How the PEAC tool deals with explosives

This month we'll review how explosives (by explosives we are referring to chemical formulations designed to react very rapidly to form a "shock wave" or "blast wave" or "over pressurization") are dealt with in the PEAC-WMD application.

There are basically two resources provided in the PEAC-WMD application to assist the user when dealing with the possibility of an explosive device. The first is the ATF Vehicle Bomb Tables and the second is the Explosion Calculator.

ATF Vehicle Bomb Table

The ATF Vehicle Bomb Table is simply a table of six (6) different sized vehicles and the estimated maximum potential destruction that could be caused by that sized vehicle packed with explosives.

The ATF Vehicle Bomb Table has information for the multiple categories of different sized vehicles and provides standoff distances based on the following criteria: (1) Maximum Explosives Capacity, (2) Lethal Air Blast Range, (3) Minimum Evacuation Distance, and (4) Falling Glass Hazard. The distances are provided in both feet and meters and the estimated explosives capacity is provided in both pounds and kilograms. The ATF provides the information with the following notations:

- Minimum evacuation distance is the range at which a life-threatening injury from blast or fragment hazards is unlikely. However, non-life-threatening injury or temporary hearing loss may occur.
- Hazard ranges are based on open, level terrain.
- Minimum evacuation distance may be less when explosion is confined within a structure.
- Falling glass hazard range is dependent on line-of-sight from the explosion source to windows. Hazard is from falling shards of broken glass.
- Metric equivalent values are mathematically calculated.
- Explosion confined within a structure may cause structural collapse or building debris hazards.
- Additional hazards include vehicle debris.

To access the information the user selects *ATF Vehicle Bombs* from the drop-down list (it is found under the *Explosives and Bombs* category) from the **Lookup By** field as shown in Figure 1.

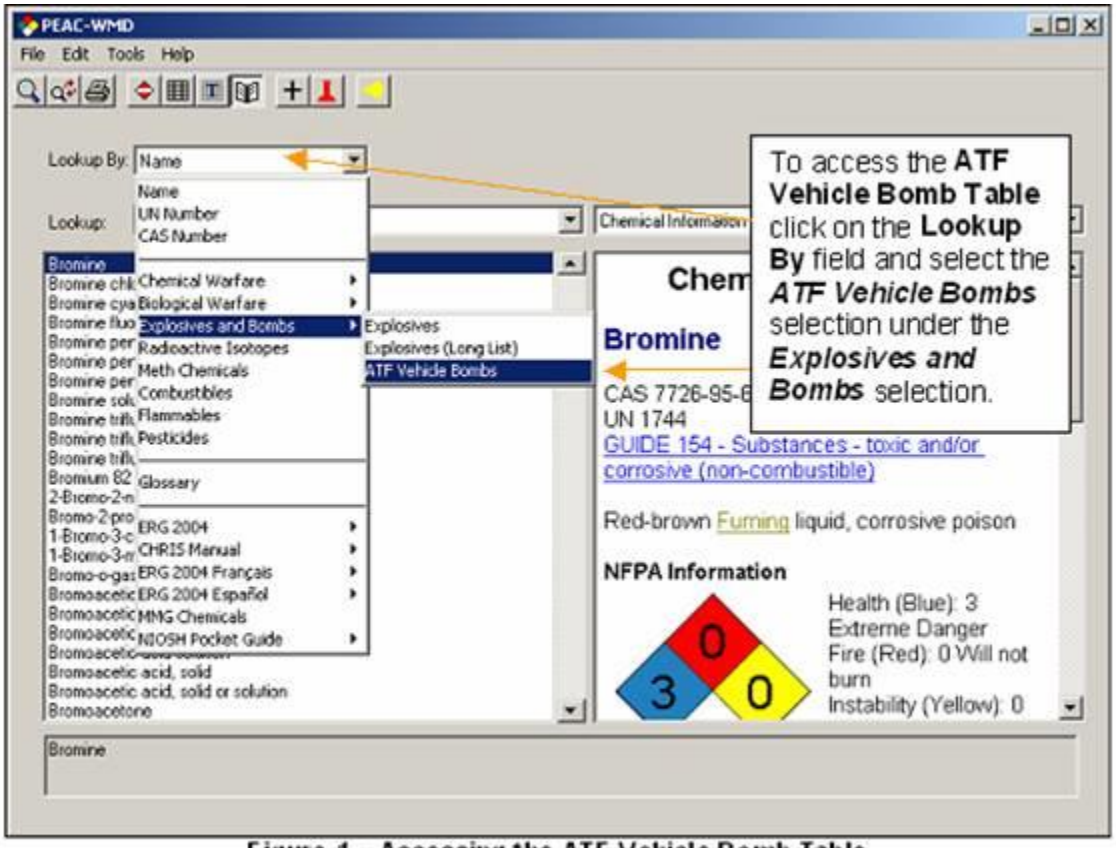

Figure 1 – Accessing the ATF Vehicle Bomb Table

The ATF Vehicle Bombs Table will display a list of six (6) different types of vehicles as shown in Figure 2. The user simply clicks on the desired vehicle type and the corresponding information is displayed in the **Data Display Field** of the window, see Figure 2.

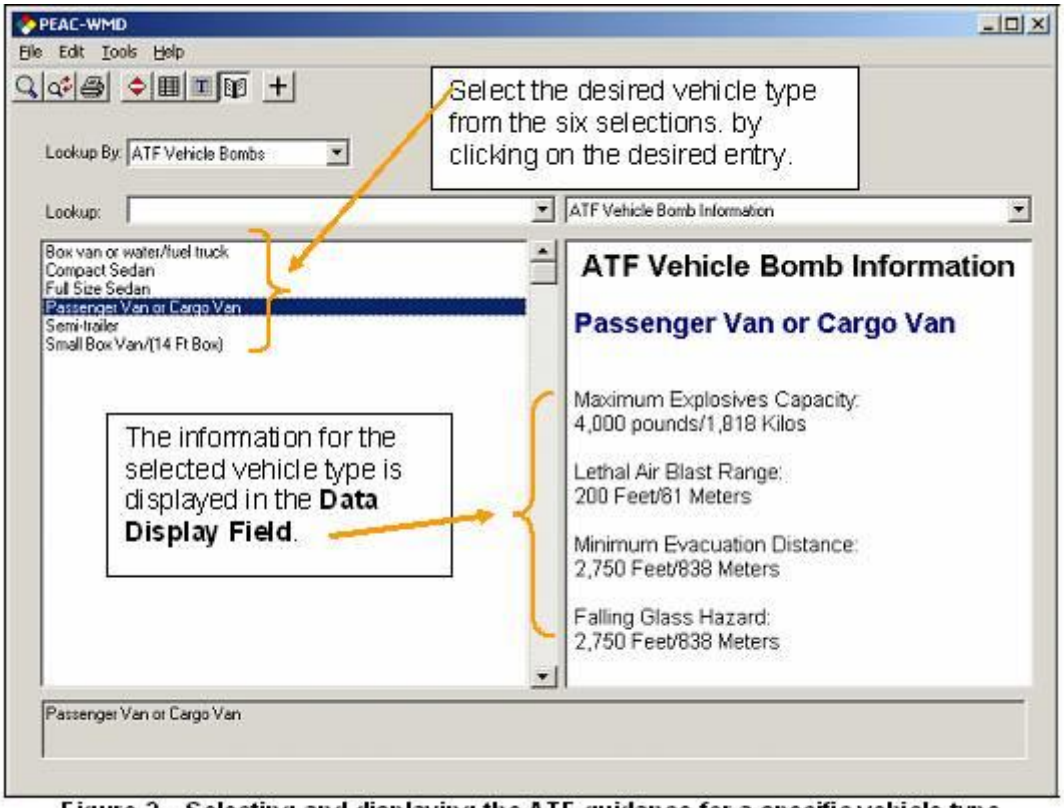

Figure 2 – Selecting and displaying the ATF guidance for a specific vehicle type

The reader should recognize that the standoff distance for lethal air blast is different than the minimum evacuation distance. This is due to the type of damage predicted for two different concerns.

The lethal air blast distance is based on a shock or blast wave that has a peak over-pressure of ~5 psi (pounds per square inch). At this pressure there is a significant risk for hemorrhaging of lungs which can lead to severe injury or even death. The minimum evacuation distance is based on shrapnel or fragments of the vehicle being thrown a great distance and the potential for injury and/or death from being struck by these flying fragments.

Explosion Calculator

A portion of the PEAC-WMD database is dedicated to providing the user with specific information related to explosive materials. As shown in Figure 1, there are sublevel categories under the ***Explosives and Bombs*** category when the drop-down menu is displayed beneath the **Lookup By** field. The two sub-categories that deal with explosive materials are the ***Explosives*** and ***Explosives (Long List).*** The only difference between the materials displayed on one list versus the other is whether or not the material is normally recognized by the typical user. The ***Explosives*** list is actually a short list of common known explosive materials; versus the ***Explosives (Long List)*** is a much longer list of sometimes relatively unknown explosive materials. The information displayed for each is basically the same.

Associated with each entry in either sub-category is the ability to calculate an appropriate standoff distance if there is enough information in the PEAC-WMD database for the specific explosive.

If the selected chemical is classified as an explosive material and the PEAC-WMD application has sufficient information in its database to calculate an evacuation distance based on a user specified over-pressurization value, the PEAC-WMD application will display an **Explosion Calculator** button or icon [ ] on the screen (see Figure 3). By clicking on this button the screen for the **Explosion Calculator** will appear. There are two versions of the **Explosion Calculator**, the version shown in Figure 4 and the version shown in Figure 5. The difference is whether the PEAC-WMD database has density or specific gravity information to calculate the mass or weight of the material based on the volume of the material. With density information, the screen shown in Figure 4 will be displayed, otherwise the user will see the screen in Figure 5 and there will be no option to enter the volume of the explosive material.

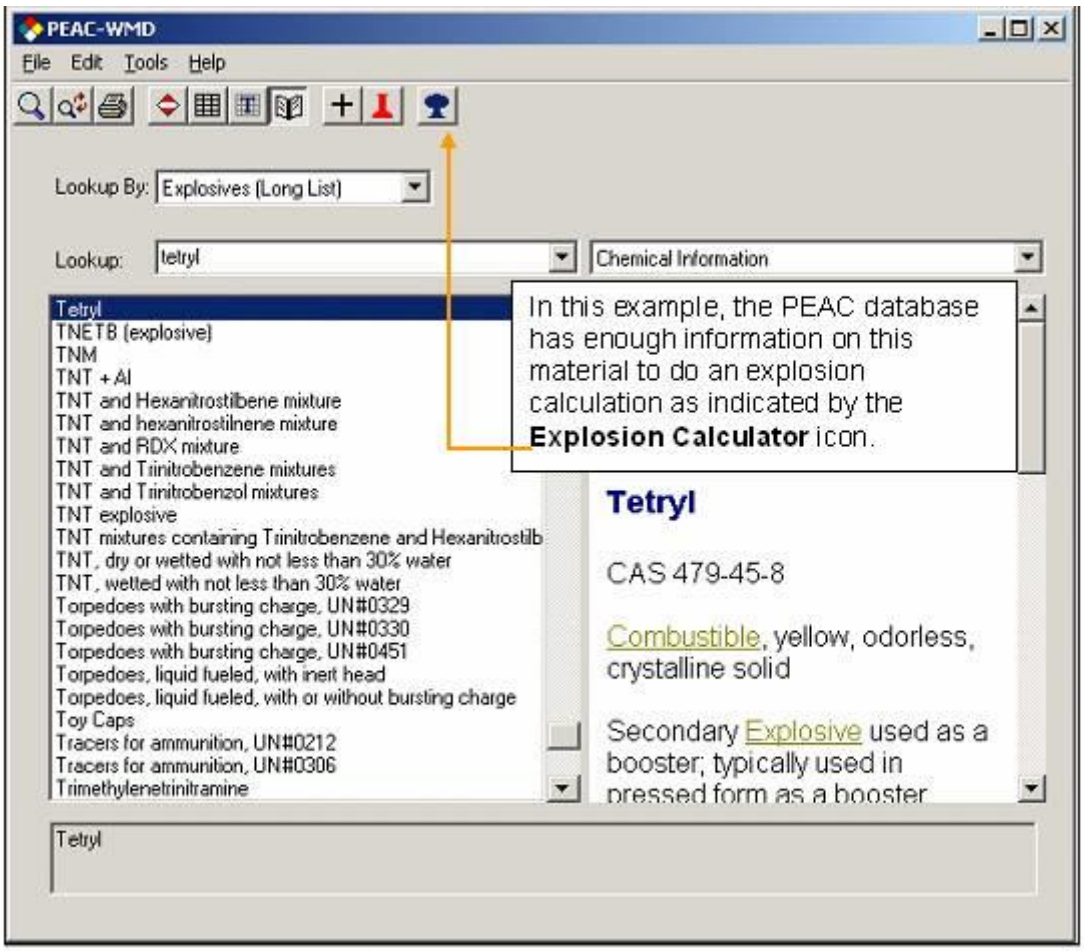

Figure 3 – The Explosion Icon

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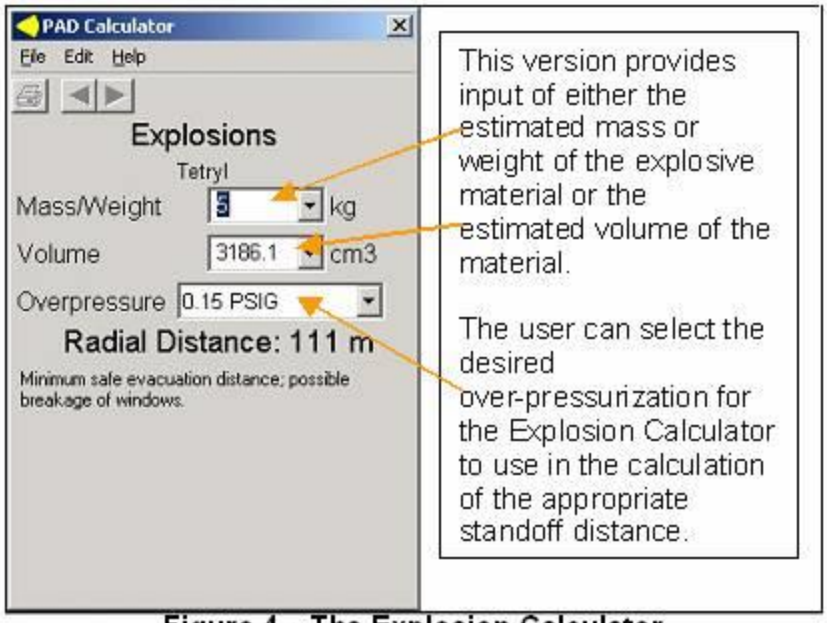

Figure 4 – The Explosion Calculator

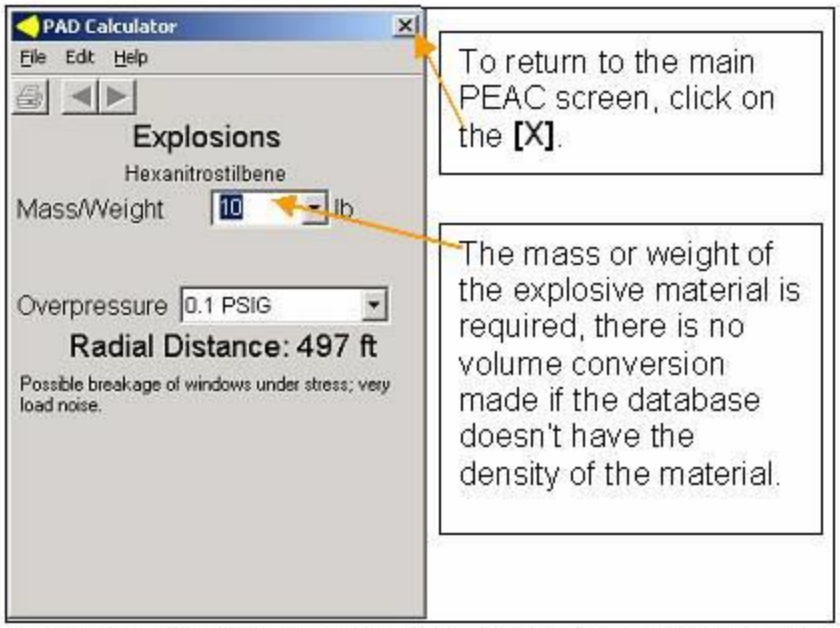

Figure 5 – Explosion Calculator without the volume option

When an explosive material is detonated, the major concern is the over-pressurization (also referred to as the pressure wave or shock wave) that emanates from the center of the explosion. The **Explosion Calculator** is designed to calculate an appropriate standoff distance from the center of an explosion that will provide adequate protection based on the over-pressurization value chosen by the user; this may not be the appropriate distance if fragmentation and shrapnel are a concern.

The user selects the mass (or optionally the volume) of explosive material by entering a value in the appropriate field or clicking the down arrow at the right end of the field and selecting a value from the pop-up list. The user selects the appropriate over-pressure value by clicking on the down arrow and selecting a value (0.1 to 20 psig) from the pop-up list of values. The **Explosion Calculator** also requires the mass or weight of explosive material to make the calculation. If the density value is available in the database, a screen similar to that shown in Figure 4 is displayed and the user can enter either a mass or volume of material. The **Explosion Calculator** will make the proper conversion if volume is entered and display the corresponding mass of the chosen material. If the density of the explosive material is not stored in the database, then a screen similar to Figure 5 will be displayed and the user will have to enter the mass of material.

Unlike the PAD calculation for toxic vapor clouds, the **Explosion Calculator** does not require geographical location, current time of day and date, or metrological information. To return to the main PEAC screen, click the **[X]**, at the top right of the screen.

The PEAC **Explosion Calculator** uses the TNT equivalence value when making the calculation, if the TNT equivalence value is not available, an **Explosion Calculator** icon will not appear.

Table 1 provides a description of the different expected damages that might be expected for a range of different over-pressurization values that can be entered.

Table 1 - Explosion Overpressure Damage Estimates

Overpressure, PSIG	Expected Damage
0.1	Possible breakage of windows under stress; very loud noise.
0.15	Minimum safe evacuation distance; possible breakage of windows.
0.30	Some minor damage to frame houses, typically 10% window breakage.
0.5	Significant window breakage, other minor damage to frame houses.
0.7	Upper limit for reversible effects on humans; window breakage and moderate damage to house structures.
1.0	Partial demolition of houses; skin lacerations from flying glass.
3.0	Threshold for significant human lethality from flying glass and other missiles; eardrum rupture; partial collapse of walls and roofs of houses.
5.0	Complete demolition of frame houses. Wooden utility poles snapped. Significant human lethality.
10	Probable total building collapse. Many deaths. Lungs hemorrhage
20	Total destruction. 99% fatality due to direct blast effects.