PEAC® - the "what if" answer machine

A popular saying and one we use many times within AristaTek is "sometimes you can't see the forest for the trees." Our staff gets so busy sometimes working on a technical problem or new feature for the PEAC tool or visiting with customers about the different features of the PEAC tool, we forget to tell our audience the biggest benefits. Why it is so easy and quick use and how it can be used as a "what if" answer machine.

When the PEAC tool was originally conceived back in early 1996, a prime objective was to simplify the input process, i.e., number of steps required, by the operator to get useful information so good sound decisions could be made. This result of this original objective is demonstrated in two forms:

1. How data or information related to a hazardous substance is accessed and displayed.
2. How the computational tools are designed to make asking "what if" questions easier for the responder.

We'll discuss briefly the first form, how the data is organized. There are different information systems or software applications available in the market place. They typically have similar information since most use many of the same references to construct their databases. One of the problems the PEAC developers identified was the available information for different hazardous substances. For a basic group of substances, that are commonly used commercially, there are volumes of data available from multiple sources. For some of these substances an individual could generate in excess of 40 pages of information on a single substance. This is a relatively small list of substances, which amount to a list of about 1200 to 1500 substances. Typically the reason there is so much information available on these substances is because they are produced in such large quantities or they are used in so many different applications or they are very hazardous and require special handling.

The other 5+ million substances found in reference sources have a much smaller amount of information available for inclusion in a database. The reason there is limited information varies, but typically it is because they are produced in relatively small volumes or used in very specific processes or they may not be that hazardous if persons are exposed to them. These may be valid reasons for the limited information, but the responder to a spill of these substances still needs access to basic information to help them make decisions.

The truth of the matter is if a substance is used in few processes and quantities are limited to small volumes, there isn't much emphasis within the commercial market place to investigate the toxicity of the substance or go to the expense of publishing data or information regarding the substance. Many substances are produced in-house at a manufacturing facility for a specific process and the manufacturer may know its chemical and physical properties but the information and data aren't in the public domain.

A common example of this fact is the limited information available from manufacturers of chemical protective clothing (CPC) and specific testing of a garment product against a wide assortment of products. The testing is expensive and therefore is performed on the more common substances for which it might be required. In other cases it may be tested against a specific substance because a customer needs CPC products for personnel working with that specific substance. Once the testing is done for the customer, it then becomes part of the manufacturer's database.

But I'm digressing from the original topic of dealing with varying amounts of information on substances. The PEAC developers felt that information *overload* was just as dangerous or inhibiting to a responder as not having enough information. The thought being who wants to wade through 10 or 20 pages of information to find the specific piece of data or information needed while planning an operation.

The eventual concept was to divide up the data or information into logical categories and allow the user to select the specific logical piece they needed. This allowed the developers to build the database with logical blocks of information that a user could digest or find the piece(s) they needed quickly and easily to make their decisions. Hence, this is why the data or information is broken into different portions; we think logical portions, for a selected hazardous substance. Maybe when all the information is assembled into a single document it is 20+ pages long, but the user can quickly go to the piece they need without having to deal with all those pages.

The eventual solution, which in retrospect seems obvious, was to have all those different portions or pieces of information and data that are related to a selected hazardous substance indexed for easy selection and display.

For an example, let's assume an incident involves the common chemical Anhydrous Hydrogen Chloride. The responder only needs to identify that an incident involves Anhydrous Hydrogen Chloride and then find the substance in the database. Now there are multiple types of data or information available at the click of a mouse button. To begin with, the default display that is provided to a user once a substance is found in the database is the Chemical Information selection (Figure 1). This provides the responder with basic information on the substance and what to expect when it is released from its container.

For instance, the header on the display will provide the substance name, CAS#, UN#, and DOT ERG guide number and name. The ERG guide number and name are in the form of a hyperlink that when clicked will display the information from the orange pages of the ERG and the green pages entry if there is a PAD recommendation.

The Chemical Information display will provide the NFPA hazard rating (NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response)* for the chemical in the form of the NFPA HAZMAT diamond that all responders certified at Awareness Level or higher recognize as per NFPA 472. The

NFPA HAZMAT diamond graphic indicates immediately that the substance presents a significant health hazard and is slightly unstable when heated.

Scrolling down the Chemical Information display the user will see data for chemical and physical properties. If the material was flammable, which Anhydrous Hydrogen Chloride is not, then values for auto ignition temperature, flash point, LEL and UEL would be provided. The boiling point of -121°F tells the responder this substance will be a vapor at normal temperatures and the vapor density of 1.3 will signal that it is heavier than air, which is noted next to the vapor density. The vapor pressure of 40+ atm (atmospheres) should be an indication that this material is probably shipped as a liquefied gas under its own vapor pressure and the container is probably at a very high pressure. This information is already shown just below the header information at the top of the display. The toxicity values indicate just how much of a health hazard the substance can be. The NFPA 704 health hazard rating was 3 and the IDLH is 50 ppm.

So very quickly the responder knows, the material is a vapor at normal temperatures, shipped as a liquefied gas (high pressure), it's not flammable, its vapor is very toxic, the vapor will seek low spaces and it may be unstable when heated. This process takes just seconds and now we're ready to learn more.

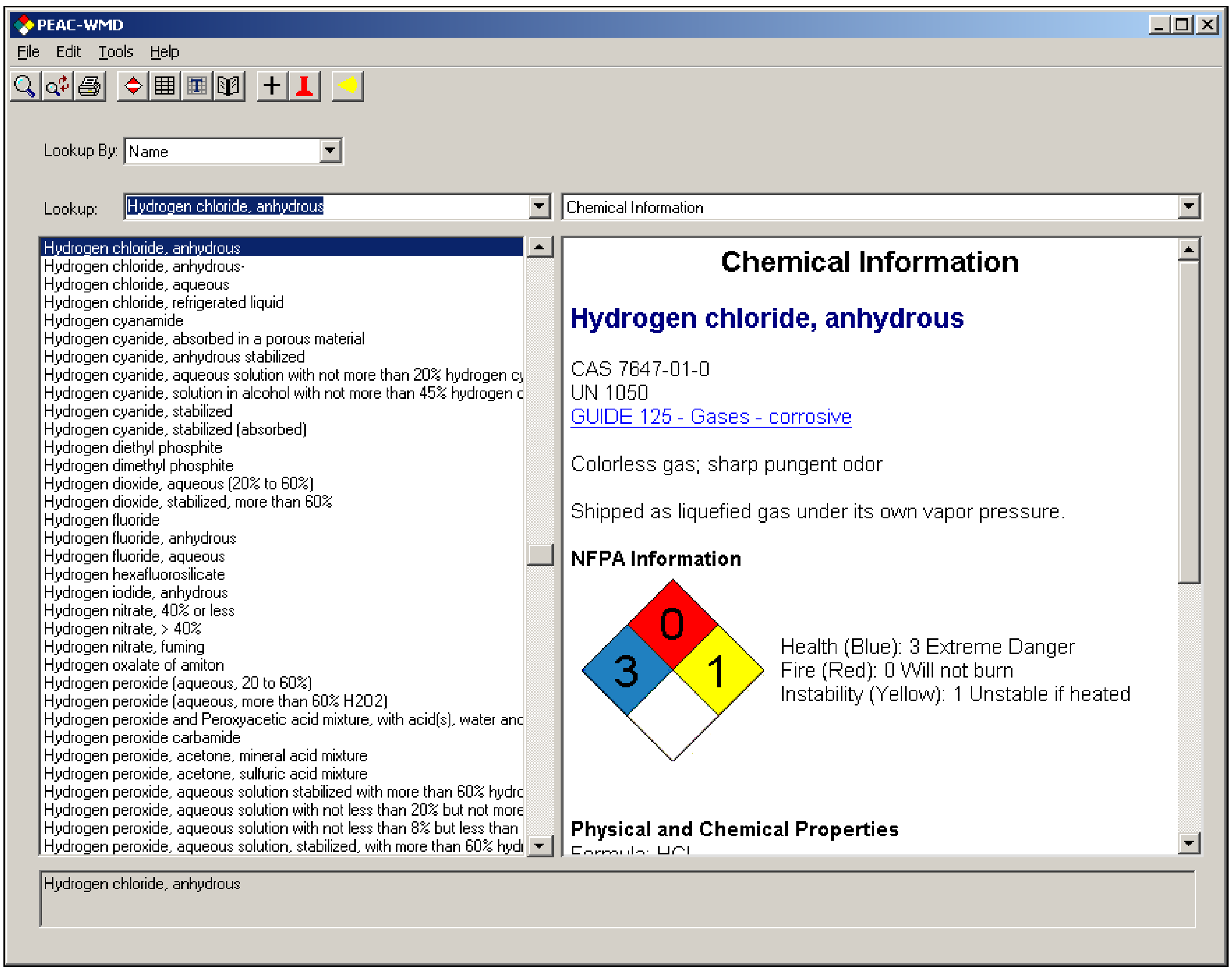


Figure 1 – Chemical Information display for Anhydrous Hydrogen Chloride

To find additional information, the user clicks on the data selection field to display the data selection options for the hazardous substance Figure 2.

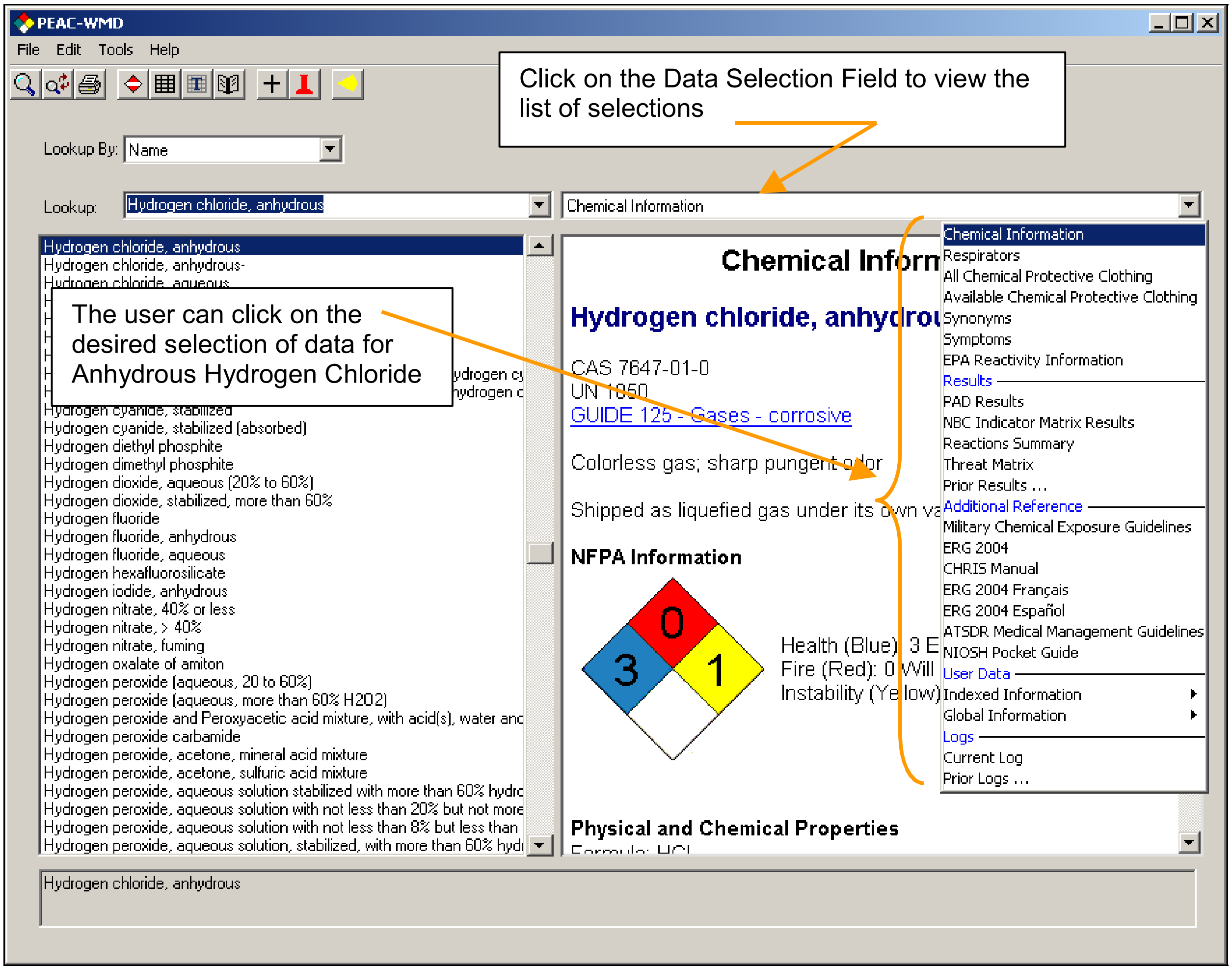


Figure 2 – Data selection options for Anhydrous Hydrogen Chloride

At this point the responder has the option to view CPC garments tested against Anhydrous Hydrogen Chloride, recommended types of respirators based on the concentration, symptoms of exposure, reactivity information, DOT ERG procedures on dealing with this type of substance, or other reference sources that describe Anhydrous Hydrogen Chloride such as the NIOSH Pocket Guide or the CHRIS Manual.

One of the most powerful features is the availability of the User Data, which allows the user to customize the PEAC tool for their particular needs. The user can create or import data of their own choosing and access it via the PEAC tool interface. Therefore, SOPs, response plans, points of contact, MSDS's, DECON procedures, and many other types of information can be incorporated into the PEAC tool structure for easy access when needed.

Any of these topics are just a click away at this point. Any of the data or information displayed on the right side of the main display window can be printed to the local printer for dissemination to other personnel.

The other aspect I'd like to quickly discuss is asking the PEAC tool "what if" questions.

Dr. John Nordin has touched on this topic in some of his technical articles in the past but I'd like to cover some of the same ground again. Sometimes when a responder arrives on scene where there is a hazardous substance release, the specifics of what has happened are not obvious. The responder may be prevented from observing the full details because of obstacles obstructing the view, fire and smoke, or hazardous chemical vapors preclude close inspection. As information related to the incident becomes available, a clearer picture will be formed and the operations plan may be changed as the incident evolves.

Because the AristaTek founders were involved in earlier field research projects at the Nevada Test Site studying vapor dispersion, the plume modeling feature of the PEAC tool received considerable thought and design attention. As everyone knows, vapor clouds don't wait for anybody, therefore the PEAC plume model was designed to allow the user to make quick assumptions and develop information quickly. The sooner an exclusion zone or protective action distance can be determined, the sooner the public can be warned and actions taken to protect them.

The PEAC PAD Calculator is designed to allow the user to do as many "what if" calculations as required ensuring all possible outcomes have been assessed and considered. An example might be arriving at a scene involving a train derailment of tank cars and there is a fire involved. Perhaps Anhydrous Hydrogen Chloride is identified as one of the derailed tank cars but it's unclear if the tank is leaking or if it's close to the involved fire.

In this situation the responder can do some quick "what if" calculations and develop some answer very quickly. Then as the full description of the scene becomes clear, the answers can be refined as needed.

First, it might be best to assume a worst-case condition that the tank car of Anhydrous Hydrogen Chloride is not breached but may be close enough to the fire that the contents may become unstable or the tank could BLEVE releasing the contents as an instantaneous release or puff. Referring back to Figure 1 or 2, we see the PAD icon [] is displayed at the right end of the row of icons at the top of the window under the menu options. This means the PEAC tool has enough data to run the plume model and compute a protective action distance (PAD) or exclusion zone.

The PEAC tool provides two methods to operating the plume model; one method allows input of container types or sizes and then a description of the source or type of release. The other method allows the user to specify either a continuous release or an instantaneous release where the user provides a flow rate or amount released as a puff.

To signal the application which mode will be used requires simply clicking an option box on the options window that is accessed off the Edit menu selection. To demonstrate how both modes work, we'll do the instantaneous or puff release using the second method described above.

To start the plume model input sequence, click on the PAD icon [ ]. The input and results windows are represented in Figures 3-5.

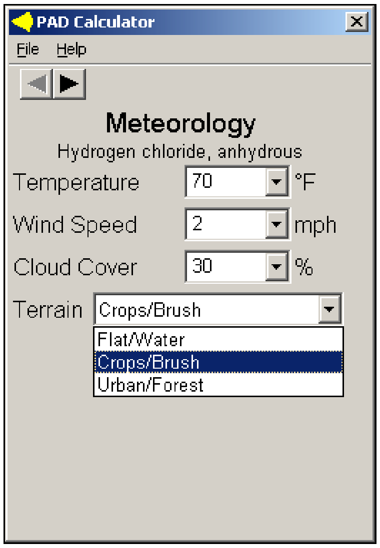


Figure 3 – Meteorology input values

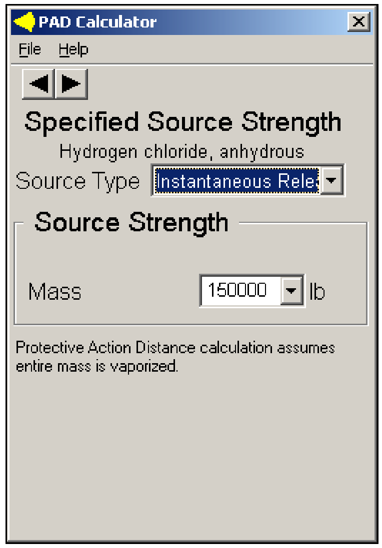


Figure 4 – Specified Source Strength values

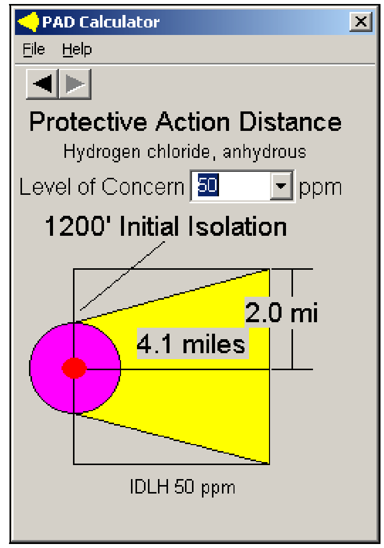


Figure 5 – Results window

For those users familiar with the PEAC tool, we've used Denver as the location and a date of March 22 and a time of 5:15 PM. In Figure 3 we used a Terrain value to describe the surrounding surface cover as crops or low-level brush. In Figure 4 we have selected the instantaneous release (puff) and an estimated mass of Anhydrous Hydrogen Chloride at 150,000 lbs or about 75 tons. The results window as shown in Figure 5 calculates a PAD of just over 4 miles and an initial isolation distance in all directions of 1200 feet, which is based on a Level of Concern of 50 ppm (the IDLH). In a time span of less than 60 seconds, we now have a worst-case exclusion zone to protect any of the public if the Anhydrous Hydrogen Chloride should be adjacent to the fire and BELVE. When we exit the results window (Figure 5) a PAD Results report is generated which can be printed or recalled later.

With some additional thought we realize maybe we don't have all our bases covered. The time is 5:15 PM and it'll soon be dark and everyone knows that once the sun goes down, we could run into more stable atmospheric conditions, which can impact the resulting PAD. But we can very quickly cover that situation by changing the time and rerunning the plume model. We leave all input values the same but now we come up with a considerable larger PAD because the more stable conditions cause the vapor cloud to disperse at a slower rate as depicted in Figure 6.

Now we have the day and night worst-case conditions but we still need to take a look at a couple of other possibilities. Perhaps the Anhydrous Hydrogen Chloride tank car has been breached and is leaking. What's a reasonable exclusion zone to establish?

Let's assume there is a 1" hole near the bottom of the tank car, what effect does this change have on our PAD?

This time we will change the plume modeling mode to use the container size input and allow the user to describe the release type with the release time still 5:15 PM. The input windows are shown in Figure 7-9.

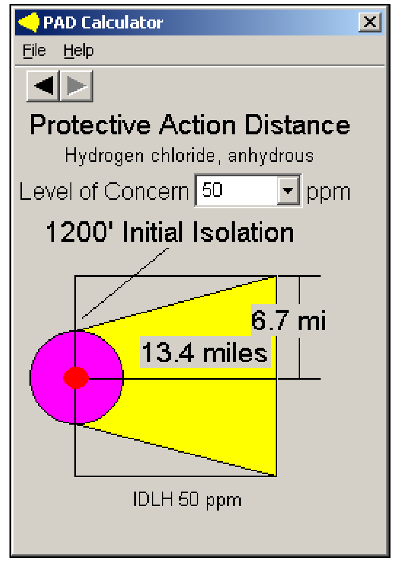


Figure 6 – PAD results for night-time conditions

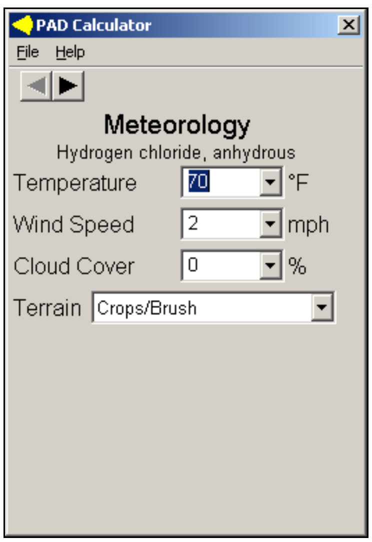


Figure 7 – Meteorology input values

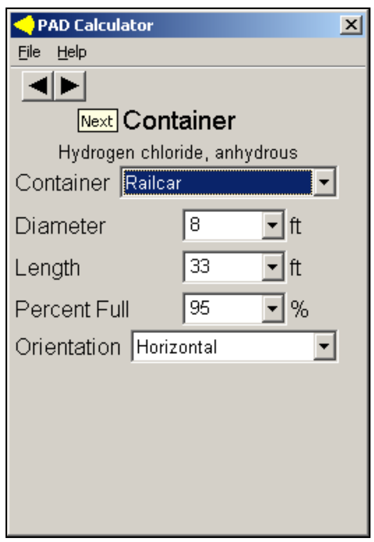


Figure 8 – Container selected is railcar with default values

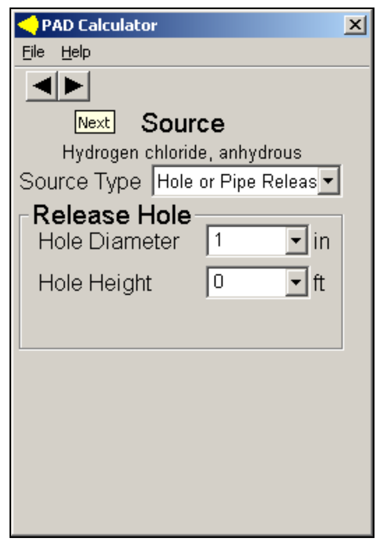
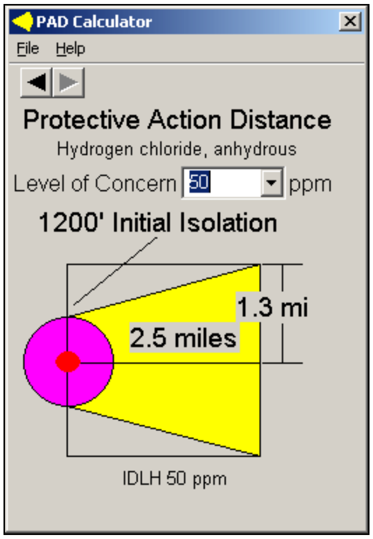


Figure 9 – Source type is hole described as 1" at bottom of the container

The results are shown in Figure 10, which predicts a PAD of 2.5 miles for the 5:15 PM time.

Depending on how long it will take to plug the leak, it seems likely the incident will last into the night, so we need to check the PAD Calculator for a night release through the 1" hole. We selected a time of 8:15 PM and stepped back through the input windows to arrive at a new exclusion zone. That value is shown in Figure 11 and predicts a PAD greater than 9.5 miles.

Based on these values and location of the surrounding population, decisions can be made as to recommendations for either evacuation and/or shelter-in-place.



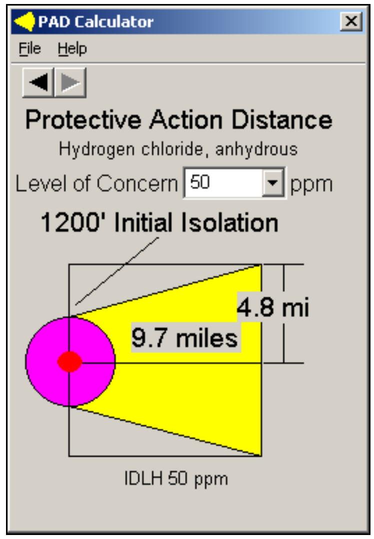


Figure 10 – PAD Calculator results at 5:15 PM

Figure 11 - PAD Calculator results at 8:15 PM

The user can do these "what if" questions very rapidly and print off the results for reference as conditions change. Likewise, the individual PAD Results reports can be recalled later as needed. Useful documentation is at your fingertips when you need it.

As the incident develops the responder can change those input values that are different and refine the results just as quickly as these four evaluations were made.

If readers have questions or suggestions, please direct them to support@aristatek.com or give us a call at 877-912-2200.