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USER MANUAL FOR VEHTRK 2.0 MODEL (CHEMVVAM WITH STAND-OFF DETECTORS)

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RESEARCH AND TECHNOLOGY DIRECTORATE

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This user manual is an update of a revised excerpt of the original Honeywell-produced manual for the Chemical Vehicle Vulnerability Model. All the text is identical to that in the original except for revisions (italics). Revisions are based upon the U.S. Army Edgewood Research, Development and Engineering Center modifications to the code and implications deduced from the original manual and program usage.

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PREFACE

The work described in this report was authorized under Project No. 1O162622A553L, CB Defense and General Investigation. This work was started in October 1992 and completed in September 1993.

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USER MANUAL FOR VEHTRK 2.0 MODEL (CHEMVVAM WITH STAND-OFF DETECTORS)

This user manual is an update of a revised excerpt of the original Honeywell-produced manual for the Chemical Vehicle Vulnerability Model (CHEMVVAM). All the text is identical to that in the original except for revisions (italics). Revisions are based upon ERDEC modifications to the code and implications deduced from the original manual and program usage.

The Vehicle Track (VEHTRK) model was developed by Honeywell to interface with *cloud transport and diffusion* models in computing chemical agent concentration and dosage histories outside and inside combat vehicles. The VEHTRK 2.0 model, which is VEHTRK modified to accept stand-off detectors with alarms, allows the user to plot a route for *one or more* combat vehicles, to move the vehicles along that route, to generate a chemical attack somewhere along that route, to measure the external and internal concentrations of chemical agent, and to integrate these concentrations into dosages outside and inside the vehicle.

This is done by utilizing previously-developed partial dosage grids to obtain the dosage at any point (x,y) on the grid at any given time t. From two consecutive times, t_1 and t_2, the current concentration can be *estimated* by differentiation. This concept was combined with a point-to-point vehicle movement model. The results were dosage and concentration histories outside the vehicle at any time (t_i) and any point on the battle grid (x_i, y_i). The model also makes use of a pair of ventilation parameters, f and g, which are related to the ingress and egress rates for the chemical agent and the combat vehicle.

The VEHTRK 2.0 model also allows the simulation of both point and stand-off chemical agent alarm systems by including data to describe the alarm response time, the communication network for a group of vehicles, communication network time delays and delay times to attain a protective posture, given an alarm.

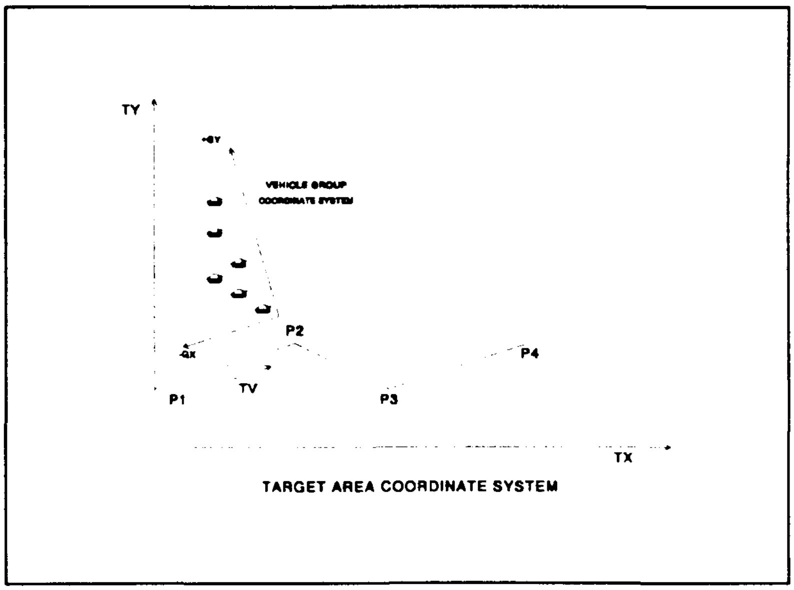

Figure 1. VEHTRK Coordinate Systems

The input data for the VEHTRK 2.0 model is organized into three *distinct data groups: scenario, ventilation, and alarm.* These groupings allow the user to easily set up parametric studies by swapping large segments of data via the three data type files.

Figure 1 illustrates the two coordinate systems used in VEHTRK 2.0. The lead vehicle of a group is assumed to be at the origin of the group system and move from point to point, the other vehicles maintaining their position relative to the lead vehicle. The left-most vehicle is the one with the greatest positive offset GY, the rightmost is at the least GY value. An *annotated* sample scenario data file is shown in Figure 2. A description of each of the variables and the size of the data field for each variable *in each record* is shown in Figure 3.

```
 2                                                  C1/MGRP
 9    2    5                                        C2/NVPG.NVPGL.NVPGR
 1      0 0      0 0                                C3/IIV.GX.GY
 2    -50 0    200 0                                C3/IIV.GX.GY
 3    -50 0    150 0                                C3/IIV.GX.GY
 4    -50 0     50 0                                C3/IIV.GX.GY
 5    -50 0    -50 0                                C3/IIV.GX.GY
 6   -100 0    200 0                                C3/IIV.GX.GY
 7   -100 0    150 0                                C3/I:V.GX.GY
 8   -100.0     50.0                                C3/IIV.GX.GY
 9   -100 0      0 0                                C3/IIV.GX.GY
 2                                                  C4/NPPT
 1    70C 0    400 0       0 0     500 0         C5/IPT.TX.TY.TV.TSTOP
 2    700 1   -100 0       1 0       0 0         C5/IPT.TX.TY.TV.TSTOP
11   11    1                                        C2/NVPG.NVPGL.NVPGR
 1      0 0      0 0                                C3/IIV.GX.GY
 2    -10.0    200 0                                C3/IIV.GX.GY
 3    -10 0    150 0                                C3/IIV.GX.GY
 4    -10 0    100 0                                C3/IIV.GX.GY
 5    -10.0     50.0                                C3/IIV.GX.GY
 6   -100 0    200 0                                C3/IIV.GX.GY
 7   -100.0    150.0                                C3/IIV.GX.GY
 8   -100.0    100.0                                C3/IIV.GX.GY
 9   -100.0     50 0                                C3/IIV.GX.GY
10   -100.0    300 0                                C3/IIV.GX.GY
11   -150.0    350 0                             C3/IIV.GX.GY
 2                                               C4/NPPT
 1    150 0    600.0       4 0       0 0         C5/IPT.TX.TY.TV.TSTOP
 2    '50 0   -200 0       4 0       0 0         C5/IPT.TX.TY.TV.TSTOP
   0.0      100.0      1 0       0 0       0 0 C6/TMIN.TMAX.TDELT.TATTCK
 9     0                                            C7/NCLD.INUNIT
   2 0        4 0      8 0      12 0      16 0 C8/TCLD
  24 0       32 0     64 0     127 9             C8/TCLD
 1   1    1    1                                    C9/IG.IV.CONFIG
 1   2    1    1                                    C9/IG.IV.CONFIG
 1   3    1    1                                 C9/IG.IV.CONFIG
 1   4    1    1                                 C9/IG.IV.CONFIG
 1   5    1    1                                 C9/IG.IV.CONFIG
 1   6    2    2                                 C9/IG.IV.CONFIG
 1   7    2    2                                 C9/IG.IV.CONFIG
 1   8    2    2                                 C9/IG.IV.CONFIG
 1   9    2    2                                 C9/IG.IV.CONFIG
 2   1    3    3                                 C9/IG.IV.CONFIG
 2   2    3    3                                 C9/IG.IV.CONFIG
 2   3    3    3                                 C9/IG.IV.CONFIG
 2   4    3    3                                 C9/IG.IV.CONFIG
 2   5    3    3                                 C9/IG.IV.CONFIG
 2   6    4    4                                 C9/IG.IV.CONFIG
 2   7    4    4                                 C9/IG.IV.CONFIG
 2   8    4    4                                 C9/IG.IV.CONFIG
 2   9    4    4                                 C9/IG.IV.CONFIG
 2  10    3    3                                 C9/IG.IV.CONFIG
 2  11    3    3                                 C9/IG.IV.CONFIG
 4                                               C10/NCONF
```

Figure 2. VEHTRK Sample Scenario Data File

Record	Variable	Format	Column	Unit	Description
1	MGRP	I5	1-5		Number of vehicle groups
2	NGRP	I5	1-5		Number of vehicles in I-th group, 1 ≤ I ≤ MGRP
	NVPGL	I5	6-10		Index number of leftmost vehicle in the group
	NVPGR	I5	11-15		Index number of rightmost vehicle in the group
3	IIV	I5	1-5		Vehicle index number *within group*
	GX	F10.0	6-15	m.	*X*-offset from lead vehicle
	GY	F10.0	16-25	m.	*Y*-offset from lead vehicle
4	NPPT	I5	1-5		Number of points in *group* route
5	IPT	I5	1-5		Route point index number
	TX	F10.0	6-15	m.	X-coordinate of route point
	TY	F10.0	16-25	m.	Y-coordinate of route point
	TV	F10.0	26-35	m/s	Velocity of vehicle as it leaves this point
	TSTOP	F10.0	36-45	sec	Length of time the vehicle is stationary at this point before leaving.
6	TMIN	F10.0	1-10	sec	Time at which simulation begins
	TMAX	F10.0	11-20	sec	Maximum simulation time
	TDELT	F10.0	21-30	sec	Incremental time step
	TATTCK	F10.0	31-40	sec	Time of chemical attack relative to first vehicle point
	RDELT	F10.0	41-50	m	Step-size for line-of-sight integration
7	NCLD	I5	1-5		Number of partial dosage clouds *in cloud file*
Note: Records 2-5 must be repeated for each group before continuing to Record 6.					

Figure 3. VEHTRK 2.0 Scenario Data Description (continued on next page)

Record	Variable	Format	Column	Unit	Description
8	TCLD	5F10.0	1-10 11-20 ...	sec	Times of sampling for partial dosage clouds
9	IG	I5	1-5		Group index
	IV	I5	6-10		Vehicle index *within group*
	CONFIG	10I5	11-15 16-20 ...		Configuration index at each point on the vehicle route *(NPPT values for each vehicle)*
10	NCONF	I5	1-5		Total number of hatch configurations

Figure 3. VEHTRK 2.0 Scenario Data Description (concluded)

The next group of data to be input is the ventilation parameters F (ingress) and G (egress) for each of the vehicle hatch configurations. These are shown in Figure 4, an *annotated* sample ventilation data file. A description of each of the variables and the size of the data field for each of the variables in each record for the ventilation data file is shown in Figure 5.

```
1 .998565E+00 .115214E-02                     C11/IIV.F.G
2 .991745E+00 .784016E-02                     C11/IIV.F.G
3 .998565E+00 .115214E-02                     C11/IIV.F.G
4 .990185E+00 .760056E-02                     C11/IIV.F.G
1     4        0.1                            C12/AFLAG.NDI.FPCON
  0.0       4.0       35.0       70.0         C13/DOSLEV
```

Figure 4. VEHTRK Sample Ventilation Data File

The definitions of the ventilation coefficients F and G are the incoming and outgoing exchange rates of the vehicle, determined empirically from test data. In terms of the first order differential equation for the ventilation process:

$$\frac{dC_i}{dt} = F \cdot C_i + G \cdot C_o$$

where C_i is the inside concentration and C_o is the outside concentration at time t. If S_1 and S_2 are defined as the volumetric flow rates into and out of the vehicle, which has total interior volume V, then $F=(S_1-S_2)/V$ and $G=S_1/V$, and each has dimensions of time^{-1}. The differential model has been replaced in VEHTRK 2.0 with a discretized model based on the incremental time *volume V, then $F=(S_1-S_2)/V$ and $G=S_1/V$, and each has dimensions of time^{-1}. The differential model has been replaced in VEHTRK 2.0 with a discretized model based on the incremental time TDELT. Consequently F and G must be defined with units of TDELT^{-1}, i.e. the fractional volume exchange per time period, a concept similar to compound interest rates.*

Record	Variable	Format	Column	Unit	Description
11	IC	I5	1-5		Configuration index
	F	E12.6	6-17	TDELT^{-1}	Ingress coefficient, volumetric exchange per time period
	G	E12.6	18-29	TDELT^{-1}	Egress coefficient, volumetric exchange per time period
12	AFLAG	I5	1-5		Alarm flag: 0=omit alarms 1=use point alarms 2=use stand-off alarms 3=use both types
	NDL	I5	6-10		Number of dosage levels used for casualty assessment
	EPCON	F10.0	11-20	mg/m^3	Smallest agent concentration to consider in the simulation
13	DOSLEV	F10.0	1-10	mg-min/m^3	Dosage level table for casualty assessment

Figure 5. VEHTRK 2.0 Ventilation File Data Description

A sample set of data for description of the alarm system is shown in Figure 6. This file is not included if AFLAG = 0 or 2 on record 12. *Some notes on the data structure are very important:*

a. Records 17 and 18 occur in pairs for each point on the alarm response curve.

b. The response curve is input for each vehicle; that is, for the card 17 shown there are four values of 0.19 corresponding to each of the four vehicles with alarms.

c. *The first two C19 records* correspond to the alarm warning delays from vehicle 1 to each of the other 20 vehicles in the group.

```
   4                                                              C14/NVA
  -1     -9   -10   -19                                           C15/LVA
   5                                                              C16/NRT
 0.19  0.19  0.19  0.19                                           C17/ACON
 34.2  34.2  34.2  34.2                                           C18/RTIM
 0.27  0.27  0.27  0.27                                           C17/ACON
 30.6  30.6  30.6  30.6                                           C18/RTIM
 28.2  28.2  28.2  28.2                                           C17/ACON
  12.   12.   12.   12.                                           C18/RTIM
 45.0  45.0  45.0  45.0                                           C17/ACON
 10.8  10.8  10.8  10.8                                           C18/RTIM
 141.  141.  141.  141.                                           C17/ACON
   6.    6.    6.    6.                                           C18/RTIM
   0     5     5     5     5    10    10    10     5     5        C19/AWD
  10    10    10    10     5    10    10    10     5     5        C19/AWD
   5    10    10    10    10     5     5     5     0     5        C19/AWD
  10    10    10    10     5    10    10    10     5     5        C19/AWD
   5    10    10    10    10    10    10    10     5     0        C19/AWD
   5     5     5     5     5    10    10    10     5     5        C19/AWD
   5    10    10    10    10    10    10    10     5     5        C19/AWD
  10    10    10    10     5    10    10    10     0     5        C19/AWD
 15.                                                              C20/TREACT
```

Figure 6. VEHTRK Sample Point Alarm Data File

A description of each of the variables and the size of the data field for each of these variables for the alarm data file is shown in Figure 7. If stand-off alarms are being used (AFLAG=2 or 3), a slightly different set of records must be provided, as shown in Figure 8, either additionally or instead. Note the record numbers follow the point-alarm data, if needed. The program reads point-alarm data, followed by stand-off alarm data, as specified by AFLAG. It is assumed that the reaction time of personnel is independent of the alarm source, so TREACT is only read once, from the first alarm data file. While users may use this as an excuse to omit the TREACT data from stand-off alarm files, the safest rule is to include this final record in the input stream to allow the exchange of input file elements when changing scenarios.

Record	Variable	Format	Column	Unit	Description
14	NVA	I5	1-5		Number of vehicles with point alarms
15	LVA	10I5	1-5 6-10 11-15		List of vehicles with alarms, by index number LVA < 0 for alarm inside vehicle, LVA > 0 outside
16	NRT	I5	1-5		Number of points in alarm response time curve
17	ACON	10F5.0	1-5 6-10	mg/m^3	Agent concentration at alarm
18	RTIM	10F5.0	1-5 6-10	sec	Alarm response time for corresponding conc.
19	AWD	10F5.0	1-5 6-10	sec	Alarm warning delay for i,j-th vehicle pair
20	TREACT	F5.0	1-5	sec	Crew reaction time to don protective gear

Figure 7. VEHTRK 2.0 Alarm File Data Description

```
    1                                                                  C21/NVASO
    5                                                                  C22/LVASO
  45.                                                                  C23/HANG
2000.                                                                  C24/RANGE
    1                                                                  C[illegible] NRTSO
 150.                                                                  C26/ACL
  30.                                                                  C27/RTIMSO
    5    5    5    5    0   10   10   10    5    5                    C28/AWDSO
   10   10   10   10    5   10   10   10    5    5                    C28/AWDSO
  15.                                                                  C29/TREACT
```

Figure 8. VEHTRK Sample Stand-off Alarm Data File

Record	Variable	Format	Column	Unit	Description
21	NVASO	I5	1-5		Number of vehicles with stand-off alarms
22	LVASO	10I5	1-5 6-10 11-15		List of vehicles with SO alarms, by index no. LVA > 0 (outside)
23	HANG	10F5.0	1-5 6-10	degrees	Horizontal angle of LOS with forward direction
24	RANGE	10F5.0	1-5 6-10	meters	Functional range
25	NRTSO	I5	1-5		Number of points in alarm response time curve
26	ACL	10F5.0	1-5 6-10	mg/m^2	Agent CL at alarm
27	RTIMSO	10F5.0	1-5 6-10	sec	Alarm response time for corresponding CL
28	AWDSO	10F5.0	1-5 6-10	sec	Alarm warning delay for i,j-th vehicle pair
29	TREACT	F5.0	1-5	sec	Crew reaction time to don protective gear; needed only if AFLAG=2

Figure 9. VEHTRK 2.0 Stand-off Alarm File Data Description

The reader has possibly noted that the input specifications above do not include the specifications for the partial-dosage cloud file. Because many models exist to generate such files, and they may or may not produce files with a format compatible with VEHTRK 2.0, Figure 10 is provided to describe the data specifications expected by VEHTRK 2.0. The program reads all the clouds from a single file assigned to I/O device 15. The clouds must be ordered by ascending time and the grid points must be constant throughout the file. Figure 8 provides the format expected for each cloud in the file.

Record	Variable	Format	Column	Unit	Description
1	NX	I5	1-5		Number of points on x-axis
	NY	I5	6-10		Number of points on y-axis
	TIME	F10.0	11-20	sec	Elapsed time after munition function
2	GRDX	10(E11.5,1X)	1-11 13-24 ...	m	x coordinates in cloud reference system
3	GRDY	10(E11.5,1X)	1-11 13-24 ...	m	y coordinates in cloud reference system
4	GRDD	10(E11.5,1X)	1-11 13-24 ...	mg-min/m^3	dosages at grid points, reading all y values for each x

Figure 10. Specifications for a Single Cloud in a VEHTRK 2.0 Cloud File

A sample output from the sample input is shown in Figure 11. The first part of the output is a listing of pertinent input data to be used in identifying the case run. Figure 12 provides a description of the output column headings. Note that the stand-off detector/alarm was not played in this sample.

```
MGRP =     2
IG,NVPGI,NVPGLI,NVPGRI =       1     9     2     5
IIV,GX,GY =        1  0.0000E+00  0.0000E+00
IIV,GX,GY =        2 -0.5000E+02  0.2000E+03
IIV,GX,GY =        3 -0.5000E+02  0.1500E+03
IIV,GX,GY =        4 -0.5000E+02  0.5000E+02
IIV,GX,GY =        5 -0.5000E+02 -0.5000E+02
IIV,GX,GY =        6 -0.1000E+03  0.2000E+03
IIV,GX,GY =        7 -0.1000E+03  0.1500E+03
```

Figure 11. VEHTRK Sample Output (input echo)

```
NGRP =    2
IG,NVPGI,NVPGLI,NVPGRI =     1    9    2    5
IIV,GX,GY =      1  0.0000E+00  0.0000E+00
IIV,GX,GY =      2 -0.5000E+02  0.2000E+03
IIV,GX,GY =      3 -0.5000E+02  0.1500E+03
IIV,GX,GY =      4 -0.5000E+02  0.5000E+02
IIV,GX,GY =      5 -0.5000E+02 -0.5000E+02
IIV,GX,GY =      6 -0.1000E+03  0.2000E+03
IIV,GX,GY =      7 -0.1000E+03  0.1500E+03
IIV,GX,GY =      8 -0.1000E+03  0.5000E+02
IIV,GX,GY =      9 -0.1000E+03  0.0000E+00
NPPTN =    2
IPT,TX,TY,TV,TSTOP =     1  0.7000E+03  0.4000E+03  0.0000E+00  0.5000E+03
IPT,TX,TY,TV,TSTOP =     2  0.7001E+03 -0.1000E+03  0.1000E+01  0.0000E+00
IG,NVPGI,NVPGLI,NVPGRI =     2   11   11    1
IIV,GX,GY =      1  0.0000E+00  0.0000E+00
IIV,GX,GY =      2 -0.1000E+02  0.2000E+03
IIV,GX,GY =      3 -0.1000E+02  0.1500E+03
IIV,GX,GY =      4 -0.1000E+02  0.1000E+03
IIV,GX,GY =      5 -0.1000E+02  0.5000E+02
IIV,GX,GY =      6 -0.1000E+03  0.2000E+03
IIV,GX,GY =      7 -0.1000E+03  0.1500E+03
IIV,GX,GY =      8 -0.1000E+03  0.1000E+03
IIV,GX,GY =      9 -0.1000E+03  0.5000E+02
IIV,GX,GY =     10 -0.1000E+03  0.3000E+03
IIV,GX,GY =     11 -0.1500E+03  0.3500E+03
NPPTN =    2
IPT,TX,TY,TV,TSTOP =     1  0.1500E+03  0.6000E+03  0.4000E+01  0.0000E+00
IPT,TX,TY,TV,TSTOP =     2  0.1500E+03 -0.2000E+03  0.4000E+01  0.0000E+00
TMIN,TMAX,TDELT,TATTCK =   0.0000E+00  0.1000E+03  0.1000E+01  0.0000E+00
NCLD =    9
TCLD =   0.2000E+01  0.4000E+01  0.8000E+01  0.1200E+02  0.1600E+02  0.2400E+02  0.3200E+02  0.6400E+02  0.1279E+03
 F AND G
   10.998565E+000.115214E-02
   20.991745E+000.784016E-02
   30.998565E+000.115214E-02
   40.990185E+000.760056E-02
EPCON =    0.10000
DOSLEV =        0.00       4.00      35.00      70.00
  0.   0.   0.   0.
 34.  34.  34.  34.
  0.   0.   0.   0.
 31.  31.  31.  31.
 28.  28.  28.  28.
 12.  12.  12.  12.
 45.  45.  45.  45.
 11.  11.  11.  11.
141. 141. 141. 141.
  6.   6.   6.   6.
     1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20

   1  0.   5.   5.   5.   5.  10.  10.  10.   5.   5.  10.  10.  10.  10.   5.  10.  10.  10.   5.   5.
   2  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
   3  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
   4  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
   5  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
   6  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
   7  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
   8  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
   9  5.  10.  10.  10.  10.   5.   5.   5.   0.   5.  10.  10.  10.  10.   5.  10.  10.  10.   5.   5.
  10  5.  10.  10.  10.  10.  10.  10.  10.   5.   0.   5.   5.   5.   5.   5.  10.  10.  10.   5.   5.
  11  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0
  12  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
  13  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
  14  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
  15  0.   0.   0.   0    0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
  16  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
  17  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
  18  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
  19  5.  10.  10.  10.  10.  10.  10.  10.   5.   5.  10.  10.  10.  10.   5.  10.  10.  10.   0.   5.
  20  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
```

Figure 11. VEHTRK Sample Output (input echo)

```
IG  NEIDL              NEXDL            NEIDLA
 1    9    9    6   1      9    9    6   1       9   3   0   0
 2   11   11    8   0     11   11    9   5      11   2   0   0
 3   20   20   14   1     20   20   15   6      20   5   0   0
IG IVG  IV    MAX XC   MAX IC  LAST IC   TIME EG  DOSE EG  DOSE IN    VEH ID    VEH ED  VEH ID/A    TWARN  ASET
 1   1   1     369.8     12.1     11.5    3308.0    133.0     21.1     154.1     193.1       5.6     48.5     1
 1   2   2       7.1      0.7      0.7    1357.0      7.0      0.6       7.6      10.9       0.0     53.5     1
 1   3   3      68.7      2.8      2.8    2325.0     31.6      3.9      35.4      45.5       0.8     53.5     1
 1   4   4      62.6      3.3      3.3    2428.0     36.8      4.3      41.1      52.6       0.6     53.5     1
 1   5   5     120.0      3.9      3.9    2547.0     43.9      5.9      49.7      63.3       1.3     53.5     1
 1   6   6      29.0      8.5      8.5     537.0     17.0      9.9      26.9      28.4       1.1     50.5     9
 1   7   7      26.2      9.0      9.0     543.0     17.9     11.9      29.9      31.5       1.6     50.5     9
 1   8   8     180.4     19.8     14.4     600.0     28.9     34.6      63.5      66.8      12.5     50.5     9
 1   9   9     223.3     16.9     14.3     599.0     28.6     27.6      56.2      59.2       6.6     45.5     9
 2   1  10     228.6      3.3      3.0    2375.0     34.0      5.8      39.8      50.9       1.[illegible]     49.5    10
 2   2  11     170.8      4.4      4.3    2617.0     48.6      7.4      55.9      71.0       2.1     54.5    10
 2   3  12     316.3      4.5      4.3    2619.0     48.7      7.8      56.6      71.8       2.5     54.5    10
 2   4  13     245.4      5.6      5.2    2756.0     59.5      9.8      69.3      87.7       3.2     54.5    10
 2   5  14     136.7      2.7      2.5    2252.0     28.3      4.2      32.5      41.8       1.0     54.5    10
 2   6  15     165.7     19.7     12.1     487.0     20.5     30.5      51.0      65.8       9.6     50.5     9
 2   7  16     149.5     21.2     12.7     492.0     21.4     31.9      53.3      68.8      11.5     55.5     9
 2   8  17      53.1     10.1      6.2     419.0     10.4     12.6      23.0      29.8       2.8     55.5     9
 2   9  18      98.6      9.5      5.8     412.0      9.6     13.0      22.7      29.4       3.8     55.5     9
 2  10  19     222.5      5.3      5.3    2763.0     60.2      8.6      68.8      87.0       1.8     47.6    19
 2  11  20     174.1      5.1      5.1    2732.0     57.5      7.8      65.3      82.7       1.6     50.5     9
```

Figure 11. VEHTRK Sample Output (concluded)

NEIDL — Number of vehicles exceeding internal dosage level (DOSLEV)
NEXDL — Number of vehicles exceeding external dosage level (DOSLEV)
NEIDLA — Number of vehicles exceeding internal dosage level (DOSLEV) when alarms are used

	Dosage Level Index (see input record 13) 1	2	3	4
Group 1	9	9	6	1
Group 2	11	11	8	2
Total	20	20	14	3

IG — I-th group
IVG — I-th vehicle within group
IV — I-th vehicle within entire scenario
MAX XC — Maximum external concentration encountered by vehicle
MAX IC — Maximum internal concentration
LAST IC — Internal concentration when vehicle leaves the cloud
TIME EG — Time in seconds needed for egress of agent to EPCON level
DOSE EG — Dosage accumulated during TIME EG
DOSE IN — Dosage accumulated during agent ingress
VEH ID — Vehicle internal dosage (DOSE EG + DOSE IN)
VEH ED — Dosage accumulated just outside of vehicle
VEH IDA — Vehicle internal dosage with alarms
TWARN — Time at which vehicle received an alarm signal
ASET — Index number of the vehicle which transmitted the alarm

Figure 12. Output Column Heading Descriptions