name of the site to use for the release. You can use the scroll bar to move to the very bottom of the list and click "Other" to define a new location.



Note: For the Hanford Site, release location options include each major operating area, each major facility that contains substantial quantities of radioactive materials, and previous user-defined release locations.

Selecting "Other" as your release location opens the Identify Site Location window. This window provides a tool bar, a text box for entering the name of the new release location, and a map of the study area.

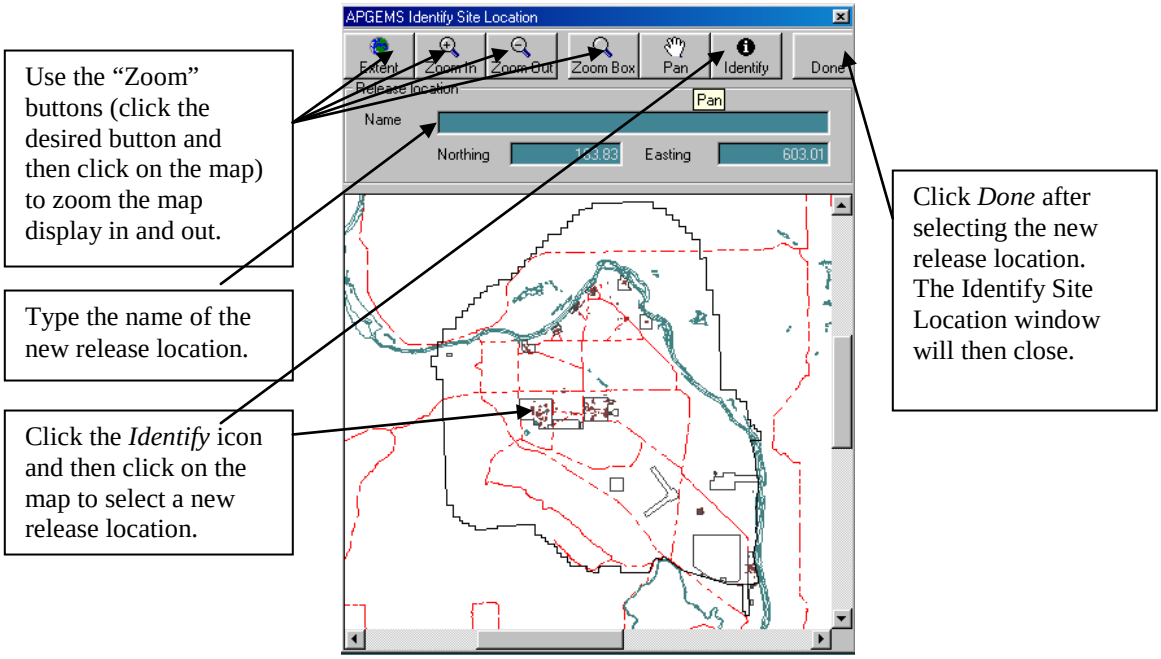
1. Zoom in on the area of the release (buildings and other structures will come into sharper focus as you zoom in) so that you can clearly identify its location.

2. In the "Name" text box, type in the unique name that you wish to use for this release location.

3. Click on the *Identify* icon, position the pointer at the new release location, and click on this location. *Note: The coordinates (Northing and Easting) of the release location will be locked-in and will no longer change when the pointer is moved across the screen.*

4. Hit the *Done* icon to close the Identify Site Location window and return to the main menu. *Note: The name you have given the release location will now appear in the text box below the "Release Description" heading on the Main Menu.*

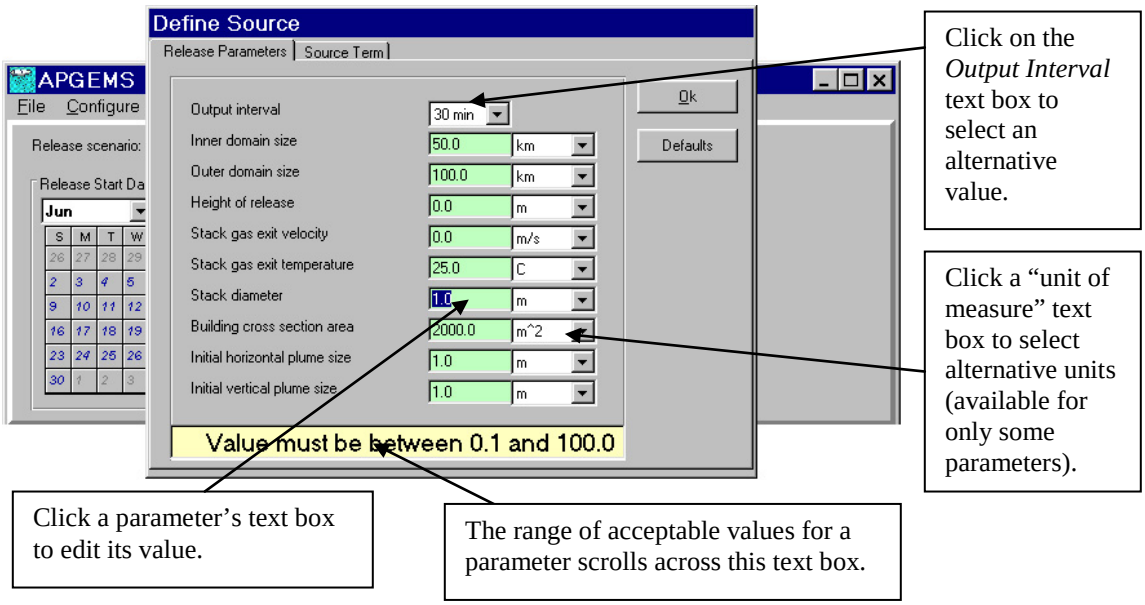
The minimum initialization of required Main Menu options is now complete. An ***APGEMS*** simulation can now be run using default first-responder assumptions for the source term and other release parameters.



3.4 Defining the Source

Upon startup, ***APGEMS*** is set for first-responder operations. This involves a unit, ground-level release of a generic, non-depositing gas. The effluent temperature is assumed to be 25°C (77°F) with a negligible exhaust velocity. A unit release rate of 1 Ci/s corresponds to a 3,600 Ci release over the course of one hour. If a non-radioactive pollutant is being studied, the quantity of material released (and resulting exposure estimates) can be interpreted as grams (or another mass unit) instead of Curies.

To review or modify release parameters, source term estimates, and a few key model operation settings, click *Define Source* on the menu bar. The Define Source menu will open and display either the "Release Parameters" or "Source Term" folder. Switch from one folder to another by clicking on the tabs at the top of the folders. The Release Parameters folder displays the current setting for a number of key release parameters and model operation settings. These parameters include model domain sizes, the time interval for model output products, the height above ground level at which pollutants are released to the atmosphere, several stack release parameters, and initial plume sizes (this is useful for making the initial size of the plume larger for explosions and small area sources).



Examine the release parameter settings to ensure that they are appropriate for this simulation. To change the Output Interval, click on the text box and a drop-down list box will display alternative selections for the current value. A 15-minute or 30-minute output interval is used for most applications. To change any other release parameter, click on its existing value and edit. When selected for editing, the acceptable range of values for the parameter will scroll across a text box on the bottom of the form. *Note: Changing a parameter to a value that is outside the accepted range will turn the background color of the parameter's text box from green to red. If this occurs, immediately re-enter a valid parameter value.*

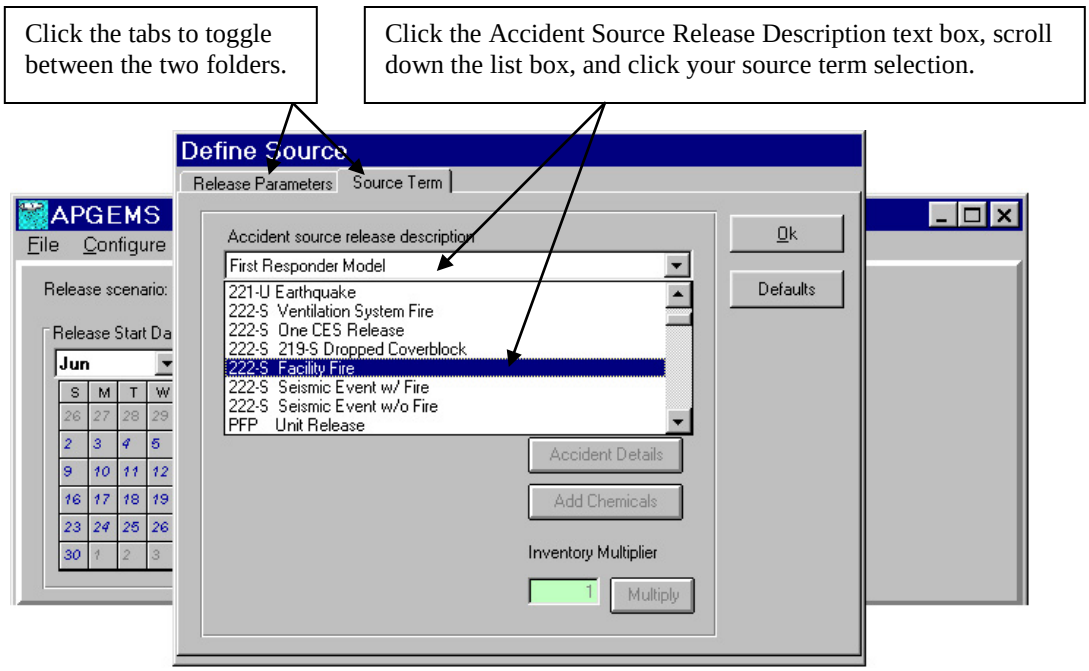
Caution: Only experienced users should ever attempt to change the model domain sizes (see Section 4.4.1 for more information).

By clicking on a unit of measure text box and then on the desired unit from the drop-down list box you can change a parameter's unit of measure. Be advised that if you change a unit of measure, the previously entered value is not automatically converted to the new units (e.g., if a stack diameter is listed as "1.0 m" and you change the units to feet, you must click on the parameter's text box and manually change the "1.0" to "3.3" to reflect the conversion from meters to feet).

Note: To restore all of the release parameters to their default setting, click the Default button before clicking OK.

For most applications, you will probably click the Source Term folder's heading tab and adjust the source release scenario before exiting the Define Source menu. If you do not need to adjust source term information, you can click *OK* and return to the Main Menu. The release parameters you have accepted will be used if you choose to run a simulation (the only exception is that a default set of release parameters is used whenever the "First Responder Model" is the accident scenario).

The Source Term folder is used to set the type and quantity of pollutants released to the atmosphere. Under the heading "Accident Scenario Source Release," either "First Responder Model" or the name of the last source term used in a simulation will appear. The first-responder is a very special release scenario. When it is active, all release parameters are hardwired to default settings (this overwrites any selections made in the release parameters form) and a unit release is assumed (1 Ci/s for a one hour release).



To examine alternative source terms, click on the "Accident source release description" text box. A drop-down list box containing a lengthy list of source release scenarios will appear. Scroll down this list and click to select a candidate scenario. For all scenarios, except the "First Responder Model," clicking a source release scenario generates a display of the constituents and inventory released to the atmosphere in that scenario. You may wish to examine the constituents and inventories of several scenarios before finalizing your selection.

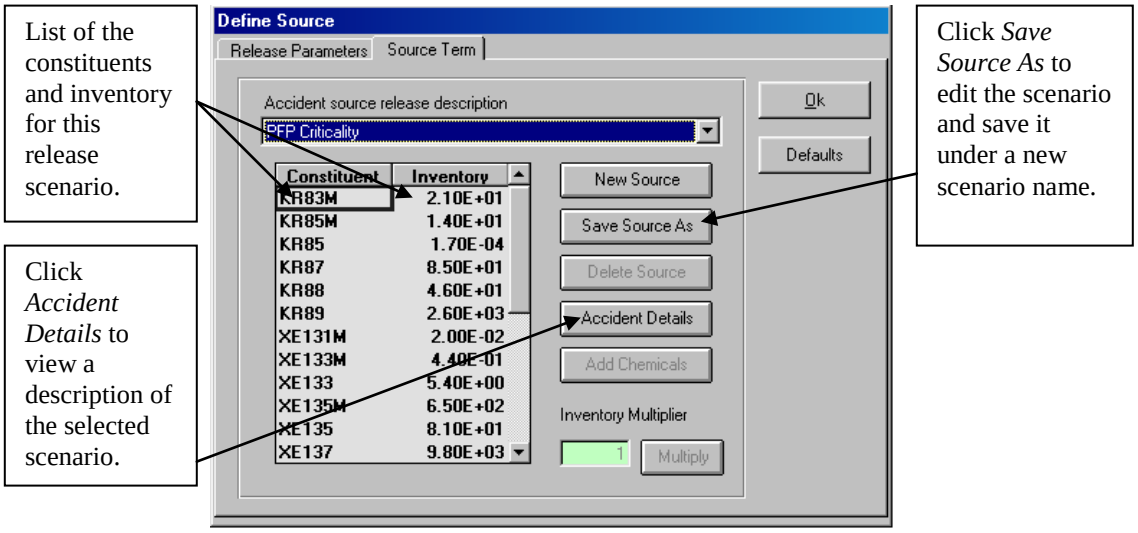
Note: To learn more about a scenario, click the Accident Details button. A brief description of the release scenario will appear in a dialog box. Most of the source release scenarios are defined from the current emergency response hazards database; others are user-defined from earlier ***APGEMS*** *simulations.*

To modify a source release scenario:

1. Click the *Save Source As* button. A dialog box will appear with the title and description of the release scenario.

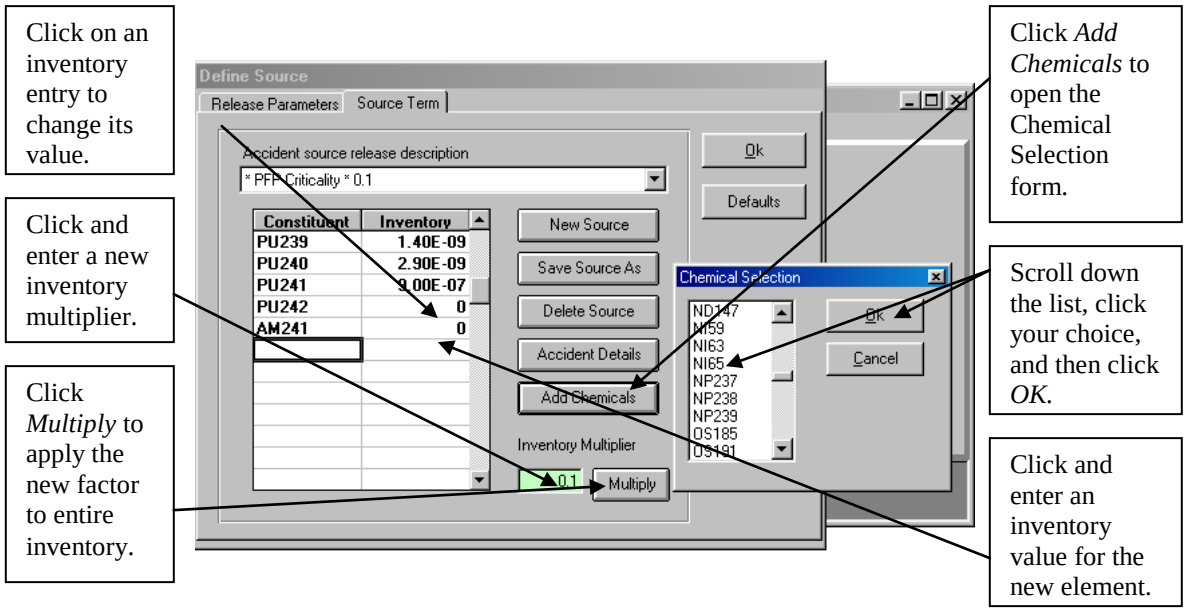
2. To make changes to the source term, the title of the scenario must first be edited (i.e., it must be given a unique name). The scenario description can also be changed at this point. Release constituents can now be added or their inventories modified.

3. To change a constituent's inventory value (including setting a constituent's inventory to zero), highlight the inventory entry and enter a different value.



4. To enter new pollutant constituents:
   - Click the *Add Chemicals* button. A Chemical Selection form will be displayed.
   - Use the scroll bar to find desired chemicals.
   - Click to select a single chemical or use Shift Click or Control Click to select more than one chemical.
   - Click *OK* to record your selection.
   - For each new pollutant added to your release scenario, type in an inventory value (in Curies*). Note: A contaminant that is already in a scenario cannot be deleted; however, it can be removed from consideration by setting its inventory to zero.*

5. To make a global change to all of the constituent inventories in a user-defined scenario, you can easily multiply all the inventories by a constant factor (e.g., 100, 0.01). Simply, enter the desired factor in the text box to the left of the *Multiply* button, and then click *Multiply*.



To create a new source release scenario from scratch:

1. Click the *New Source* button. A dialog box will appear.

2. Enter a unique title and description for the new release scenario.

3. To enter pollutant constituents, click the *Add Chemicals* button.

4. For each chemical selected, type in an inventory value (in Curies).

To delete an existing user-defined source release scenario, select that scenario and click the *Delete Source* button. **Caution: This will permanently remove the displayed release source scenario from the user database.**

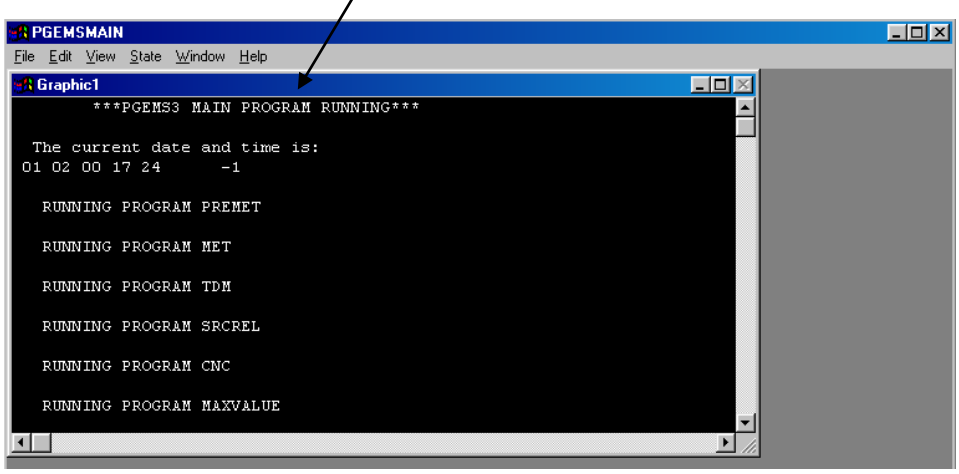
Note: To reset the source release scenario to "First Responder Model", click the Default button.

After selecting or creating the source release scenario you wish to use in your next simulation and finishing all other work in the Define Source menu, click the *OK* button in the upper right corner of the form. You will exit the Define Source menu and return to the Main Menu. The accident scenario and release parameters in place when exiting this form will be used when you run the simulation. The title of this accident release scenario will now be displayed on the Main Menu

3.5 Running a Simulation

You are now ready to run a simulation. On the Main Menu, click *Run Simulation*. A window will open and display the progress of the model as it runs through different ***APGEMS*** programs. A model run may take from a few seconds to a few minutes to complete. Run times depend on the duration of the simulation, output interval, number of contaminants, the mode in which the model is being run, and the speed of the computer. For most applications it only takes 5 to 60 seconds to complete a simulation. In general, running the model in its Exercise Data Generation mode produces the longest run times. In this mode, ***APGEMS*** must compute and process a much greater number of output files to track field team readings for a variety of monitoring instruments.

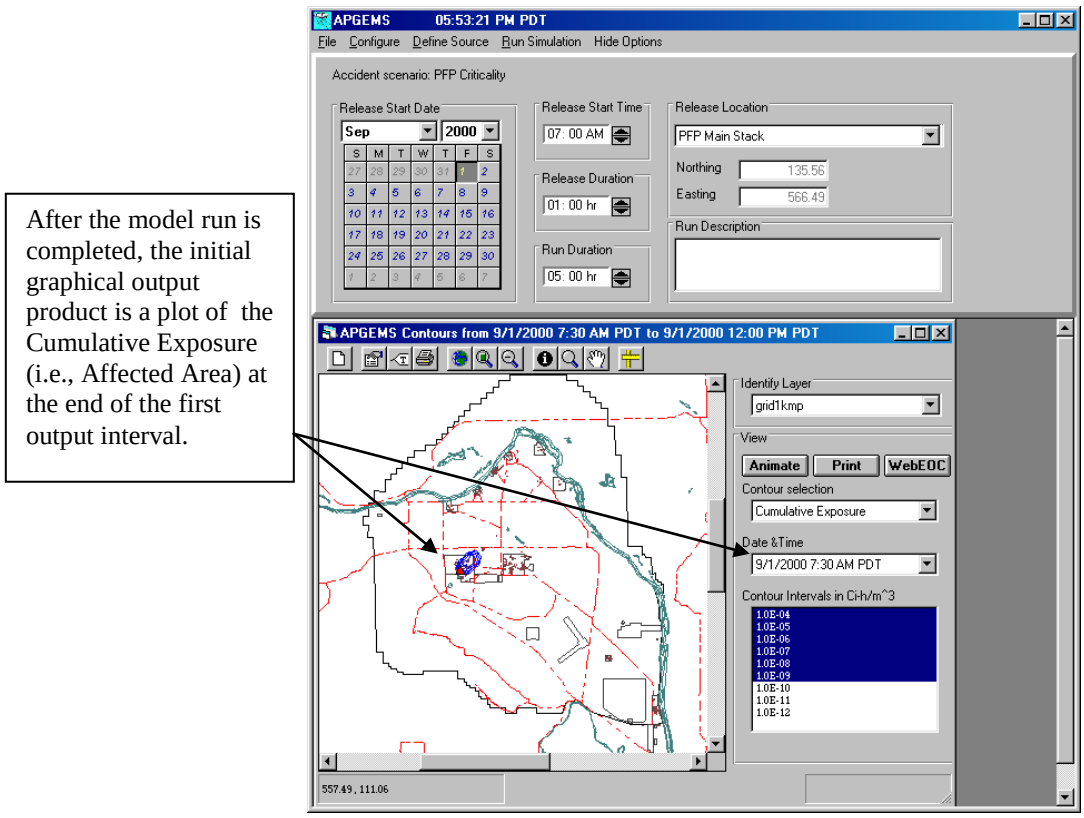
Window displaying the progress of the model as it runs through various programs.



APGEMS reports its progress by listing the name of each key program that is run. These programs perform meteorological data preprocessing, meteorological modeling, transport and diffusion modeling, source release generation, pollutant concentration and dose calculation, maximum value identification, contour calculation, and post-processing of meteorological data.

After the ***APGEMS*** completes its transport, dispersion, and impact computations, it will begin to automatically generate graphical output products. A message will be displayed indicating the model is "Processing Contours." The name of the product being processed will also be displayed. It generally only takes a few seconds to generate output products for a simple simulation. Increasing the length of the simulation and decreasing the output interval increases processing times. Increasing the number of different types of output products generated (e.g., running the model in the Exercise Generator mode) also increases processing times.

After the model run is completed, a graphical output display window opens beneath the Main Menu. A background map of the study is displayed and the Cumulative Exposure (i.e., Affected Area) contours at the end of the first output interval are plotted.



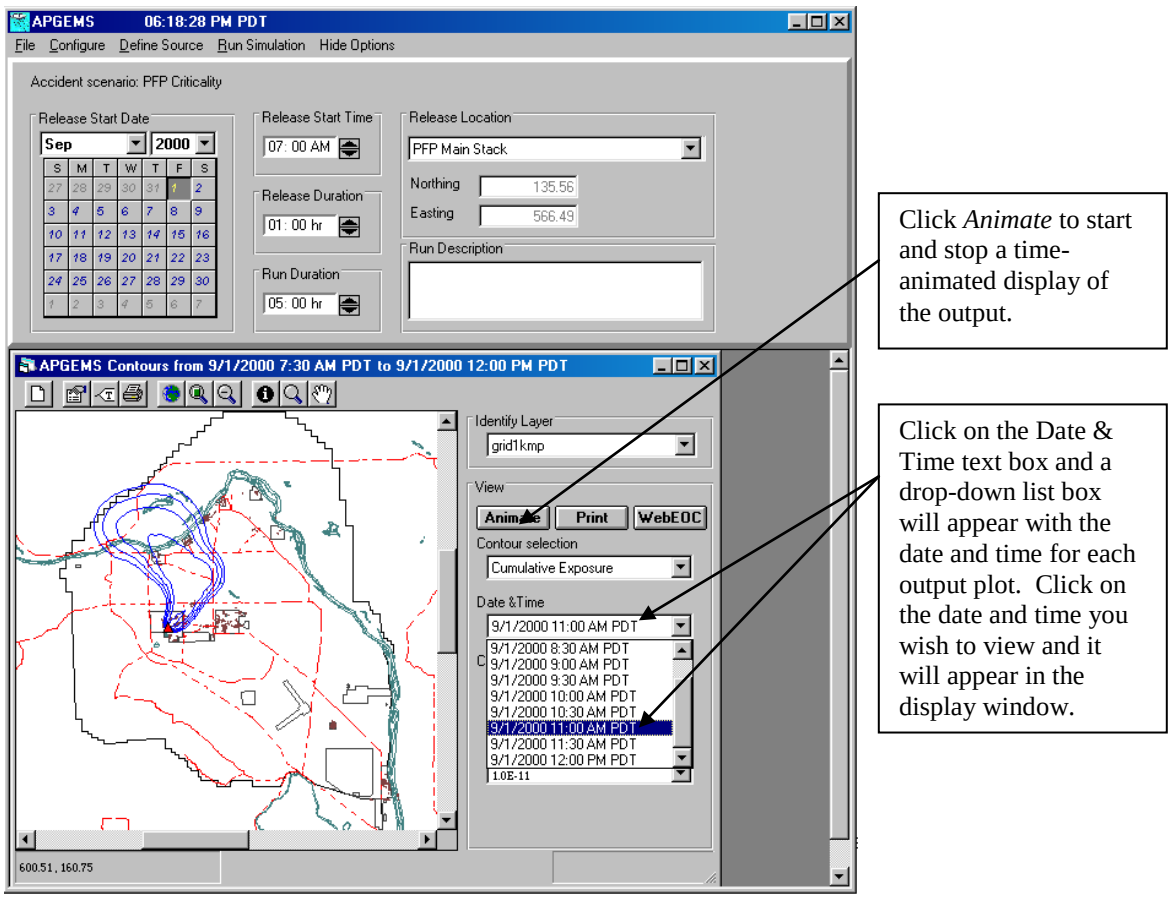
3.6 Viewing Model Output

APGEMS output products are intended to be easy to interpret and manipulate. The user can display results for each type of output product and for each of the simulation's output intervals. For each display, the user can select the contours to plot, zoom in and out to get different perspectives, and pan across the modeling domain. Instructions for viewing and manipulating the display products are discussed in this section.

3.6.1 Displaying Time Sequences of Data

Click the *Animate* button to start an animated display of the specified output product. The display will sequentially advance through each output interval. Animation is a continuous loop; once the plot from the simulation's last output interval is displayed the animation will resume from the beginning of the simulation. To stop the animation, click the *Animate* button.

To view data for a specific time period, click on the "Date & Time" text box. This will generate a drop-down list box with all the dates and time at which output plots are available. Click on the date and time of the plot you wish to view.



3.6.2 Manipulating the Display

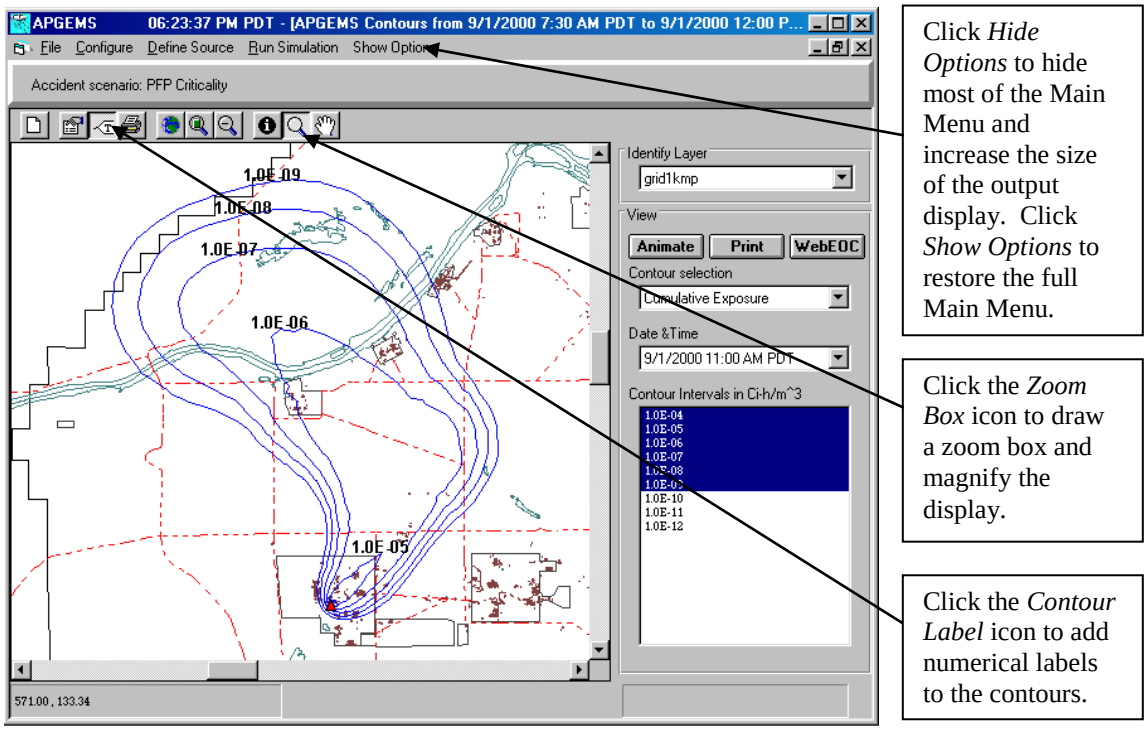
The model output display can be made larger by maximizing the display window. Clicking *Hide Options* on the menu bar expands the output display even further. The expanded display covers almost the entire ***APGEMS*** window, obscuring all Main Menu options below the Accident Scenario name. After *Hide Options* is selected, it is replaced on the menu bar by *Show Options*. Click *Show Options* to restore the Main Menu and decrease the size of the output display product.

The image displayed can be magnified or you can pull back to view a broader area. A number of tools are available on the toolbar above the display to support this function.

- *Original Extent* and *Zoom to Layer* set the output product to certain preset perspectives.

- *Zoom Out 2x* pulls the image back so that horizontal and vertical dimensions of the displayed product are doubled (increasing the area displayed by a factor of four).

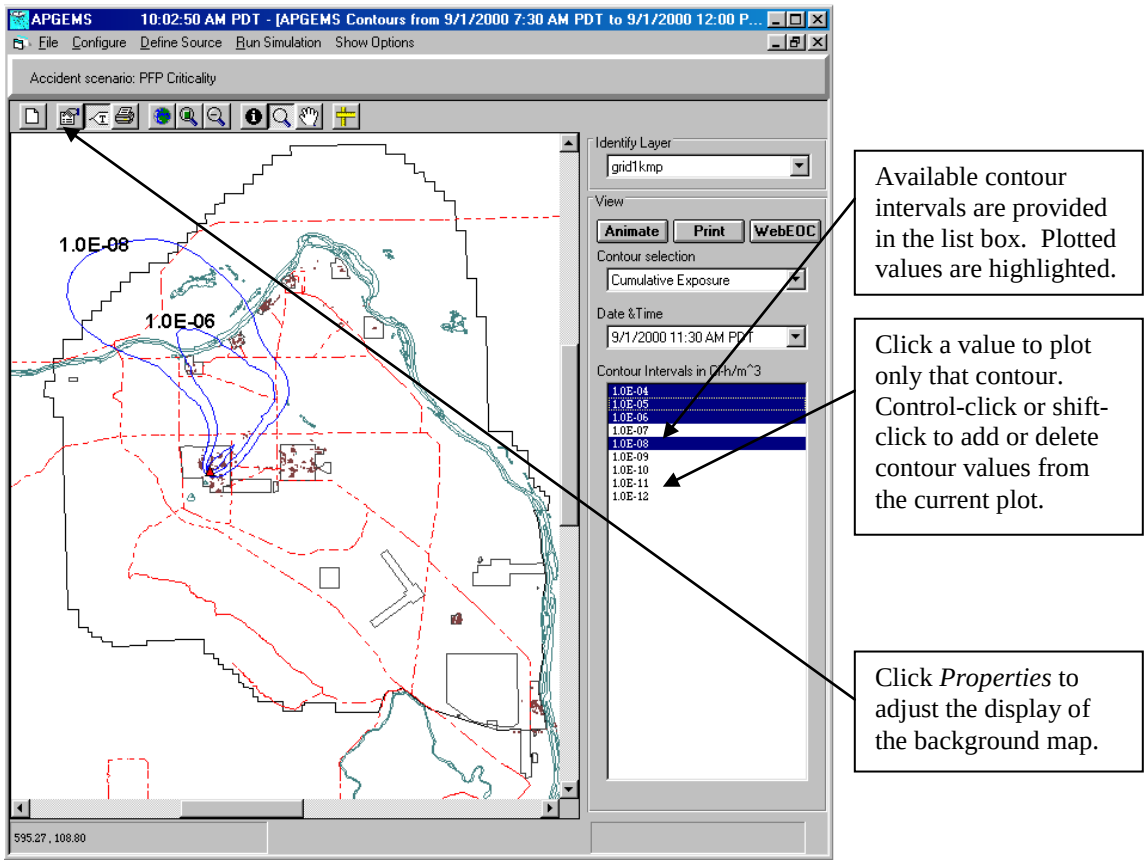
- *Zoom Box* allows the user to zoom in for a detailed look at model output. With *Zoom Box* selected, click on the output product and drag the pointer (with left mouse button depressed) to create a zoom box. When the mouse button is released, the area in the zoom box will fill the display.



The default presentation of display contours is without labels. To add numerical labels for each contour click the *Contour Label* icon. *Note: For contours that take up a relatively small area of the display, contour labels are not visible unless you zoom in for a closer look at that contour.*

To change the displayed contour intervals, go to the "Contour Interval" list box. To display only a single contour, click the numerical value of the desired contour in the list box. Use either Control-click or Shift-click to select or deselect other contours for display. The heading of the Contour Interval list box indicates the units of the plotted value (e.g., Ci-h/m^3 for cumulative exposure).

To adjust the map background, click the *Properties* icon and adjust the display parameters by setting different layers to visible or invisible, turning on and off outlines, and adjusting colors.



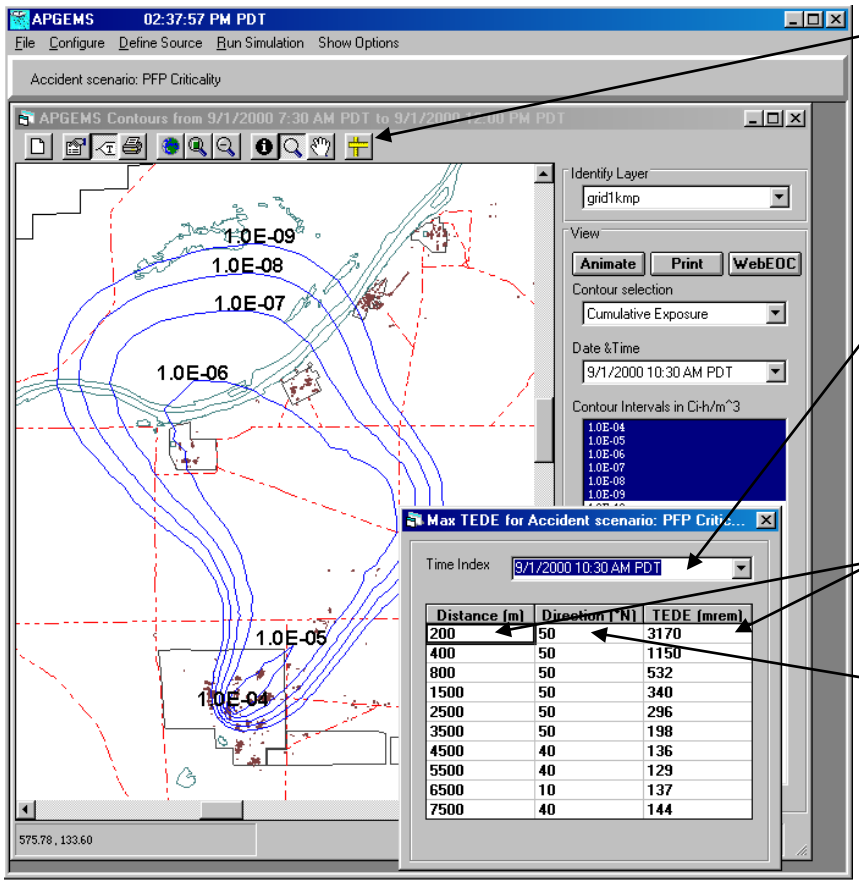
If a model run includes radiological constituents, clicking the *Numerical TEDE Output* icon on the display tool bar will generate a window entitled "Max TEDE for Accident Scenario." This window presents a numerical display of maximum Total Effective Dose Equivalent (TEDE) values reported at key distances downwind from the source. Select the date and time for the data you wish to examine by clicking on the "Time" Index text box.

Three columns of data will be presented:

1. the distance downwind from the source to the receptor

2. the direction sector in which the maximum TEDE value is recorded for the indicated distance downwind from the source

3. the maximum TEDE value at the given distance.



Click the *Numerical TEDE Output* icon to generate a table of maximum impacts at key distances from the release location.

Click the Time Index text box to select data for a different time period.

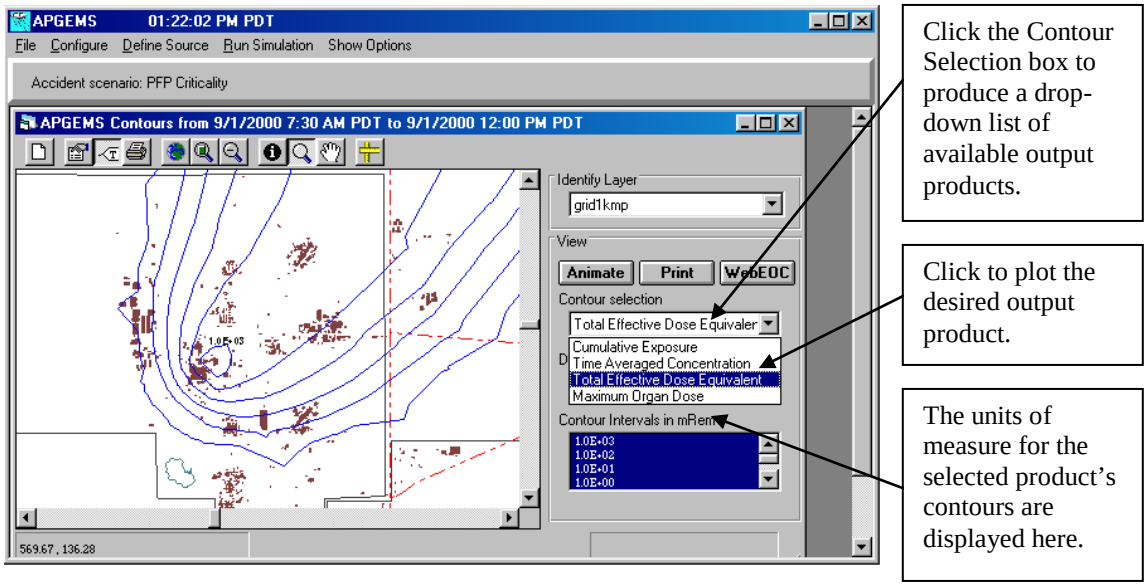
The maximum TEDE values (mrem) for each indicated downwind distance is presented. The transport direction from the source to the maximum impact point is also presented.

The focus of this assessment is on values located relatively close to the release location in comparison to the overall size of the modeling domain. Click the close button in the upper right hand corner of the numerical display to close this window.

3.6.3 Selecting Alternative Output Products

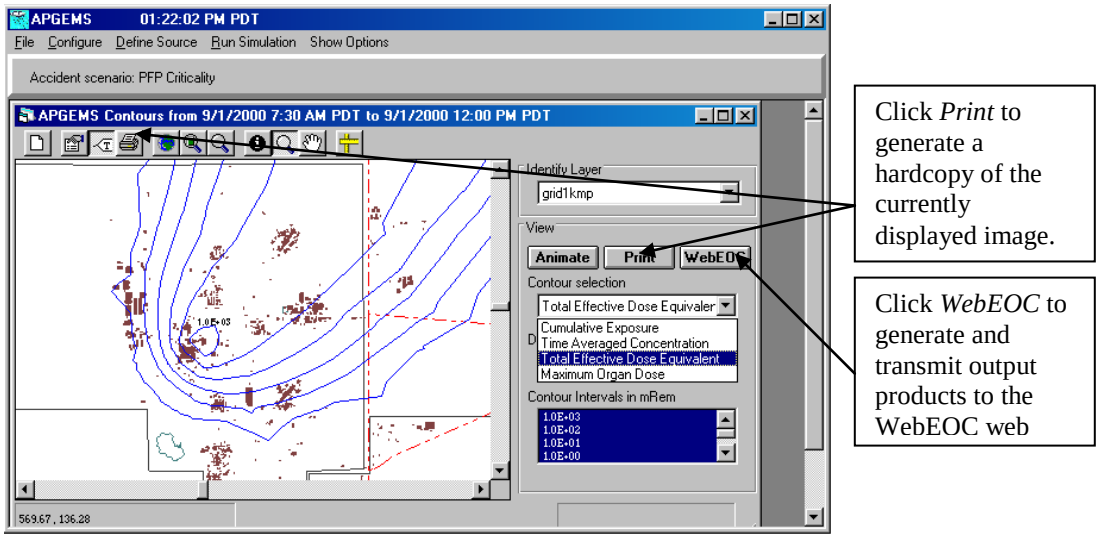
To change the output product, click the "Contour selection" text box. A drop-down list box will present available display products. Click on the type of output product you wish to display.

If the simulation were run using the “First Responder Model”, “Cumulative Exposure” and “Time Averaged Concentration” are the only available output products. For releases involving radiological source terms, “Total Effective Dose Equivalent” and “Maximum Organ Dose” are also available choices. If the model were run in the Exercise Data Generation mode, a series of additional instrument output products would also be available.



3.6.4 Sharing Output Products

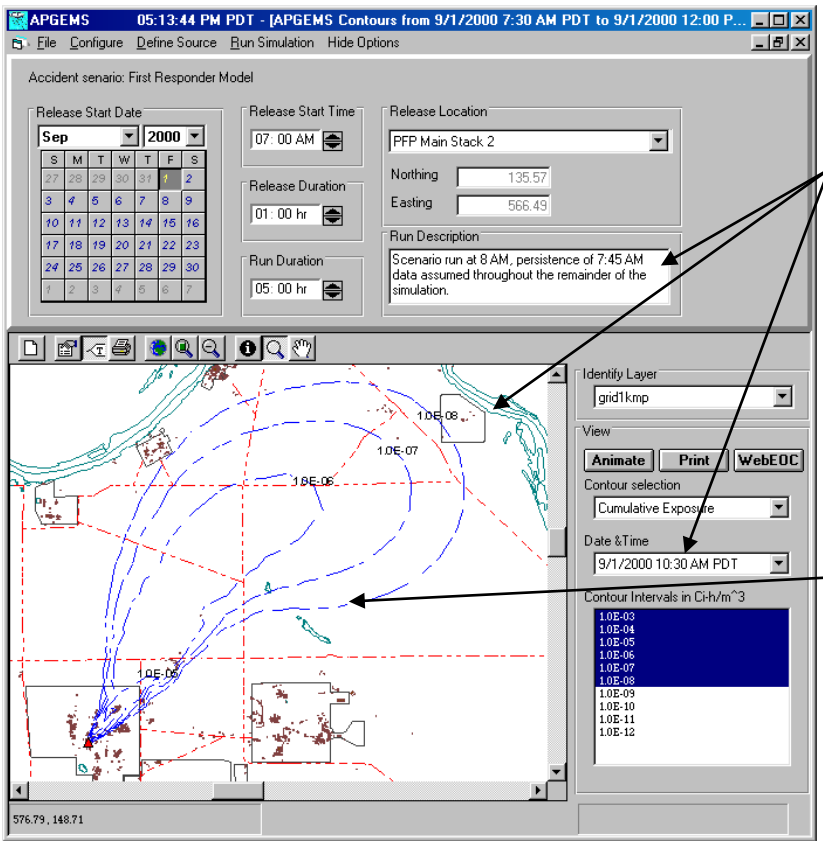
Click the *Print* button (or the *Print* display tool bar icon) to generate a hardcopy of the output product displayed on the screen. Click the *WebEOC* button to send all output products from the current simulation to the WebEOC system.



3.6.5 Using Persistence Meteorology

APGEMS will use all of the relevant available meteorological data when conducting a model simulation. Operationally, there are many cases when the model simulation will need to go beyond the current time. For example, this occurs when a release has recently occurred and impacts need to be estimated several hours into the future. It also occurs when a release has not yet occurred and the EOC needs to conduct "what if" simulations involving a hypothetical atmospheric release that may take place at some point in the near-future.

Whenever the model simulation goes beyond the time of the last available meteorological data, the model assumes the indefinite persistence of most recent meteorological conditions. When the model is generating output for a time period in which the persistence of meteorological conditions is assumed, the output products will be plotted using dashed contour lines instead of solid lines.



This is a Cumulative Exposure plot that assumes the persistence of meteorological data into the future. The last available meteorological data is from 7:45 AM. The output product estimates exposure at 10:30 AM.

Contours generated using the persistence of meteorological data are drawn using dashed lines.

In many instances, persistence of current meteorology is the best short-term forecast available. However, as the model simulates conditions further and further into the future, the ability of the most recent meteorological data to represent future conditions diminishes. As a result, plots with dashed contour lines may have a greater level of uncertainty associated with them than plots with solid contour lines. This level of uncertainty tends to increase as the length of time from the most recently available meteorological data increases. Uncertainty also increases substantially when meteorological conditions are variable or in transition. It is important to discuss the uncertainty of future projections when presenting model output to EOC decision-makers.

3.6.6. Acquiring Updated Meteorological Data and Running a New Simulation

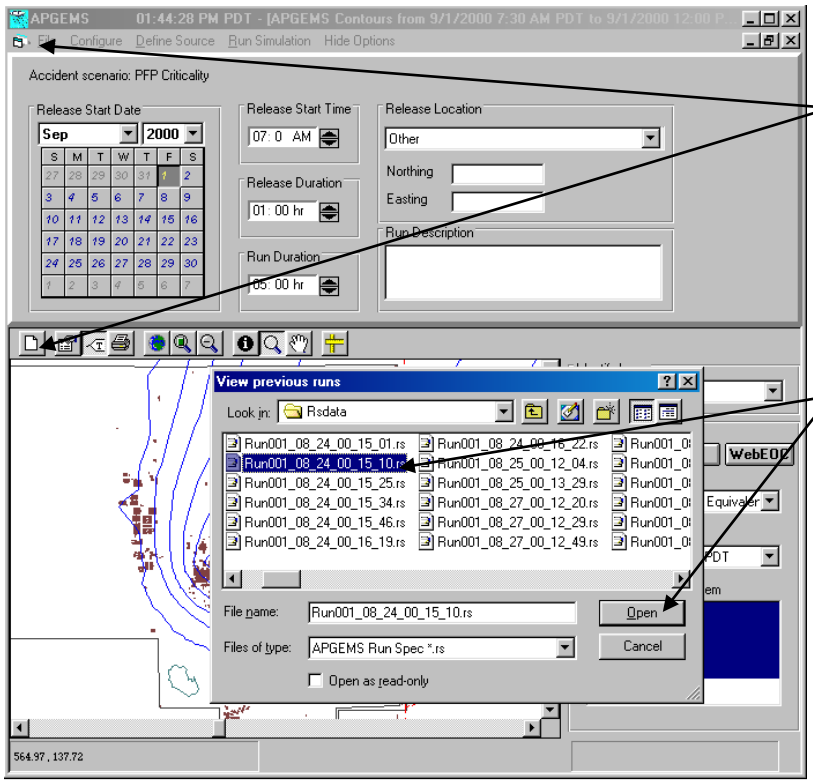
When you are finished examining and sharing output products, a new simulation can be run. If new meteorological data has arrived since the most recent simulation, updated results will be obtained by simply rerunning the previous simulation (no action needs be taken by the user to incorporate the new meteorological data – this is done automatically). New meteorological data may substantially alter impact projections. The impact area may change (for example, there may be substantial differences as winds shift transport material in different directions). The magnitude of impacts to Site workers and the public may also change as the rate of atmospheric diffusion is modified or the location of maximum impacts is altered.

To rerun a simulation using automatically updated meteorological data, simply click *Run Simulation* on the menu bar after the new data arrives. The user can reset any of the simulation, release, and source parameters accessible from the Main Menu before clicking *Run Simulation*.

3.6.7 Viewing Output from a Previous Simulation

To view output products from a previous model run, click the *Open Run File* icon on the display tool bar. Alternatively, the user can click the *File* button on the menu bar, and then click *Open* on the resulting pull-down menu. This will open the “View Previous Runs” menu.

This menu displays the names of the run specification files from previous model runs (these files are found in the “RSDATA” directory). Each file name indicates the date and time that the model simulation was run. You can click on the file whose output you wish to view or type its name in the “File Name” text box. Clicking the open button directs ***APGEMS*** to load the output files from this simulation for viewing and the first Cumulative Exposure product from that simulation will be displayed.



To display output from a previous simulation, access the "View Previous Runs" menu by clicking *File* on the main menu or *Open Run File* on the display bar.

The "View Previous Runs" text box lists the run specification file for each previous model simulation. Click the desired file and then click *Open* to plot output from that simulation.

4.0 DETAILED DESCRIPTION OF THE APGEMS USER INTERFACE

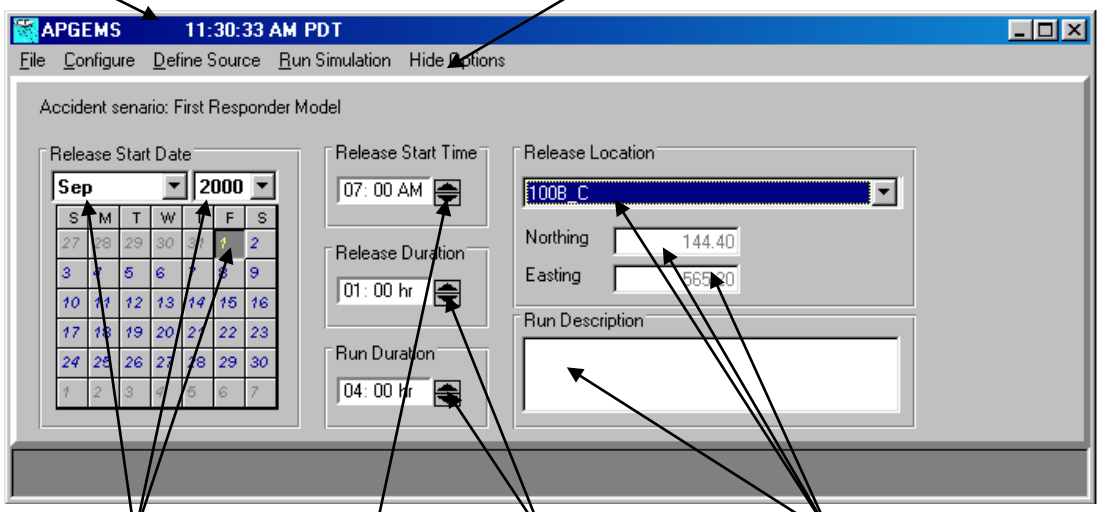
In this section we present detailed descriptions of each component of the ***APGEMS*** user interface. Each display screen is presented and all icons, buttons, text boxes, and other features are labeled and described.

4.1 The Main Menu

The Main Menu is the initial display after ***APGEMS*** initialization is complete. From this screen, simulation parameters can be adjusted, a simulation can be run, and output products displayed. The Main Menu contains a title bar; menu bar; text boxes that display model run parameters; drop-down list boxes for use in selecting dates/times and release locations; and an output display window.

The ***APGEMS*** Title Bar presents the name of the model and the current time.

The Menu Bar presents items that allow you to open previous model runs, adjust model configuration, define source term information, hide most of the Main Menu, and run the model.



Adjust the release starting date as required. Drop-down list boxes are used to select the month and year. Click the appropriate day on the calendar to complete setting the date.

Click the spinner buttons to reset the starting time for the release.

Click the spinner buttons to reset the duration of the release and the simulation. The time displayed is the elapsed time from the beginning of the simulation.

The Release Description allows the user to select a release location from a drop-down list or to select "Other" to define a new release location. The coordinates of the release location are presented. You can enter text in the Run Description field.

4.1.1 The Menu Bar

The menu bar is located directly beneath the title bar (the title bar displays the name of the model and the time). The menu bar presents five menu item choices. These are:

- **File –** Clicking *File* presents two choices – *Open* and *Exit*. *Open* allows you access and display output from a previous ***APGEMS*** model simulation. *Exit* is used to exit the model.

- **Configure** – Clicking *Configure* opens the Configuration Menu. There are three folders in the Configuration Menu – Directories, Map Layers, and Met Station Status. The Configuration Menu is discussed in Section 4.2.

- **Define Source** – Clicking *Define Source* pulls up the Define Source Menu. There are two folders in the Define Source Menu – Release Parameters and Source Term. The Define Source Menu is discussed in Section 4.3.

- **Run Simulation** – Clicking *Run Simulation* begins the execution of an ***APGEMS*** model run. The program will run using the current set of parameter selections.

- **Hide Options/Show Options** - Clicking *Hide Options* expands the output display to cover all but the Title Bar, Menu Bar, and the Accident Scenario name. The *Hide Options* menu item will change to "*Show Options*." Clicking *Show Options* returns the display to its normal size and restores all of the components of the Main Menu. The *Show Options* menu item will change back to *Hide Options*.

4.1.2 Setting the Release Start Date and Time

The Release Start Date portion of the Main Menu is used to set the date for the start of the release of pollutants to the atmosphere. The release start date is also used as the starting date for the simulation. This date information is used along with time information to access the appropriate meteorological data files needed to run the simulation. On startup, the Release Start Date will be set to the current date and time (as of the last quarter hour) as indicated by the computer's internal clock.

When adjusting the release start date it is usually best to start with the year. To adjust the year:

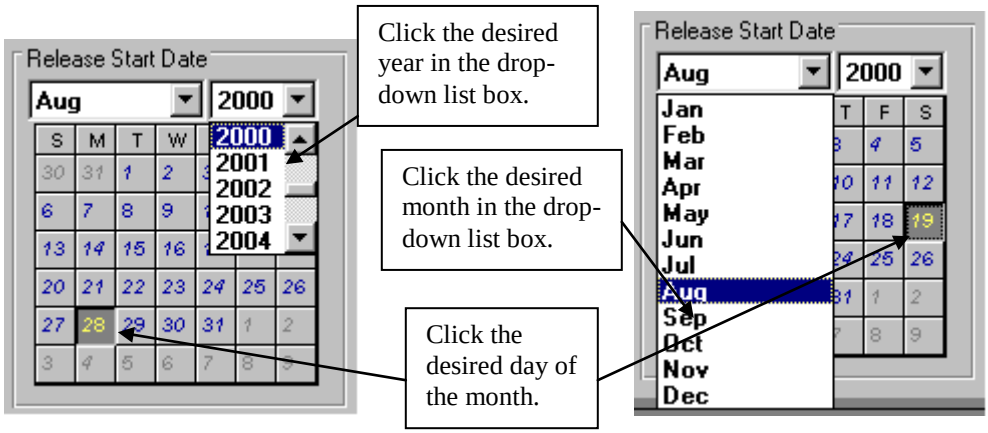
- Click on the displayed year's text box.

- A drop-down list box will appear presenting a comprehensive list of years. The currently selected year will be on the top of the display. Earlier or later years than those displayed can be accessed using the scroll bars.

- Click on your choice for the release start year. The list box will close and your selection will appear in the text box.

Note: The monthly calendar display will change to reflect the calendar for the newly selected year.

The same procedure is followed for adjusting the month of the year. The drop-down list box for the month of the year displays all twelve months beginning with January.

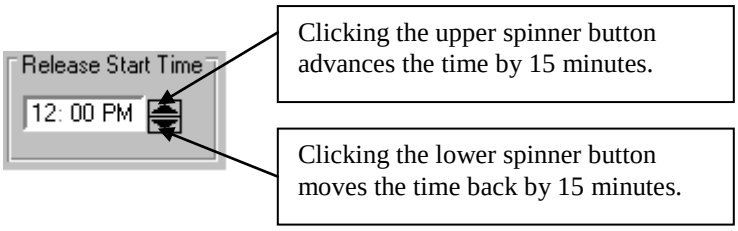


To select the day of the month, simply click on that day on the monthly calendar. The selected day will have a different appearance from the other days of the month – it will be highlighted and shaded in such a manner that it looks "pushed-in" when compared to the other days on the calendar. Changing the date of the start of the release has no impact on the release start time or any other parameters. The calendar may contain a few days from the end of the previous month or the beginning of the next month. Clicking a date from the beginning of the next month advances the calendar to that month and highlights the selected date (the same holds when you select a date from the previous month). This is a convenient shortcut for changing the release date when working near the end or beginning of a month.

The Release Start Time display box is used to set the time for the start of the release of pollutants to the atmosphere. This release start time is also used as the starting time for the simulation. On startup, the release start time will be set to the current date and time (as of the last quarter hour) as indicated by the computer's internal clock.

To reset the starting time, click on the spinner buttons located immediately to the right of the time display. Each click on the upper spinner button advances the time by 15 minutes. Each click on the lower spinner button moves the time back by 15 minutes. Clicking and holding a spinner button quickly advances or retreats the time. If the time display passes through midnight, the date on the calendar will automatically move ahead

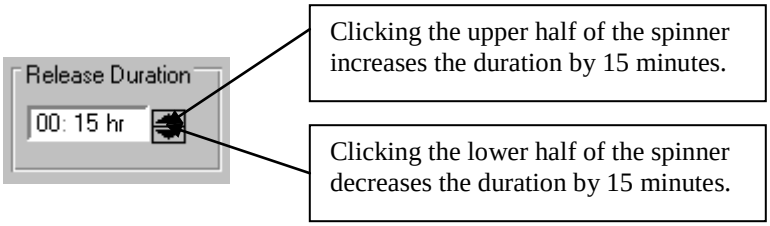
or back one day to account for passing into a different day. *Note: The time display can only change through the use of the spinner; the time display cannot be manually edited.*



4.1.3 Setting the Release Duration

The Release Duration display box is used to set the elapsed time for the release of all pollutants to the atmosphere. During this release period, the release rate for each pollutant will be constant (i.e., the total activity of the pollutant released [Ci] divided by the elapsed time of the release [s]). On startup, the default setting for the release duration is one hour.

To reset the release duration, click on the spinner buttons located immediately to the right of the release duration display. Each click on the upper spinner button increases the release duration by 15 minutes. Each click on the lower spinner button decreases the release duration by 15 minutes. Clicking and holding a spinner button quickly advances or retreats the release duration. The minimum release duration is 15 minutes (instantaneous releases need to be modeled with a 15-minute release duration). Clicking and holding the spinner quickly advances or retreats the release duration. The release duration can only change through the use of the spinner; the release duration cannot be manually edited.

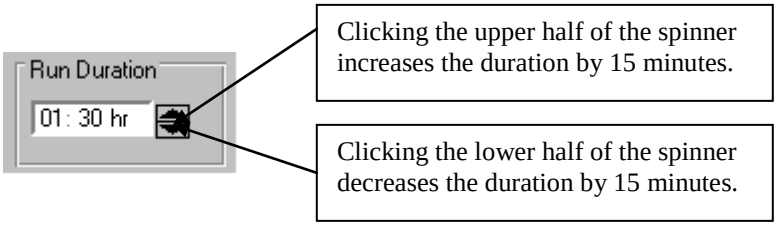


4.1.4 Setting the Run Duration

The *Run Duration* display box is used to set the time simulated in the model run. On startup, the default setting for the *Run Duration* is four hours. The simulation always starts at the same time as the release. The simulation may, and often does, go much longer than the release. This allows you to track the movement and impact of all released pollutants until they are all transported beyond the limits of the modeling domain or their continuing impacts become minimal.

To reset the *Run Duration*, click on the spinner buttons located immediately to the right of the run duration display. Each click on the upper spinner button advances the run duration time by 15 minutes. Each click on the lower spinner button decreases the run

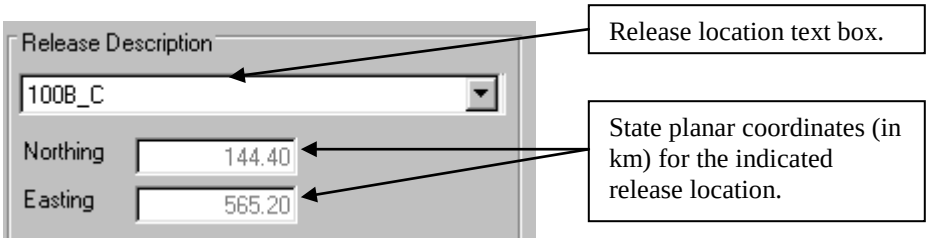
duration by 15 minutes. Clicking and holding a spinner button quickly advances or retreats the run duration. The minimum run duration is 15 minutes; though in practice simulations it is almost always one-hour or longer. The *Run Duration* can only change through the use of the spinner; the release duration cannot be manually edited.



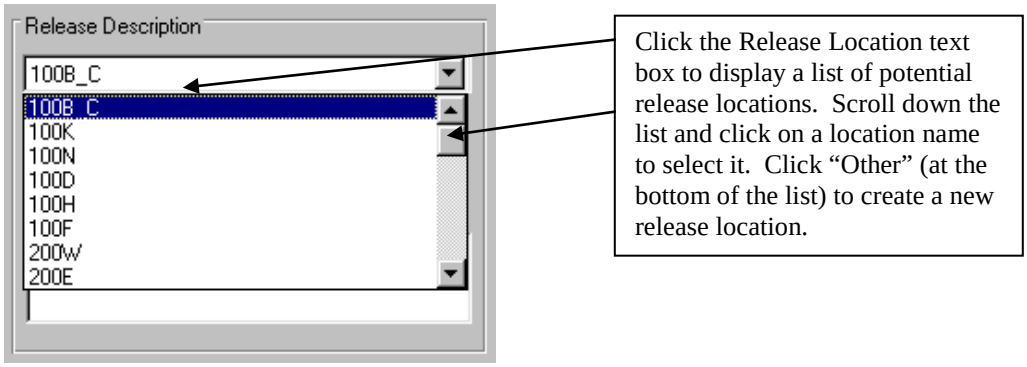
4.1.5 The Release Location

The Release Location allows you to select a release location and view the location's coordinates. The release location can be selected from a list of pre-defined locations. For the Hanford Site, predefined release locations exist for the center of each major operating area and for each major onsite facility. You can also define your own release locations. Subsequent users will be able to access these new release locations. User-defined release locations may be associated with minor facilities, new facilities, specific locations within facilities, or transportation accident sites.

Below the Release Location text box are two text boxes labeled Northing and Easting. These give the coordinates (in Washington State Planar coordinates [km]) for the given release location. This coordinate display only changes when the release location is changed (these coordinates are determined when the release location is first defined). The values in these text boxes cannot be manually edited.



To select a different release location, click on the text box under the "Release Description" heading. A drop-down list box will appear with the names of defined release locations. Scroll down the list and click on the release location that best suits your release scenario. Major operating areas are at the top of the list, followed by major facilities that contain substantial quantities of radioactive materials (these facilities are generally grouped alphabetically within their major operating area). Near the bottom of the list are user-defined release locations from earlier model runs. The last entry on the list is "Other." Click on an existing release location to select it or click "Other" to generate a new release location.

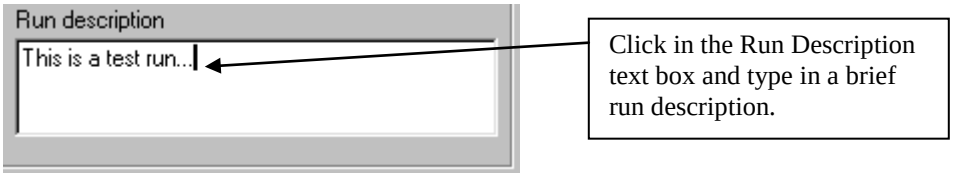


If "Other" is selected, the "Identify Site Location" window will open and display a map of the Hanford Site (see Section 4.2 for instructions on how to use this window to define a new source location).

4.1.6 The Run Description

The Run Description box provides a venue for writing a brief description to capture key features of the model run. This is an optional field. A sample run description might say:

"There is no evidence that a release has occurred at this time. This simulation estimates what would occur if there were a release of 25 Ci of I-131 from the 325 Building at 2 PM. Persistence is assumed for meteorological conditions after 2 PM."

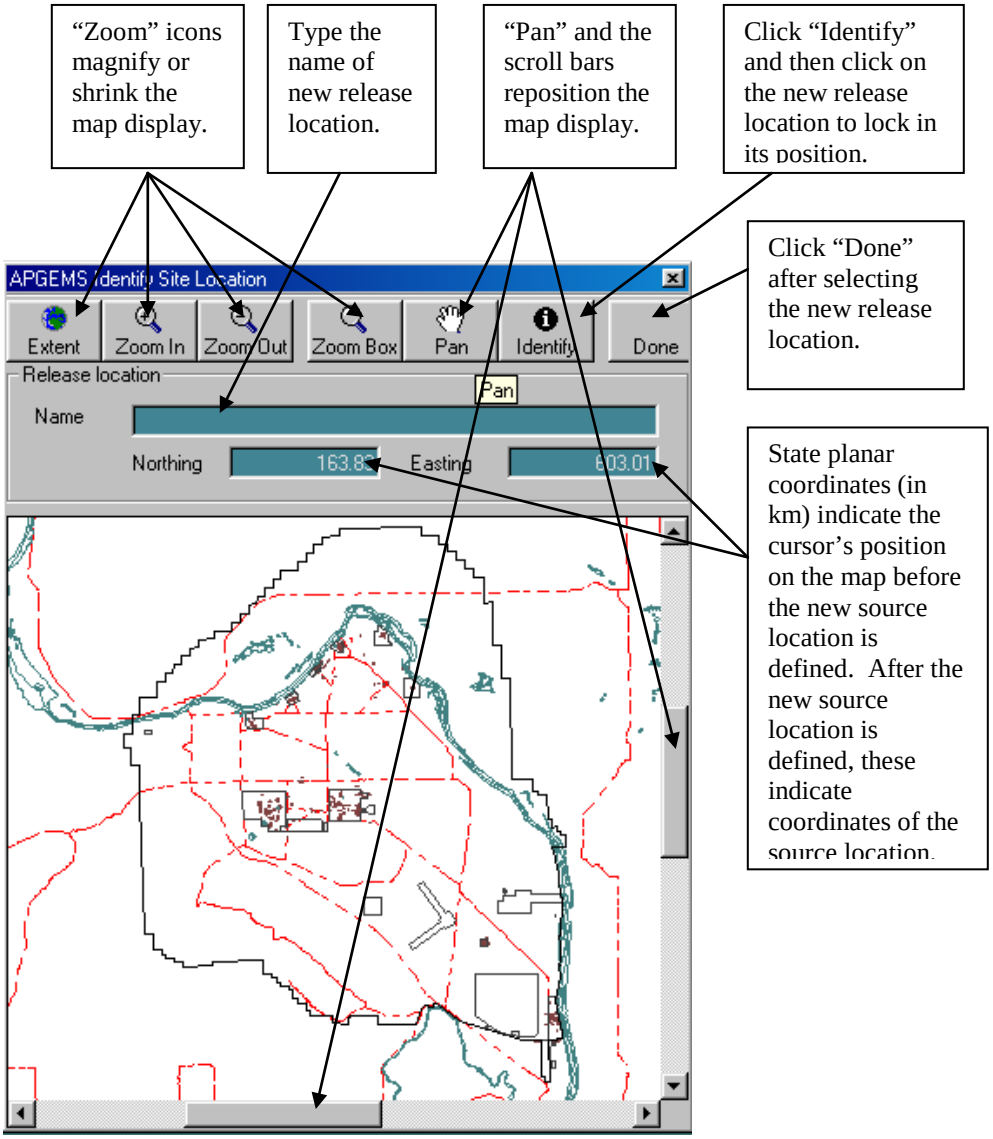


4.2 Identify Source Location Menu

When "Other" has been selected as a release location, the ***APGEMS*** Main Menu becomes inactive and the Identify Source Location window opens. This new window allows you to specify the name and location of a new release location. Beneath the title bar of this new window appears a tool bar with seven buttons. Below this bar is a text box for entering the name of the new release location. Below that are text boxes that indicate the state planar coordinates of the cursor as it moves across the map that occupies the lower two-thirds of the menu.

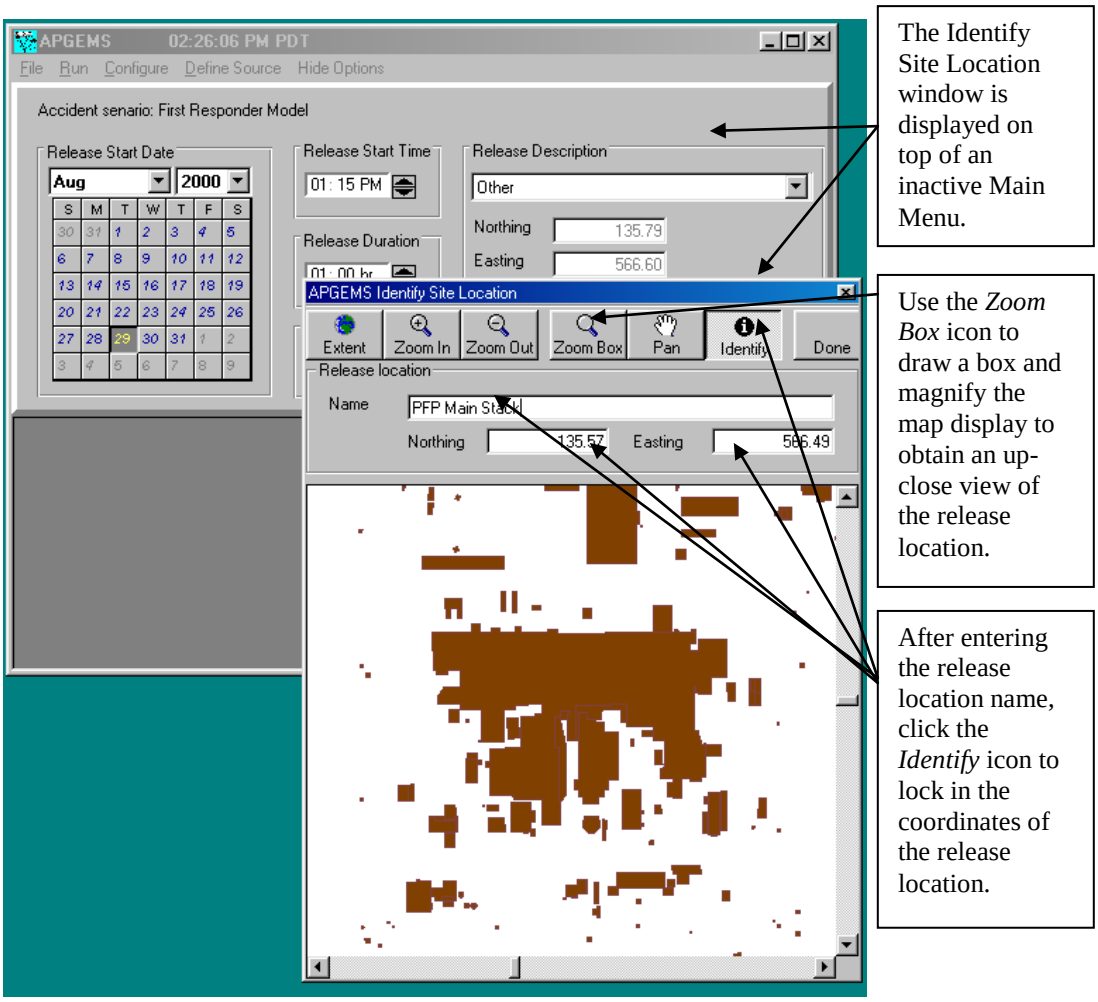
4.2.1 Using the Identify Source Location Menu

The standard procedure for using the Identify Source Location window is to use the zoom buttons to obtain a close-up view of the release location you wish to define. Typically, this involves zooming in on an operating area (using the zoom icons as described in Section 4.2.2) until the facility or location at which the release occurs comes into clear focus.



Next enter the name of the release location into the "Name" text box. Please enter a unique name; duplicates of an existing release location name will not work.

Next, click the *Identify* icon on the tool bar. The program will interpret the next click on the map as the release location. When this is done, the state planar coordinates under the release location name will remain fixed – they represent the coordinates of the release location. Click the *Done* icon to lock in your selection, exit this window, and reactive the ***APGEMS*** Main Menu.



4.2.2 The Identify Source Location Tool Bar

The first five icons on the title bar are for zooming in and out and panning.

- The *Extent* icon sets the map to a preset perspective.

- The *Zoom In* and *Zoom Out* icons change the image so that the horizontal and vertical dimensions of the displayed product are halved (decreasing the area displayed by a factor of four) or doubled (increasing the area displayed by a factor of four).

- The *Zoom Box* icon allows the user to zoom in for a detailed look at model output. When *Zoom Box* is selected, click on the map and drag the mouse (with left mouse button depressed) to create a zoom box. When the mouse button is released, the area in the zoom box will fill the display.

- The *Pan* icon allows the user to reposition the map from north to south and east to west. It is a bit more efficient than repositioning the map using the horizontal and vertical scroll bars located below and to the right of the map.

The *Identify* and *Done* icons (described in the previous section) are for selecting the release location and exiting the Identify Source Location window, respectively.

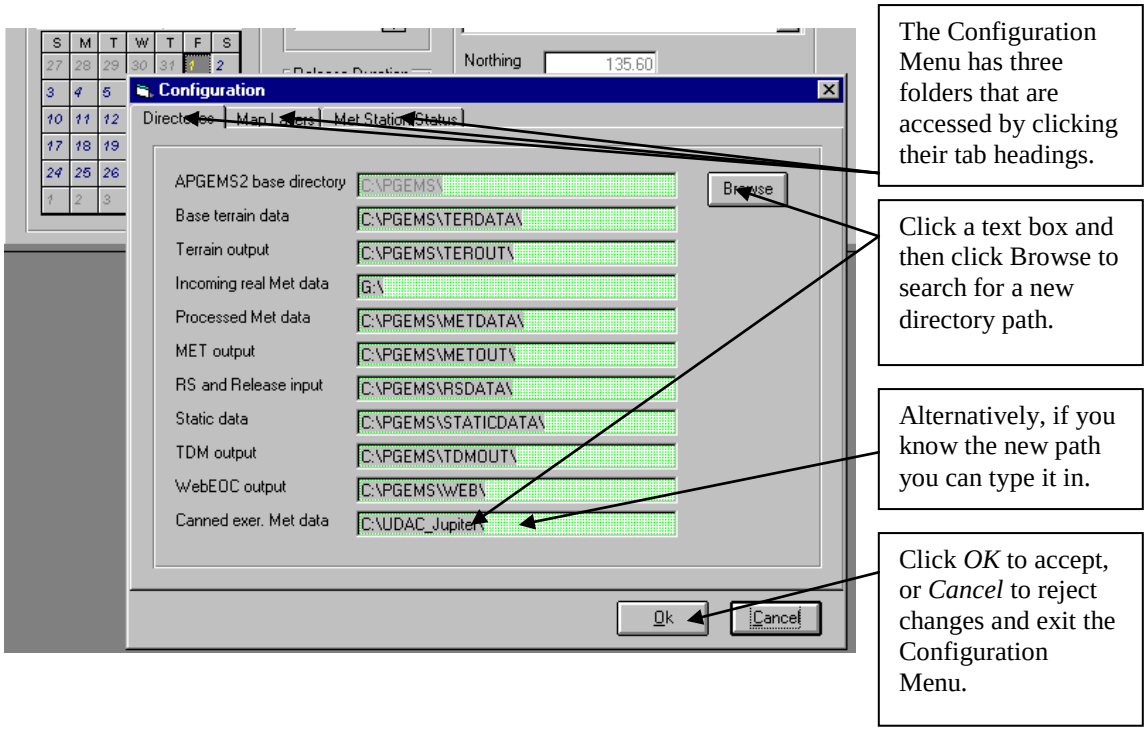
4.3 Configuration Menu

Clicking *Configure* on the menu bar of the Main Menu produces the Configuration Menu. The Configuration Menu has three folders: Directories, Map Layers, and Met Station Status. The Directories folder is used to set the directories from which ***APGEMS*** accesses input files and to which ***APGEMS*** places output products. The Map Layers folder is used to adjust the properties of the map displays in graphical output products and in the map used to identify user-defined release locations. The Met Station Status folder is used to accept or reject data from individual meteorological monitoring stations. This folder allows the experienced user to temporarily turn off stations that may be experiencing data measurement difficulties (e.g., a malfunctioning sensor) or stations that may be having an undue influence on dispersion conditions outside their immediate vicinity. You can switch between the folders by clicking on the heading tab for the folder you wish to view. The tabs are found near the top of the menu, just below the menu's title bar.

To exit the Configuration Menu and accept any changes that you have made in any of the three folders, click the *OK* button. Click the *Cancel* button to erase any changes you have made and restore your previous Configuration Menu entries to their value at the time the *Configure* menu item was selected. Clicking either button closes the Configuration Menu and returns you to the Main Menu.

4.3.1 The Directories Folder

When the Configuration Menu is first displayed, the Directories Folder is the default folder that is opened. The Directories Folder presents eleven directory paths (see Table 4.1) for different types of input and output products.



To change a directory setting, click on the text box for the directory path and change its setting using standard keyboard editing. An alternative method for changing the directory setting is to use the Browse function.

1. Click the text box of the directory name you wish to change.

2. Next click the *Browse* button in the upper right hand corner of the Directories folder. The Path Selection window will appear. You can use this window to change drives and directories.

3. To change a drive, click on the bottom text box and a list of available drives will appear. Click on the drive that you wish to use in your directory setting.

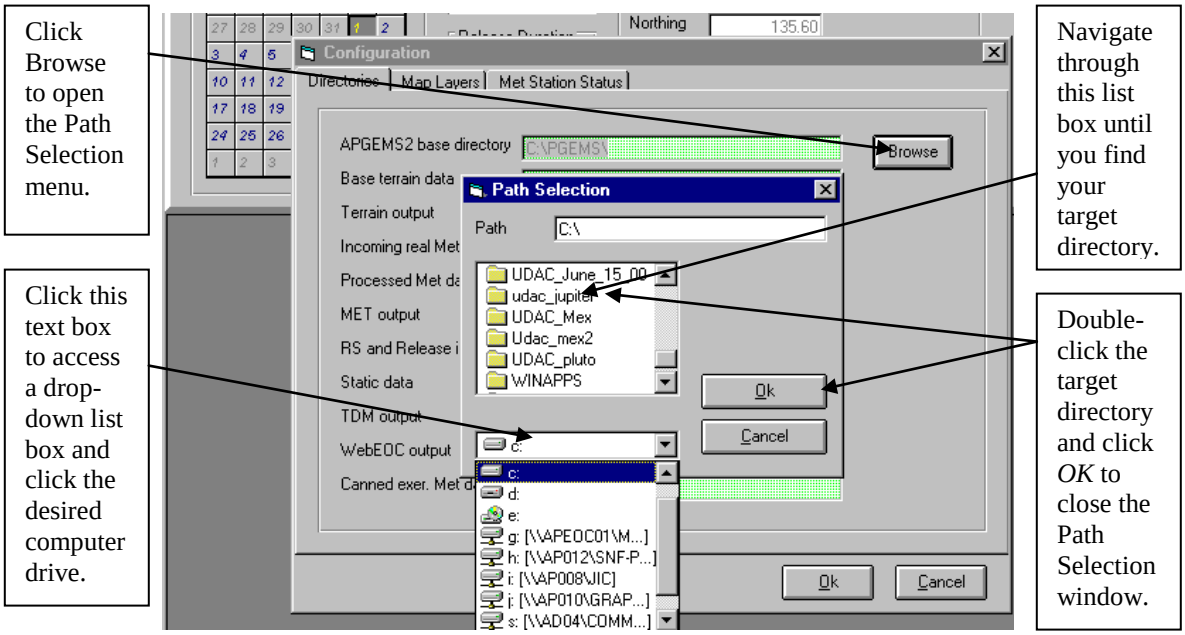
Table 4.1 Information on Key ***APGEMS*** Directories

Directories Label	Explanation
APGEMS2 base directory	The main program directory where all of the ***APGEMS*** executables are located
Base terrain data	Directory containing the base terrain files that are processed by the ***APGEMS*** terrain model
Terrain Output	Directory to which output from the ***APGEMS*** terrain model is written
Incoming Real Met Data	Directory from which real-time meteorological data are obtained
Processed Met data	Directory to which processed meteorological data files from the ***APGEMS*** are written. These files are generated by the ***APGEMS*** meteorological preprocessor model and used by the ***APGEMS*** meteorological model.
Met output	Directory to which output from the ***APGEMS*** meteorological model is written. These data are used by the APGEMS Transport and Diffusion Model (TDM).
RS and Release input	Directory containing the run specification and release specification data files that are generated by the user interface and used to run the model.
Static Data	Directory containing generally static (i.e., unchanging) data files (e.g., data on release locations, the source term database, shape files for generating background maps).
TDM output	Directory to which output from the ***APGEMS*** TDM are written.
WebEOC Output	Directory to which graphical output files from ***APGEMS*** are stored for display on the WebEOC system.
Canned exer. Met data	Directory from which meteorological data files for canned exercises are read. The files in this directory are only accessed when the model is run in the Exercise mode (real-time meteorological data files are by-passed in this mode).

4. To change the directory, click on middle text box and click through the directory structure until you reach the desired directory. Double-clicking the directory will highlight your choice and its directory path will automatically be written in the "Path" text box near the top of the Path Section window.

Click the *OK* button to accept the new directory path or the *Cancel* button to keep the previous directory path. Clicking either button closes the Path Selection window and returns you to the Configuration Menu.

Note: If the directory setting is valid (i.e., the directory is found at the indicated path), the text box will have a green background color. If the directory path is not valid, the text box will have a red background color.



4.3.2 The Map Layers Folder

The Map Layers Folder is used to adjust the properties of the map display used in all graphical output products and in the selection of user-defined release locations. Using the Map Layers Folder you can add or delete different layers of graphical information or change the order in which they are plotted.

A layer can contain information such as a plot of major roads, building footprints, operating area boundaries, terrain features, or state planar coordinate gridlines. The folder also allows you to make a layer visible or invisible, draw an outline around the

outside of the plotted feature, adjust layer and outline colors, set the line/fill style, adjust labeling, and set the map background color.

To open a new layer:

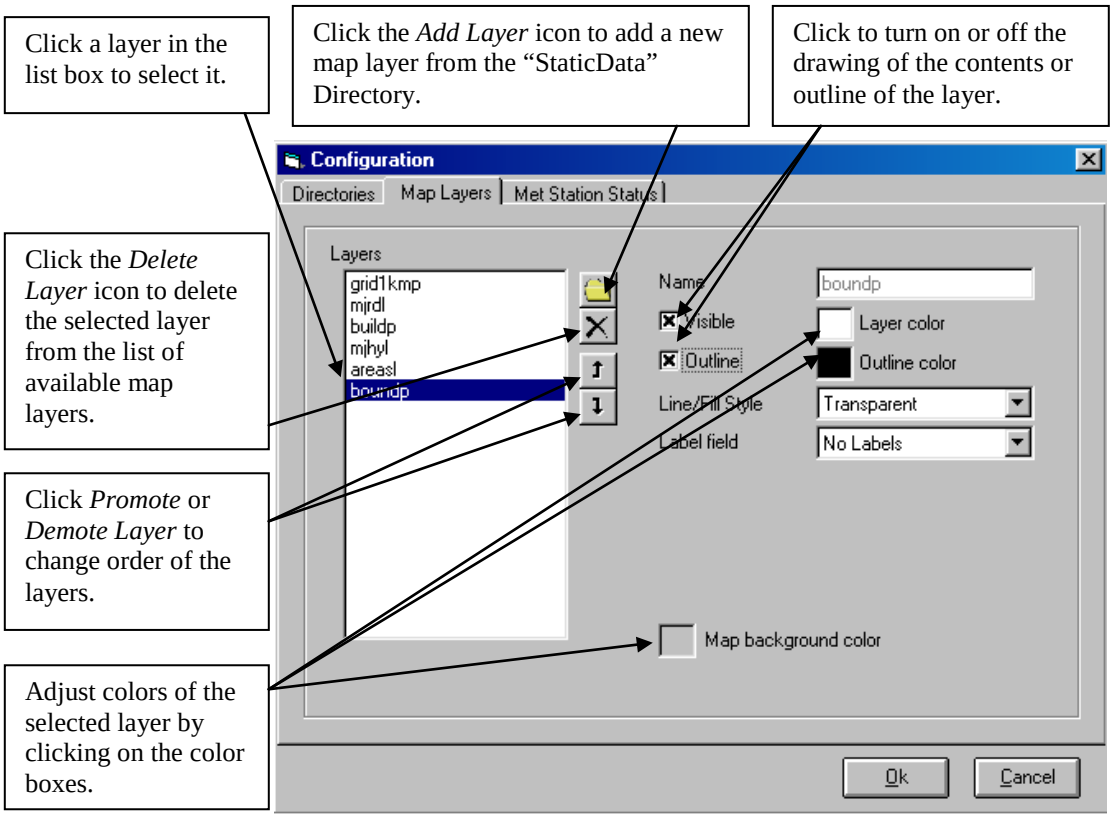
1. Click the *Add Layer* icon.

2. The "Add New Layer" window will open and a list of "SHP" files in the "StaticData" directory will be presented.

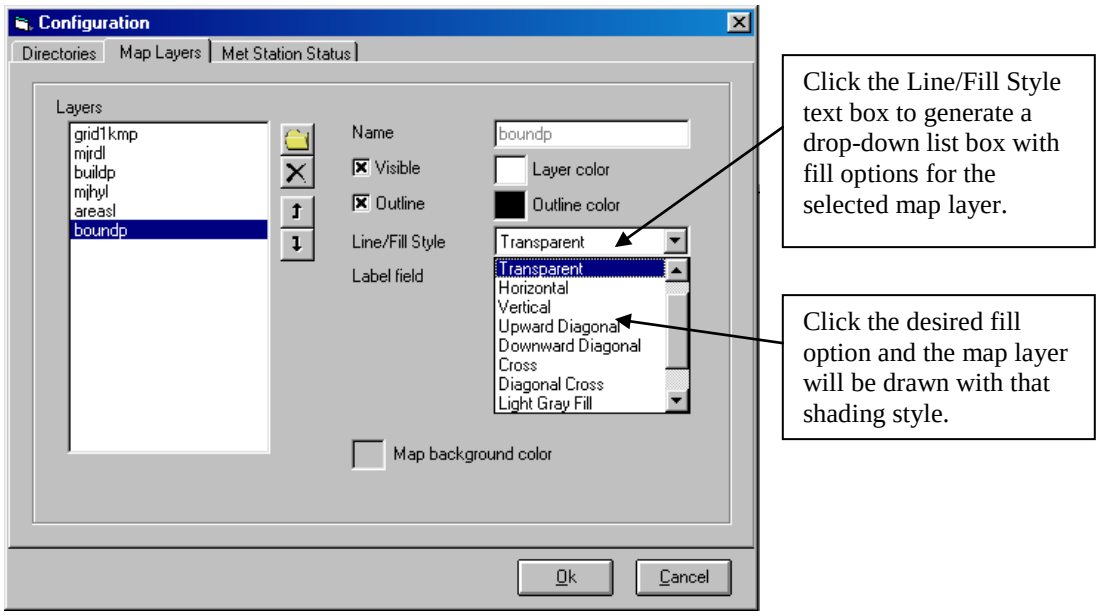
3. Click on the file you wish to select

4. Click the window's *Open* button.

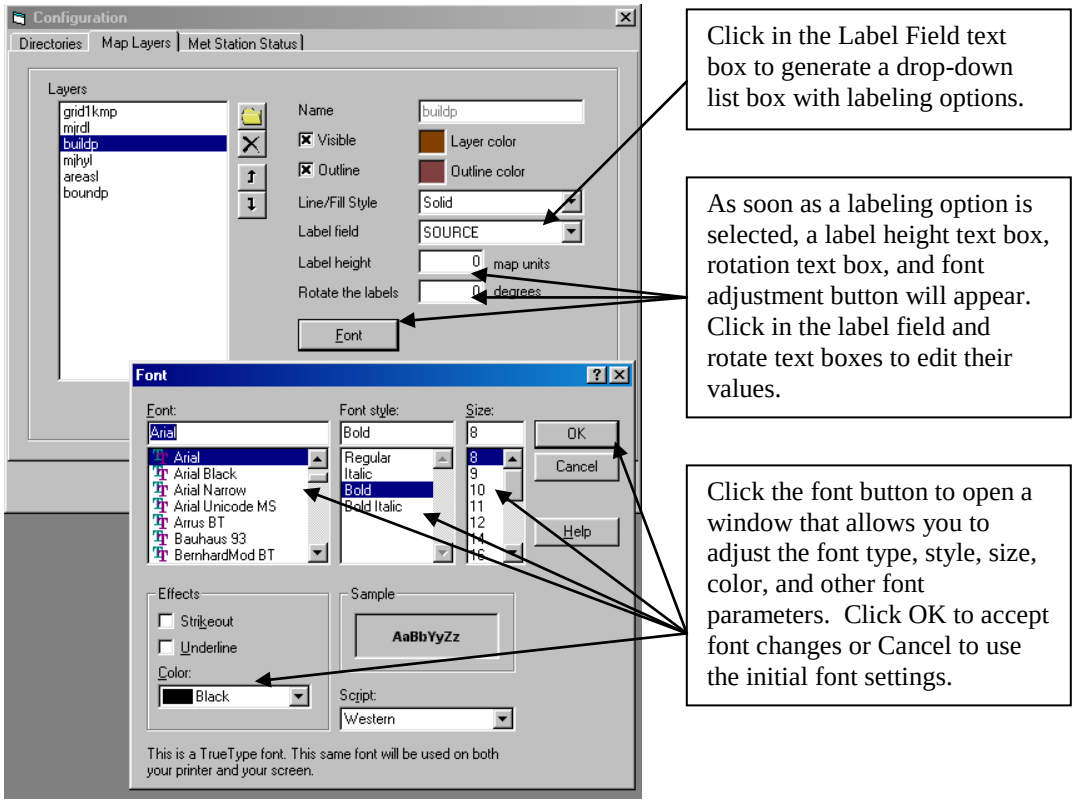
The selected file will be added as a new map layer.



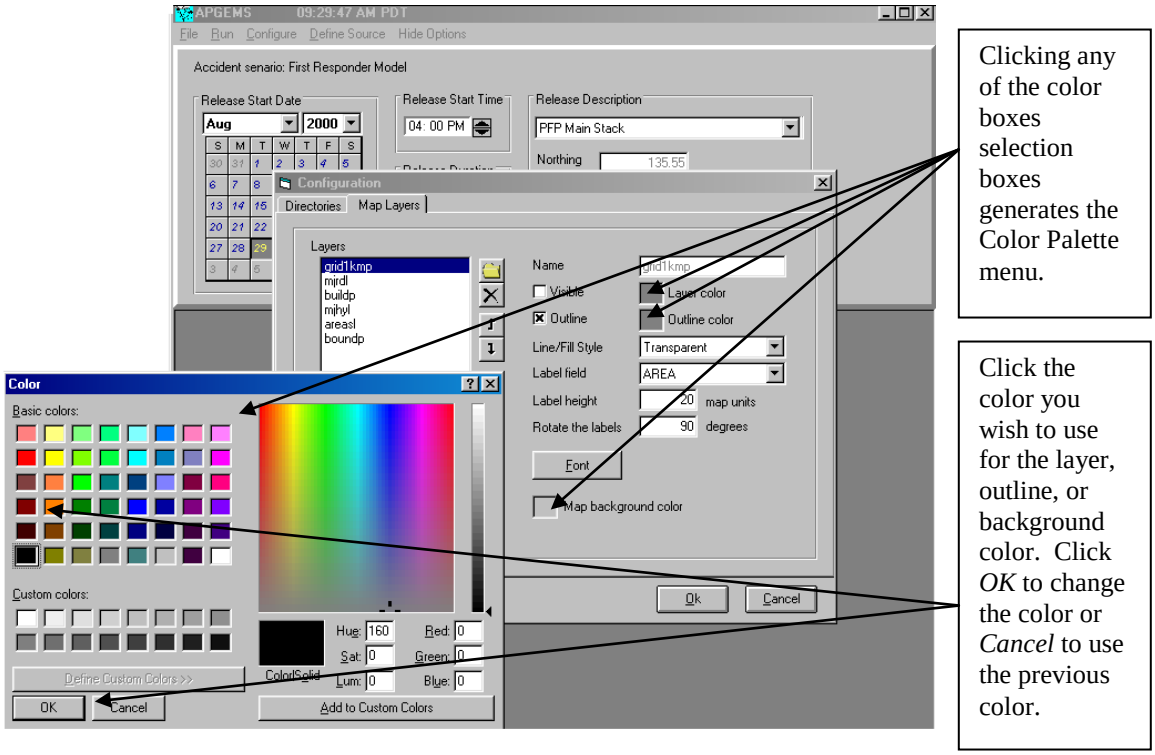
There are a variety of line/fill style options that you can select for a map layer. These include transport, solid, vertical and horizontal lines, and diagonals. Click on the Line/Fill Style text box and select your choice from the drop-down list box.



Certain layers have label fields that can be overlaid on graphical output products. Click on the Label Field Style text box and select your choice from the drop-down list box. The preferred setting for most applications is "No Labels." If a label field is chosen, you will have the option of adjusting its height, rotation, and font. Click the *Label Height* or *Rotate* text boxes to adjust their settings. Clicking the *Font* button presents a menu for adjusting the font (e.g., style, size) of the labels.



The color of the map background, layer features, and layer outline can be adjusted. Putting the cursor on the *Map background color*, *Layer color*, or *Outline color* boxes will turn the standard cursor into an inkwell image. Clicking on the box when the inkwell cursor is visible, produces the Color menu. Clicking the *Define Custom Colors* button adds the custom colors pallet to the menu. Basic or Custom colors can now be selected from this menu by clicking on your color choice and clicking the *OK* button. The Color menu will close and the color you selected will now fill the box to the left of the heading.



Caution: If modifications are made to the map properties that are unacceptable to the code, the program may return an error message and abort. If this occurs and you are unable to successfully restart APGEMS, perform the following ten-step operation to delete the problematic settings and restart using default settings:

1. Click your Windows *Start* button (found in the lower left hand corner of your monitor).
2. Click *Run* and type *Regedit* in the "Open:" text box
3. The Registry Editor window will open. Under *My Computer*, a series of "HKEY" directories will be seen.
4. Double click on *Software* (a subdirectory under *HKEY_CURRENT_USER*)
5. Double click on *VB and VBA Program Settings* (a subdirectory under *Software*)
6. Delete *APGEMS* (a subdirectory under *VB and VBA Program Settings*). This can be done by the following method:
   - Click on *APGEMS* to select this subdirectory

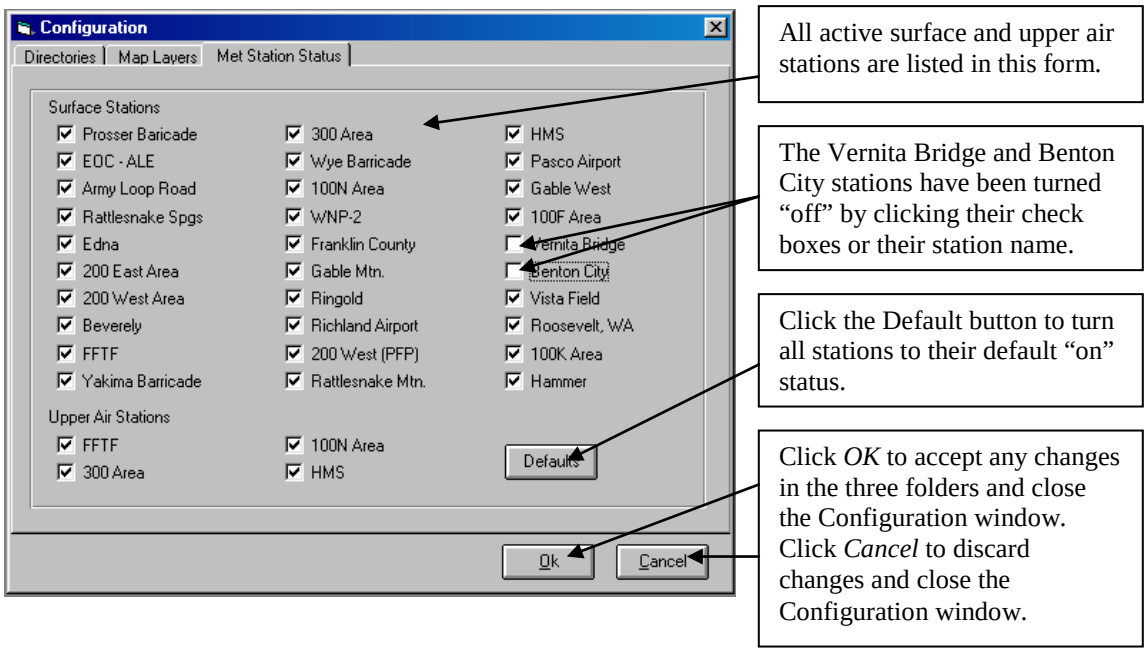
- On the menu bar, Click *Edit*. A series of menu options will appear under *Edit*.
- Click *Delete*
- Click *Yes* when asked "Are you Sure You Want to Delete this Key?"

7. The *APGEMS* subdirectory under *VB and VBA Program Setting* will be removed
8. On the Menu Bar, click *Registry*. A series of menu item will appear.
9. Click *Exit*
10. Restart ***APGEMS*** by double clicking its icon.

The deleted subdirectory will be regenerated by the model when changes are made to the default Map Layer properties.

4.3.3 Met Station Status

The Met Station Status folder allows the advanced user to turn off selected meteorology stations. The meteorological data from a station that is turned off will not be used by ***APGEMS*** during a simulation. This allows you to turn off monitoring stations that may have malfunctioning instruments (e.g., a broken or frozen anemometer vane that will not change direction with the wind). It also allows you to exclude data from a station that may be unduly influencing transport and diffusion characteristics outside of its immediate vicinity. For example, wind observations at the summit of Rattlesnake Mountain are occasionally decoupled from those at lower elevations. Under such circumstances winds at the summit of the mountain are not representative of flows in adjoining areas that may be 900 m (3,000 ft) lower in elevation. In such cases, you may want to run simulations without Rattlesnake Mountain data.



All of the surface stations and upper air stations[2] are turned "on" in their default configuration. To turn a station "off," click on the station name or its check box. A check mark in the box indicates a station is turned on. An empty box indicates a station is turned off. To quickly reset the form and turn all meteorological stations back on, click the *Default* button. As is your option from any folder in the Configuration Menu, click the *OK* button to save all the changes you made in the Configuration Menu and return to the Main Menu. Click the *Cancel* button to disregard changes made in all three folders and return to the Main Menu.

4.4 Define Source Menu

Clicking *Define Source* on the Main Menu's menu bar generates the Define Source Menu. The Define Source Menu has two folders: Release Parameters and Source Term. The Release Parameters folder displays the current setting of key release parameters. These include pollutant release height, stack diameter, effluent temperature, and initial plume size. It also includes the time interval for generating model output products and domain sizes. The Source Term folder is used to select the pollutant constituents and quantities released to the atmosphere.

4.4.1 Release Parameters Folder

The Release Parameters folder displays the current settings for key parameters used to define model operation and characterize the release. These parameters, their definitions, default values, and permissible ranges are provided in Table 4.2.

The Output Interval is the first parameter presented in the Release Parameters folder. This is the length of time between the production of output files. To adjust the length of the output interval, click on the text box to the right of its heading and a drop-down list box will appear. Click on the desired interval for spacing output products. The "15 min" output interval provides the most time resolution in the output. The drawback to using this setting is that it generates the largest number of output files and may slightly increase model execution times. For most applications, a 15 or 30 minute output interval is suggested. For simulations that will cover long periods (>12 hour), longer output intervals may be the optimal choice.

The Inner and Outer Domain Sizes are almost always set to their default values (50 and 100 km, respectively). The domain size can be changed to address the particular needs of a simulation. To provide greater resolution when modeling impacts that have small spatial scales, the inner and outer domain sizes can be decreased. If the existing terrain files can handle a larger modeling domain (see Allwine and Bian 1995), than the inner and outer modeling domains can be increased in size to handle greater transport distances.

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[2] "Surface station" refers to a near-surface monitoring station (often a 10-m tower) and an "upper air station" refers to a station with a tall tower (60- or 120-m towers) or equipment that makes remote measurements of wind aloft (e.g., Doppler acoustic sodar).

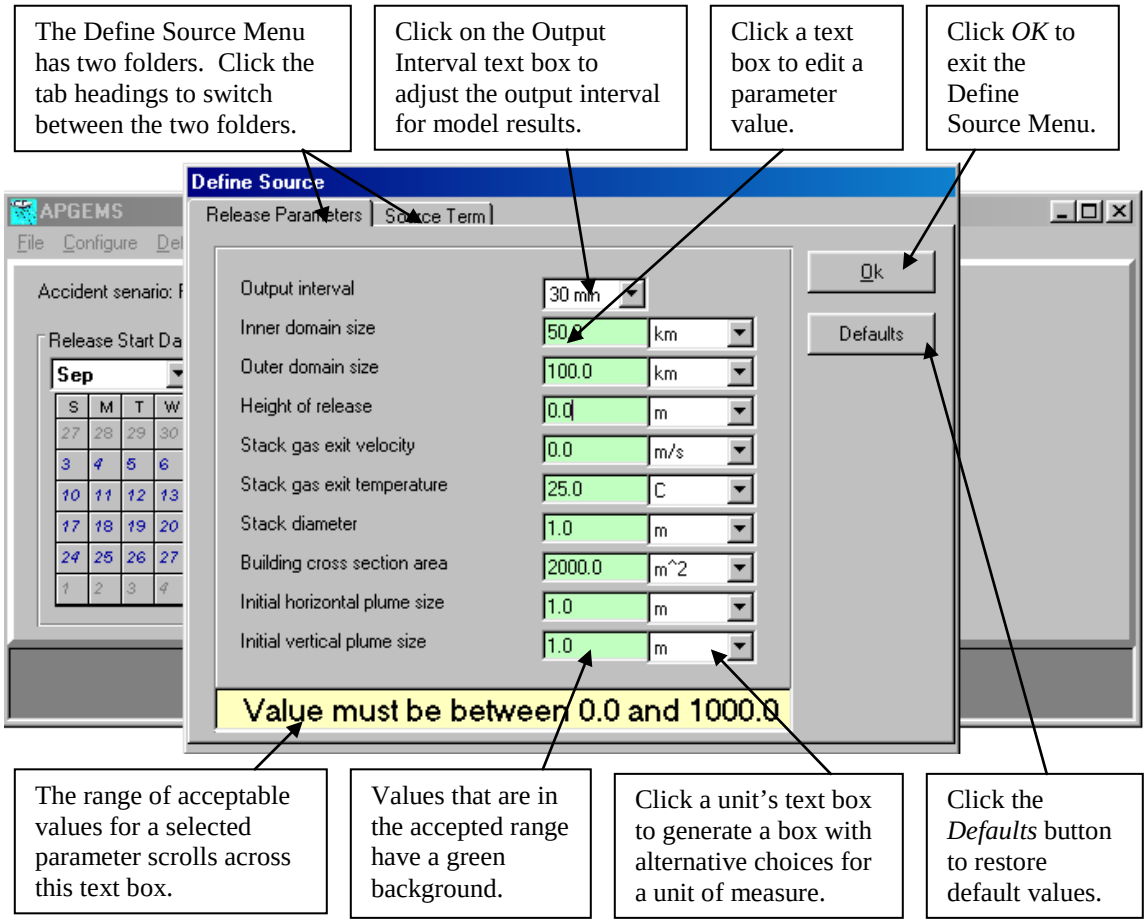
Table 4.2 Description of Parameters Defined in the Release Parameters Folder

Parameter	Definition	Default Value	Permissible Range
Output Interval	Time interval between output products	30 min	15, 30, 60, and 120 min
Inner Domain Size	Size of the interior modeling domain (higher resolution)	50 km	10 km to 500 km[3]
Outer Domain Size	Size of the outer modeling domain (lower resolution)	100 km	10 km to 500 km[4]
Height of Release	Height above ground level at which pollutants are emitted to the atmosphere	0 m	0 to 100 m above ground level
Stack gas exit velocity	The vertical exit velocity of pollutants as they are emitted to the atmosphere	0 m/s	0 to 100 m/s
Stack gas exit temperature	The temperature of the effluent as it exits the stack	25°C	-50°C to 500°C
Stack diameter	The inner diameter of the emissions stack	1 m	0.1 m to 100 m
Building cross section area	Cross sectional area of the building from which pollutants are emitted to the atmosphere	2000 m^2	100 to 10,000 m^2
Initial horizontal plume size	Initial horizontal size of the plume as it enters the atmosphere	1 m	0 to 100 m
Initial vertical plume size	Initial vertical size of the plume as it enters the atmosphere	1 m	0 to 100 m

The Height of Release, Stack Gas Exit Velocity, Stack Gas Temperature, and Stack Diameter are all used to compute the effective release height of pollutants. The model directly computes buoyant plume rise but not momentum-driven plume rise. Momentum effects, if any, need to be factored into your initial estimate of Height of Release. The default release parameters assume a ground level release with no appreciable vertical velocity from a 1-m diameter stack. The default effluent temperature is 25°C (77°F) – approximately the indoor air temperature in most facilities.

The Initial Horizontal and Vertical Plume Size can be adjusted to account for larger plumes entering the atmosphere. Larger initial plume sizes can simulate the effects of an explosion, fire, or small area source. The default value of 1.0 m for these parameters conservatively produces a small, concentrated release.

[3] If corresponding data files are available to support changes in the modeling domain size.



In the absence of additional information, the default release assumptions tend to minimize buoyant plume rise and initial spreading, and thereby maximize ground level impacts near the source. As information becomes available from the field, these release parameters can be adjusted to more accurately estimate the initial behavior of the pollutant effluent. At any point when working in the Release Parameters folder, you can discard all of your changes to the release parameters and return to default setting. This is accomplished by clicking the *Default* button.

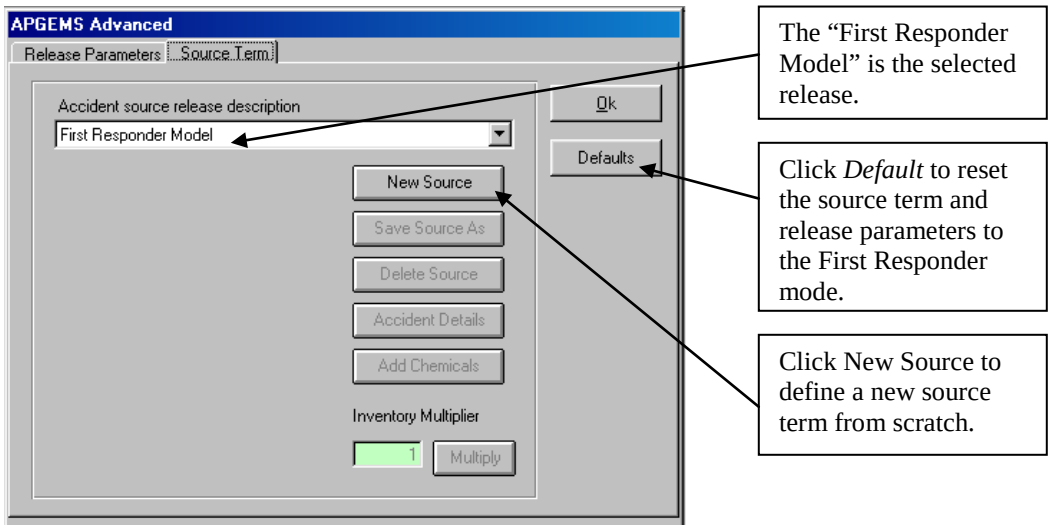
The units that are used to enter release parameters can be adjusted. Click on the units text box for any release parameter (other than the Output Interval which is always in minutes) and a drop-down list will appear with alternative units of measure. If the units are changed, the release parameter values are not automatically adjusted. For example, if the stack diameter is given as 1.0 m and you want to change the stack diameter to 3 ft, you must change the units to "feet" and the value of the release parameter to "3". All input values are converted to a standard metric unit when copied to ***APGEMS*** input files, but are displayed for editing on the Release Parameter form using the units you last selected.

When you click on any release parameter, the acceptable range of values for that release parameter will scroll across the text box at the bottom of the form. All range values are given in the standard metric unit. If you provide a value that is outside the accepted range, the background color of the release parameter's text box will change from green to red.

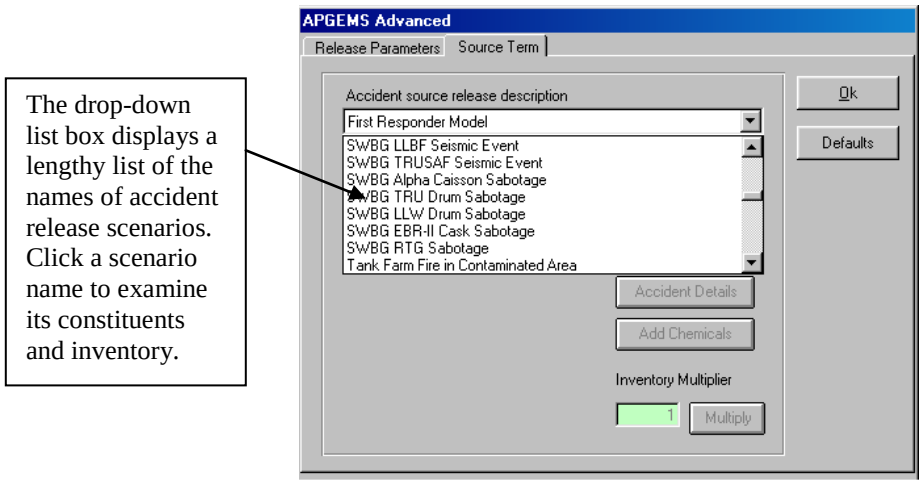
Once you've completed your modification of the release parameters (or restored default settings), you can click the *OK* button to accept your changes and close the Define Source Menu. You can also click the Source Term tab and switch folders to work on selecting your source term.

4.4.2 Source Term Folder

The source term folder is used to define the constituents released to the atmosphere and their release inventories. Initially, the Source Term folder is set to the "First Responder Model" mode. Most of the buttons in this folder are deactivated at this point. The user can accept this source term scenario, select an alternative scenario, or create a new scenario. If a different source term scenario has been selected during the current ***APGEMS*** session, the folder will display information from that scenario.

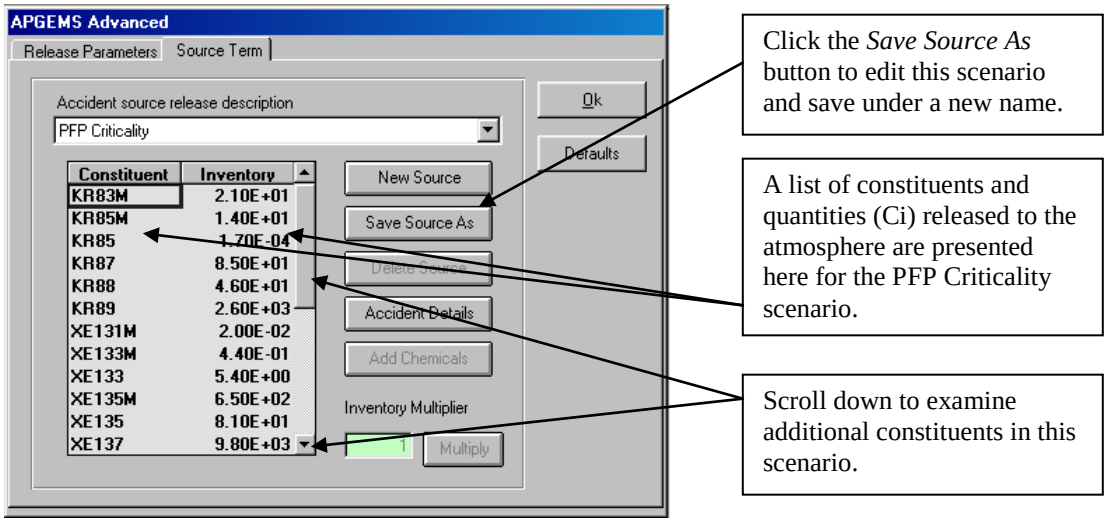


Click on the "Accident source release description" text box to select another scenario. A drop-down list box will appear with a lengthy set of potential source term scenarios from which you can choose. These source term scenarios are defined from the current emergency response hazards database. Each scenario has a title, descriptive information, a list of radionuclides involved in the scenario, and the quantity of each radionuclide material (in Curies) released to the atmosphere. Scenario information is contained in an external file (See Section 6) and is periodically updated by EOC staff as waste inventories change.

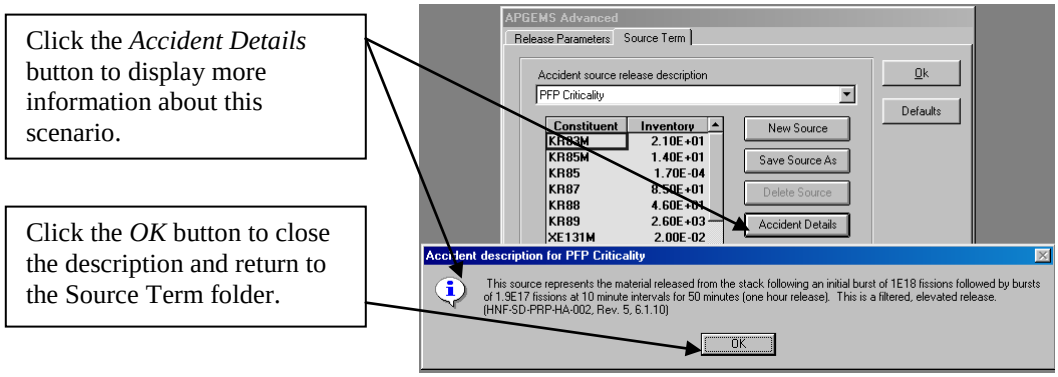


The scenarios each have a short, descriptive title. The first word in the title is the name of the facility at which the accident occurs (e.g., "SWBG is the Solid Waste Burial Ground). The remainder of the title indicates characteristics of the accident, such as the waste involved and the occurrence that causes the release to occur. The scenarios are generally placed in alphabetical order by operating area. Scenarios involving the 100 Area are provided first, followed by 200 Area, 400 Area, and 300 Area scenarios (beginning with the northern most operating areas and moving southward across the Site). Transportation accident scenarios are presented after the 300 Area's scenarios. User-defined scenarios are at the bottom of the list and are presented in the order in which they were developed (from oldest to most recent).

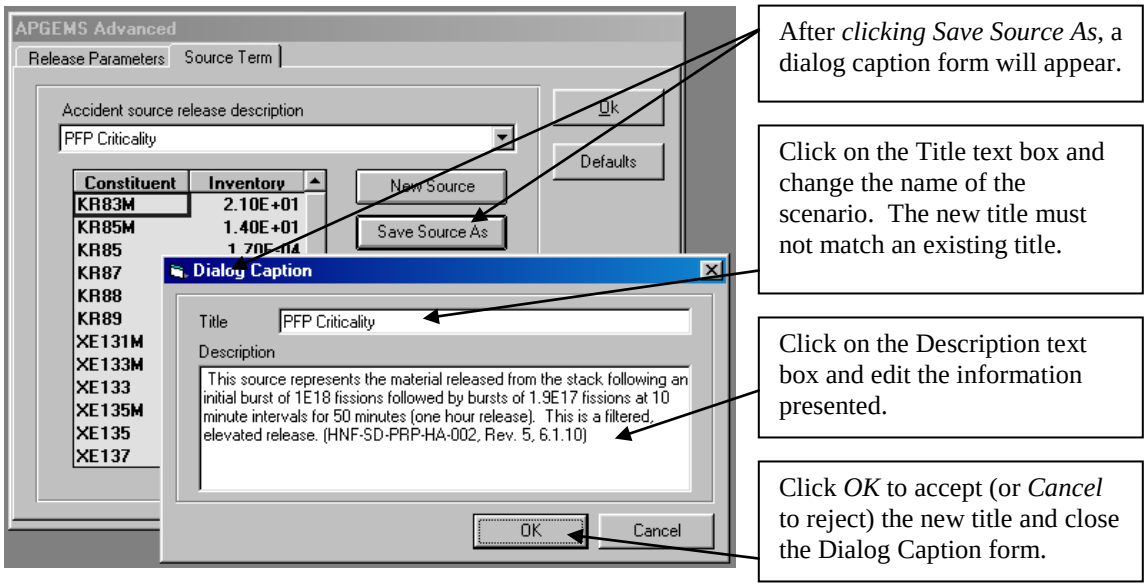
Click on a scenario title to access information on that scenario. The drop-down list box will close, the name of the selected scenario will appear in the "Accident source release description" text box, the pollutant constituents and inventory of the release will appear on the menu, and the "Save Source As" and "Accident Details" buttons will become active. If the list of constituents is larger than the space allocated for their display, a scroll bar allows you to scroll through the list of constituents and their inventory.



Click the "Accident Details" button to get more information on the scenario. Descriptive information from the emergency response hazards database will appear in a dialog box. Click the *OK* button in the dialog box to return to the Source Term folder.

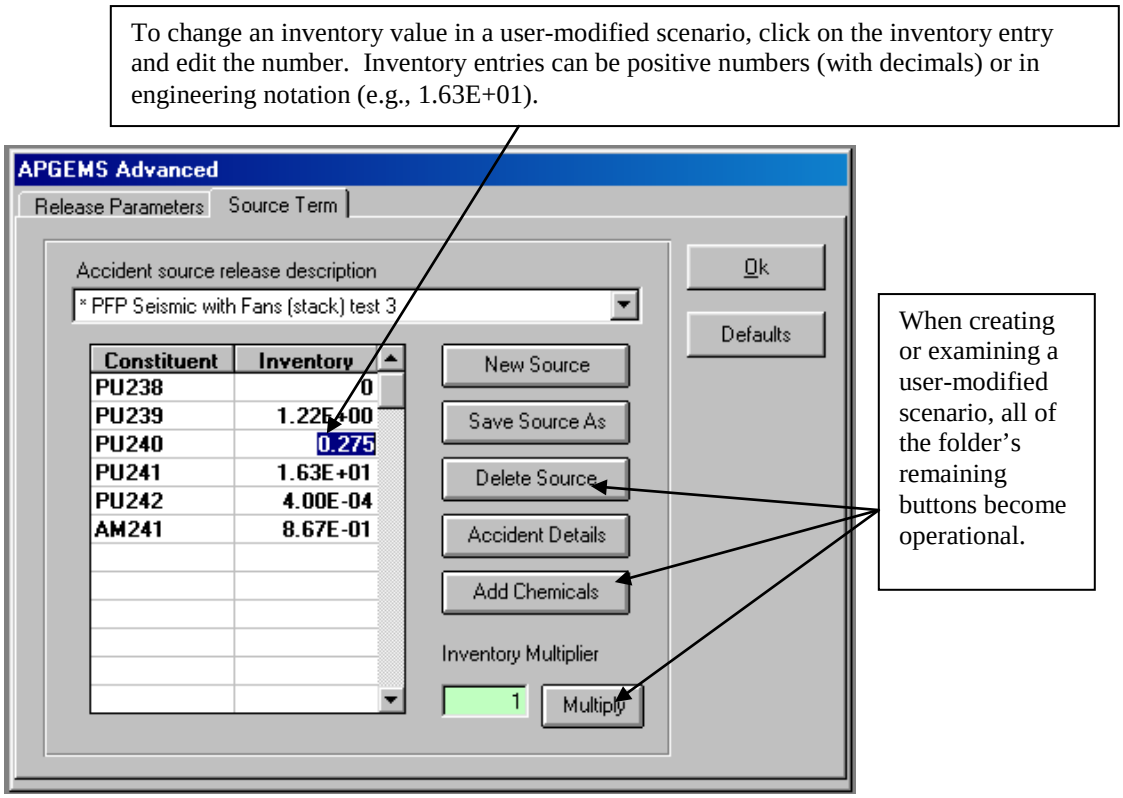


By modifying and saving a scenario under a new name, you can make changes to the constituents and their inventories. To do this, click the *Save Source As* button. A Dialog Caption form will appear displaying the title and description of the existing release scenario. Click on the Title text box to edit the title (the new title must be unique). It is recommended that the modified title capture the change to the scenario. For example, the title "PFP Criticality" can be changed to "PFP Criticality Modified – 50% Reduction in Source." The Description text box should also be edited to reflect the difference between the original scenario and the modified scenario. The description is saved with your constituent and inventory changes and provides a way of recalling why the modified scenario was created. Click the *OK* button in the Dialog Caption form after you have completed modifying the title and description. If you have not entered a new and unique title for the scenario, an error message will be displayed on the screen (i.e., "Accident title must be unique!"). You will need to modify the title or click the *Cancel* button to return to the Source Term folder without setting up a revised scenario.

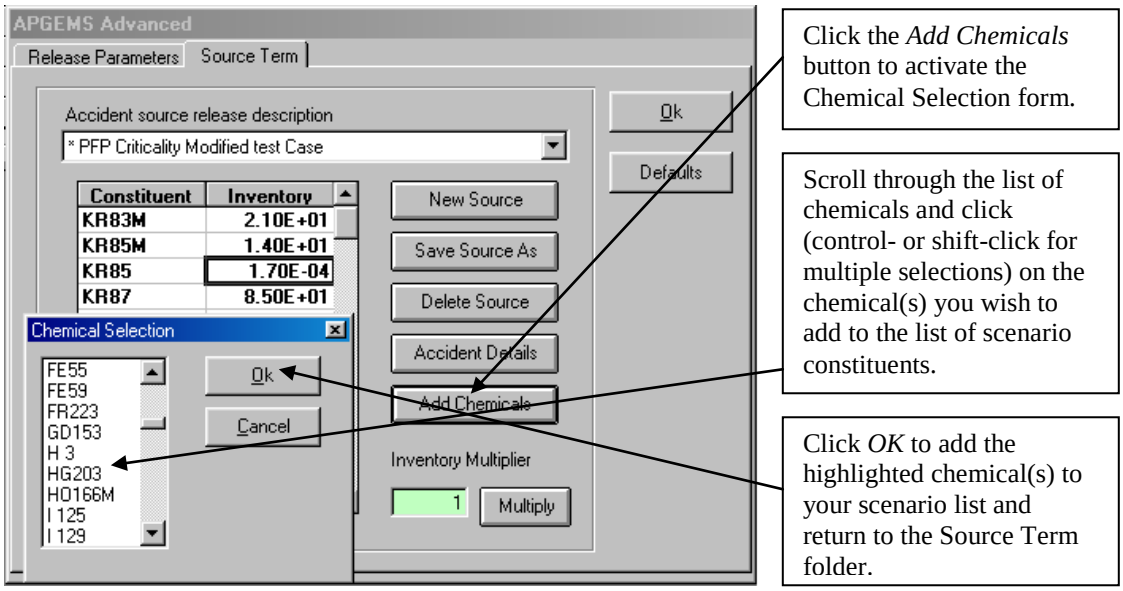


Once a revised source term scenario has been set up, you can make changes to the release constituents and their inventory. All of the buttons on the folder are now active, including *Add Chemicals*, *Multiply*, and *Delete Source*.

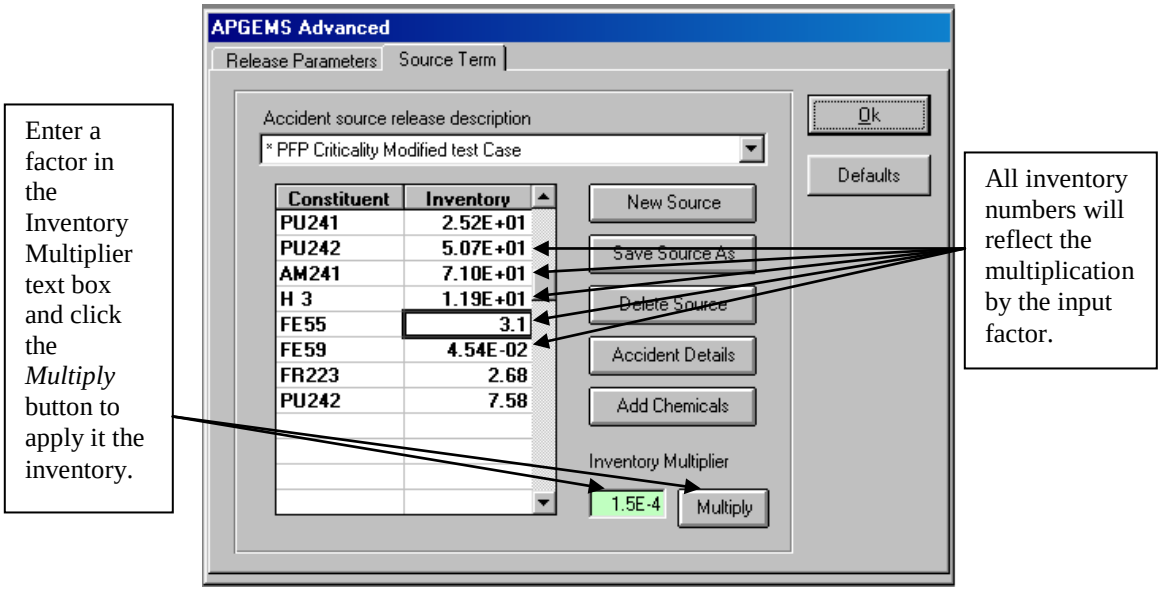
To change a constituent value (including setting a constituent's inventory to zero), click on the inventory entry and enter a different value. Values can be entered as real numbers (e.g., 701.5) or using engineering notation (7.02E+02). Individual constituents cannot be removed from the list once they are there. Instead, reduce the inventory of an unwanted constituent to zero and it will not be released in the revised source term scenario.



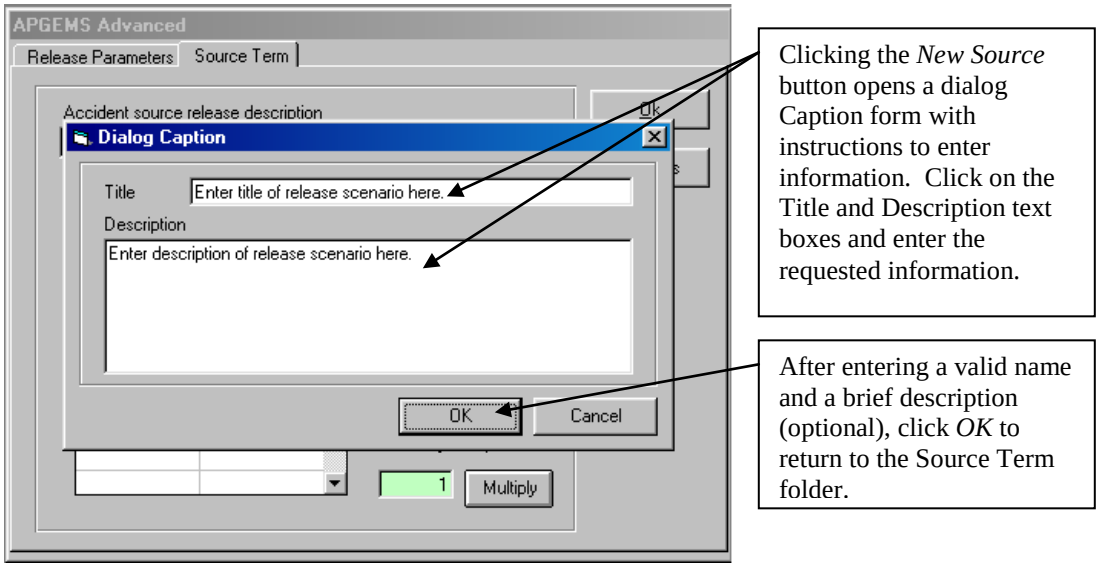
To add a new constituent to the release, click the *Add Chemicals* button. A "Chemical Selection" form will open. Scroll down the list and click on the chemical to be added to the list of constituents. Multiple chemicals can be selected by holding down the Control key and clicking on each chemical to be added. Blocks of chemicals can be selected by clicking on the first chemical in the block and pressing down the shift key while clicking on the last chemical in the block. Click *OK* to add your chemical selection(s) to the constituent list, close the Chemical Selection form, and return to the Source Term folder.



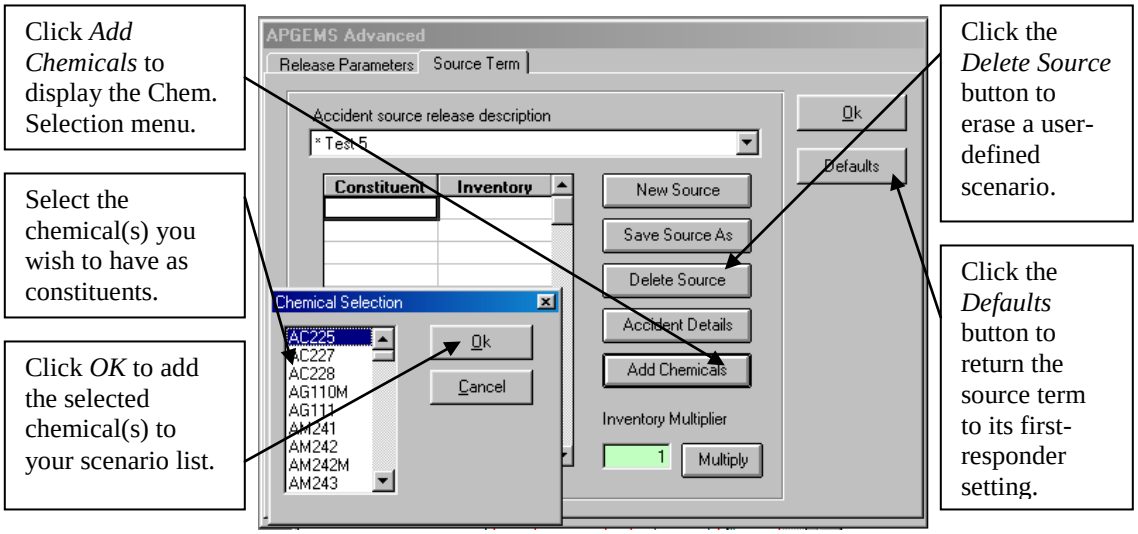
There are times when a user-defined scenario needs to have its entire release inventory increased or decreased by a set factor. For example, if the number of waste drums involved in a fire is ten times the amount first indicated, you might want to quickly increase each of the constituents release inventories by a factor of ten. On another occasion, information from an accident site might indicate that the actual atmospheric release needs to be reduced by two orders of magnitude from the original conservative estimate. The Multiply button allows you to increase or decrease by the same factor each constituent's inventory in the user-modified release scenario. Click on the text box under the heading "Inventory Multiplier". Enter a multiplication factor. It can be any real number greater than, less than, or equal to zero (e.g., 10, 5.3, 0, 0.0125), including numbers presented using engineering notation (e.g., 1.5E+5, 2.0E-4). Click the Multiply button, and all of the constituent inventories will be multiplied by the entered factor.



Instead of modifying an existing release scenario, click the *New Source* button to create a new release scenario from scratch. A Dialog Caption window will appear displaying "Enter title of release scenario here" in the title text box and "Enter description of release scenario here" in the description text box. Click on these text boxes, erase the placeholder phrase, and enter a descriptive (and unique) title and a brief description of the release scenario. Click *OK* after you have completed entering a new title and description. If you have not entered a title that is already used by another scenario, an error message will be displayed on the screen (i.e., "Accident title must be unique!"). You will need to modify the title or click *Cancel* to return to the Source Term folder without setting up a new scenario.



After accepting the new title and description, click the *Add Chemicals* button and begin adding constituents for the release (follow the instructions provided earlier in this section adding chemicals). After this is completed, click on the blank inventory entries and enter an amount (in Ci) of each constituent released to the atmosphere.



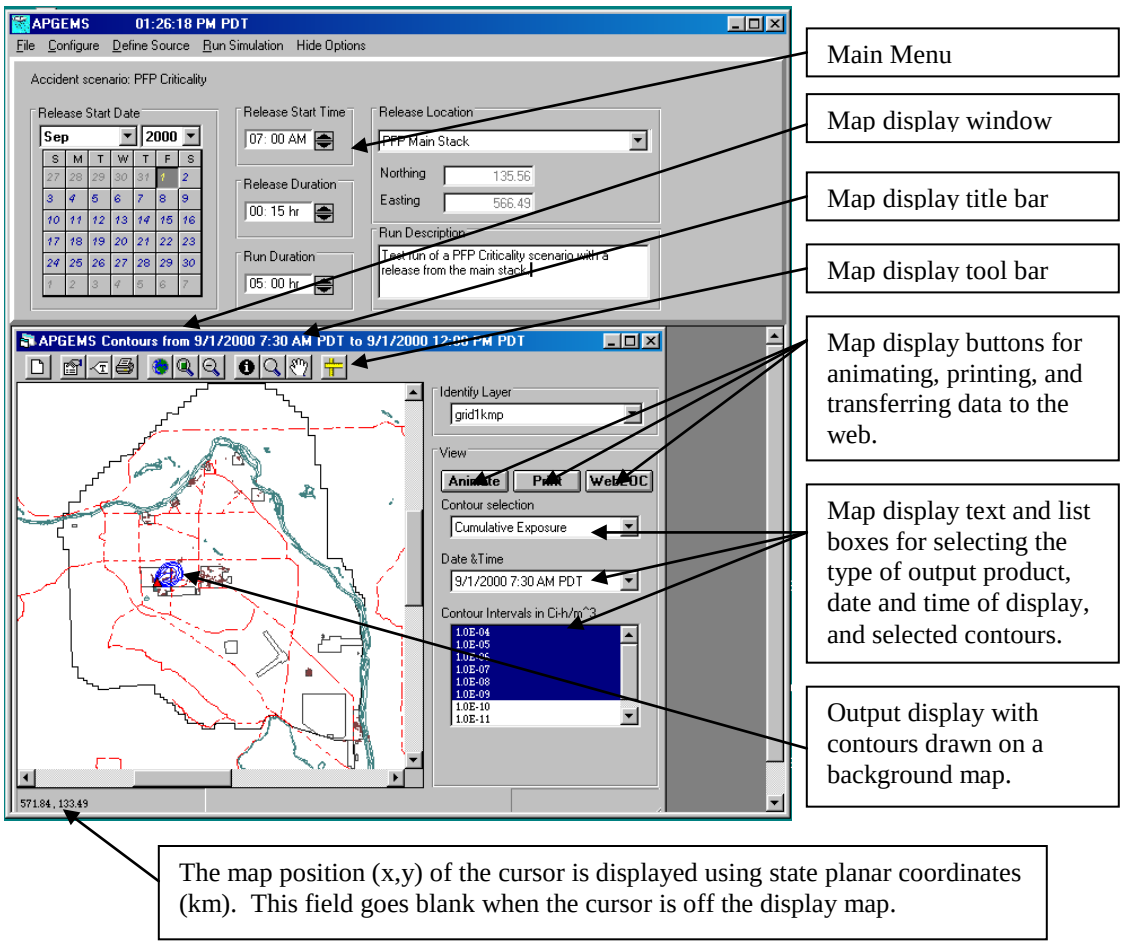
The *Delete Source* button is only active when displaying a user-defined source term. Click *Delete Source* to permanently delete the displayed scenario. This feature comes in handy when old user-created scenarios are no longer needed.

Clicking the *Default* button resets the source term to the "First Responder Model". **Caution: In the "First Responder Model", the program always ignores the release parameter values set in the Release Parameters folder and instead uses default first-responder settings.**

When you've completed your modification of the source term, you can switch folders by clicking the Release Parameters tab, or you can click the *OK* button to accept your changes and close the Define Source Menu. The source term scenario last displayed in the Define Source folder will be the scenario used to run the next ***APGEMS*** simulation.

4.5 Model Output Products

After a simulation has been run, model output products are presented in the Map Display window located below the Main Menu. The Map Display window has a number of components. At the top of Map Display window is the title bar and the toolbar.

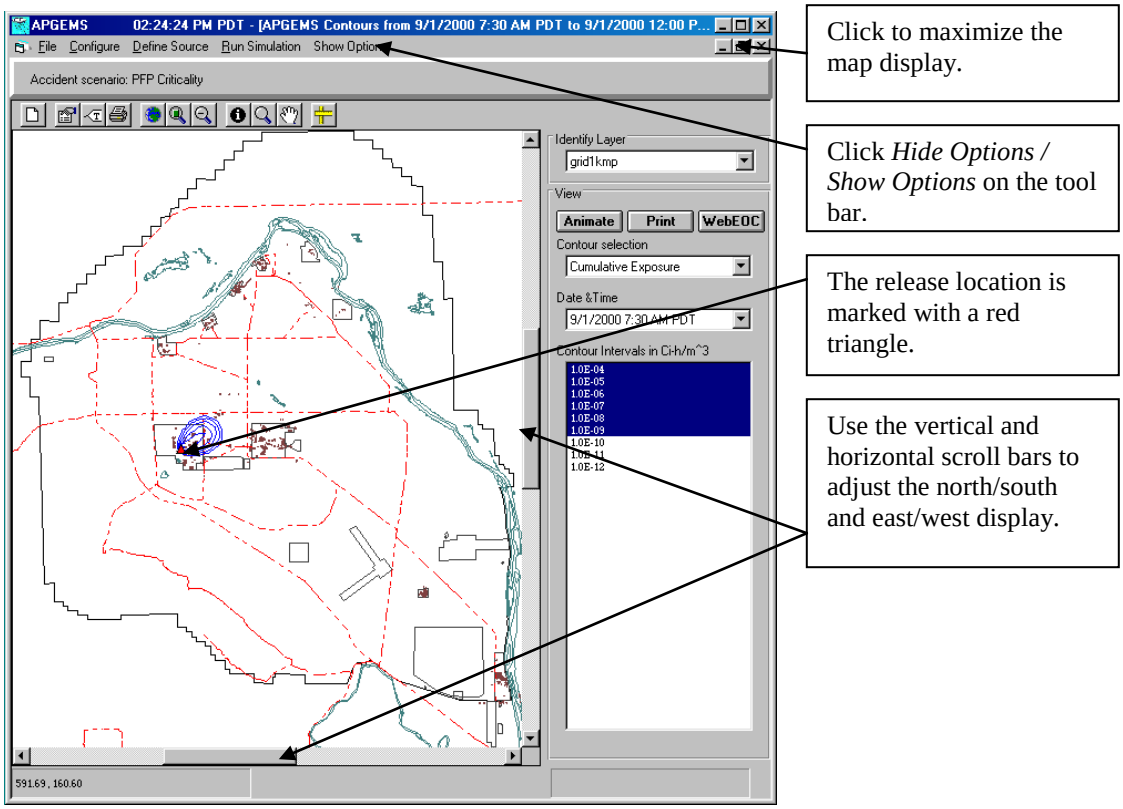


The title bar says “APGEMS Contours” and is followed by the date and time for the first and last available output products. The toolbar has a series of icons that are used to manipulate the output display. A series of text boxes and drop-down lists in the right margin of the Map Display window allow you to select the type of output product, choose the date and time of the data, and manipulate the contours to be displayed. Buttons are also available to animate the display product, print a hardcopy of the display, and copy data to the WebEOC.

In the following sections we discuss each of these aspects of the map display. The initial presentation of data after a model simulation is always the Cumulative Exposure (i.e., “Affected Area”) plot at the end of the very first output interval. Unlabeled contours of exposure are drawn on the background map. The release location is marked with a small red triangle.

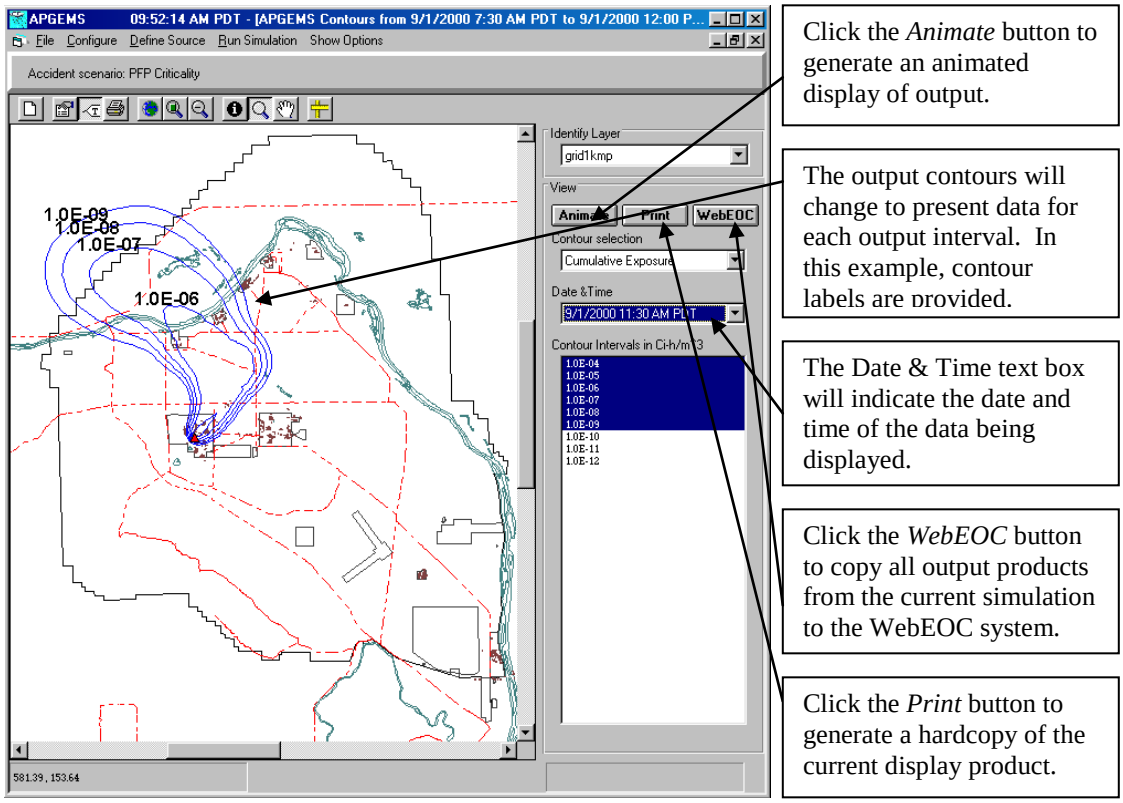
4.5.1 Maximizing the Display

A convenient way to display output products is to maximize the size of the map display window and to click the *Hide Options* menu item on the Main Menu’s menu bar. Maximizing the map display will have it completely fill the area below the Main Menu. Clicking *Hide Options* will expand the output display area even further, as nearly all of the Main Menu is hidden from view. Once engaged, the *Hide Options* menu item will turn into the *Show Options* menu item. Clicking *Show Options* restores the Main Menu and reduces the size of the output display.



4.5.2 The Animation Button

The initial presentation of output is for the first output interval in the simulation. Click the *Animate* button to see an animated display of the output at the end of each output interval. Each output product is displayed for about one second before the display transitions to the next output interval. This provides a time-lapse depiction of the movement of the contaminants and expansion in size of the affected area. The animation product operates using a continuous loop; once the plot for the last output interval is displayed the animation will resume from the beginning of the simulation. To stop the animation once it's underway, click the *Animate* button.



4.5.3 The Print Button

The *Print* button is located immediately to the right of the *Animate* button. Click the Print button to generate a hardcopy of the output product that is displayed on the screen. The standard Windows print dialog box will appear on the screen and allow you to redirect your output to another printer (though the default printer almost always suffices), select multiple copies, and specify other print options.

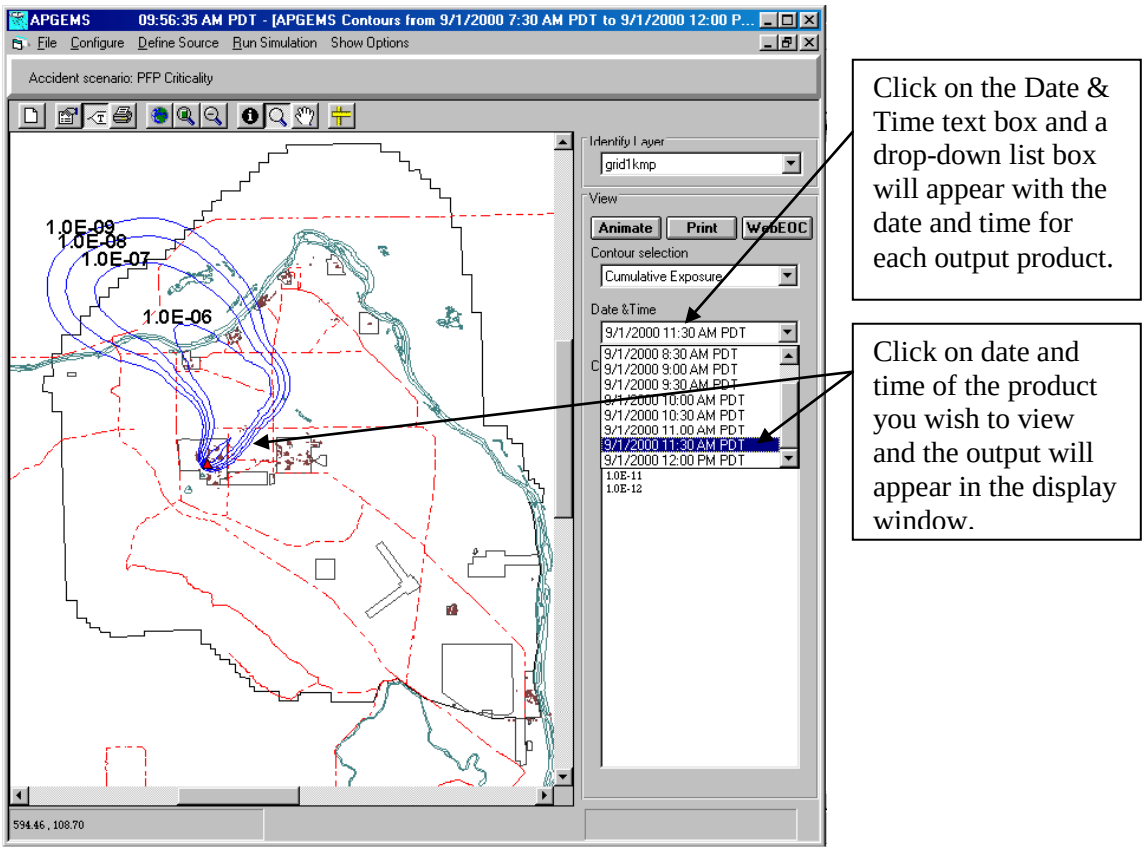
The ***APGEMS*** hardcopy product has a slightly different format than the screen display. Samples of the model's hardcopy output products are presented in Appendix A.

4.5.4 The WebEOC button

Click the "WebEOC" button to generate electronic output in an Internet-compatible format. All the output intervals for all graphical output products are transmitted when the WebEOC button is clicked. Separate software has been prepared to allow the display of ***APGEMS*** products on the Internet-based WebEOC system.

4.5.5 Selecting the Date and Time of the Output Product

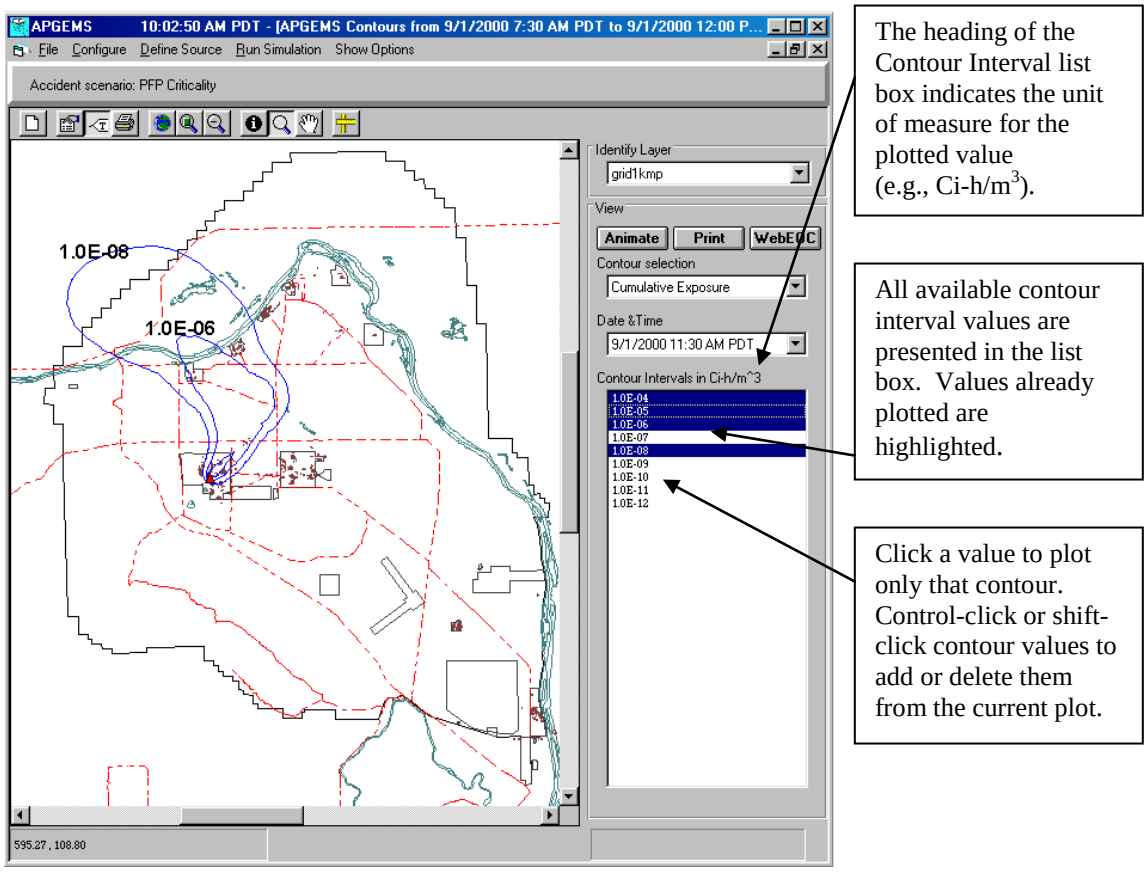
APGEMS generates output products at the specified output interval throughout a simulation. The *Animate* function provides a method for quickly viewing output for the entire simulation; output can also be displayed for one user-selected output interval at a time. To do this, click on the text box directly under the "Date & Time" label. A drop-down list box will appear with each of the date and time combinations for available simulation output products. Output products are listed with the earliest product at the top of the list and the last output product at the bottom of the list. All date and time combinations are labeled as being either standard time or daylight time. If the number of output products exceeds the space provided in the list box, a scroll bar will allow you to access the entire list. Click your selection on this list, and the output product for the date and time of your selection will immediately be plotted in the display window.



4.5.6 Selecting the Contours to Display

Contours are used to display order of magnitude differences in model output. Contours always have a value of 10^x, where x is a positive or negative integer. The default display begins with the highest possible contour value and up to five additional contours (each representing an order of magnitude decrease in value from the previous contour) may be plotted. Fewer contours are plotted if values fall below minimum threshold limits. Contours that are plotted are highlighted in the Contour Interval list box. The unit of measure for the plotted values is reported in the label above the list box.

To display only one contour in your plot, click on the desired contour value in the list box. All the other contours will be erased and the contour you selected will be plotted. To add an additional contour to the plot, control-click on the desired contour value in the list box. The selected contour will be plotted without erasing existing contours. To add a range of contours, shift-click the desired end-point value in the list box for your contour range. All contour values between your selected value and the closest contour value that was previously highlighted will be plotted. To turn off a contour value that is on display (to reduce clutter on the plot), control-click (in the list box) the contour value you wish to erase. That contour value will be erased from the plot and the value will no longer be highlighted in the list box.



4.5.7 Selecting Different Output Products

To change the output product, click the “Contour selection” text box. A drop-down list box will present available display products. If the simulation were run as a first-responder operation, only “Cumulative Exposure” and “Time Averaged Concentration” are available output products. For releases involving radiological source terms, “Total Effective Dose Equivalent” and “Maximum Organ Dose” are also available choices. If the model were run in the Exercise Data Generation mode, a series of instrument products are also available (see Table 4.3).

After examining the choices in the drop-down list box, click on the type of output product you wish to display. The previous display product will be erased and your selected product will be plotted. At the same time, the contents of the “Contour Interval” list box and the units label in its heading will be updated. The date and time of the data display will remain unchanged.

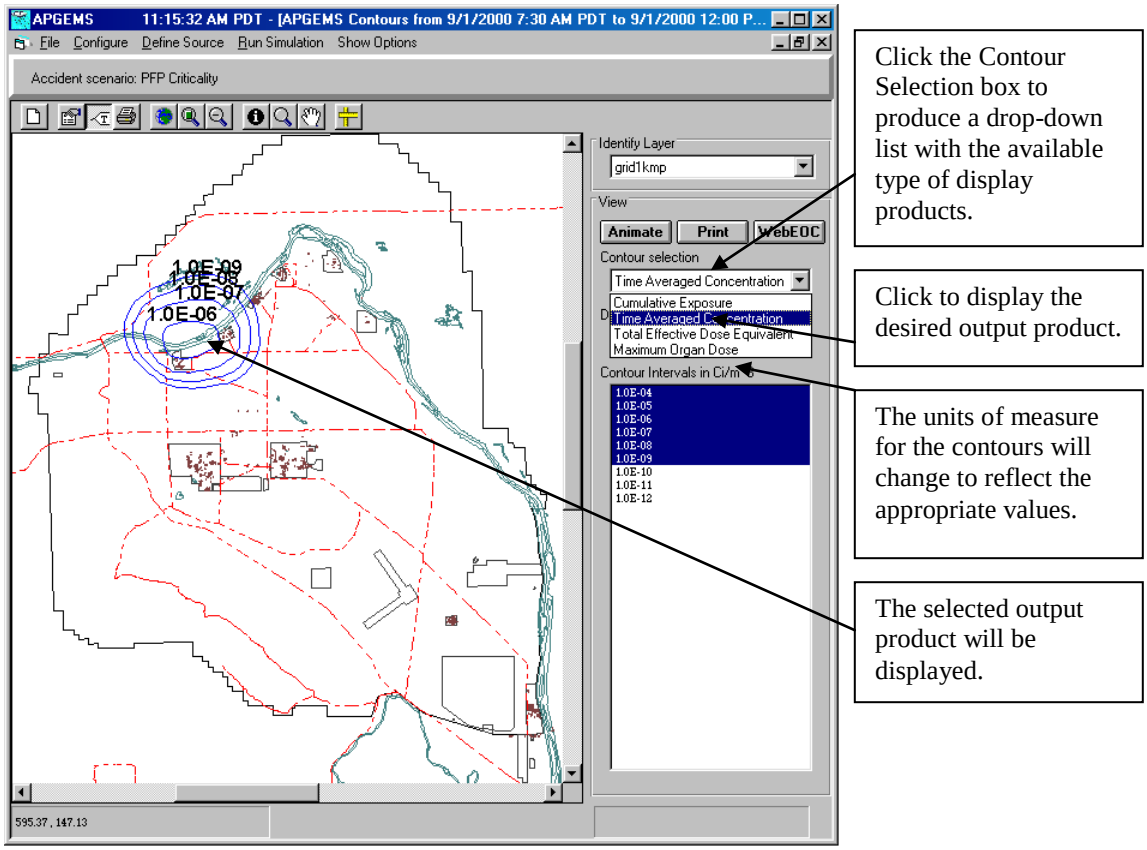
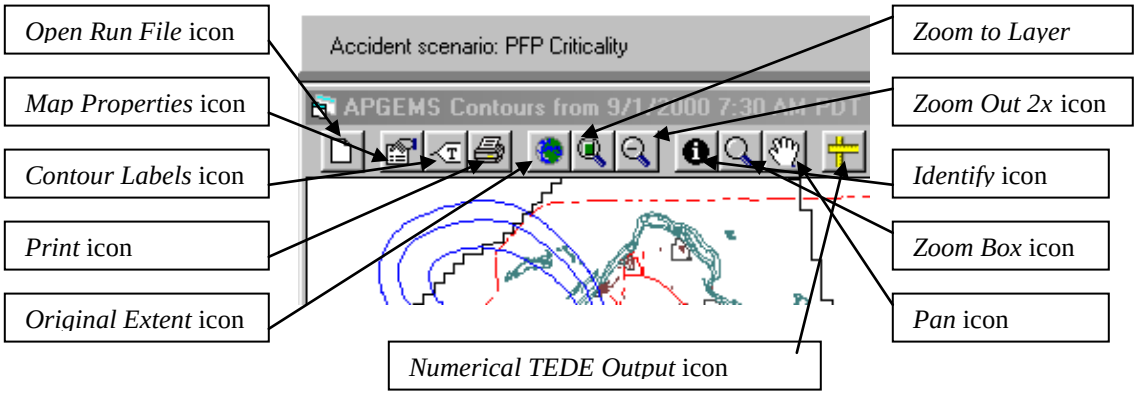


Table 4.3. Model Output Products.

Output Product	Description	When Generated	Units
Cumulative Exposure	Affected area plot. Indicates cumulative exposure from the beginning of the simulation	All modes	Ci-hr/m^3
Time Averaged Concentration	Puff position plot. Indicates the average pollutant concentration during the 15-min interval proceeding the output time	All modes	Ci/m^3
Total Effective Dose Equivalent	50-year dose commitment from inhalation and direct exposure (excludes groundshine)	All except 1st-Respdr.	mRem
Maximum Organ Dose	50-yr maximum committed dose to any organ from inhalation and direct exposure	All except 1st-Respdr.	mRem
Activity Grab Air - Alpha	Alpha radiation from a grab bag air sample	EG only	cpm/ft^3
Activity Grab Air – Beta	Beta radiation from a grab bag air sample	EG only	cpm/ft^3
PAM Air	Measurement of alpha radiation in the air	EG only	cpm
PAM Ground	Measurement of alpha radiation from material deposited on the ground	EG only	cpm
GM-P11 Air	Measurement of beta and gamma radiation in the air	EG only	cpm
GM-P11 Ground	Measurement of beta and gamma radiation from material deposited on the ground	EG only	cpm
CP Air – Window Open	Measurement of beta and gamma radiation in the air	EG only	mR/hr
CP Air – Window Closed	Measurement of gamma radiation in the air	EG only	mR/hr
CP Ground – Window Open	Measurement of beta and gamma radiation from material deposited on the ground	EG only	mR/hr
CP Ground – Window Closed	Measurement of gamma radiation from material deposited on the ground	EG only	mR/hr
Micro Rem Meter Air	Measurement of gamma radiation in the air	EG only	μR/hr
Instrument units of measure include counts per minute (cpm), counts per minute per cubic foot (cpm/ft^3), millirem (mRem or mR), and microrem (μRem).			

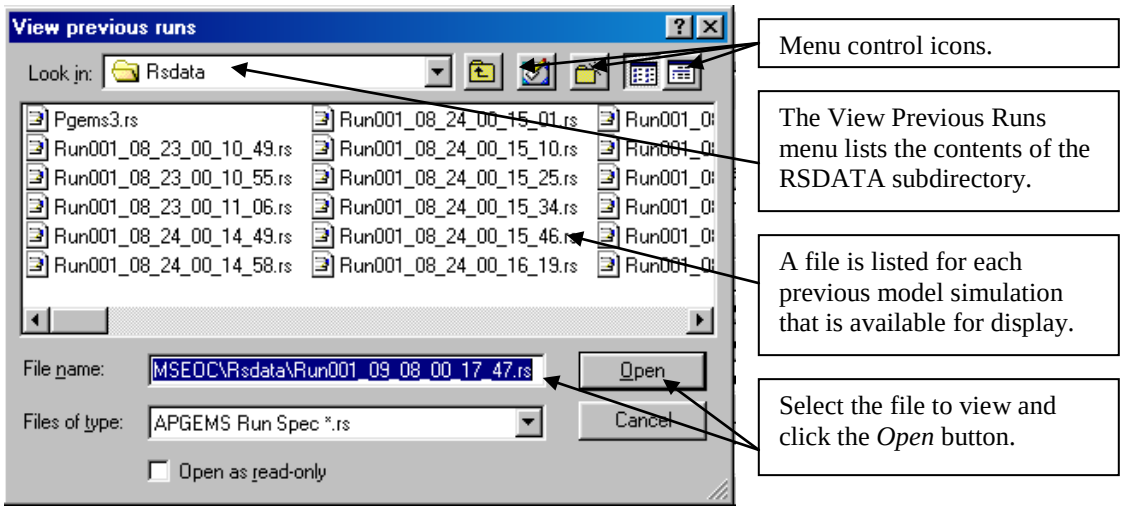
4.5.8 Using Display Toolbar Icons to Adjust the Output Display

At the top of the output display window is a display tool bar that contains a series of icons that can be used to modify the display products and provide additional information.



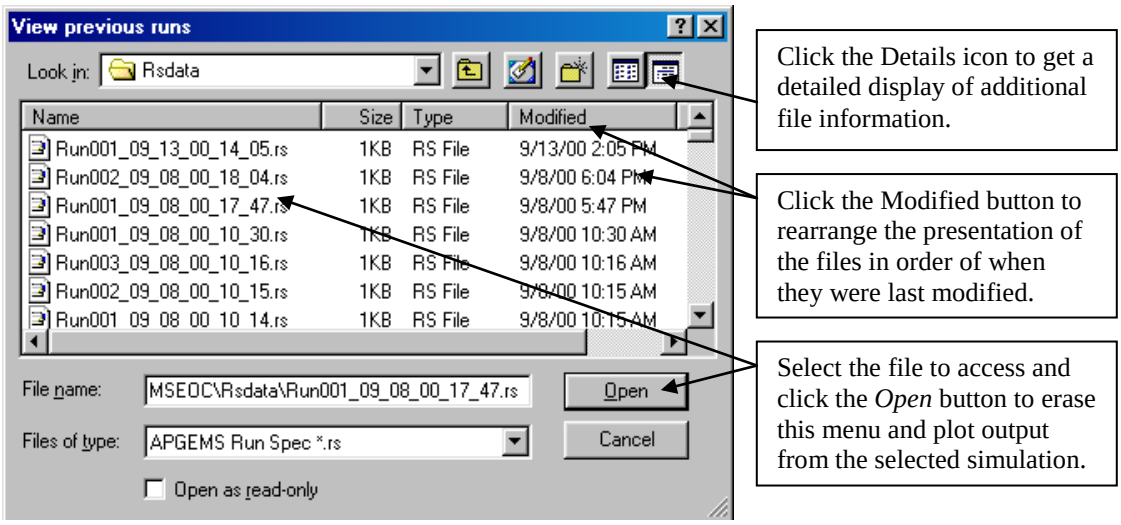
4.5.8.1 The *Open Run File* Icon

The first icon on the display tool bar is *Open Run File*. This will open the "View Previous Runs" menu from which you can select the output from an earlier model simulation for display. This function can also be accessed by clicking *File* on the Main Menu's menu bar and then clicking *Open*. The View Previous Runs menu should display the contents of the "RSDATA" directory. This directory, located in the main ***APGEMS*** directory, contains run specification files (".rs" files) from previous model runs. The file names indicate the date and time that the model simulation was first run (note that this is not the starting date and time for the release of pollutants, but the actual date and time on the computer's internal clock when the simulation was first run). The selected run specification file provides information on the name of output files in the "TDMOUT" directory that will need to be accessed to display output products.



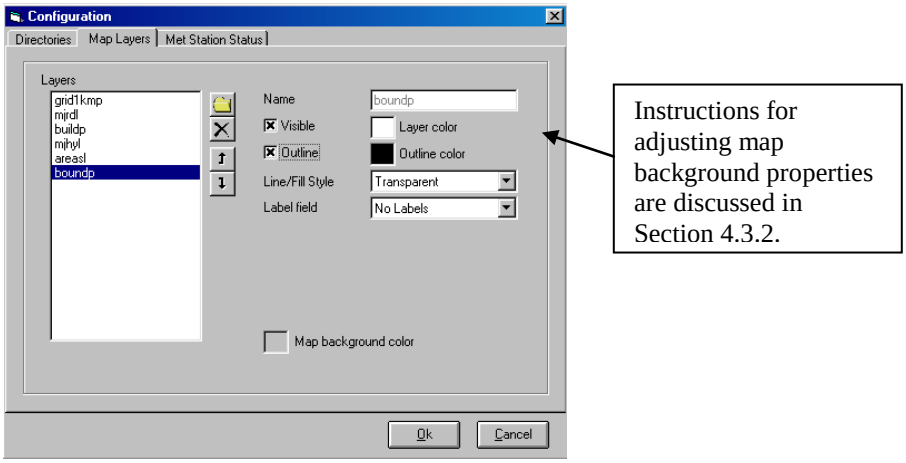
Search through the contents of the RSDATA directory to find the date and time of the model output you wish to display. A convenient way to do this is to change to the "detailed list" form of the directory content display and then click the "Modified" heading so that files are grouped in order of their age. This way you can quickly search through the files in the order in which they were created.

Click on the file whose output you wish to view or type its name in the File Name window. Clicking the open button directs the program to load the output files from this simulation into the ***APGEMS*** display window. The Cumulative Exposure plot from that simulation's first output interval will be displayed and all other plots from that simulation will be accessible through the output display window. The simulation output that was displayed immediately prior to accessing output from the past simulation will be erased and can only be retrieved by once again accessing the View Previous Runs menu.



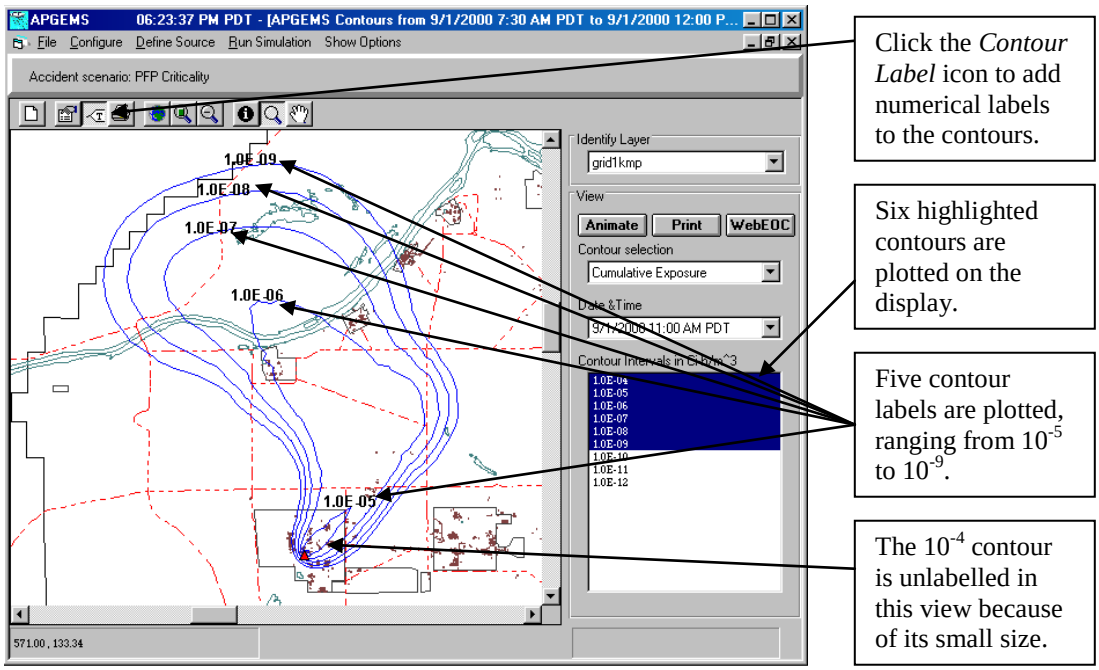
4.5.8.2 The *Properties* Icon

The proprieties icon is used to adjust the map background. Click the *Properties* button and the Configuration menu will open with the Map layers folder displayed. Section 4.3.2 describes how to adjust map display properties using the Map Layers folder.



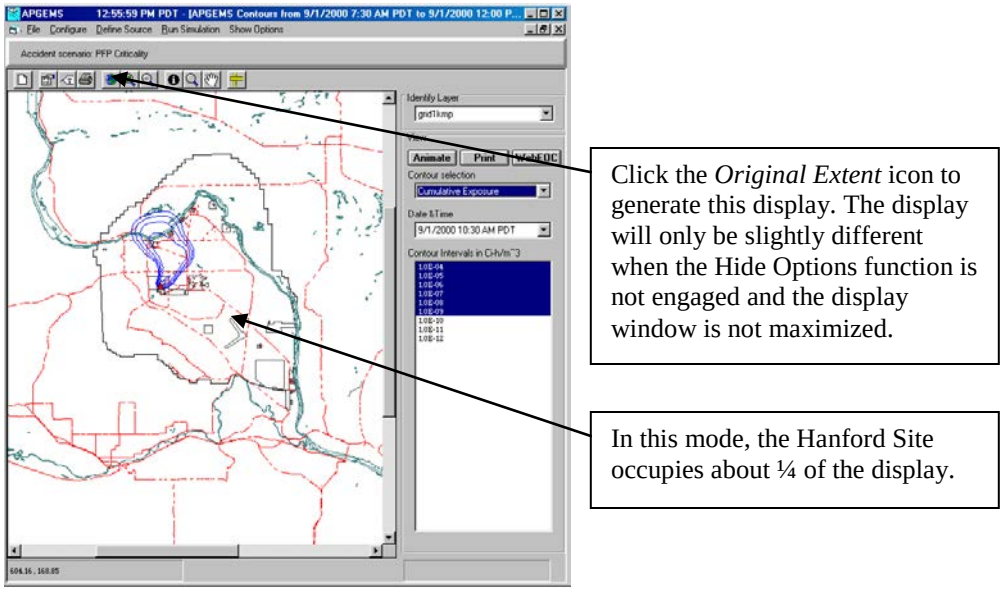
4.5.8.3 The *Contour Label* Icon

The default presentation of display contours is without numerical labels. To add numerical labels for each contour, click the *Contour Label* icon. Contour labels are drawn by the program with a size and at a position determined by the program – the user has no control over these details. The user cannot define a specific contour level; contours are automatically generated by the model and are in the form of 10^x, where x is a positive or negative integer. For contours that take up a relatively small area of the display, contour labels may not be plotted. To see the contour label for such small contours, zoom in for a closer look at that contour (see Section 4.5.8.4).

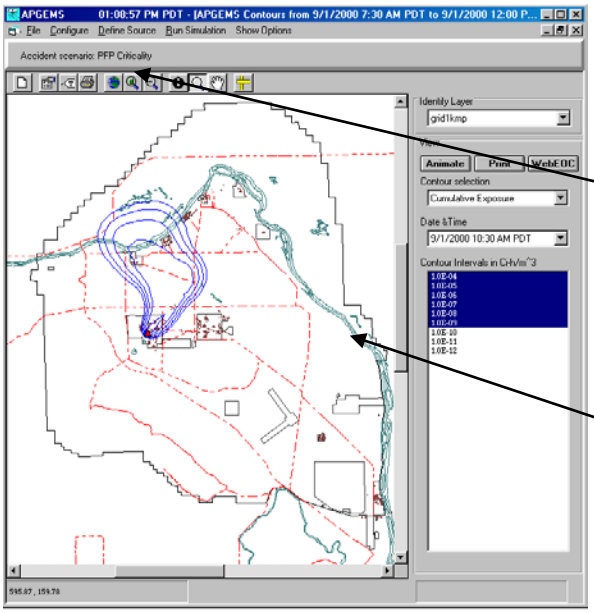


4.5.8.4 The *Original Extent, Zoom to Layer, Zoom Out 2x,* and *Zoom Box* Icons

Using the zoom icons, you can zoom in and magnify an area of the output display or you can pull back to view a broader area. A number of tools are available on the display toolbar to support this function. The *Original Extent* and *Zoom to Layer* icons set the output product to certain preset perspectives. Click the *Original Extent* icon and the display shows a broad area of the modeling domain. For use at the Hanford Site, the original extent display shows an area from the Saddle Mountains in the north to the center of the Horse Heaven Hills to the south; from Sunnyside (in the Yakima Valley) in the west to the confluence of the Snake and Columbia Rivers in the east.



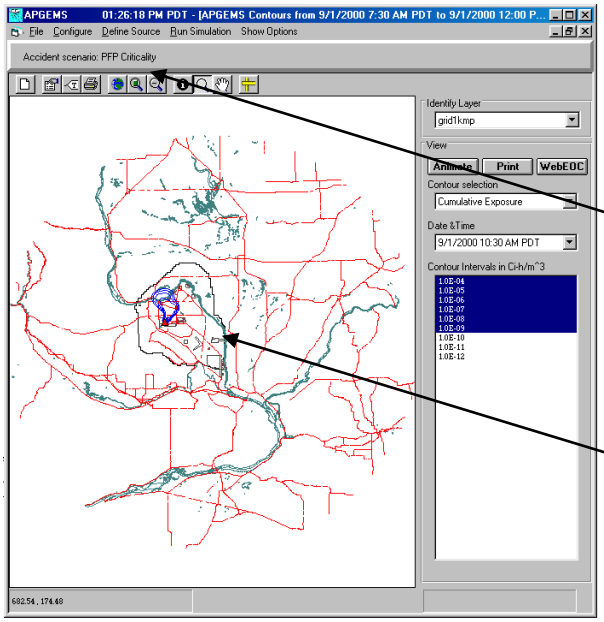
Click the *Zoom to Layer* icon and the display focuses on a smaller area of interest. For use at the Hanford Site, clicking this icon produces a display that shows the entire Site. The northern and southern borders of the Site represent the north-south extent of the display; the western and eastern borders are just within the east-west extent of the display.



Click the *Zoom to Layer* icon to generate this display. The display will only be slightly different when the Hide Options function is not engaged and the display window is not maximized.

In this mode, the Hanford Site occupies most of the display.

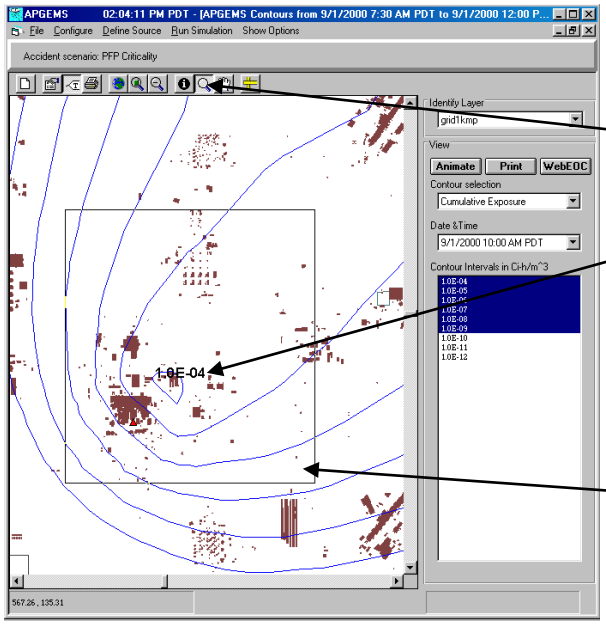
The *Zoom Out 2x* icon pulls the image back so that horizontal and vertical dimensions of the displayed product are doubled (increasing the area displayed by a factor of four). This icon can be repeated many times until the maximum limits of the display region are reached. The maximum limit of the display ranges from Ellensburg in the west to Dayton in the east; from Ephrata in the north to near Heppner (Oregon) in the south.



Clicking the *ZoomOut 2x* icon doubles the horizontal and vertical dimensions of the display. This icon can be clicked multiple times until the maximum limits of the display are reached.

In this display, the *Zoom Out 2x* icon has been used to reach the maximum limit of the regional display centered on the Hanford Site.

The *Zoom Box* icon allows the user to zoom in for a detailed look at the model output. With the 'Zoom Box" tool selected, click on the output product and drag the cursor (with left mouse button depressed) to create a zoom box. When the mouse button is released, the area in the zoom box will fill the display.



Click the *Zoom Box* icon to zoom in on an area of the display. This area can be as small as under a hundred meters on a side or as large as the modeling domain.

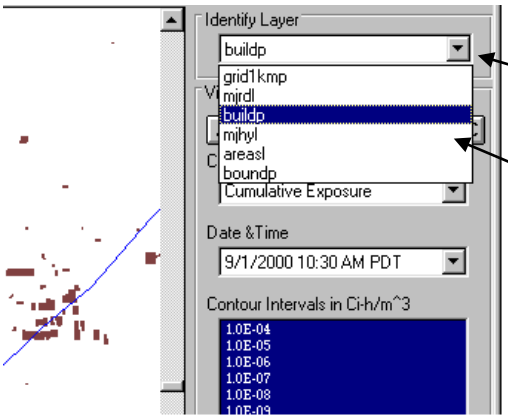
This display illustrates a zoomed in view of the release location and surrounding facilities. Zooming in allows the highest-concentration contour and its label to become visible.

In this display, a new zoom box has been drawn. When the user releases the left mouse key, the display will be redrawn with the zoom box forming the approximate outer margins of the display.

There are limits to how close you can zoom-in with the zoom box. If you zoom in absurdly close (e.g., a zoom box that is 10 m on a side), the program's graphics routine may generate an error message and cause the premature termination of your session.

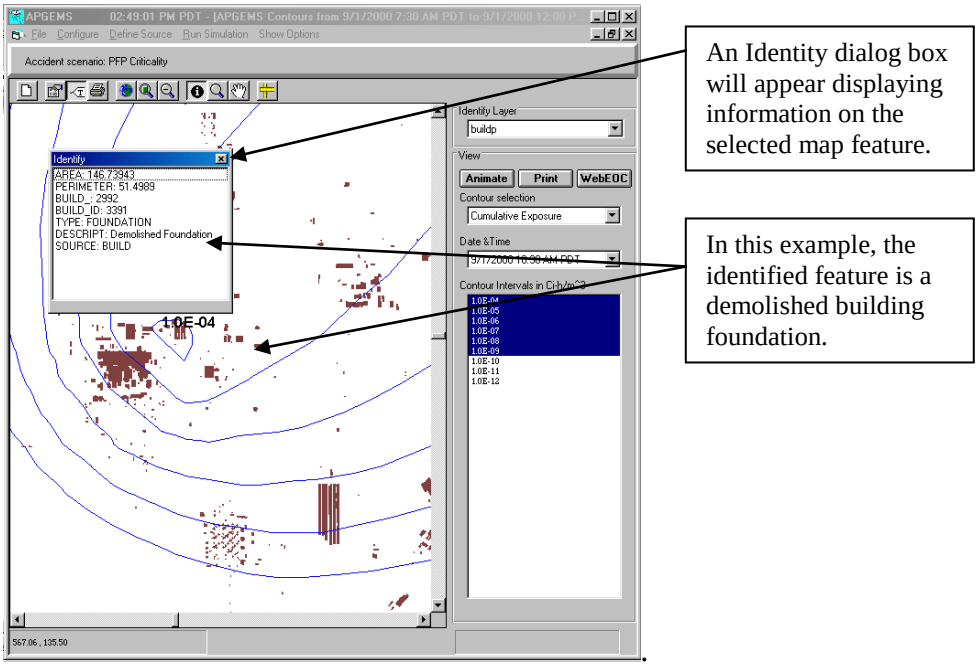
4.5.8.5 The *Identify* Icon

The *Identify* icon is used in conjunction with the "Identify Layer" text box to display information about background map features. First, click the *Identify* icon. Next, select a background map layer. To do this, click within the Identify Layers text box (the upper right most text box in the output display window). A drop-down list box will appear presenting a list of all the layers plotted in the display. Click one of the layers to select it.



After clicking he *Identify* icon, click the Identify Layer text box and a drop-down list of display layers appears. Click the layer for which you want additional information.

Next, click on a map feature and an Identify box will appear presenting information on that item. Among the standard set of available layers are grid lines, major roads, major hydrological features, buildings, and area boundaries.

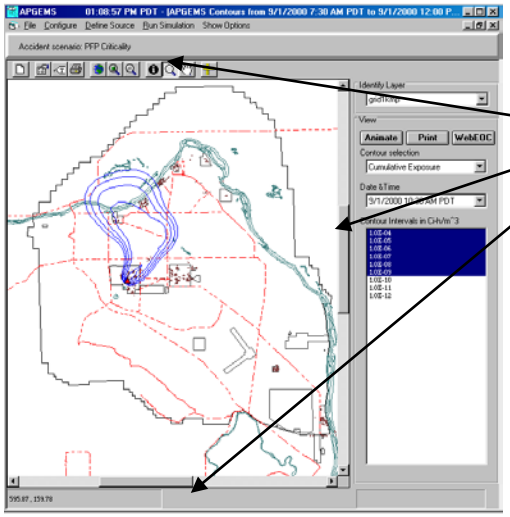


An Identity dialog box will appear displaying information on the selected map feature.

In this example, the identified feature is a demolished building foundation.

4.5.8.6 The *Pan* Icon

Within any display product, the user can use the *Pan* icon or the horizontal and vertical scroll bars to move the displayed image and examine any location in the covered domain. Click *Pan* and position the cursor within the display. Click on the image while keeping the left mouse key depressed. Drag the image across the screen to reposition the display. When you release the mouse key the image will be fully redrawn in its new position.



Use the *Pan* icon or the horizontal or vertical scroll bars to reposition the display image.

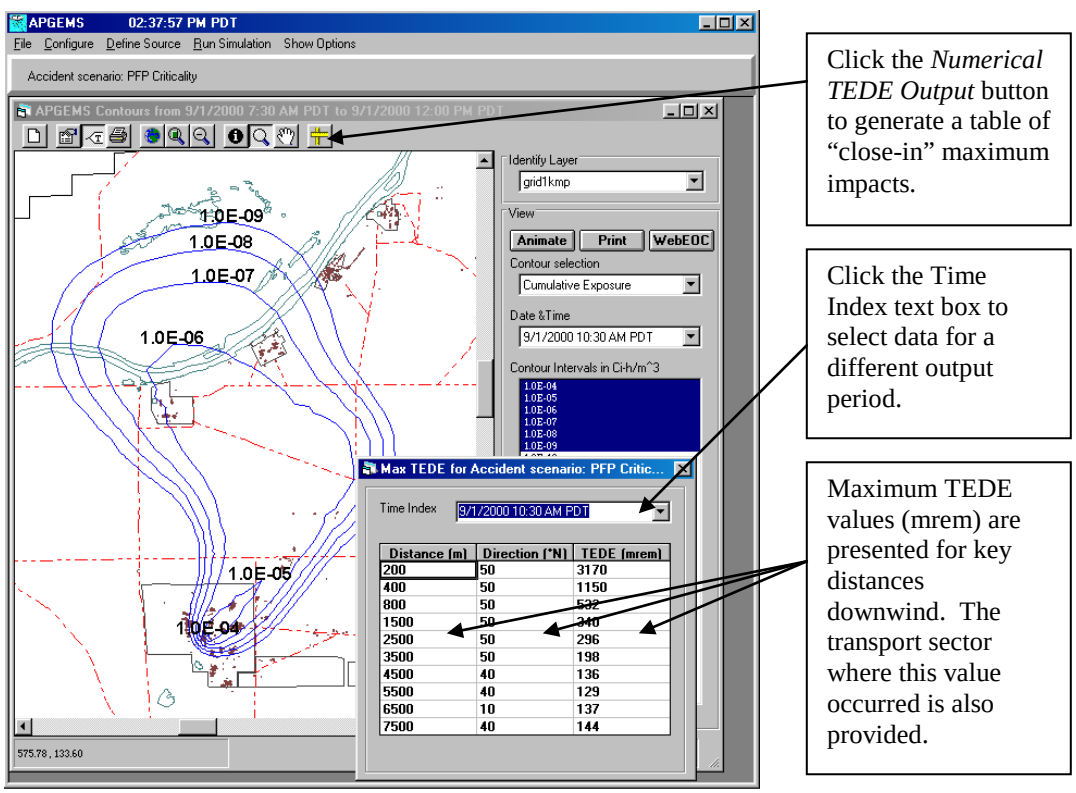
4.5.8.7 The *Numerical TEDE Output* Icon

If a model run includes radiological constituents, clicking the *Numerical TEDE Output* icon on the display tool bar will generate a window entitled "Max TEDE for Accident Scenario:…". This window presents a numerical display of maximum TEDE values reported at key distances downwind from the source. Select the date and time for the data to display by clicking on the Time Index text box. A drop-down list box will appear with the available dates and times for numerical output (these are identical to the choices available for graphical output). The numerical output will consist of three columns of data:

1. the distance downwind from the source to the receptor. The downwind distances are 200, 400, 800, 1500, 2500, 3500, 4500, 5500, 6500, and 7500 m. These values cannot be adjusted using the ***APGEMS*** Main Menu.

2. the direction sector in which the maximum TEDE value is recorded at the given distance downwind from the source. Directions are provided in 10° increments beginning with 0° (due North of the release site).

3. the maximum TEDE value at the given distance.



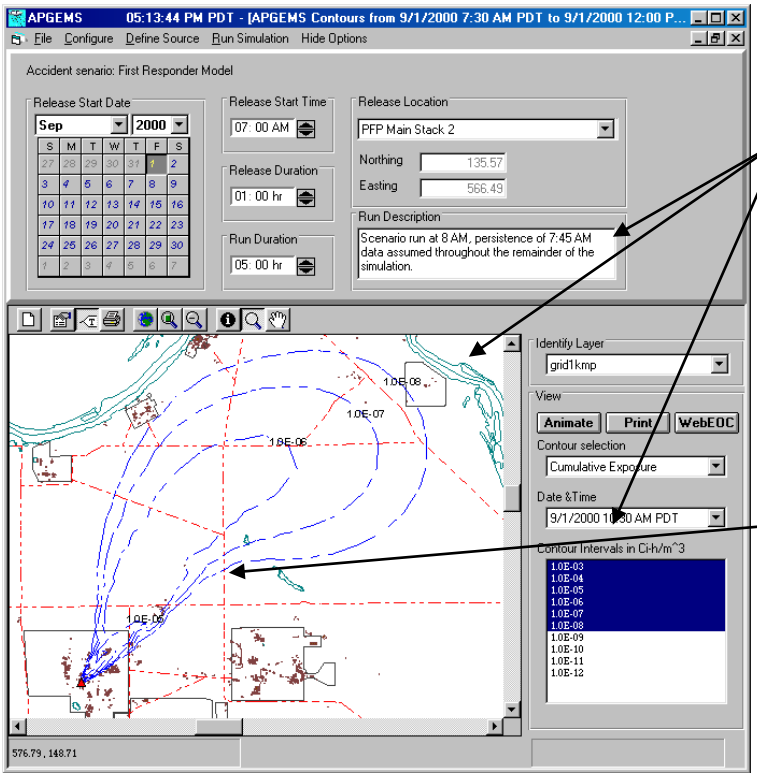
Click the *Numerical TEDE Output* button to generate a table of "close-in" maximum impacts.

Click the Time Index text box to select data for a different output period.

Maximum TEDE values (mrem) are presented for key distances downwind. The transport sector where this value occurred is also provided.

4.5.9 Products Generated Using the Persistence of Meteorological Data

APGEMS will use all of the relevant available meteorological data when conducting a model simulation. Operationally, there are many cases when the model simulation will need to go beyond the current time. In such cases, the model assumes the persistence of meteorological conditions using the last available data. This occurs when a release has recently occurred and impacts need to be estimated for several hours into the future. It also occurs when a release has not yet occurred and you conduct "what if" simulations involving a hypothetical atmospheric release in the near-future. When the model is generating output for a time period in which the persistence of meteorological conditions was assumed, the output products will be plotted using dashed contour lines instead of solid lines.



This is a Cumulative Exposure plot that assumes the persistence of meteorological data into the future. The last available meteorological data is from 7:45 AM. The output product estimates exposure at 10:30 AM.

Contours generated using the persistence of meteorological data are drawn as dashed lines. Plots with dashed lines generally are associated with elevated levels of uncertainty.

In many instances, persistence of current meteorology is the best short-term forecast available. However, as the model simulates conditions further and further into the future, the adequacy of the most recent meteorological data to represent future conditions diminishes. As a result, plots with dashed contour lines tend to have a greater level of uncertainty associated with them than plots with solid contour lines. This level of uncertainty increases as the length of time from the most recently available meteorological data increases. Uncertainty also increases substantially when meteorological conditions are variable or in transition.

For example, when meteorological conditions are relatively constant, the assumption that these conditions will persist may be a very reasonable forecast for as four or more hours

into the future. This situation can occur during the middle of stable, nighttime drainage flows. It also occurs when there is a large-scale weather feature driving local winds. When meteorological conditions are variable or systematically changing, persistence forecasts for only 15 or 30 minutes may perform poorly. This situation can occur during the onset or breakup of nighttime drainage flows or when frontal systems move across the Site.

It is important to discuss the uncertainty of future projections when presenting model output to EOC staff members and decision-makers. These discussions should include uncertainties in puff position and the magnitude of potential impacts.

5.0 HARDCOPY OUTPUT PRODUCTS

When the *Print* function is selected, ***APGEMS*** will generate the displayed hardcopy output product. A series of output products is presented in Appendix A. Each product has a heading that identifies:

- the type of output product (e.g., "Cumulative Exposure", "Time Averaged Concentration", "Total Effective Dose Equivalent")
- the simulation date
- the simulation time

The contents of the output display are drawn below and to the left of the heading. Below and to the right of the heading is a lengthy column of information that reports key information from the simulation. This includes:

- the run identification title. This is the same title used to identify the run specification file. It includes the date and time (according to your computers internal clock) that the simulation was run
- the simulation start date and time
- the run duration
- the release duration
- the averaging interval (i.e., are values presented cumulative from the start of the release or are they averaged over the output interval)
- the amount released (i.e., "Unit Release Rate" of 1 Ci/s for a first-responder run and a message to see the source term data provided further down the column for all other runs).

For non-first-responder runs, the information provided continues with:

- the inner domain size for the model run
- the outer domain size for the model run
- the height of the release (includes the stack height plus any momentum plume rise)
- the stack gas exit velocity (used in buoyant plume rise calculations)
- the stack gas exit temperature (used in buoyant plume rise calculations)
- stack diameter (used in buoyant plume rise calculations)
- building cross section area (used in calculating enhanced diffusion in the wake of buildings)
- initial horizontal plume size
- initial vertical plume size.

All model runs then provide a list of the "Contours Displayed." The units of measure (e.g., Ci-h/m^3, Ci/m^3, mRem) are also presented.

Finally, for all simulations except first-responder runs, the list of contaminants and their release inventories are presented.

6.0 DIRECTORY STRUCTURE AND REQUIRED FILES

In this section we describe the ***APGEMS*** directory structure and required files. This includes a discussion of the purpose and contents of each subdirectory within the main ***APGEMS*** directory. In this section, the main directory is referred to as the "APGEMS" directory. In actuality, someone installing ***APGEMS*** on their computer may place the main directory within an existing directory (e.g., c:\Program Files\APGEMS) or give the main directory a name other than "APGEMS" (e.g., "PGEMS" or "APGEMS_EOC").

6.1 The APGEMS Main Directory

The ***APGEMS*** main directory contains several files and a series of subdirectories that contain input and output data files. The most important files in the main directory are the ***APGEMS2*** and ***PGEMSMAIN*** executables. ***APGEMS2.exe*** is the user interface. It is used to set up model simulations and view output. The ***PGEMSMAIN.exe*** is the physical model and it's launched from ***APGEMS2.exe***.

The CONVERT.CSV file provides unit conversion information. There are almost 1,400 unit conversions in this file (e.g., to convert form mi/s to km/s multiple by 1.609). While only a few are used in ***APGEMS***, it is important to have this file to ensure that all data are provided in appropriate units. The ST5UNST.LOG is a log file that is used to record information about model installation. This file needs to be kept in the directory to ensure that the program can be upgraded or de-installed in the future. PGEMS.DEP is an optional dependency file. The PGEMS.INI file holds the last model configuration settings. If this file is not present, the program will open with its configuration set to a default setting and the program will write its own PGEMS.INI file. The RS.TXT file is an optional parameter definition file that is provide for user information purposes only.

Name	Size	Type
MetData		File Folder
MetOut		File Folder
RsData		File Folder
Shapes		File Folder
StaticData		File Folder
TdmOut		File Folder
TerData		File Folder
TerOut		File Folder
Web		File Folder
APGEMS2.EXE	423KB	Application
CONVERT.CSV	37KB	Microsoft Excel Comma Separ...
PGEMS.DEP	19KB	DEP File
PGEMS3.INI	1KB	Configuration Settings
PGEMSmain.exe	1,557KB	Application
RS.TXT	3KB	Text Document
ST5UNST.LOG	14KB	LOG File

After the first ***APGEMS*** simulation is started, an additional series of files will be created in the main directory. These are files that have ".FIL", ".RS", ".TRC",".RAD", ".REC", and other extensions. These files are created at the beginning of each simulation and generally transmit information from the user-interface to ***APGEMS*** or reflect summary output from the model that may be used for quality assurance purposes. These files are overwritten at the beginning of each simulation so their contents only reflect information from the last model run.

Contour.dat	99KB	WordPerf...
CONTOUR.RS	1KB	RS File
Coord.dat	142KB	WordPerf...
PGEMS3.TRC	6KB	TRC File
POSTMET.FIL	1KB	FIL File
POSTMET.RS	1KB	RS File
CNC.RS	1KB	RS File
MET1.FIL	1KB	FIL File
MET1.RS	1KB	RS File
MET2.FIL	1KB	FIL File
MET2.RS	1KB	RS File
PREMET.FIL	1KB	FIL File
PREMET.RS	1KB	RS File
PREMET.TRC	2KB	TRC File
SRCREL.FIL	1KB	FIL File
SRCREL.RS	1KB	RS File
SRCREL.TRC	2KB	TRC File
TDM.FIL	1KB	FIL File
TDM.RAD	1KB	RAD File
TDM.REC	1KB	REC File
TDM.REL	1KB	REL File
TDM.RS	1KB	RS File
TDM.SRC	1KB	SRC File

The ***APGEMS*** meteorological model is usually run using a nested grid (i.e., and inner and outer grid). The ".FIL" files contain the full path names of the input files required by the major components of APGEMS. Output path names are also specified where required. Each ".FIL" file provides information to the model component identified in the ".FIL" file's name (i.e., PREMET= the meteorological data preprocessor, MET = meteorological model, SRCREL = source release model, and TDM = transport and diffusion model). There are two ".FIL" files generally required for the meteorological processor. MET1.FIL and MET2.FIL contain meteorological specifications for the inner and outer modeling domains, respectively (if only one grid is used than only MET1.FIL is needed).

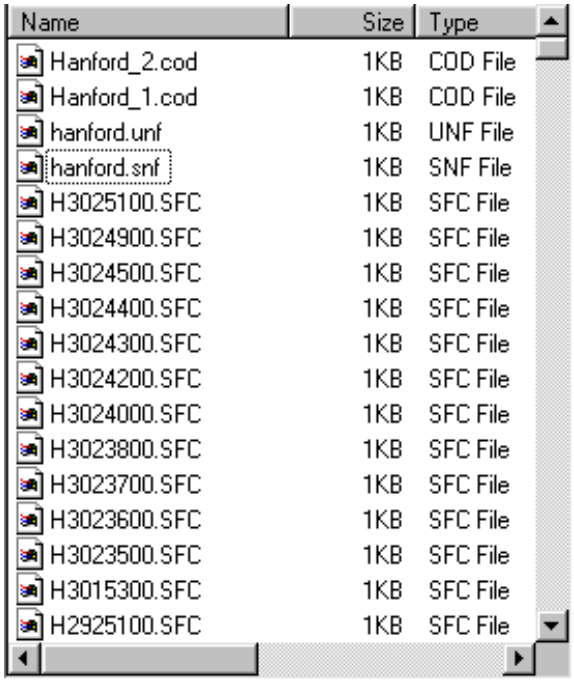
The ".RS" files are run specification files. These provide the values of key parameters required during the execution of the component of ***APGEMS*** that is indicated by the file's name. The ".TRC" files are trace files. These are diagnostic and summary files that document the execution of the ***APGEMS*** component identified in the file's name. The "TDM.REL" file is a source term file that contains release rate information for each

contaminant in the simulation. The “TDM.SRC” file contains information on the simulation release parameters. The “TDM.RAD” file contains information on the half-lives and interaction of the contaminants involved in a simulation. The “TDM.REC” file contains information on the receptor coverage in the simulation.

More information on these files, including their contents and format, is provided in Allwine and Bian (1995). In contrast to the above files, all of the information used to run a given simulation is also contained in files that are never overwritten. These files have names that identify the date and time the simulation was run so that they can be retrieved and analyzed after subsequent model runs. These files are located in subdirectories and are described in the following subsections.

6.2 METDATA directory

The “METDATA” directory is used to hold meteorological data and supporting information. At the Hanford Site, the “HANFORD.SNF” file provides a list of the surface stations and their status. The “HANFORD.UNF” file provides the same information for upper air stations. The “.SNF” files are generated by ***APGEMS*** after reading the meteorological input files. Each file provides a summary of the near-surface meteorological data at the indicated station for the duration of the simulation. Each simulation that includes new meteorological data writes a new “.SFC” file for each station. In the first column of data in the “.SFC” file, a ‘*’ indicates a station is active and a ‘_’ indicates the station is inactive. For upper air meteorological monitoring stations there is an analogous set of files called “.UP”



Name	Size	Type
Hanford_2.cod	1KB	COD File
Hanford_1.cod	1KB	COD File
hanford.unf	1KB	UNF File
hanford.snf	1KB	SNF File
H3025100.SFC	1KB	SFC File
H3024900.SFC	1KB	SFC File
H3024500.SFC	1KB	SFC File
H3024400.SFC	1KB	SFC File
H3024300.SFC	1KB	SFC File
H3024200.SFC	1KB	SFC File
H3024000.SFC	1KB	SFC File
H3023800.SFC	1KB	SFC File
H3023700.SFC	1KB	SFC File
H3023600.SFC	1KB	SFC File
H3023500.SFC	1KB	SFC File
H3015300.SFC	1KB	SFC File
H2925100.SFC	1KB	SFC File

The “HANFORD_1.COD” and “HANFORD_2.COD” files are used to designate whether portions of the inner and outer modeling domain are dominated by water (1) or land (2). At the Hanford, each of these file arrays are filled with “2” to indicate the dominance of land features on local meteorology. More information on all of the meteorology input and output files can be found in Allwine and Bian (1995).

6.3 METOUT Directory

The “METOUT” directory is used to hold meteorological output from ***APGEMS***. Three types of files are created: “.BLP”, “.WND”, and “.VEC” files. The “.BLP” files contain boundary layer parameter information. The “.WND” files are binary direct-access files that give the amplitude terms for the winds at each time step. The “.VEC” files are also binary direct-access files associated with vector products. The run title name is presented before each file extension. This identifies the model run for which these files were created. More information on these files can be found in Allwine and Bian (1995).

Name	Size	Type
Run005_09_15_00_10_45_1.VEC	176KB	VEC File
Run005_09_15_00_10_45_2.VEC	176KB	VEC File
Run005_09_15_00_10_45_2.BLP	36KB	BLP File
Run005_09_15_00_10_45_1.BLP	36KB	BLP File
Run005_09_15_00_10_45_1.WND	146KB	WND File
Run005_09_15_00_10_45_2.WND	146KB	WND File

6.4 RSDATA Directory

The “RSDATA” directory is used to hold run and release specification information. Two types of files are found here: “.RS” and “.REL” files. The “.RS” files contains run specification information that is written by the ***APGEMS*** user interface and used by the physical model to generate a more detailed set of input files. The “.REL” files do the same thing for release specification information. The date and time the simulation was run is part of the file name.

Name	Size	Type
Run005_09_15_00_10_45.rel	1KB	REL File
Run005_09_15_00_10_45.rs	1KB	RS File
Run004_09_15_00_10_39.rel	1KB	REL File
Run004_09_15_00_10_39.rs	1KB	RS File
Run003_09_15_00_10_17.rel	1KB	REL File
Run003_09_15_00_10_17.rs	1KB	RS File

The following is a sample ".RS" file:

```
"**PGEMS3 Run Specifications**","PFP Seismic without Ventilation"
9,15,0,10,17
3,30
0,1,0
50.,100.
9,1,0,6,0
5,0
1,0
0.,0.,25.,1.,1.,1.,2000.
566490,135570,3
```

The following are the parameter definitions for the ".RS" file are:

```
IMC,IDC,IYC,IHC,IMNC
NRUN, TIMESTEP
ISRCN, IACDNT, EXERCISE
DOMSIZE1, DOMSIZE2
IMB,IDB,IYB,IHB,IMNB
IHDur, IMMDur
IHRel, IMMRel
ZSOURC, SVELOC, STEMP, SRADIUS, SIGY0, SIGZ0, BLDAREA
XSRC, YSRC, ICOD1
```

Where:

IMC, IDC, IYC, IHC, IMNC = current month, day of the month, year, hour of the day, minutes after the top of the hour
NRUN = Sequential number of run used in naming output files. [default 1]
TIMESTP = Time step to output results (15, 30 or 60 minutes). [default 30.]
ISRCN = Id number of release location (0 to 13). If ISRCN = 0 then read source coordinates from last line in this file.
IACDNT = Id number of accident scenario (-1 to 63). [see notes below]
EXERCISE = If an exercise run then EXERCISE = 1 else EXERCISE = 0
DOMSIZE1 = Size of one side of inner square domain (km). [default 50.]
DOMSIZE2 = Size of one side of outer square domain (km). [default 100.]
IMB, IDB, IYB, IHB, IMNB = month, day, year, hour, and minutes after the top of the hour at the beginning of the release
IHDur, IMMDur = Duration of simulation in hours and minutes [default 4,0]
IHRel,IMMRel = Duration of release in hours and minutes [default 1,0]
ZSOURC = Height of release (m AGL). [default 0.]
SVELOC = Stack-gas exit velocity (m/s). [default 0.]
STEMP = Stack-gas exit temperataure (C). [default 25.]
SRADIUS = Stack diameter (m). [default 1.]
SIGY0 = Initial horizontal plume size - Sigma Y (m). [default 1.]
SIGZ0 = Initial vertical plume size - Sigma Z (m). [default 1.]
BLDAREA = Cross-sectional area of buildings (m^2). [default 2000.]
XSRC = X-coord. of release in Longitude (deg), UTM E (km), or State Plane E (m).
YSRC = Y-coord. of release in Latitude (deg), UTM N (km), or State Plane N (m).
ICOD1 = Coordinate system used (1=Long-Lat; 2=UTM E-N, 3=State E-N) [default=3]

NOTES:

1. Iacdnt = 0 means read from RELEDIT.DAT file for nuclides and releases.
2. For Iacdnt = 0 if release is negative then set total release (Ci) such that have a release rate of 1 Ci/s (Rel = release duration in sec).
3. Iacdnt = -1 means read from RELAFCD.DAT file for nuclide and release. Conditions are set for determining "affected area." Doses are not calculated; decay, deposition, and wake effectives are not active; release height and plume rise are zero; and a unit release rate of 1 Ci/s over the release duration is assumed.

The following is a sample ".REL" file:

```
Rad Name   Total Release (Ci)
"PU238",2.15E-02
"PU239",3.88E-01
"PU240",9.91E-02
"PU241",1.74E+00
"PU242",8.37E-05
"AM241",5.78E-02
```

The file lists each of the constituents released to the atmosphere and the quantity of material released (in Curies).

6.5 SHAPES Directory

The "SHAPES" directory is used to hold the contour shape files for plotting output products. Three types of files are found here and used to plot contours: ".DBF", ".SHP", and ".SHX" files. The run title name and output product type is presented before each file extension. The output product type is indicated by a three letter code, where "CEX" is Cumulative Exposure, "CCN" is Time Integrated Concentration, "CDT" is Total Effective Dose Equivalent, and "CDO" is Maximum Organ Dose.

Name	Size	Type
Run003_09_15_00_10_17cdo.dbf	7KB	DBF File
Run003_09_15_00_10_17cdo.shp	133KB	SHP File
Run003_09_15_00_10_17cdo.shx	1KB	SHX File
Run003_09_15_00_10_17cdt.dbf	5KB	DBF File
Run003_09_15_00_10_17cdt.shp	101KB	SHP File
Run003_09_15_00_10_17cdt.shx	1KB	SHX File
Run003_09_15_00_10_17ccn.dbf	3KB	DBF File
Run003_09_15_00_10_17ccn.shp	37KB	SHP File
Run003_09_15_00_10_17ccn.shx	1KB	SHX File
Run003_09_15_00_10_17cex.dbf	4KB	DBF File
Run003_09_15_00_10_17cex.shp	78KB	SHP File
Run003_09_15_00_10_17cex.shx	1KB	SHX File

6.6 STATICDATA Directory

The "STATICDATA" directory is used to hold a variety of data files that are generally read by ***APGEMS*** and not altered. These include a series of contour shape files for plotting background map features. The files with the ".DBF", ".SHP", and "SHX" extensions are used for these applications. These files contain information on area boundaries, major roads, major hydrologic features, buildings, and a one-kilometer grid that can be superimposed over the Site.

AREASL.DBF	GRID1KMP.DBF	MJRDL.SHP
AREASL.SHP	GRID1KMP.SHP	MJRDL.SHX
AREASL.SHX	GRID1KMP.SHX	NEWFACIL.DAT
BOUNDP.DBF	HRMDLIB.DAT	Pgems3.par
BOUNDP.SHP	HUDUFACT.DAT	RelAfcd.dat
BOUNDP.SHX	MJHYL.DBF	RittmannLib.dat
buildp.dbf	MJHYL.SHP	SrcLoc.dat
buildp.shp	MJHYL.SHX	USERFACIL.DAT
buildp.shx	MJRDL.DBF	USERSRCLOC.DAT

Another key file is the "PGEMS3.PAR" file. This file can be used to adjust model input parameters to support testing and the development of new model algorithms. Users are discouraged from editing this file unless they have checked with the authors of this user's Guide to discuss the implications of altering certain key parameters.

The "RELAFCD.DAT" file is a default release specification file for first-responder applications. "RITTMANLIB.DAT" contains factors for computing dose rates and converting activity concentrations to instrument readings. To illustrate its contents, Figure 6.1 presents file heading information and data for several radionuclides.

The "NEWFACIL.DAT" file (figure 6.2) presents source term information for each standard release scenario. Information presented includes operating area, name of the release scenario, the accident source release description, the constituents and inventory of the atmospheric release, the height of the release, and the identification number of the closest meteorology monitoring station. This file format was originally developed for use by the old Hanford Unified Dose Utility and is now used by ***APGEMS***. The "USERFACIL.DAT" file (Figure 6.3) presents source term information for each user-defined release scenario. It contains similar information to the New FACIL.DAT file (minus the height of the release and closest meteorology monitoring station) in a more compact form. The contents of this file are regularly changed as release scenarios are created (and deleted when no longer needed) to support exercises and user training.

The "SRCLOC.DAT" file (Figure 6.4) provides location information on a generic, centralized source release location for each major Hanford Site operating area. Locations are defined using multiple coordinate systems for the six 100 Areas, 200 West and 200 East Areas, 300 Area, 400 Area, the 1100 Area, HAMMER training facility, and the US Ecology waste disposal area. The "USERSRCLOC.DAT" file (Figure 6.5) provides the location of source release locations that are not defined in the SRCLOC.DAT file. This includes locations that correspond to each facility that contains substantial quantities of radiological material and user-defined release locations. User-defined locations include portions of buildings (to identify where the release to the atmosphere occurs from large structures), potential release locations during brushfires and exercise training sessions, and potential transportation accident locations. The contents of this file will be modified on a regular basis to account for the movement of radiological materials, adding new release locations for exercise and training purposes, deleting old exercise release locations, and mission changes.

```
September 28, 1999     KJ Allwine   PNNL            APGEMS  --  RITTMANNLIB.DAT
This file is the merging of two files from Paul Rittmann giving field instrument
response factors. The two files are Dra-cpm.dat and Dra-mrh.dat and were
merged using program FILEMERGE.  The name of the radionuclides were made
compatable with the APGEMS HUDU libraries (all uppercase and no dashes).
Below are the notes from the top of each of P. Rittmann's files:
-------------------------------------------------------------------------------
FILE: DRA-CPM.DAT
Converting Activity Concentrations to PAM and GM/P-11 Readings
by Paul D. Rittmann, PhD CHP            September 1, 1999
  A1 & A2:  conversions for the PAM with a 50 cm2 probe area
  B1 & B2:  conversions for the GM with a 15 cm2 P-11 probe area
Ground surface contamination is a thin layer over a large area.
          PAM reading (cpm) = (A1)(Bq/m2 on ground)
          GM reading (cpm) = (B1)(Bq/m2 on ground)
Air sample filter paper has an area of about 15 cm2
          PAM reading (cpm) = (200)(A1)(Bq on filter)
          GM reading (cpm) = (667)(B1)(Bq on filter)
Airborne contamination surrounds the detector
          PAM reading (cpm) = (A2)(Bq/m3 in the air)
          GM reading (cpm) = (B2)(Bq/m3 in the air)
Note:  These are the same as in ED4.WQ1
Note:  GM/P-11 responds to photons also --  3600 cpm per mR/h
------------------------------------------------------------------------------
FILE: DRA-MRH.DAT
Infinite Cloud & Infinite Plane Photon Dose Rate Factors
by Paul D. Rittmann, PhD CHP           September 28, 1999
Air Submersion:  dose rates at the center of an infinite hemisphere
                 in units of mR/h and mrem/h per Bq/cu.m
Ground Surface:  dose rates 1 meter above a 1 cm layer of contaminated soil
                 (density 1.5 kg/L) in units of mR/h and mrem/h per Bq/m2
Notes:  (1) mrem/h use ANSI/ANS-6.1.1 1991 for isometric exposure (all directions)
        (2) results computed by IDF Version 1.2 (May 1997)
        (3) nuclide data from DRALIST (Kocher 1981)
-------------------------------------------------------------------------------------
--
           ---------FILE: DRA-CPM.DAT------------    ---------FILE: DRA-MRH.DAT----------
--
                                                      Air, per Bq/cu.m    Ground, per
Bq/m2
Nuclide      A1        A2        B1        B2         mR/h     mrem/h     mR/h     mrem/h
H_3      0.00E+00  0.00E+00  0.00E+00  0.00E+00    2.42E-13  1.11E-15  1.89E-15  1.01E-17
BE7      0.00E+00  0.00E+00  0.00E+00  0.00E+00    1.38E-06  8.37E-07  1.74E-08  1.06E-08
BE10     0.00E+00  0.00E+00  1.14E-02  4.32E-03    1.14E-08  4.74E-09  1.99E-10  8.55E-11
C_10     0.00E+00  0.00E+00  1.26E-02  2.98E-02    4.79E-05  2.95E-05  5.98E-07  3.67E-07
C_11     0.00E+00  0.00E+00  1.23E-02  1.11E-02    2.83E-05  1.72E-05  3.58E-07  2.17E-07
C_14     0.00E+00  0.00E+00  5.27E-03  2.93E-04    6.00E-10  1.16E-10  9.80E-12  2.25E-12
N_13     0.00E+00  0.00E+00  1.24E-02  1.56E-02    2.83E-05  1.72E-05  3.58E-07  2.17E-07
N_16     0.00E+00  0.00E+00  1.26E-02  1.10E-01    1.25E-04  9.69E-05  1.00E-06  7.74E-07
O_14     0.00E+00  0.00E+00  1.26E-02  2.87E-02    9.10E-05  6.14E-05  9.86E-07  6.59E-07
O_15     0.00E+00  0.00E+00  1.25E-02  2.69E-02    2.84E-05  1.72E-05  3.60E-07  2.18E-07
F_18     0.00E+00  0.00E+00  1.17E-02  5.68E-03    2.74E-05  1.66E-05  3.46E-07  2.10E-07
NA22     0.00E+00  0.00E+00  1.07E-02  4.22E-03    6.04E-05  3.85E-05  7.14E-07  4.55E-07
NA24     0.00E+00  0.00E+00  1.23E-02  1.85E-02    1.12E-04  7.83E-05  1.15E-06  7.96E-07
MG27     0.00E+00  0.00E+00  1.24E-02  2.54E-02    2.46E-05  1.56E-05  2.95E-07  1.87E-07
MG28     0.00E+00  0.00E+00  1.03E-02  2.80E-03    3.77E-05  2.42E-05  4.36E-07  2.79E-07
AL26     0.00E+00  0.00E+00  1.02E-02  1.26E-02    7.35E-05  4.84E-05  8.28E-07  5.43E-07
AL28     0.00E+00  0.00E+00  1.26E-02  5.26E-02    4.90E-05  3.33E-05  5.23E-07  3.56E-07
SI31     0.00E+00  0.00E+00  1.23E-02  2.05E-02    1.13E-07  6.37E-08  1.83E-09  1.03E-09
SI32     0.00E+00  0.00E+00  6.78E-03  5.84E-04    1.23E-09  3.05E-10  2.04E-11  5.79E-12
P_32     0.00E+00  0.00E+00  1.24E-02  2.51E-02    1.18E-07  6.46E-08  2.08E-09  1.15E-09
P_33     0.00E+00  0.00E+00  7.66E-03  8.31E-04    1.78E-09  4.93E-10  2.97E-11  9.24E-12
S_35     0.00E+00  0.00E+00  5.10E-03  3.08E-04    6.69E-10  1.36E-10  1.09E-11  2.63E-12
CL36     0.00E+00  0.00E+00  1.13E-02  6.03E-03    1.79E-08  8.09E-09  3.16E-10  1.46E-10
```

Figure 6.1. Edited Version of the Beginning of the RITTMANLIB.DAT File

```
Combined Source Library              LRC                   5/2000

Area - 100

Facility - 105-F Fuel Element Drop

A fuel element that was left behind when the 105-F fuel storage basin was
closed is excavated during remediation and accidentally dropped.  The RRF
is 1E-03.
(BHI-01287, Rev. 0, 6.1.1).

Source Term

SR90      2.93E-04
CS137     2.97E-04
EU152     1.50E-09
PU238     1.80E-07
PU239     1.50E-05
PU241     5.34E-05
KR85      8.60E-06
SM151     3.60E-06
NB94      8.00E-09
SE79      2.00E-09
PD107     2.00E-10
AM241     3.90E-06
TC99      1.00E-05
ZR93      2.00E-08
U 238     6.00E-08

Height of Release - 0.        ft

Met Tower:  7

Area - 100

Facility - 105-F waste Fire Scenario

Burning of material excavated from the 105-F fuel storage basin releases
radioactivity into the air. The RRF is 1E-03.
(BHI-01287, Rev. 0, 6.1.2).

Source Term

CO60      1.06E-04
NI59      2.25E-05
NI63      2.49E-03
SR90      1.84E-03
NB94      4.50E-08
TC99      4.50E-08
CS137     1.92E-03
EU152     3.44E-05
EU154     7.32E-05
U 238     6.75E-07
PU238     3.92E-06
PU239     1.39E-04
AM241     5.30E-05
PU241     5.28E-04

Height of Release - 0.        ft

Met Tower:  7
```

Figure 6.2. The Beginning of the NEWFACIL.DAT File. Information is presented for the first two scenarios in the file.

```
3
"FFTF Interim Storage Cask * 2"
"Accident Description - FFTF ISC Crushed by Crane . A crane falls on one of the Interim
Storage Casks crushing seven irradiated fuel elements.  Open area ground level release.
Release is double that for the standard FFTF Interim Storage Cask scenario"
29,"H3",1100,"KR85",9400,"SR90",1.76,"Y90",1.76,"TC99",0.0008,"RU106",1.72,
"AG110M",0.0032,"CD113M",0.0046,"TE125M",0.104,"SB125",0.42,"I 129",0.092,"CS134",0.88,
"CS137",4.8,"CE144",0.6,"PR144M",0.007,"PR144",0.6,"PM147",3,"SM151",0.182,"EU154",0.178,
"EU155",0.42,"PU238",0.098,"PU239",0.122,"PU240",0.094,"PU241",5.2,"AM241",0.088,
"AM242M",0.0066,"CM242",0.0066,"CM243",0.007,"CM244",0.007
"PFP    Criticality *.5"
"Accident Description - PFP Complex Criticality *05. Reduction of PFP Criticality
emissions by 50%.  The PFP Criticality sceranio says: A liquid solution criticality
occurs in the PFP Complex with 1E18 initial fissions followed by bursts of 1.9E17
fissions at ten minute intervals.  All noble gases and 25 percent of the iodines are
released into the room volume. A transmission factor of 5 x 10-4 for particulate is used
for a single HEPA filter (not noble gases or iodines). Only first hour fissions
considered. ."
24,"KR83M",10.5,"KR85M",7,"KR85",0.000085,"KR87",42.5,"KR88",23,"KR89",1300,"I 131",0,
"I 132",30,"I 133",3.95,"I 134",105,"I 135",11,"XE131M",0.01,"XE133M",0.22,
"XE133",2.7,"XE135M",325,"XE135",40.5,"XE137",4900,"XE138",1050,"PU238",0.00000015,
"PU239",0.000000007,"PU240",0.0000000145,"PU241",0.0000045,"AM241",0.000000006,
"PU242",0.00000000011
"Burial Grounds  TRU Drum Sabotage * 0.3"
"Accident Description - TRU Drum Sabotage . An explosion releases material from four TRU
drums.  The total airborne release is 4 grams of TRU.  The Hazards Assessment added 300
meters to the receptor point distances to account for plume rise.   Assume only 240 gm of
Pu instead of 800 gm"
6,"PU238",0.0164,"PU239",0.0624,"PU240",0.0354,"PU241",1.36,"AM241",0.072,
"PU242",0.0000014
```

Figure 6.3. A Sample USERFACIL.DAT file with Three Release Scenarios. The number on the first line indicates the number of scenarios. Each scenario name (e.g., “FFTF Interim Storage Cask * 2”, “PFP Criticality *.5”, "Burial Grounds TRU Drum Sabotage * 0.3") is followed by an accident description field. This is followed by the number of constituents in the release, and a list of the constituents and their release inventory (Ci).

NO.	NAME	WA-S N (m)	WA-S E (m)	LAT (deg)	LONG (deg)	UTM N (m)	UTM E (m)	N-mid (km)	E-mid (km)
1	100B_C	144400	565200	46.62931	119.64853	5167200	297300	5170	300
2	100K	146500	569000	46.64781	119.59858	5169100	301100	5170	300
3	100N	149500	571200	46.67458	119.56939	5172000	303500	5170	305
4	100D	151600	573400	46.69325	119.54031	5174000	305800	5175	305
5	100H	152800	577600	46.70356	119.48519	5175000	310000	5175	310
6	100F	147800	580600	46.65822	119.44683	5169900	312800	5170	315
7	200W	135000	567000	46.54458	119.62636	5157700	298600	5160	300
8	200E	136500	573500	46.55739	119.54139	5158900	305200	5160	305
9	300A	116000	594000	46.37042	119.27819	5137500	324800	5140	325
10	400A	123100	587600	46.43517	119.36003	5144900	318700	5145	320
11	1100A	111000	593300	46.32554	119.28829	5132500	323900	5135	320
12	HAMMER	114000	590500	46.35292	119.32408	5135700	321200	5135	320
13	US_ECOLOGY	134300	572200	46.53775	119.55869	5156800	303800	5155	305

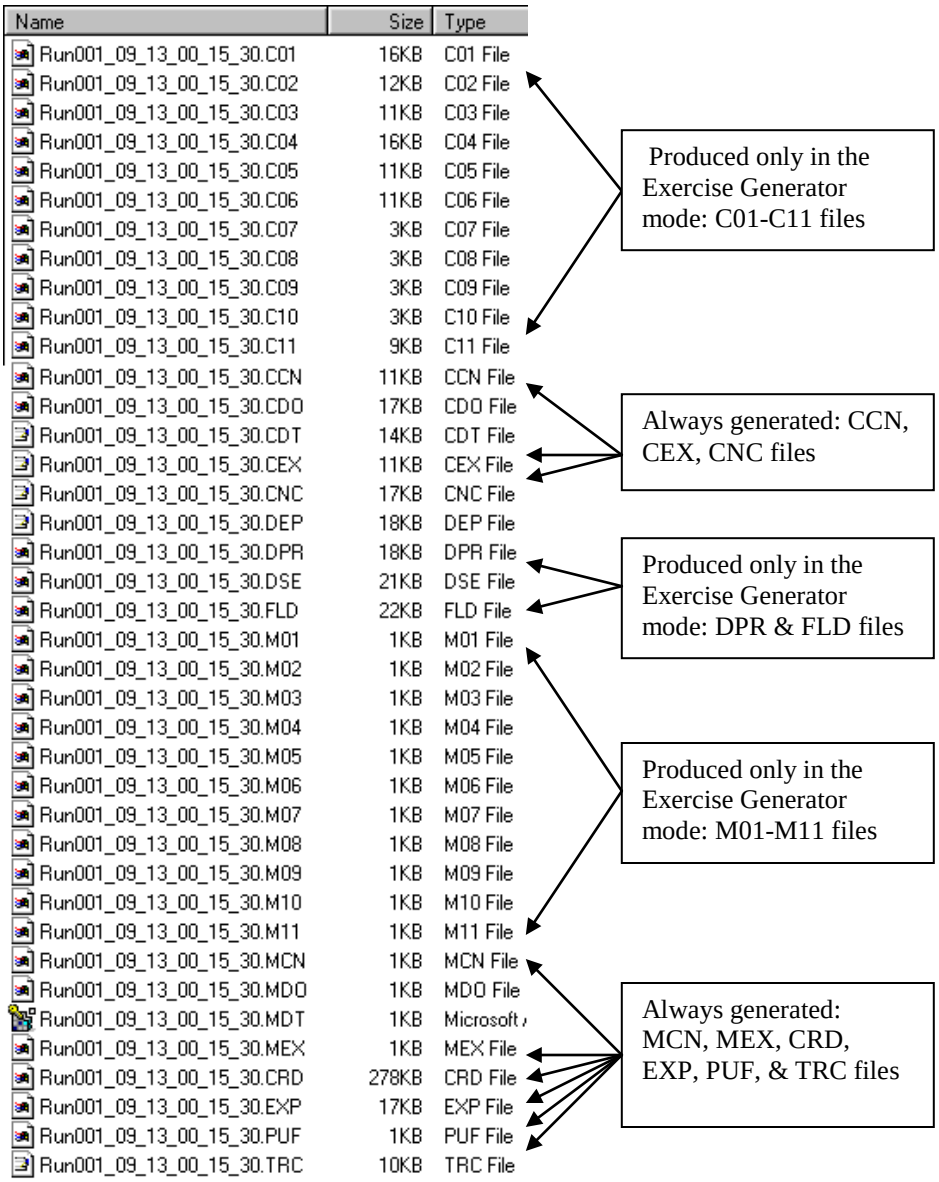
Figure 6.4. The SRCLOC.DAT file. Each line presents the number, name, and coordinates (in several different systems) for a centralized location in each major operating area.

```
62
"(100K)Cold Vacuum Drying Facility",146320,568640
"105B Retired Reactor (100B/C)",144540,565290
"105C Retired Reactor (100B/C)",144040,565350
"105DR Retired Reactor (100D/DR)",151300,573760
"105D Retired Reactor (100D/DR)",151590,573750
"105F Retired Reactor (100F)",147620,580430
"105H Retired Reactor (100H)",152550,577770
"105KE",146720,569180
"105KW",146450,568640
"105N Retired Reactor (100N)",149510,571190
"(200E) BPlant",136470,573540
"(200E) ETF/LERF",137320,575900
"(200E) PUREX",135650,575110
"(200E) Solid Waste Burial Ground",137360,572970
"(200E) WESF",136470,573350
"(200W) Burial Grounds",137160,565530
"(200W) Central Waste Complex",136090,565840
"(200W) Plutonium Finishing Plant",135670,566470
"(200W) TPlant",136850,567560
"(200W) U03 Facility",135170,567540
"(200W) WRAP",136520,565840
"202S Facility (200W)",133960,567340
"203S Facility (200W)",134020,567340
"212N Storage Facility (600)",140340,569880
"212R Storage Facility (600)",140350,571480
"222S Laboratory (200W)",133890,567420
"224B Building (200E)",136400,573410
"241B Tank Farm (200E)",137450,573430
"241S Tank Farm (200W)",134360,566780
"241T Tank Farm (200W)",136730,566790
"241U Tank Farm (200W)",135080,566800
"242A Evaporator (200E)",136000,575380
"241C Tank Farm (200E)",136470,575200
"241A Tank Farm",136120,575400
"283W Chlorinator (200W)",136100,567660
"300 Area Fuel Shutdown (303;3712;3716)",116070,593860
"303K Building",116110,593800
"308 Building",115790,594110
"310 TEDF",117380,593730
"324 Building",115790,594250
"325 Building",115800,593970
"327 Building",115960,593980
"337 Building",115670,594500
"340 Building",115960,594150
"(400)FFTF",123120,587600
"Prosser Barricade",128170,585030
"Yakima Barricade",138435.22,559232.72
"Pfp Test 3",136270,565870
"March 28 CWC Exercise",136220,565990
"PFP Main Stack",135560,566490
"325 building north wing",115830,593980
"ringold",134080,595820
"628fire2",151130,549010
"628fire3",138420,549680
"628fire4",132910,551850
"FlamFrontNorth",135750,561550
"FlmFrontSouth",124210,577100
"222S 200West",133940,567390
"300Drum",115940,593910
"6652D Ale",117100,575990
"Tank 201 AN - 200E - Exer Jupiter",136390,575350
"PFP test 7",135600,566450
```

Figure 6.5. Sample USERSRCLOC.DAT file.

6.7 TDMOUT Directory

The "TDMOUT" directory contains the exposure, concentration, and dose output files from each ***APGEMS*** simulation. File names follow the standard convention of including the data the model simulation was run. Each model run generates a number of different types of output files. The first-responder runs generate the smallest number of files



Files generated by all model runs include files with the extensions TRC, PUF, EXP, CRD, CCN, CEX, CNC, MCN, and MEX. Files generated when a source release scenario other than the first-responder include those with extensions CDO, CDT, DEP, DPR, DSE, FLD, MDO, MDT. The Exercise Generator model produces files with the extension C01-C11 and M01-M11. All these files are briefly described in Table 6.1.

Table 6.1. Types of TDMOUT Output Files

File Extension	Description	When Generated
C01	Contours of Activity Grab Air - Alpha	EG mode only
C02	Contours of Activity Grab Air – Beta	EG mode only
C03	Contours of PAM Air	EG mode only
C04	Contours of PAM Ground	EG mode only
C05	Contours of GM-P11 Air	EG mode only
C06	Contours of GM-P11 Ground	EG mode only
C07	Contours of CP Air – Window Open	EG mode only
C08	Contours of CP Air – Window Closed	EG mode only
C09	Contours of CP Ground – Window Open	EG mode only
C10	Contours of CP Ground – Window Closed	EG mode only
C11	Contours of Micro Rem Meter Air	EG mode only
CNC	Radionuclide concentration information	All except 1st respd
CD0	Contours of Maximum Organ Dose	All except 1st respd.
CDT	Contours of Total Effective Dose Equivalent	All except 1st respd
CCN	Contours of Time Integrated Concentration	All modes
CEX	Contours of Cumulative Exposure	All modes
DEP	Array of ground deposition values	All modes
DPR	Array of deposition values for each radionuclide	EG mode only
DSE	Detailed dose information used to calculate TEDE and max organ dose	All except 1st respd
FLD	Array of Instrument reading values	EG mode only
M01	Maximum values at key distances of Activity Grab Air - Alpha	EG mode only
M02	Maximum values at key distances of Activity Grab Air – Beta	EG mode only
M03	Maximum values at key distances of PAM Air	EG mode only
M04	Maximum values at key distances of PAM Ground	EG mode only
M05	Maximum values at key distances of GM-P11 Air	EG mode only
M06	Maximum values at key distances of GM-P11 Ground	EG mode only
M07	Maximum values at key distances of CP Air – Window Open	EG mode only
M08	Maximum values at key distances of CP Air – Window Closed	EG mode only
M09	Maximum values at key distances of CP Ground – Window Open	EG mode only
M10	Maximum values at key distances of CP Ground – Window Closed	EG mode only
M11	Maximum values at key distances of Micro Rem Meter Air	EG mode only
MCN	Maximum values at key distances of Time Integrated Concentration	All modes
MDO	Maximum values at key distances of Maximum Organ Dose	All except 1st respd
MDT	Maximum values at key distances of Total Effective Dose Equivalent	All except 1st respd
MEX	Maximum values at key distances of Cumulative Exposure	All modes
CRD	Record coordinates	All Modes
EXP	Exposure tracking information for each contaminant	All modes
PUF	Puff tracking information	All modes
TRC	Diagnostic and summary file	All modes

6.8 TERDATA Directory

The "TERDATA" directory contains the terrain data input files required by the model. There are two kinds of files in this directory, ".BTF" and ".HTF" files. The ".BTF" files are base terrain data files in binary format. Contained in this type of file are terrain heights in latitude and longitude coordinates. For Hanford Site operation, terrain data are provided with a spacing of 30 arc-seconds in the "SE_WASH.BTF" file and with a spacing of 3 arc-seconds in the "WALLA_WALLA-W.BTF" file.

Name	Size	Type
Se_wash.btf	408KB	BTF File
SE_WASH.HTF	1KB	HTF File
walla_walla-w.btf	2,818KB	BTF File
walla_walla-w.htf	1KB	HTF File

The ".HTF" file is a short text file the gives the properties of the base terrain file. The "SE_WASH.HTF" file is:

```
121.995830, 117.004200, 47.904170, 45.012500, 30.0
600, 348
1.
```

The "WALLA_WALLA-W.BTF file is:

```
120., 119., 47., 46., 3.0
1201, 1201
1.
```

Both files are of the form:

RFLONGW, RFLONGE, RFLATN, RFLATS, ARCSEC
IPTS, JPTS
FACM

Where:

RFLONGW = West longitude of the west-side of the region (+ degrees)
RFLONGE = West longitude of the east-side of the region (+ degrees)
RFLATN = North latitude of the north-side of the region (degrees)
RFLATS = North latitude of the south-side of the region (degrees)
ARCSEC = Spacing between grid points (arc-seconds)
IPTS = Number of grid points in north-south direction
JPTS = Number of grid points in west-east direction
FACM = Multiplier to convert given elevation to meters

More information on terrain data files are provided in Allwine and Bian (1995).

6.9 TEROUT Directory

The "TEROUT" directory contains the terrain data output files generated by the model. There are two kinds of files in this directory, ".TRC" and ".TER" files. The ".TRC" files are diagnostic and summary files generated during each run of the ***APGEMS*** terrain processing program.

Name	Size	Type
245_5110_120.TRC	5KB	TRC File
245_5110_120F.TER	15KB	TER File
245_5110_120S.TER	20KB	TER File
275_5140_060.TRC	5KB	TRC File
275_5140_060F.TER	15KB	TER File
275_5140_060S.TER	20KB	TER File
260_5130_080.TRC	5KB	TRC File
260_5130_080F.TER	15KB	TER File
260_5130_080S.TER	20KB	TER File
280_5150_040.TRC	5KB	TRC File
280_5150_040F.TER	15KB	TER File
280_5150_040S.TER	20KB	TER File

There are two types of ".TER" files that are generated, "---S.TER" and "---F.TER" files. The "S.TER" file provides the gridded average terrain heights that are used by the ***APGEMS*** meteorology and transport/diffusion models. The "F.TER" file provides the values for the "lower" terrain height, obstacle height, and the drainage direction on a 10 by 10 grid that covers the modeling domain. These are part of the model's Froude terrain statistics. More information on these files, including their format and usage, is provided in Allwine and Bian (1995).

6.10 WEB Directory

The "WEB" directory receives Internet-compatible output products from ***APGEMS***. This directory contains a number of different types of files. The key files in this directory have ".HTML, ".JS", and ".GIF" extensions.

The ".HTML" files are the screens used by WebEOC users to select the output products to display. The ".JS" files are Java script files that are used by the ".HTML files to aid in the display of WebEOC output products. The actual ***APGEMS*** WebEOC output products are provided as ".GIF" files. The title of each file gives the date and time the simulation was run and the type of output it contains (see Table 6.1 for the definitions of the three letter codes used to name output products). The number presented in front of the ".GIF" extension indicates the sequence of the output products (e.g., 1 = results at the end of the first output interval, 2 = results at the end of the second output interval). Output form other programs may be copied to this directory. Two files in the above example, METRESULTS.JS and WNDVCTR.GIF, provide WebEOC output of

meteorological data display graphics generated by the ***MetView*** program[4]. These two files are not used or generated by ***APGEMS***.

Name	Size	Type
UDACBack.jpg	1KB	JPEG Image
Animate.js	1KB	JScript Script File
WND.html	1KB	Microsoft HTML ...
CCN.html	2KB	Microsoft HTML ...
CDO.html	2KB	Microsoft HTML ...
CDT.html	2KB	Microsoft HTML ...
CEX.html	2KB	Microsoft HTML ...
WEBEOC.html	3KB	Microsoft HTML ...
Run001_09_22_00_13_31cex1.gif	74KB	GIF Image
Run001_09_22_00_13_31cex2.gif	74KB	GIF Image
Run001_09_22_00_13_31cex3.gif	74KB	GIF Image
Run001_09_22_00_13_31cex4.gif	74KB	GIF Image
Run001_09_22_00_13_31ccn1.gif	74KB	GIF Image
Run001_09_22_00_13_31ccn2.gif	74KB	GIF Image
Run001_09_22_00_13_31ccn3.gif	74KB	GIF Image
Run001_09_22_00_13_31ccn4.gif	74KB	GIF Image
Run001_09_22_00_13_31cdt1.gif	74KB	GIF Image
Run001_09_22_00_13_31cdt2.gif	74KB	GIF Image
Run001_09_22_00_13_31cdt4.gif	74KB	GIF Image
Run001_09_22_00_13_31cdt3.gif	74KB	GIF Image
Run001_09_22_00_13_31cdo2.gif	74KB	GIF Image
Run001_09_22_00_13_31cdo1.gif	74KB	GIF Image
Run001_09_22_00_13_31cdo3.gif	74KB	GIF Image
Results.js	1KB	JScript Script File
Run001_09_22_00_13_31cdo4.gif	74KB	GIF Image
wndvctr.gif	282KB	GIF Image
MetResults.js	1KB	JScript Script File

[4] ***MetView*** is a meteorological display and assessment tool used at the EOC, HMS, and other locations (Glantz et al. 2000). It is often used to analyze meteorological conditions associated with an ***APGEMS*** simulation.

7.0 OPERATING IN THE EXERCISE AND EXERCISE GENERATOR MODE

The default operation mode for the ***APGEMS*** program is the Standard mode. Other modes of operation are the Exercise and Exercise Generator modes. The Standard mode is used during actual emergencies or drills and uses real-time data.

The Exercise mode is used during drills that involve "canned" meteorological data. These are usually exercises in which historical meteorological data that fit the drill's training criteria are re-dated to work during the training event.

To run in the Exercise Mode, double-click on the ***APGEMS*** Exercise icon on the desktop. The command line of this shortcut runs "***APGEMS.EXE /e"*** . The "/e" flags the program to run in the Exercise mode. In this mode, data files are accessed from the appropriate exercise data directory rather than the real-time data directory. The directory path for exercise data is specified in Canned Exercise Met. Data text box in the Directories folder (part of the Configuration Menu).

Exercise data are only accessible by the model at times when that data would be available if this were a real event. Typically it takes about ten minutes for data to be collected, processed, reformatted, and transmitted to the EOC. Therefore, in this mode, data are initially accessible ten minutes after the time for which the data are valid.

For example, the exercise data directory may contain meteorological data from 8 AM to 4 PM for the day of the exercise. This data may have been loaded into this directory days or weeks before the exercise. At 9 AM on the day of the exercise, the model can access exercise data from 8 AM through 8:45 AM. The 9 AM data will not be accessible until 9:10 AM. Data from later times are also inaccessible at 9 AM. If at 9 AM a three-hour simulation is run with a release start time of 8 AM, the model can only use meteorological data from 8 AM through 8:45 AM in the simulation. Meteorological data from 8:45AM if used to represent conditions from then through the simulation's end at 11 AM. If the same simulation is rerun at 9:12 AM, the model can use meteorological data from 8 AM through 9:00 AM in the simulation. Meteorological data from 9:00AM is used to represent conditions from at time through the simulation's end at 11 AM. In this way, the model's acquisition of exercise data accurately simulates the way it acquires data during a real event.

The Exercise Generation mode is used to create the comprehensive exercise data packages that are used by exercise controllers to run a training event. In addition to generating estimate of the affected area, plume position, and dose impacts throughout the exercise, the model also generates readings for each type of monitoring instrument used by field teams (e.g., PAM Air, GM-P11, CP, Micro Rem Meter).

To run in the Exercise Generator Mode, double-click on the ***APGEMS*** Exercise icon on the desktop. The command line of this shortcut runs "***APGEMS.EXE /g"*** . The "/g"

flags the program to run in the Exercise Generator mode. In this mode, data files are accessed from the exercise data directory rather than the real-time data directory. The directory path for exercise data is specified in Canned Exercise Met. Data text box in the Directories folder (part of the Configuration Menu).

Graphical plots of all output products, including instrument readings, are produced at intervals as short as 15-minutes for the entire exercise.

8.0 METEOROLOGICAL DATA FILES

There are five types of meteorological data files that are used by ***APGEMS***.

1. Telemetry file - contains near-surface data from each of the monitoring network's stations. This file has a "TE" designation in its name.

2. Surface observation file - contains observations entered by the duty meteorologist. This includes data such as cloud ceiling, solar radiation, mixing depth, and visibility. This file has an "OB" designation in its name.

3. 200-ft tower data file - contains data from all heights on the "200-ft" towers. This file has a "2F" designation in its name.

4. 400-ft tower data file - contains data from all heights on the HMS's "400-ft" tower. This file has a "2F" designation in its name.

5. Sodar data file - contains data from the Doppler acoustic sodars. This file has a "SO" designation in its name.

In the following sections we present the naming convention for the meteorological data files and describe in detail each type of file.

8.1 Meteorological Data File Naming Convention

Every 15 minutes new meteorological data are received at the HMS and processed into data files that are automatically copied to ***APGEMS*** servers (including the EOC server). File names contain the date and time for which the files contain data. The following naming convention is observed for all files:

YyMmDdHh.NnT

where: Yy = the two digit year code (e.g., 99 = 1999, 00 = 2000)
Mn = the two digit month code (e.g., 01 = January, 02 = February)
Dd = the day of the month (e.g., 01 = the 1st, 02 = 2nd, 31 = 31st)
Hh = hour of the day (01 = 1 AM, 13 = 1 PM, 23 = 11 PM)
Nn = the name of type of data file (i.e., TE, OB, 2F, 4F, or SO)
T = the first digit in the minutes after the hour, where "0" indicates the data for the top of the hour, "1" for 15 min after the hour, "3" for 30 min after the hour, and "4" for 45 min after the hour.

All date/time combinations are in Pacific Standard Time (PST) throughout the year. Because Pacific Daylight Time (PDT) is one hour ahead of PST, the file "00061923.TE3" provides data for June 20, 2000, at 12:30 PDT (June 19, 2000 at 23:30

ST). The decision to keep files date/time in PST was made because the meteorology station operates on PST throughout the year. In addition, if we allowed the date/times in the file name to transition between PST and PDT, we would have a missing hour of data during the spring transition to PDT and two hours of data with the exact same file names during the fall transition.

8.2 Description of the Telemetry Data File

The telemetry data file presents near-surface meteorological data. For Hanford, this means meteorological measurements made at each of 30 monitoring stations. A sample telemetry data file is provided in Figure 8.1. The first three lines of the file present introductory information. This includes a label (i.e., "HMS Telemetry Data"), the date and time at the end of the 15-minute monitoring period, and the number of active monitoring stations. The next two lines present the parameter name and unit of measure for each column of data to be presented in the file. Following this introduction, meteorological data and station information are presented with one line of data for each station. Each line of station data presents the:

- ID number for the station
- 4-character name of the station
- wind direction – this is the average direction of the wind (in degrees from North) at approximately 9 m (30 ft) above ground level. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-min averaging period and then dividing by the number of observations.
- wind speed – this is the average speed of the wind (in mph) at approximately 9 m (30 ft) above ground level. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-min averaging period and then dividing by the number of observations.
- air temperature – this is the average temperature (°F) during the 15-min averaging period at approximately 1.7 m (5.5 ft) above ground level. It is computed by averaging all the temperature observations reported at 5-second intervals during the 15-min averaging period.
- precipitation amount during the15-min measurement period (inches per 15 min). It is measured using a tipping rain gage. Precipitation values represent the liquid water content of the precipitation. Stations that are not measuring precipitation present a missing data code "-99.00".

```
HMS Telemetry Data
 11/09/1999 13:45 PST
 30 stations
num,name, wdir , wspd , temp , precp, pres , elev , LONGITUDE, LATITUDE, ELEV,  UTM E,  UTM N , WA-S E, WA-S N
          (deg), (mph),(degF), (in.),(inHg), (ft.),   (deg)  ,   (deg) ,  (m),   (m) ,   (m)  ,   (m) ,   (m)
  1,PROS, 330.7,   5.2,  50.3,   .00,-99.00, 480.0, 119.41214, 46.39181,  146, 314542, 5140191, 583663, 118226
  2,EOC , 123.4,   2.1,  49.6,   .00,-99.00,1240.0, 119.53703, 46.39225,  378, 304942, 5140540, 574058, 118150
  3,ARMY, 294.5,   2.7,  50.9,   .00,-99.00, 565.0, 119.55122, 46.48933,  172, 304199, 5151362, 572837, 128927
  4,RSPG,   4.7,   3.8,  49.8,   .00,-99.00, 680.0, 119.70006, 46.50597,  207, 292840, 5153591, 561393, 130650
  5,EDNA, 317.8,   6.2,  51.2,-99.00,-99.00, 410.0, 119.39747, 46.58714,  125, 316329, 5161860, 584488, 139951
  6,200E, 309.6,   4.8,  50.5,   .00, 29.11, 680.0, 119.52147, 46.55614,  207, 306719, 5158712, 575029, 136380
  7,200W, 339.0,   4.2,  50.3,   .00,-99.00, 650.0, 119.66264, 46.54272,  198, 295848, 5157577, 564221, 134764
  8,BVLY, 309.2,   1.9,  49.8,   .00,-99.00, 555.0, 119.94364, 46.75236,  169, 275175, 5181635, 542506, 157875
  9,FFTF, 320.2,   4.8,  49.7,   .00, 29.22, 570.0, 119.35986, 46.42953,  174, 318687, 5144261, 587623, 122475
 10,YAKB, 334.6,   2.7,  49.4,   .00, 28.97, 795.0, 119.72622, 46.57806,  242, 291109, 5161670, 559306, 138641
 11,300A, 330.9,   6.6,  50.5,   .00, 29.40, 390.0, 119.28617, 46.36425,  119, 324139, 5136841, 593398, 115304
 12,WYEB, 302.3,   4.7,  50.3,   .00,-99.00, 550.0, 119.39119, 46.48211,  168, 316456, 5150175, 585133, 128285
 13,100N, 240.7,   3.7,  51.8,   .00, 29.33, 460.0, 119.55083, 46.68886,  140, 304947, 5173531, 572600, 151104
 14,WPPS, 315.1,   5.0,  50.9,   .00,-99.00, 450.0, 119.34481, 46.47014,  137, 319977, 5148739, 588714, 127005
 15,FRNK, 320.8,   4.3,  48.6,-99.00,-99.00, 875.0, 119.23792, 46.41733,  267, 328017, 5142633, 597016, 121262
 16,GABL, 311.5,   5.1,  47.9,-99.00,-99.00,1085.0, 119.46011, 46.59844,  331, 311569, 5163263, 579671, 141142
 17,RING, 248.8,   5.0,  51.3,   .00,-99.00, 620.0, 119.23761, 46.54494,  189, 328443, 5156811, 596812, 135444
 18,RICH, 306.4,   6.3,  49.5,   .00, 29.37, 390.0, 119.30103, 46.30072,  119, 322790, 5129816, 592362, 108227
 19,PFP ,   1.3,   4.2,  49.5,-99.00, 29.11, 675.0, 119.63258, 46.54539,  206, 298163, 5157796, 566523, 135085
 20,RMTN, 209.1,  20.9,  44.2,   .00,-99.00,3560.0, 119.59292, 46.39431, 1085, 300652, 5140909, 569758, 118328
 21,HMS , 349.0,   3.1,  49.8,   .00, 29.06, 733.0, 119.59917, 46.56278,  220, 300788, 5159643, 569063, 137047
 22,PASC, 289.3,   6.0,  52.4,   .00,-99.00, 410.0, 119.11425, 46.25714,  125, 337045, 5124573, 606834, 103619
 23,GABW, 286.1,   4.1,  50.7,-99.00,-99.00, 490.0, 119.55792, 46.61181,  149, 304126, 5164988, 572161, 142533
 24,100F, 307.8,   3.2,  51.5,   .00,-99.00, 410.0, 119.45231, 46.63458,  125, 312292, 5167260, 580216, 145167
 25,VERN, 257.7,   6.9,  50.2,-99.00,-99.00, 430.0, 119.72750, 46.64111,  131, 291254, 5168679, 559140, 145649
 26,BENT,  48.0,   5.1,  48.8,   .00,-99.00,1055.0, 119.60767, 46.29003,  322, 299137, 5129360, 568755, 106725
 27,VSTA, 310.2,   6.0,  51.1,   .00,-99.00, 503.0, 119.20122, 46.21833,  153, 330223, 5120443, 600200,  99192
 28,SURF, 231.8,   3.5,  48.2,   .00, 29.44, 275.0, 120.19861, 45.72500,  107, 251096, 5068253, 523463,  43579
 29,100K, 249.3,   5.3,  51.0,   .00, 29.34, 450.0, 119.57750, 46.65733,  137, 302792, 5170094, 570601, 147575
 30,HAMR, 337.4,   5.6,  50.1,-99.00,-99.00, 450.0, 119.32583, 46.35639,  137, 321062, 5136057, 590359, 114385
```

Figure 8.1. A Sample Telemetry Data file. This file is named 99110913.TE4, indicating that it is the telemetry file for November, 19, 1999 at 1:45 PM PST

- atmospheric pressure – this is the average atmospheric pressure (inches of Mercury) during the 15-minute averaging period. Atmospheric pressure is measured at ~ 1.7 m (5.5 ft) above ground level. It is computed by averaging all the temperature observations reported at 5-second intervals during the 15-minute averaging period. Stations that are not measuring pressure present a missing data code "-99.00".

- station elevation[5] (feet above sea level)

- station longitude (degrees West)

- station latitude (degrees North)

- station elevation[4] (meters above sea level)

- local UTM east/west coordinate (meters East)

- local UTM north/south coordinate (meters North)

- Washington State planar east/west coordinate (meters East)

- Washington State planar north/south coordinate (meters North)

8.3 Description of the Surface Observation Data File

The surface observation data file presents hourly meteorologist observations and a summary of key instrument readings. The data in this file are not automatically updated; instead, new data must be input by the meteorologist. If new data are not available, the surface observation data file will still be generated every 15 minutes using the most recent data available (even if the data are old). A sample surface observation data file is provided in Figure 8.2. The first two lines of the file present introductory information. This includes a label (i.e., "HMS Surface Observation") and the date and time at which the data were observed. The next two lines present the parameter names and units of measure for the data presented in the file. Following this introduction, a line of surface observation data is presented. This line provides:

- cloud ceiling height (hundreds of feet above the surface) – this is the height of the cloud base. At night, the ceiling height is measured using a cloud ceiling light projector and a clinometer. During the day, ceiling height is estimated from aviation reports and other sources of information.

---

[5] Station elevation is provided twice in each line of data (using two different units of measure). This allows the telemetry data file to meet the requirements of different software products that access these data.

```
HMS Surface Observation
 11/09/1999 13:00 PST
 ceil,  vis, slpr , dewpt,  dir,  spd, stapr, dry,wetb,  rh,   sc  ,precp,  solar, mix
(hft),(mi.), (mbs),  (F) ,(deg),(mph),(inHg), (F), (F), (%),(10ths),(in./hr),(ly/mn), (m)
   60,  150,1010.6,    45,   80,    4, 29.06,  50,  47,  82,     10,  .00,    .18, 500,
0
```

Figure 8.2. A Sample Surface Observation file. This file is named 99110913.OB4, indicating that it is the surface observation file for November, 19, 1999, at 1:45 p.m. PST

- visibility (miles) – subjectively determined by the duty meteorologist based on ability to discern landmarks at known distances.

- atmospheric pressure corrected to sea level (millibars) – the station pressure measured near the top of the hour is multiplied by the appropriate factors to obtain the pressure that would be observed if the station were located at sea level instead of its actual elevation of 220 m (772 ft) above sea level.

- wind direction (°F) – this is based on an observation made near the top of the hour using the instrument mounted at the 30-m (50-ft) level on the "400-ft" tower.

- wind speed (mph) – this is based on an observation made near the top of the hour using the instrument mounted at the 30-m (50-ft) level on the "400-ft" tower

- station atmospheric pressure (inches of Mercury) – this is based on a measurement of atmospheric pressure made near the top of the hour.

- dry bulb temperature (°F) – this is another name for the air temperature. It is based on an observation made near the top of the hour using a temperature sensor mounted at 1.5 m (5 ft) above ground level.

- wet bulb temperature (°F) – the temperature to which a parcel of air is cooled by evaporating water into it until the air is saturated. This is a measure of atmospheric moisture. It is based on an observation made near the top of the hour using a sensor mounted at 1.7 m (5.5 ft) above ground level.

- relative humidity (%) – is the ratio of amount of moisture the air is holding to the maximum amount it can hold at its current temperature. It is computed based on measurements made by temperature and atmospheric moisture sensors.

- sky cover (tenths) – this is the amount of the visible sky that is obscured by cloud cover. This observation by the meteorologist is made near the top of each hour.

- precipitation (inches per hour) – this is the cumulative amount of precipitation collected during the past hour. It is measured using an automatic tipping rain gage. When temperatures are at or below freezing, the collected precipitation is melted to estimate its liquid water content.

- solar radiation (langelys/minute) – this is an average of the incoming solar radiation measured by sensors over the past hour.

- mixing depth (meters) – this is the height above the surface through which the atmospheric is well mixed via the action of thermal and/or mechanical turbulence. Mixing depth estimates are based on data collected by sodars and other instruments.

- frozen precipitation flag – if there is no precipitation or the precipitation is in a liquid state, this flag will be "0". If frozen precipitation is reported, the value of this flag will be set to "1" or another non-zero value.

8.4 Description of the 200-ft Tower Data File

The "200-ft" tower data file presents data measured on the instrumented 60-m (200-ft) instrumented towers that are located in the 100-, 300-, and 400-Areas (FFTF). A sample "200-ft" tower data file is provided in Figure 8.3. Data are provided for each of the Site's "200-ft" towers in this one file. Data for the 400 Area's tower is provided first, followed by data for the 300 Area, and then data for the 100 Area tower. The first three lines of the file present introductory information. This includes a label (i.e., "HMS 60-m Towers"), the date and time at the end of the 15-min monitoring period, and the number of active "200-ft" towers. The next line contains the name of the first tower for which data are presented. The following two lines present the name and units of measure for each column of data to be presented for this tower. Following this introduction, meteorological data are presented for each monitoring height on the tower. Each line of data presents observations of:

- the height above ground (ft) that the winds and temperature are monitored.

- wind direction – this is the average direction of the wind (in degrees from North) at the measurement height. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-minute averaging period and then dividing by the number of observations.

- wind speed – this is the average speed of the wind (in mph) at the measurement height. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-min averaging period and then dividing by the number of observations.

- air temperature – this is the average temperature (°F) during the 15-minute averaging period at the measurement height. It is computed by averaging all the temperature observations reported at 5-second intervals during the 15-min averaging period.

```
HMS 60m Towers
                11/09/1999 13:45 PST
                3 stations
               FFTF
               level, wdir , wspd , temp
                (ft),(deg.), (mph),(deg.F)
                197., 319.4,   5.1,  48.6
                 82., 321.0,   5.1,-999.9
                 33., 320.2,   4.8,  49.4
                      dewpt,   rh , temp , delta
                  6.,  40.3,  70.0,  49.7,   -.8
               300A
               level, wdir , wspd , temp
                (ft),(deg.), (mph),(deg.F)
                197., 326.0,   6.9,  49.3
                 82., 327.2,   6.8,-999.9
                 33., 330.9,   6.6,  50.1
                      dewpt,   rh , temp , delta
                  6.,  44.6,  80.1,  50.5,   -.9
               100N
               level, wdir , wspd , temp
                (ft),(deg.), (mph),(deg.F)
                197., 236.9,   3.8,  50.3
                 82., 239.4,   3.8,-999.9
                 33., 240.7,   3.7,  51.3
                      dewpt,   rh , temp , delta
                  6.,  42.5,  70.3,  51.8,   -.9
```

Figure 8.3. A Sample 200-ft Tower Data File. This file is named 99110913.2F4, indicating that it is the 200-ft tower data file for November, 19, 1999, at 1:45 p.m. PST.

The next line of data provides the name of another set of parameters and is followed by a line of data. This line of data presents:

- the height above ground (ft) that the parameters are monitored
- dew point temperature (°F) – the temperature to which a parcel of air is cooled to reach 100% saturation (dew formation). This is a measure of atmospheric moisture.
- relative humidity (%) – is the ratio of amount of moisture the air is holding to the amount it can hold at its current temperature.

- air temperature – this is the average temperature (°F) during the 15-minute averaging period at the measurement height.

- Delta T (°F) – this is an estimate of the average difference in temperature between the 60-m (200 ft) and 9-m (30 ft) levels on the tower ($T_{60\,m} - T_{9m}$). The Delta T value represents the average of the difference in temperatures measured at 5-second intervals during the 15-minute averaging period. This value may differ from the difference in the 15-minute averages of the temperatures at 60-m (200-ft) and 9-m (30-ft). Delta T can be used to estimate atmospheric stability via methods employed by the U.S. Nuclear Regulatory Commission (NRC) (Table 8.1) and the U.S. Environmental Protection Agency (EPA) (Table 8.2).

Table 8.1 The NRC Delta T Method for Determining Atmospheric Stability.

Atmospheric Stability	Vertical Temp. Difference (°C/100m)
A or 1 – very unstable	$\Delta T/\Delta Z \leq -1.9$
B or 2 - moderately unstable	$-1.9 < \Delta T/\Delta Z \leq -1.7$
C or 3 – slightly unstable	$-1.7 < \Delta T/\Delta Z \leq -1.5$
D or 4 – neutral	$-1.5 < \Delta T/\Delta Z \leq -0.5$
E or 5 – slightly stable	$-0.5 < \Delta T/\Delta Z \leq 1.5$
F or 6 – stable	$1.5 < \Delta T/\Delta Z \leq 4.0$
G or 7 – extremely stable	$4.0 < \Delta T/\Delta Z$

Table 8.2 The EPA Solar Radiation Delta-T (SRDT) Method for Estimating Stability.

Stability during the Daytime: 1-hr after sunrise to 1-hr before sunset.

Wind Speed (mph)	Solar Radiation (Langleys/min)			
	>1.32	1.32 - 0.97	0.96 - 0.25	<0.25
< 4.5	A	A	B	D
4.5 - 6.7	A	B	C	D
6.8 - 11.1	B	B	C	D
11.2 - 13.4	C	C	D	D
> 13.4	C	D	D	D

Stability during the Nightime: 1-hr before sunset to 1-hr after sunrise.

Wind Speed (mph)	Vertical Temperature Gradient	
	<0	≥ 0 (Inversion)
< 4.5	E	F
4.5 - 5.5	D	E
> 5.5	D	D

At the end of this data line, data from the first station is completed. The information format now repeats itself for the next “200-ft” tower and so on until all the “200-ft”

stations have reported their data (i.e., the next line of data contains the name of the second tower for which data are presented).

8.5 Description of the 400-ft Tower Data File

The "400-ft" tower data file presents data measured on the instrumented 125-m (410-ft) instrumented tower that is located at the Hanford Meteorology Station. A sample "400-ft" tower data file is provided in Figure 8.4. The first two lines of the file present introductory information. This includes a label (i.e., "HMS 400ft Tower") and the date and time at the end of the 15-minute monitoring period. The next two lines present the parameter name and unit of measure for each column of data to be presented for this tower. Following this introduction, meteorological data are presented for each monitoring height on the tower. Each line of data presents observations of:

- the height above ground (ft) that the winds and temperature are monitored

- wind direction – this is the average direction of the wind (in degrees from North) at the measurement height. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-minute averaging period and then dividing by the number of observations.

- wind speed – this is the average speed of the wind (in mph) at the measurement height. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-minute averaging period and then dividing by the number of observations.

- air temperature – this is the average temperature (°F) during the 15-minute averaging period at the measurement height. It is computed by averaging all the temperature observations reported at 5-second intervals during the 15-minute averaging period.

The next two lines of data provide the name and units of measure for the set of parameters and that is presented in the next line of data. The following line of data presents:

- the height above ground (ft) that the parameters are monitored

- solar radiation (langelys/min)-this is a measurement of the average incoming solar radiation during the 15-min averaging period.

- relative humidity (%)-is the ratio of amount of moisture the air is holding to the amount it can hold at its current temperature

- dew point temperature (°F)-the temperature to which a parcel of air is cooled to reach 100% saturation (dew formation). This is a measure of atmospheric moisture.

- atmospheric stability class (see Tables 8.1 and 8.2 for information on stability).

```
HMS 400ft Tower
 11/09/1999 13:45 PST
level, wdir , wspd , temp
 (ft),(deg.), (mph),(deg.F)
 400., 336.2,   3.0,  46.8
 300.,-999.9,-999.9,  47.4
 250.,-999.9,-999.9,  47.8
 200., 342.6,   3.3,  48.0
 100.,-999.9,-999.9,  48.5
  50., 343.4,   3.2,  49.0
  30., 349.0,   3.1,  49.1
   3.,-999.9,-999.9,  49.8
       solar, dewpt, stab
    (ly/min),(degF), (A-G)
   0.,  .120,  45.1, 4
```

Figure 8.4. A Sample 400-ft Tower Data File. This file is named 99110913.4F4, indicating that it is the "400-ft" tower data file for November 19, 1999, at 1:45 p.m. PST.

8.6 Description of the Sodar Data File

The Sodar data file presents data measured by the Doppler acoustic sodars. The sodars use sound waves to measure three-dimensional winds and turbulence parameters at multiple heights from near the surface up to 600 m (2000 ft) above the ground.
The Sodar data file is provided in Figures 8.5 and 8.6. The Sodar data file is the most difficult of the five meteorological files to read and understand. The method of processing and formatting sodar data is much more complicated than those from other instruments. Formatting errors and other problems are also more common in the sodar file than the other types of meteorological data files. The first line of the file presents an identification number for the sodar station, the date and time for the observation, and other information. This includes:

- "DM" which indicates the beginning of data from a sodar station

- identification number for the sodar station – "101" is 100N, "102" is 200 Area (HMS), "103" is the 300 Area, and "104" is the 400 Area (FFTF).

- date and time – information is presented using two-digit codes for the month, day of the month, year, hour, and minutes after the hour.

- additional instrument information that is not used by ***APGEMS.***

For example, "DM 101 11 09 99 13 41 …," means data are presented for the 100N station on November 9, 1999, at 01:41 p.m. The second line of the file is generally blank. The next line, provides data labels for each column of data that will be presented. These include the height of the measurement ("range"), "Echo" and "S Echo" (raw sound echo readings), wind speed ("speed"), wind direction ("theta"), sigma theta ("S TETA"), vertical velocity (W), sigma W ("S W"), and others. The next line is generally blank and is followed by multiple lines of data from the sodar (beginning with the upper most measurement height and working downward towards the surface). Each data line presents:

- a data validity code – "A" indicates an invalid reading (only found below the lowest valid height, "V" is a valid reading (data was received for this height), and "I" is invalid (a valid reading was not obtained for this height).

- height above ground for which the readings are made (m)

- two data elements of echo information

- wind speed (cm/sec) at the measurement height

- wind direction (° from North) at the measurement height

- standard deviation of wind direction (°)[5]

- vertical wind speed (cm/sec)[5]

- standard deviation of vertical wind speed (cm/sec)[5]

Missing data are indicated by "-9999,"are simply omitted or indicated with "0." A "$" may follow the last line of data for a station (the last line of data generally presents readings for 2 m above ground level). After a sodar site's data is completed, a line beginning with "DM" indicates the start of data for the next sodar site.

```
DM 101   11     09     99       13     26     18        0     61     23

 RANGE   ECHO S ECHO  SPEED   TETA S TETA      W    S W ETAM  STA  S U  S V

I  510  -9999  -9999
I  480  -9999  -9999
I  450  -9999  -9999
I  420  -9999  -9999
I  390  -9999  -9999
I  360  -9999  -9999
I  330  -9999  -9999
I  300  -9999  -9999
I  270  -9999  -9999
I  240     21     20
I  210     21     30
I  180  -9999  -9999
I  150  -9999  -9999
I  120  -9999  -9999
I   90  -9999  -9999
I   60  -9999  -9999
A   10      0      0      0      0      0      0      0    0    0    0    0
A    2      0      0      0      0      0      0      0    0    0    0    0
$
```

Figure 8.5. First Part of a Sample Sodar Data File. This figure presents the data from the first sodar site reported in this file (the data from the other three sodar sites are presented in Figure 8.6). This sodar data file is named 99110913.SD4, indicating that it is the sodar data file updated for November 9, 1999, at 1:45 p.m. PST.

```
DM 102   11      9     95       13     30      0      229    285     32

 RANGE   ECHO S ECHO  SPEED   TETA S TETA      W    S W ETAM  STA  S U  S V

I  420  -9999  -9999
I  400  -9999  -9999
I  380  -9999  -9999
I  360  -9999  -9999
I  340  -9999  -9999
V  320  -9999  -9999  -9999  -9999  -9999  -9999  -9999    0    0    0    0
V  300  -9999  -9999  -9999  -9999  -9999  -9999  -9999    0    0    0    0
V  280    149     14    220    141     18     -6     15    0    0    0    0
V  260  -9999  -9999  -9999  -9999  -9999  -9999  -9999    0    0    0    0
V  240    134     24    204    120  -9999     14      1    0    0    0    0
I  220  -9999  -9999
I  200  -9999  -9999
I  180  -9999  -9999
I  160  -9999  -9999
I  140  -9999  -9999
I  120  -9999  -9999
A   10      0      0      0      0      0      0      0    0    0    0    0
A    2      0      0      0      0      0      0      0    0    0    0    0
$
DM 103   11      9     99       13     30      1      262     33    193

 RANGE   ECHO S ECHO  SPEED   TETA S TETA      W    S W ETAM  STA  S U  S V

I  510  -9999  -9999
I  480  -9999  -9999
I  450     54     13
I  420  -9999  -9999
I  390     56     24
I  360     51     22
I  330     59     25
I  300     53     32
I  270     65     37
V  240    116     55    157     19  -9999      0      1    0    0    0    0
V  210     60     55  -9999  -9999  -9999     13      1    0    0    0    0
V  180     38     29  -9999  -9999  -9999      0      1    0    0    0    0
V  150     35     38  -9999  -9999  -9999     -7      1    0    0    0    0
V  120     32 -30431  -9999  -9999  -9999  -9999  -9999    0    0    0    0
V   90     46 -21536  -9999  -9999  -9999  -9999  -9999    0    0    0    0
V   60     39 -25045  -9999  -9999  -9999  -9999  -9999    0    0    0    0
A   10      0      0      0      0      0      0      0    0    0    0    0
A    2      0      0      0      0      0      0      0    0    0    0    0
$
DM 104   11      9     99       13     30      0      188     85    153

 RANGE   ECHO S ECHO  SPEED   TETA S TETA      W    S W ETAM  STA  S U  S V

I  420  -9999  -9999
I  390  -9999  -9999
I  360  -9999  -9999
V  330    123     32    638    158      1     73      1    0    0    0    0
V  300    184     58    521    146     23     53     12    0    0    0    0
V  270    122     43    340    130     34     55     10    0    0    0    0
V  240    163     39    225    123     44     28     12    0    0    0    0
V  210    127     54  -9999  -9999  -9999     27     12    0    0    0    0
V  180    111     30  -9999  -9999  -9999     19      7    0    0    0    0
V  150    193     27  -9999  -9999  -9999     15     10    0    0    0    0
V  120    249     39  -9999  -9999  -9999      2     14    0    0    0    0
V   90    114     51  -9999  -9999  -9999     10      9    0    0    0    0
V   60     78     45  -9999  -9999  -9999     14      1    0    0    0    0
A   10      0      0      0      0      0      0      0    0    0    0    0
A    2      0      0      0      0      0      0      0    0    0    0    0
```

Figure 8.6. The Remainder of the Sample Sodar Data File. This figure presents the data from the second through fourth sodar sites in the file named 99110913.SD4.

9. 0 REFERENCES

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