BECv4

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THE DDESB BLAST EFFECTS COMPUTER—VERSION 4.0

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ABSTRACT

Version 1.0 of the Department of Defense Explosives Safety Board (DDESB) Blast Effects Computer (BEC) was demonstrated at in 1997, Version 2.0 was released in 1998 and Version 3.0 was published in 1999. With every version, the capabilities of the BEC have been increased. Version 4.0 continues this trend. This latest version adds the High Performance Magazine to the list of structures and also revises the algorithms used for predicting the effects from Aboveground Structures. In addition, this new version includes the effects of altitude on airblast. The paper will also show several uses of the BEC.

BACKGROUND

The Department of Defense Explosives Safety Board (DDESB) has had an active role in producing various types of explosion effects computation aids[1]. In 1978, these culminated in the release of a circular slide rule called the "Blast Effects Computer (BEC)[2]." This slide rule was designed to solve problems and provide data related to the expected damage to various potential targets due to blast effects resulting from an explosion of ammunition or explosives stored above ground or in earth-covered magazines.

The algorithms that were developed for the original BEC are described in detail in Reference 1. In 1997, these algorithms were implemented into an EXCEL spreadsheet template. This version, Version 1.0, referred to as BECV1, was released in November 1997 and was reported at PARARI 97[3]. Version 2.0[4] was released in 1998 as BECVE2 and BECVM2. BECVE2 is in English units and BECVM2 is in Metric units. In 1999, Version 3.0 was released[5]. With the release of Version 3.0, several additional Potential Explosion Sites (PES) were added. Algorithms for predicting both dynamic pressure and dynamic pressure impulse, more accurate algorithms for estimating the probability of window breakage, and algorithms for predicting the probability of ear drum rupture and the probability of lethality due to lung damage were also included.

The current version, Version 4.0, includes the following changes:

- Improvement of the low pressure yield estimates (resulting in improved airblast predictions at pressures below 1 psi)
- Revision of the algorithms used for above ground sites (AGS)
- Presents the effects of PES altitude on airblast
- Automatic English-Metric and Metric-English conversions
- Warning flags when input conditions are out of range
- Automatic generation of a summary table
- Revision of the input-output interface

VERSION 4.0 GENERAL INFORMATION

Version 4 of the Blast Effects Computer is also written as a Microsoft EXCEL spreadsheet template. In order to use Version 4, EXCEL 97/EXCEL 98 (or later) must already be installed on your computer. Simply copy the template to your hard drive. To use the program, either double click on the BECV4 filename or launch EXCEL and then use the ***OPEN*** command located in the **FILE** menu. Because it is written as an EXCEL template, the Blast Effects Computer will run on any machine that can run EXCEL. At this time, it has been tested on both Macintosh and WINTEL machines.

When you run the template, EXCEL opens a copy of the spreadsheet for you to use. Changes you make affect only the copy--***the original template is preserved***. The copy of the template is a new, unsaved document with a temporary name based on the template name. For example, when you open the Blast Effects Computer template named BECV4.xlt, Microsoft EXCEL gives the copy the temporary name BECV41. When you save or close the copy, the ***Save As*** dialog box appears. You can type a new name for the document, accept the temporary name suggested by EXCEL, or you don't save this copy when you close out.

When you open the template with EXCEL 97/EXCEL 98, you will be presented with a dialog box that indicates, ***" ... contains macros"***. Click on the "***Enable Macros***" button to proceed.

The following templates are available:

- English Units
- Conversion of the English Units Worksheet into Metric Units
- Metric (SI) Units
- Conversion of the Metric Units Worksheet into English Units

At the start of a session, the user simply selects the appropriate tab at the bottom of the worksheet. The two "***Conversion tabs***" work as follows. The "***English-to-Metric Conversion***" simply converts what is shown on the "***English Units***" worksheet into the corresponding Metric units. The "***Metric-to-English Conversion***" converts what is shown on the "***Metric Units***" worksheet into English units.

CHANGES INCORPORATED INTO VERSION 4.0

The results[6] of the recently conducted 40-tonne trial in Australia were used to update/refine the AGS algorithms used in the BEC. Previous data[7] seemed to indicate that the presence of a barricade (traverse) might have an effect on the airblast measured behind the barricade. This was reflected in Version 3 with predictions for both barricaded and unbarricaded directions around an aboveground site (AGS). The 40-tonne data showed that this was not the case. The measured results in both the barricaded and unbarricaded directions fell on the same pressure-distance curve. In addition, the 40-tonne data showed that there was a problem with the low-pressure hemispherical yields used by the BEC; namely, the yields were too low, resulting in predicted pressures and impulses that were lower than the measured values. These differences are discussed in more detail in Reference 6. Version 4 corrects both of these problems.

The Blast Effects Computer predicts the airblast for sea level conditions. If the PES is not at sea level, corrections should be made for the atmospheric conditions (barometric pressure and temperature). These corrections are discussed in Reference 8. The following equations summarize these corrections:

$$\Delta P_z = \Delta P_0 * S_p$$
$$R_z = R_0 * S_d$$
$$Time_z = Time_0 * S_t$$
$$Impulse_z = Impulse_0 * S_I$$

Where the subscript z refers to the parameter at altitude, z, and the subscript 0 refers to the parameter at sea level. P represents pressure and R distance. The formulae for the correction factors S_p, S_d, S_t, and S_I are shown below.

$$S_p = (P_z/P_0)$$

$$S_d = (P_0/P_z)^{1/3}$$

$$S_t = (P_0/P_z)^{1/3} * (T_0/T_z)^{1/2}$$

$$S_I = (P_z/P_0)^{2/3} * (T_0/T_z)^{1/2}$$

where P_0 = atmospheric pressure at sea level (14.696 psi or 101.3289 kPa)
P_z = atmospheric pressure at altitude z
T_0 = atmospheric temperature at sea level (288.16°K)
T_z = atmospheric temperature at altitude z

These corrections are implemented in Version 4 by entering either an altitude or atmospheric pressure and the temperature. The BEC displays the computed correction factors and two sets of output predictions—one for sea level and one for the conditions specified.

Another new feature in Version 4.0 is the automatic generation of a summary table. This table shows the variation of the various sea level airblast parameters with distance. The user selects an initial range (R) and the table is automatically generated. The default distances used in the summary table are: R, 1.2*R, 1.4*R, 1.6*R, 1.8*R, 2.0*R, 2.5*R, 3*R, 4*R, 5*R, 6*R, 7*R, 8*R, 9*R, 10*R, 14*R, 16*R, 18*R, 20*R, 25*R, 30*R, and 50*R. In addition, the first line of the table will always be the values for the "**Range to ES**" that was selected.

The following warnings are generated when the associated inputs are out of range:
ECM (total NEW must be less than 500,000 pounds or 226,795 kg)
HAS (total NEW must be less than 10,000 pounds or 4536 kg)
AGS (total NEW must be less than 500,000 pounds or 226,795 kg)
Ship (total NEW must be less than 2,000,000 pounds or 907,180 kg)
HPM (MCE must be less than 60,000 pounds or 27,215 kg)

In addition, warnings are generated if the apparent scaled range (actual range/equivalent hemispherical weight $^{1/3}$) is too large or too small. Too small is defined as less than 2 ft/lb$^{1/3}$ (0.79 m/kg$^{1/3}$) and too large as greater than 100 ft/lb$^{1/3}$ (39.67 m/kg$^{1/3}$).

USING THE COMPUTER

The following steps should be followed to use the computer:

- Launch the template -- either by double clicking on the template icon or by starting EXCEL and using the ***open*** command (under the **File** menu)
- Select either English Units or Metric Units from the tabs at the bottom
- Enter the required information in the **INPUT SECTION**

- Use the ***Potential Explosion Site*** menu to choose the appropriate PES
- Use the ***Select Type of Weapon*** menu to choose the appropriate type of weapon
- Use the ***Select Type of Explosive*** menu to change the default explosive type (if necessary)
- Choose either a **Total NEW** or **Number of Weapons** from the ***Select Number of Weapons or Total NEW*** menu.
- Enter either the **Total NEW** or the **Number of Weapons** as required
- Enter **Range to ES**
- Enter **Initial Range for Summary Table**
- Use the ***Select Atmospheric Description*** menu to choose either altitude or barometric pressure (Note: if altitude corrections are not required, this step may be omitted)
- Enter either the **Altitude** or the **Barometric Pressure** as required (Note: if altitude corrections are not required, this step may be omitted)
- Enter **Temperature** (Note: if altitude corrections are not required, this step may be omitted)

When those inputs are completed, the results are immediately available in the output section. In addition to the specific run for the input conditions listed above, a summary table is also generated. This table is located below and to the right the general BEC output. When ***Print*** is selected from the **File** menu, two pages will be generated. The first page contains **INPUT** and **OUTPUT** sections for the specific run; the second page is the summary table. The heading at the top of the summary table repeats the input selections that have been made and then presents the table itself.

Once you have selected a PES, weapon type, and explosive type, the explosion effects are dependent upon the inter-relationship of three sets of data: the Net Explosive Weight (or Number of Weapons), the selected range, and the type of explosion effect (time of arrival, peak pressure, probability of fatality due to lung rupture, etc.). If two of these are known, then the third can be computed. When the NEW and range are known, the BEC computes the effect. This is the procedure described above. However, it is sometimes useful to reverse the process; i.e., to enter the effect and either the range or NEW/Number of Weapons and compute the other variable. This reverse process is referred to as "Back Calculation."

When it is planned to use this feature, either the range or the NEW must be entered at the top of the spreadsheet. An arbitrary value for the other input variable must also be used--any number greater than zero. Make the appropriate selections from the other inputs: ***Select Explosion Site***, ***Select Type of Weapon***, and ***Select Type of Explosive***. When the other inputs are complete, select the ***Goal Seek*** Function under the EXCEL **TOOLS** menu. When this option is selected, the following dialog box (Figure 1) is displayed:

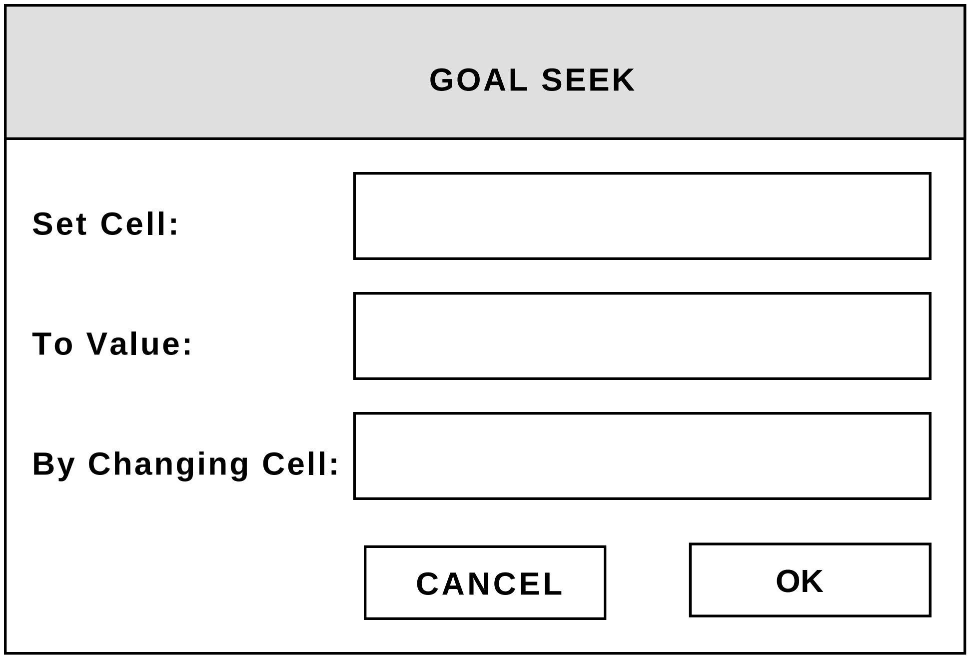

FIGURE 1. GOAL SEEK DIALOG BOX

Enter the Cell Reference of the cell you wish to compute into the ***Set Cell:*** box. Enter the value you wish the cell to obtain in the ***To Value:*** box. Enter the Cell Reference of the Cell you wish to change into the ***By Changing Cell:*** box. The Cell Reference can be set by first placing the cursor in the appropriate ***GOAL SEEK*** dialog box then clicking on the cell of choice in the BEC.

SAMPLE PROBLEMS

The following examples are intended to illustrate some of the features of the Blast Effects Computer.

Example 1.

> Twenty-seven tonnes of MK 82 bombs (Tritonal filled) will be detonated inside a barricaded, aboveground structure at or near sea level. What are the expected airblast effects at a range of 500 meters from the event? Generate a pressure-distance curve for the event. At what range is there a 40% probability of breaking float annealed windows whose dimensions are 30.5 cm x 61 cm x 0.02 cm? What is the English equivalent output for the 40% window breakage problem?

Choose the Metric Units version of the BEC

Figures 2 and 3 show the output for this example.

INPUT SECTION

Metric Units (kg, m, kPa, Pa-s, ms)

Select Potential Explosion Site (PES)	Select Number of Weapons or Total NEQ	Enter initial range for Summary Table	Select Atmospheric Description
AGS	Total NEQ (kg)	100	Altitude (meters)
Select Type of Weapon	**Enter Total NEQ (kg)**		**Enter Altitude (m)**
MK82 (500 lb Bomb)	27,000.0		1,000.00
Select Type of Explosive	**Range (m)**		**Enter Temperature (°C)**
Tritonal	500.0		15.00

OUTPUT SECTION

EXPLOSIVE PARAMETERS		ATMOSPHERE PARAMETERS	
Total NEQ (kg)	27,000.0	Pressure (mbar)	897.4
NEW per weapon (kg)	87.090	Temperature (°C)	15.00
TNT Equivalence	1.07	Pressure (S_p)	0.8857
		Distance (S_d)	1.0413
Equivalent Hemispherical Weight (kg)	19,332.2	Time (S_t)	1.0413
Effective Yield (kg)	28,890.0	Impulse (S_I)	0.9223
(N.B.: Both Weight and Yield are in kg of TNT)			

AIRBLAST PARAMETERS

	SEA LEVEL	ALTITUDE (meters) 1000
Range (m)	500.0	442.9
Time of Arrival at Range (msec)	1230.88	1281.7
Over-Pressure at Range (kPa)	6.67	5.9
Reflected Press. at Range (kPa)	13.63	12.1
Positive Phase Duration at Range (ms)	156.4	162.9
Positive Phase Impulse at Range (Pa-s)	456.9	421.4
Reflected Impulse at Range (Pa-s)	829.1	764.6
Dynamic Overpressure at Range (kPa)	0.2	0.14
Dynamic Overpressure Impulse at Range (Pa-s)	9.3	8.6

OTHER INFORMATION

Probability of Window Breakage (percent) at Range (note: dimensions are cm)				
	Area = 0.186 m^2 30.5 x 61.0 x 0.223 Float annealed	**67.5**	Area = 1.626 m^2 152.4 x 106.7 x 0.559 Plate annealed	**100.0**
	Area = 0.372 m^2 61.0 x 61.0 x 0.223 Float annealed	**100.0**	Area = 2.787 m^2 182.9 x 152.4 x 0.559 Plate annealed	**100.0**
	Area = 0.975 m^2 106.7 x 91.4 x 0.305 Float annealed	**100.0**	Area = 4.645 m^2 304.8 x 152.4 x 0.762 Plate annealed	**100.0**

Probability of Eardrum Rupture (percent) at Range	**0.0**	(Mercx)
	0.0	(Eisenberg)
Probability of lethality due to lung damage (percent) at Range	**0.0**	

FIGURE 2. EXAMPLE 1: INPUT AND OUTPUT

SUMMARY TABLE

Explosion Site (ES)	AGS	Type of Weapon	MK82 (500 lb Bomb)
Type of Explosive	Tritonal	Total NEQ (kg)	27,000.00

RANGE (meters)	TIME OF ARRIVAL (ms)	INCIDENT PRESSURE (kPa)	INCIDENT IMPULSE (Pa-s)	POSITIVE DURATION (ms)	REFLECTED PRESSURE (kPa)	REFLECTED IMPULSE (Pa-s)	DYNAMIC PRESSURE (kPa)
500.0	1230.88	6.67	456.90	156.41	13.63	829.08	0.16
100.0	148.20	60.35	1683.80	84.05	149.17	3713.82	12.53
120.0	192.79	46.91	1555.01	93.48	111.02	3324.60	7.59
140.0	240.10	37.82	1430.47	101.09	86.73	2983.93	4.90
160.0	289.49	31.36	1315.26	107.43	70.29	2689.43	3.34
180.0	340.47	26.59	1210.86	112.84	58.59	2435.52	2.38
200.0	392.67	22.96	1117.21	117.58	49.94	2216.26	1.76
250.0	526.82	16.87	924.61	127.38	35.92	1786.08	0.94
300.0	664.32	13.17	779.14	135.27	27.67	1476.52	0.57
400.0	945.05	8.97	580.98	147.44	18.52	1072.63	0.27
500.0	1230.88	6.67	456.90	156.41	13.63	829.08	0.16
600.0	1520.20	5.23	374.39	163.37	10.60	670.97	0.10
700.0	1811.30	4.23	316.82	169.20	8.56	562.54	0.07
800.0	2102.26	3.48	275.12	174.54	7.10	485.02	0.04
900.0	2391.12	2.95	243.49	179.86	6.00	427.80	0.03
1,000.0	2676.20	2.55	218.69	185.46	5.15	384.51	0.02
1,400.0	out of range	1.66	163.90	out of range	out of range	out of range	out of range
1,600.0	out of range	1.44	150.76	out of range	out of range	out of range	out of range
1,800.0	out of range	1.24	137.53	out of range	out of range	out of range	out of range
2,000.0	out of range	1.07	122.97	out of range	out of range	out of range	out of range
2,500.0	out of range	0.78	97.03	out of range	out of range	out of range	out of range
3,000.0	out of range	0.61	79.95	out of range	out of range	out of range	out of range
5,000.0	out of range	0.30	out of range	out of range	out of range	out of range	out of range

FIGURE 3. EXAMPLE 1: SUMMARY TABLE

The second portion of the example was to determine the range at which there was a 40% probability of window breakage for a particular sized window. This can be accomplished using the same input conditions and then choosing the ***GOAL SEEK*** option under the **Tools** menu. When the ***GOAL SEEK*** dialog appears, set up the problem as follows:

Set Cell: **C53 (Window Breakage probability)**
To Value: **40**
By Changing Cell: **B11 (range)**

The answer is 635 meters. This can be seen in Figure 4, which gives the Metric output for this problem. The information contained in this figure can be converted to English units using the Metric-to-English conversion. This is shown in Figure 5.

INPUT SECTION

Metric Units (kg, m, kPa, Pa-s, ms)

Select Potential Explosion Site (PES)	Select Number of Weapons or Total NEQ	Enter initial range for Summary Table	Select Atmospheric Description
AGS	Total NEQ (kg)	100	Altitude (meters)
Select Type of Weapon	**Enter Total NEQ (kg)**		**Enter Altitude (m)**
MK82 (500 lb Bomb)	27,000.0		1,000.00
Select Type of Explosive	**Range (m)**		**Enter Temperature (°C)**
Tritonal	634.8		15.00

OUTPUT SECTION

EXPLOSIVE PARAMETERS		ATMOSPHERE PARAMETERS	
Total NEQ (kg)	27,000.0	Pressure (mbar)	897.4
NEW per weapon (kg)	87.090	Temperature (°C)	15.00
TNT Equivalence	1.07	Pressure (S_p)	0.8857
		Distance (S_d)	1.0413
Equivalent Hemispherical Weight (kg)	18,570.9	Time (S_t)	1.0413
Effective Yield (kg)	28,890.0	Impulse (S_I)	0.9223
(N.B.: Both Weight and Yield are in kg of TNT)			

AIRBLAST PARAMETERS

	SEA LEVEL	ALTITUDE (meters) 1000
Range (m)	634.8	562.3
Time of Arrival at Range (msec)	1621.40	1688.3
Over-Pressure at Range (kPa)	4.88	4.3
Reflected Press. at Range (kPa)	9.81	8.7
Positive Phase Duration at Range (ms)	165.5	172.3
Positive Phase Impulse at Range (Pa-s)	352.1	324.7
Reflected Impulse at Range (Pa-s)	628.8	579.9
Dynamic Overpressure at Range (kPa)	0.1	0.08
Dynamic Overpressure Impulse at Range (Pa-s)	5.4	5.0

OTHER INFORMATION

Probability of Window Breakage (percent) at Range (note: dimensions are cm)				
	Area = 0.186 m^2 30.5 x 61.0 x 0.223 Float annealed	**40.0**	Area = 1.626 m^2 152.4 x 106.7 x 0.559 Plate annealed	**100.0**
	Area = 0.372 m^2 61.0 x 61.0 x 0.223 Float annealed	**100.0**	Area = 2.787 m^2 182.9 x 152.4 x 0.559 Plate annealed	**100.0**
	Area = 0.975 m^2 106.7 x 91.4 x 0.305 Float annealed	**100.0**	Area = 4.645 m^2 304.8 x 152.4 x 0.762 Plate annealed	**100.0**

Probability of Eardrum Rupture (percent) at Range	**0.0**	(Mercx)
	0.0	(Eisenberg)
Probability of lethality due to lung damage (percent) at Range	**0.0**	

FIGURE 4. EXAMPLE 1: RANGE FOR 40% WINDOW BREAKAGE PROBABILITY

METRIC-TO-ENGLISH CONVERSION

(converts Metric Units Worksheet into English Units)

Units of lb, ft, psi, psi-ms, ms

Explosion Site (PES)	**AGS**
Type of Weapon	**MK82 (500 lb Bomb)**
Type of Explosive	**Tritonal**

Total NEQ (kg)	**27,000.00**
Range to ES (meters)	**634.80**

OUTPUT SECTION

EXPLOSIVE PARAMETERS		ATMOSPHERE PARAMETERS	
Total NEW (lb)	59,525.1	Pressure (psi)	13.02
NEW per weapon (lb)	192.0	Temperature (°C)	15.00
TNT Equivalence	1.07	Pressure (S_p)	0.8857
		Distance (S_d)	1.0413
Equivalent Hemispherical Weight (lb)	40,942.0	Time (S_t)	1.0413
Effective Yield (lb)	63,691.9	Impulse (S_I)	0.9223
(N.B.: Both Weight and Yield are in lb of TNT)			

AIRBLAST PARAMETERS

	SEA LEVEL	ALTITUDE (feet) 3281
Range (ft)	2082.68	1844.68
Time of Arrival at Range (ms)	1621.40	1688.33
Over-Pressure at Range (psi)	0.71	0.63
Reflected Press. at Range (psi)	1.42	1.26
Positive Phase Duration at Range (ms)	165.49	172.32
Positive Phase Impulse at Range (psi-ms)	51.07	47.10
Reflected Impulse at Range (psi-ms)	91.20	84.11
Dynamic Overpressure at Range (psi)	0.01	0.01
Dynamic Overpressure Impulse at Range (psi-ms)	0.78	0.72

OTHER INFORMATION

Probability of Window Breakage (percent) at Range				
	Area = 2 ft^2 12" x 24" x 0.088" Float annealed	**40.0**	Area = 17.5 ft^2 60" x 42 " x 0.22" Plate annealed	**0**
	Area = 4 ft^2 24" x 24" x 0.088" Float annealed	**100.0**	Area = 30 ft^2 72" x 60" x 0.22" Plate annealed	**0**
	Area = 10.5 ft^2 42" x 36" x 0.12" Float annealed	**100.0**	Area = 50 ft^2 120" x 60" x 0.30" Plate annealed	**0**

Probability of Eardrum Rupture (percent) at Range	**0.0**	(Mercx)
	0.0	(Eisenberg)
Probability of lethality due to lung damage (percent) at Range	**0.0**	

FIGURE 5. EXAMPLE 1: METRIC-TO ENGLISH CONVERSION

<u>Example 2</u>.

Consider the scenario described in Example 1. At Sea Level, the pressure is 22.96 kPa at a range of 200 meters. If the altitude is 1,600 meters, at what range does this pressure (22.96 kPa) occur?

This scenario can be analyzed by using the same input conditions and then entering the altitude of 1,600 meters. Then choose the ***GOAL SEEK*** option under the **Tools** menu. When the ***GOAL SEEK*** dialog appears, set up the problem as follows:

Set Cell:	**D31 (Incident Pressure at altitude)**
To Value:	**22.96**
By Changing Cell:	**B11 (range)**

The answer is 143 meters. This can be seen in Figure 6.

INPUT SECTION

Metric Units (kg, m, kPa, Pa-s, ms)

Select Potential Explosion Site (PES)	Select Number of Weapons or Total NEQ	Enter initial range for Summary Table	Select Atmospheric Description
AGS	Total NEQ (kg)	100	Altitude (meters)
Select Type of Weapon	**Enter Total NEQ (kg)**		**Enter Altitude (m)**
MK82 (500 lb Bomb)	27,000.0		1,600.00
Select Type of Explosive	**Range (m)**		**Enter Temperature (°C)**
Tritonal	173.9		15.00

OUTPUT SECTION

EXPLOSIVE PARAMETERS		ATMOSPHERE PARAMETERS	
Total NEQ (kg)	27,000.0	Pressure (mbar)	833.4
NEW per weapon (kg)	87.090	Temperature (°C)	15.00
TNT Equivalence	1.07	Pressure (S_p)	0.8226
		Distance (S_d)	1.0673
Equivalent Hemispherical Weight (kg)	19,029.8	Time (S_t)	1.0673
Effective Yield (kg)	28,890.0	Impulse (S_I)	0.8779
(N.B.: Both Weight and Yield are in kg of TNT)			

AIRBLAST PARAMETERS

	SEA LEVEL	ALTITUDE (meters) 1600
Range (m)	173.9	143.0
Time of Arrival at Range (msec)	324.67	346.5
Over-Pressure at Range (kPa)	27.91	23.0
Reflected Press. at Range (kPa)	61.80	50.8
Positive Phase Duration at Range (ms)	111.3	118.7
Positive Phase Impulse at Range (Pa-s)	1241.8	1090.1
Reflected Impulse at Range (Pa-s)	2509.6	2203.1
Dynamic Overpressure at Range (kPa)	2.6	2.16
Dynamic Overpressure Impulse at Range (Pa-s)	91.9	80.6

FIGURE 6. EXAMPLE 2: ALTITUDE EFFECTS

WHY NOT CONWEP?

Why is the BEC necessary? Why not use an already existing program such as CONWEP[9] to perform the required analyses? Why is another set of software necessary? The BEC is optimized for airblast predictions. It takes into account the effect of the PES, the type of weapon, and the TNT equivalence of the explosive. The BEC results are within a few percent of actual measured data for each of the input options. CONWEP assumes all weapons are spheres or hemispheres and only makes a correction for TNT equivalence. It does not take into account the effects of the weapon case or shape and it does not take into account the effects of any structure that may exist around the explosion source. For example, if CONWEP airblast predictions for a MK 82 bomb are compared with actual bomb data, the differences can be significant.

SUMMARY

The latest version of the DDESB Blast Effects Computer has been presented. The differences between Version 4.0 (the current version) and previous versions have been discussed. Sample problems that demonstrates some of the features of the calculator are presented.

REFERENCES

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