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INPUT MANUAL FOR THE ARMY UNIT RESILIENCY ANALYSIS (AURA) COMPUTER SIMULATION MODEL: 1990 UPDATE

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DECEMBER 1990

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The purpose of this report is limited, viz. to update the compendium of commands and formats used for the Army Unit Resiliency Analysis (AURA) computer simulation model. The commands in this report are organized with respect to the functional category to which they correspond such as: Program Controls, Asset Descriptors, Deployment, Weapon Effects, Individual Task Inputs and Outputs. In addition, sections are included detailing general information of the AURA methodology and an appendix containing examples of AURA input runstreams for a hypothetical mission in a nuclear, chemical, and conventional scenario.

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I. INTRODUCTION

Since its inception in 1978, the Army Unit Resiliency Analysis (AURA) methodology has been applied to an ever broader spectrum of unit-level survivability/sustainability problems by an increasing number of analysts in the United States and abroad. Meanwhile, the methodology has continued to grow to respond to special needs that have arisen in the many applications. This situation resulted in a strong need for the publication of an AURA user's manual to update the AURA user community on the current input command formats. The first such a manual was published in 1985[1] and updated in 1988.[2]

Since the publication of these manuals, several new methodologies and associated inputs have been added, including a major extension to the sleep deprivation model, a new methodology for degradation due to heat stress, and a new methodology for dose accumulation. Thus, the need for an updated manual has become apparent. This report is designed to fill that need.

As with the previous user's manuals, the purpose of this report is quite limited, viz., to provide a concise compendium of input commands and formats for the AURA computer simulation model. It is assumed that the reader is reasonably familiar with the AURA family of methodologies in general, and with the purpose and function of the many options of the AURA code itself. Therefore, only a brief description of command functions will be given with each entry. For a detailed description of the AURA methodology, the user is referred to Volume 1 of the AURA Programmer/Analyst Guide.[3]

The command descriptions in this report are grouped by function: those that describe assets are presented together, followed by those that describe threat weapons, etc. Within each grouping, the entries are arranged alphabetically.

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1. J. Terrence Klopcic, *Input Manual for the Army Unit Resiliency Analysis (AURA) Methodology*, USA Ballistic Research Laboratory, BRL-TR-2670, (SEP 85), AD A159327, (UNCLASSIFIED).

2. J. Terrence Klopcic, *Input Manual for the Army Unit Resiliency Analysis (AURA) Methodology: 1988 Update*, USA Ballistic Research Laboratory, BRL-TR-2914, (MAY 88), (UNCLASSIFIED).

3. R. Sheroke, et al, *Programmer/Analyst Guide for the Army Unit Resiliency Analysis (AURA) Computer Simulation Model, Volume 1: AURA Methodology*, USA Ballistic Research Laboratory, DRAFT REPORT, (AUG 90), (UNCLASSIFIED).

Appendix A is provided to illustrate and clarify the organization and format of AURA input runstreams. Contained within the appendix are examples of input runstreams representing the hypothetical mission of an Ammunition Supply Point (ASP) unit in a nuclear, conventional, and chemical scenario. Appendix C provides a complete index of all AURA commands.

II. EXECUTION and GENERAL INFORMATION

A. EXECUTION

Described below is a brief overview of the inputs and files required to execute the AURA model. The user is referred to Volume 2 of the AURA Programmer/Analyst Guide[4] for a detailed description of the execution process.

1. **Required Files.** Execution of the AURA model requires the following data and files:

Standard input data;
AURA input runstream file;
AURA lethality file(s);
Executable AURA binary code.

The format and contents of each of these files will be described in the following sections.

2. **Standard Input.** It is necessary to assemble the data and filename(s) for an AURA run to be read as standard input. The standard input data must be in the following format:

Comment line describing AURA run
Offset Coordinates (used to reposition unit - optional)
TP2 / TP3 / TP4 (whichever is needed, if any)
TP5
Output filename
4 character unique run identifier (optional)

where:

TP2 is the name of the conventional lethality file;
TP3 is the name of the nuclear lethality file;
TP4 is the name of the chemical lethality file;
TP5 is the name of the AURA input runstream.

Note:

It is generally convenient to assemble the standard input data and filenames into a file to be read as standard input. The 'xqtaura' shell pro-

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4. R. Sheroke, et al, *Programmer/Analyst Guide for the Army Unit Resiliency Analysis (AURA) Computer Simulation Model, Volume 2: AURA Source Code,* USA Ballistic Research Laboratory, BRL-TR-3103, (JUL 90), (UNCLASSIFIED).

gram creates such a file (called FILES) which is read into AURA as standard input.

3. **AURA Input Runstream File.** The AURA input runstream file contains the commands and formats needed to establish the AURA modeling scenario. The organization, conventions, commands and functions of the AURA input runstream are the subject of this report.

4. **AURA Lethality File(s).** An AURA lethality file contains the weapon effects data for the corresponding desired modeling scenario. AURA uses the following standard weapon effects methodologies for each lethality scenario:

Conventional Lethality - JTCG/ME FULL SPRAY methodology;[5]
Nuclear Vulnerability - NUDACC methodology;[6]
Chemical Dispersion - NUSSE methodology.[7]

Detailed descriptions of the above methodologies are beyond the scope of this report. The interested reader is referred to the references cited below. Format examples of the conventional, nuclear, and chemical lethality files are illustrated in Appendix B of Volume 2 of the AURA Programmer/Analyst Guide.[8]

5. **Executable AURA Binary Code.** The executable AURA binary code is derived from the successful FORTRAN compilation of the file 'AURA.f' (see Section III of Volume 2 of the AURA Programmer/Analyst Guide[9]).

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5. *Computer Program for General Full Spray Material MAE Computations*, Joint Technical Coordinating Group for Munitions Effectiveness, 61 JTCG/ME-79-1-1, (JAN 79), (UNCLASSIFIED).

6. William L. Vault, *Vulnerability Data Array: The Agreed Data Base - Final Report*, Harry Diamond Laboratories, HDL-TR-1906, (JUL 80), (SECRET).

7. R. Saucier, *NUSSE3 Model Description*, U.S. Army Chemical Research, Development and Engineering Center, CRDEC-TR-80746, (MAY 87), (UNCLASSIFIED).

8. R. Sheroke, et al, *Programmer/Analyst Guide for the Army Unit Resiliency Analysis (AURA) Computer Simulation Model, Volume 2: AURA Source Code*, USA Ballistic Research Laboratory, BRL-TR-3103, (JUL 90), (UNCLASSIFIED).

9. Ibid.

B. GENERAL INFORMATION

1. **Formats.** All AURA data sets are preceded by a mnemonic control card and followed by an END card. For example, the mnemonic control to input deployment data is "DEPLOYMENT". Depending on the particular mnemonic, several cards of data may then follow: the most recent mnemonic "remains in effect" until followed by an END card or superseded by another mnemonic card. Thus, if several pieces of data are appropriate for a particular mnemonic (e.g. several items are to be deployed), the DEPLOYMENT mnemonic need only appear once, followed by several cards of deployment data. Each data set should end with an END card. However, if an END card is missing, the input routine will detect the following mnemonic control card and begin a new data set. Mnemonic control cards may be abbreviated to the first six letters.

2. **Order.** With few exceptions, the various data sets may be input in any order. The major exceptions to the any-order rule are:

1. The first data set must be the NAMES or REPERTOIRE data set.

2. Functional forms (LINKs, CREWs, SUBCHAINs, ORLINKs, COMPOUND LINKs) must be input before any higher level functional forms (CREWs, SUBCHAINs, ORLINKs, COMPOUND LINKs, CHAINs) which use them.

3. **Number Types.** Numbers in AURA are either INTEGERS or REALS. (REALS are floating point numbers or exponential numbers with decimal points.) AURA checks to assure that the anticipated combination of INTEGERS and REALS is input and will terminate a run on a FATAL FORMAT ERROR if an errant combination is detected. Unless indicated otherwise, the values of all non-character AURA input parameters is 0 if integer of 0.0 if real. The following sections specify the types of numbers anticipated.

4. **Names, General.** Names for assets, weapons and functional structure parts (LINKs, CREWs, SUBCHAINs, ORLINKs, COMPOUND LINKs) may not contain more than 18 characters, including embedded blanks. Use of special characters within names (see following section) may cause fatal errors or unanticipated behavior and should be avoided.

5. **Special Characters.**

(a) **Continuation Cards.** Data may be continued on a subsequent card. A continuation card is denoted by a dollar sign ($) as the first character on the card, followed by data in the appropriate format. A comma may, but need not, follow the dollar sign.

Continued data falls into two types: supplementary data (data that is different from that of the preceding card) and overflow data (of the same type which did not fit on the preceding card). Several data sets allow options which must be entered on supplementary continuation cards. For example, to specify an alternate posture for a deployed asset, the deployment data card is followed by a supplementary continuation card containing the alternate posture code and the mean time to change posture.

(b) **Comments.** The pound sign (#) immediately stops the scan of a card by the AURA read routines. Thus the user can insert comment cards (for his own use, not to be read as data) into an AURA runstream by beginning the card with a pound sign. Similarly, any data card can have a comment appended, as shown below.

```
#THIS IS AN EXAMPLE OF COMMENTS IN A RUNSTREAM
DEPLOYMENT      # BASED ON FM - XYZ
MECHANIC, 100., 352., 1.0, 1,1,1,1,1,0  # MOTOR POOL
```

(c) **Functional Structure Names.** As described in the following sections, names for the CREW, SUBCHAIN, ORLINK and CPLINK functional structure begin with =, *, + and ! respectively.

(d) **Embedded Procedure Commands.** Potential extensions of the AURA input routines include the development of embedded procedures, which will be signified by a backslash (\) in column 1. An example of such a procedure is the embedded offset (under DEPLOYMENT) which translates the unit to new deployment coordinates.

6. AURA Terminology.

ASSETS - Personnel and equipment belonging to and deployed with the unit.

BASELINE - Initial set of input data from which all related AURA excursions for a specific study will be generated.

CASUALTY - Personnel asset removed from this simulation. This is a function of the kill criteria selected by the user.

CHAIN - A collection of AURA constructs which span the activities of a unit to represent the unit mission. A chain is the highest level AURA construct.

CONSTRUCT - A task or combination of tasks. Each construct indicates a specific relationship between its elements (i.e. an ORLINK represents an 'OR' relationship, SUBCHAIN represents an 'AND' relationship, etc.).

COMPOUND LINK - An AURA construct used to represent several groups of tasks/jobs such that the total activity is a summation of the independent contributions of the different constructs. A compound link may be comprised of orlinks, subchains, crews, and/or links.

CREW - An AURA construct used to represent sets of subtasks that must work together to accomplish part of the mission. The relationship between these subtasks are generalized parallel structures and all crew tasks are links.

DUMMYLINK - A job which has no asset of the same name. Dummylinks are links which have no particular assets assigned to them but are filled, when needed, by substitutes.

EXCURSION - Input set for which initial baseline input data have been varied from the baseline to determine the sensitivity of the results to the input parameters.

FUNCTIONAL STRUCTURE - The organization of activities and tasks that result in the accomplishment of a unit's mission. These activities are represented by the organization of AURA constructs. A detailed description of the organization and content of the AURA functional structures is included in Volume 1 of the AURA Programmer/Analyst Guide.[10]

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10. R. Sheroke, et al, *Programmer/Analyst Guide for the Army Unit Resiliency Analysis (AURA) Computer Simulation Model, Volume 1: AURA Methodology*, USA Ballistic Research Laboratory, DRAFT REPORT, (AUG 90), (UNCLASSIFIED).

HOMELINK - A link which has the same name as the asset that fills it. An asset is immediately available for its 'homelink' task and contributes to the homelink's accomplishment at 100 percent effectiveness unless degraded otherwise.

LETHALITY - The ability of a weapon to inflict damage.

LETHALITY FILE - The input file containing the lethality data for the environment(s) being modeled.

Environment	Lethality file
Conventional	FORTRAN unit # 2
Nuclear	FORTRAN unit # 3
Toxic/Chemical	FORTRAN unit # 4

LETHALITY EVENT - A process by which the AURA model simulates the effects (damage, contamination, dosage, etc.) resulting from a conventional, chemical, or nuclear attack.

LINK - The lowest task/job delineation of all AURA constructs. Links may be used as independent constructs or combined to represent any higher AURA construct.

MISSION - Performance rate or capability upon which the study unit is being evaluated. For example, a supply unit might be evaluated on its ability to issue 2000 tons of supplies per day.

OPTIMIZATION - The process by which the AURA model allocates available assets in the attempt to maximize the effectiveness of the unit. The optimization process is performed over all mission constructs which can be improved during the course of the mission.

ORLINK - An AURA construct representing mutually exclusive choices for the accomplishment of part of the mission. Orlinks may be comprised of subchains, crews, and/or links.

RECONSTITUTION - A 'snapshot' of the unit's status taken at specified time periods within an AURA execution.

RECONSTITUTION EVENT - A process by which the AURA Asset Allocation Algorithm (the commander's decision model) simulates the reallocation of surviving assets in order to optimize the unit's mission accomplishment.

REPLICATION - One complete pass through the events of an AURA simulation. Due to variances resulting from random number generation, several (50 or more) replications are generally specified and the unit effectiveness and casualty estimates are averaged over all replications. This process insures a more statistically sound representation of the events simulated.

RUNSTREAM - The input file (FORTRAN unit # 5) containing the AURA commands and parameters required to model a particular scenario.

SEGMENT - An element in a chain. A segment can be a compound link, orlink, subchain, crew, or a link.

SLUNIT - (SLeep unit). Unit of measure used to represent the amount of rest associated with a personnel asset. 1 SLUNIT = 1 minute of fully efficient rest.

SUBCHAIN - An AURA construct used to represent a group of tasks which must work together to accomplish part of the mission. A subchain may be comprised of crews and/or links.

SURVIVOR - An asset that is still available to the unit after an attack.

UNIT EFFECTIVENESS - The capability of the unit to perform its selected mission. Note: The unit's effectiveness is evaluated based upon its ability to perform selected mission(s) which have an associated rate defined as 100% performance.

VULNERABILITY - Susceptibility of a target to damage.

WEAK LINK - The individual tasks in a construct which have the most degrading effects on the capability of the construct. There may be more than one WEAK LINK.

WEAPON - Incoming weapon. The term 'weapon' includes warheads and delivery systems.

7. **Units, Times and Time Intervals.** Much of the data which is input into AURA has associated units, most commonly length or time. It is essential, therefore, to establish a consistent system of units, since parameter values can be markedly different in different systems. (For example, an event time could be input as 3600., 60., or 1. depending on whether seconds, minutes or hours are being used.)

With the exception of certain nuclear algorithms which contain built-in basic data, AURA can be used with any consistent set of units. However, achieving such consistency may require a great deal of thoroughness. For example, both length and time are buried in the threshold value for chemical alarm functioning. Therefore the following set of units, consistent with the nuclear algorithms, are recommended:

MEASURES	UNITS
Time	minutes
Distance	meters
Angles	degrees
Toxic deposition	milligrams/meter^2
Toxic dose	milligrams-min/meter^3
Nuclear dose	rads (cGy)
Nuclear yield	kilotons (kt)

Some of the AURA options require the input of a time duration. For example, to allow individuals under attack to change posture requires specifying the mean time for the change. On the other hand, those options which result in the scheduling of an event, such as the options which specify that an attack will occur, require input of an absolute (clock) time into the simulation. In this report, all time inputs will be identified as (intrvl) or (clock) to indicate whether the value is a duration interval or an absolute event time.

8. **AURA's Coordinate Systems.** Three coordinate systems are used in AURA to express data that refer to geographical locations or extents. These coordinate systems are defined as follows:

(a) **The Unit Coordinate System.** Any right-handed coordinate system may be used to lay out the study unit. Any particular point in the unit, such as the geographical center or "lower left" corner, may be designated as the origin of the unit coordinate system, and all other unit elements are deployed relative to that point. Note: All target and deployment points from the fire direction and wind direction coordinate systems are defined relative to points within the unit coordinate system.

(b) **The Incoming Fire (Range-Deflection) System.** Threat weapon parameters are specified in range and deflection, where range is in the direction of the incoming fire, and deflection is perpendicular to range such that range-deflection define a right-handed, horizontal coordinate system. The user can specify the orientation of the range direction relative to the unit coordinate system.

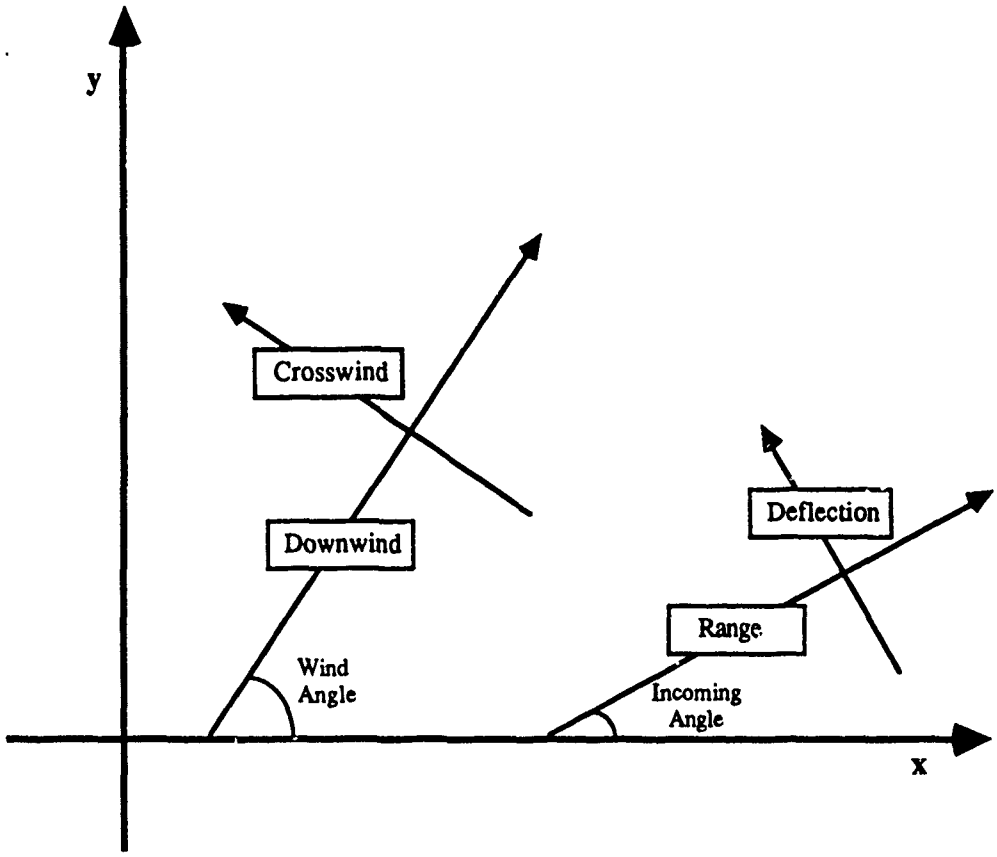
(c) **The Wind Direction (Downwind-Crosswind) System.** Chemical cloud dispersion is specified in the downwind and crosswind directions, which are defined to form a right-handed, horizontal coordinate system. The user can specify the orientation of the downwind direction relative to the unit coordinate system.

Usage of the AURA coordinate systems is summarized in Table 1, while Figure 1 illustrates the AURA coordinate systems.

Table 1. Coordinate Systems for Geographically Related Parameters

Parameter	Coordinate System	Comment
Deployment of items	UNIT	Define X-Y System
Aim point	UNIT	e.g. signature point
Target Location Error	RANGE-DEFLECTION	Measured from aim point
Delivery errors	RANGE-DEFLECTION	Measured from aim point
Burst point of munitions	UNIT	Internally computed by AURA
Conventional weapon effects (Lethal radii)	RANGE-DEFLECTION	Measured from burst point
Chemical contamination and vapor clouds	DOWNWIND-CROSSWIND	Measured from burst point
Volley parameters (length, volley, etc.)	RANGE-DEFLECTION	Measured from aim point

Unit Coordinate System



The incoming fire and wind direction coordinate systems are defined relative to the unit coordinate system. AURA ultimately converts any coordinates specified in incoming fire (or wind direction) coordinates to unit system coordinates.

Figure 1. AURA's Coordinate Systems

III. NAMES

The first data set in an AURA input stream is a list of names to be used for assets and weapons. This block may be headed by a NAMES or REPERTOIRE card and must be terminated (after all asset and weapon names have been listed) by one END card. A group of asset names must be headed by an ASSETS card; weapon names must be headed by a WEAPONS card. Note: An END card may not be placed between the asset and weapon name lists.

Format:

ASSETS
asset name1, alternate name1a, alternate name1b, ...
asset name2, alternate name2a, ...
....
WEAPONS
weapon name1, alternate name1i, alternate name1j, ...
weapon name2, alternate name2i, ...
....
END

where:
all names conform to restrictions listed on p. 5

Each asset and weapon must have at least one unique name. Alternate names are used to associate common parameters to groups of assets or weapons. To invoke certain code defaults, the following alternate names MUST be used:

CONVENTIONAL - must be attached to each conventional or combined conventional/toxic weapon attack
NUCLEAR - must be attached to each nuclear weapon (NUKE can be used as a substitute)
PERSONNEL - must be attached to each personnel asset
TOXIC - must be attached to each toxic or combined conventional/toxic weapon attack

IV. AURA INPUT COMMANDS and OPTIONS

A. ASSET INPUTS

The following data sets input parameters that describe the assets (personnel and equipment) of a unit.

1. **ALARM.** This command identifies both vapor dosage sensitive and vapor concentration sensitive chemical alarms and indicates threshold for activation due to each weapon. The user must designate a threshold value of < 0 to indicate a vapor concentration sensitive alarm and a value > 0 to specify a vapor dosage sensitive alarm.

Format:

ALARM
asset name of alarm (as defined in NAMES input)
weapon name1, threshold dosage for alarm to sound (REAL) (Default: 0.0)
weapon name2, threshold dosage ....
....

NOTE:

Toxic dissemination data (UNIT #4) must be read in first to allow the code to adjust for dose normalization (see TOXIC DISPERSION DATA, p. 42). Alarms are deployed by asset name like any other equipment (see DEPLOYMENT, p. 22). Alarms will have no effect (will be too late) if personnel begin to MOPP-up as soon as round arrives. Must use ROUND NO option (see MOPP, p. 24).

2. **CONTAMINATED USAGE.** This command allows designating those items of equipment which may be used when contaminated, along with the missions (CHAINs) in which this usage is allowed.

Format:

CONTAMINATED USAGE
asset name, CHAIN numbers (INTEGERS)
....

NOTE 1:

If contaminated usage card is not included in a runstream for which a toxic event occurs, contaminated items of equipment will be used as long as personnel are in MOPP4.

NOTE 2:

If CHAIN numbers are omitted, all CHAINs are assumed.

Option 1:

If asset name is "ALL", all assets become contaminated-usable.

Option 2:

If MUST MOPP ON, contaminated items usable only if all personnel in a safe posture.

Format:

MUST MOPP ON
MUST MOPP OFF (Default: OFF)

3. **EXPENDABLE.** This command identifies assets that are expended as they are used. Two forms are available: Expenditure by time and expenditure by repair completion.

EXPENDABLE

Option 1:

expenditure by time:

Format:

asset name, rate of usage by time (per minute) (REAL)

Option 2:

expenditure by repair completion:

Format:

$asset name

NOTE 2:

For assets identified as expendable under option 1, the amount that is assessed as expended at any time point depends upon the amount of mission time spent since the previous update and the effectiveness of the unit during that time. (Mission time is that time which follows a reconstitution and extends until interrupted by a lethality event.) Assets identified as expended during repair or decontamination activities must have HOMELINKs which appear in the consuming repair SUBCHAINs (see REPAIR, p. 18). LINK parameters should describe the amount needed for one repair (see LINKS, p. 45).

4. **FAILURE RATE.** This command specifies the rate at which ·ets undergo spontaneous (reliability-type) failures. Equipment can fail so as tc :quire light, medium, or infeasible repair; personnel can only have dead failures.

Format:

FAILURE RATE
asset name, mtbf, fl, fm

where:

mtbf	is the mean time (intrvl) between any failures (REAL)
fl	is the fraction of failures requiring light repair (REAL)
fm	is the fraction requiring medium repair (REAL)

NOTE 2:

If fl and fm are not specified, all failures are taken as dead.

Option 1:

Preload pool of ongoing repairs at time 0:

Format:

PREFAIL,ON

NOTE 3:

When PREFAIL is ON (the default case), light and medium repairs are prestarted, simulating an ongoing process at the initial time of the study. This option avoids having too many items available at time zero, too many failing afterwards, and a delay in the repair return rate.

Option 2:

If mtbf is entered as a negative number, the value of mtbf is taken as a probability of not being present at time 0. Requires PREFAIL option to be ON.

5. **GRANULARITY.** This command causes the iterative portion of the optimal allocation processor to consider allocating an asset in specified portions, thus decreasing the possibility of over-allocating to one task at the detriment of others. Since the optimization algorithm has built-in checks against such over-allocation, this command is used to allocate an asset to more than one job.

Format:

GRANULARITY
asset name, grnl

where:
grnl is the largest increment per allocation step (REAL) (Default: 1.0)

6. **REINFORCEMENTS/LOSSES.** This command causes specified assets (personnel or equipment) to appear/disappear at specified times in an encounter. This command has been used, for example, in a detailed study in which an a priori decision to reinforce/remove some assets at a point in the encounter was part of the scenario.

Format:

REINFORCEMENTS
TIME, time of event
$asset name, number gained
$asset name, number gained
...
$asset name, number gained
$asset name, number gained
TIME, time of event
$asset name, number gained
$asset name, number gained

or

LOSSES
TIME, time of event
$asset name, number lost
$asset name, number lost
...

where:
time is the (clock) time of reinforcement (REAL)
number is the number of assets added/removed (INTEGER)

NOTE:
LOSSES can only remove assets which have survived to the time of removal.

7. **REPAIR.** This command inputs data relative to the repair of damaged or failed equipment. Included in the inputs are the subtasks (LINKs or SUBCHAINs) needed for repair, the mean time and standard deviation in the mean time for repair, and the penalty (0.0 - 1.0) that the commander would be willing to take in his immediate mission in order to fix the item if the need for the item were the choke point in the mission. AURA also uses the penalty value to help prioritize possible repairs at various levels.

Repairs can be specified on three levels: 0 = decontamination needed, 1 = light repair needed, and 2 = medium repair needed. It is assumed that light or medium repair can be applied to the specified item regardless of the source of need i.e. either failure or combat damage. See FAILURE RATE, p. 16, for specification of equipment failures.

NOTE:

Repairable combat damage requires both that the item appear as a repairable under this mnemonic and that the item has exactly three kill criteria specified in the lethality file.

Format:

REPAIR
asset name
$cp1,lvl1,pnlt1,mt1,sd1,xrp1,yrp1
$cp2,lvl2,pnlt2,...
...

where:

cpI	is the LINK or SUBCHAIN needed to perform level I repair on the named asset
lvlI	is the level of repair being described (INTEGER)
pnltI	is the acceptable mission penalty for level I repair (REAL)
mtI	is the mean time to accomplish level I repair (REAL)
sdI	is the standard deviation in mtI (REAL)
xrpI and yrpI	are the coordinates of the location at which repair of this item at this level would take place (REAL)

NOTE:

If an asset name for which multi levels of damage are assessed is not followed by repair card(s), a warning is printed. AURA then assumes that the user wants combat damage levels checked and tallied, but knows that there is no repair available.

Option 1:

GENERAL REPAIR. This option allows specification of general repair LINKs or SUBCHAINs, i.e. capabilities which must be satisfied ONCE in order for any repairs to be conducted.

Format:

GENERAL REPAIR
$gnrl cp, lvl

where:

gnrl cp is the LINK or SUBCHAIN needed for any repair at level lvl
lvl is the level for which gnrl cp applies (INTEGER)

Option 1:

MAXIMUM NUMBER. This option allows specifying the maximum number of repairs which can be going on at any time.

Format:

MAXIMUM NUMBER, maxrp

where:

maxrp is the maximum number of repairs that can be ongoing at any one time (INTEGER). Default: maxrp = 50

Option 2:

NO REPAIR. This option allows specifying those CHAINs in which no repair or decontamination is allowed.

NOTE:

CHAIN input must precede REPAIR input if this option is used.

Format:

NO REPAIR,nch1,nch2,nch3,...

where:

nchI are the CHAINs which do not allow repair or decontamination.

8. **SECONDARY EXPLOSIVE.** This command allows identifying some assets as being potential sources of secondary explosions (i.e. being detonated by an incoming round and becoming additional lethality sources themselves). To use this command, the "explosive potential" is given a name (e.g. AMMO STACK, SECONDARY) which appears in the NAMES list as both an ASSET and a WEAPON. Similarly, the name appears in the conventional lethality file (see Appendix B of Volume 2 of the AURA Programmer/Analyst Guide)[11] as both a target for other warheads, where data describes probability of detonation, and as a warhead, where data describes the effect of a detonation against all other targets in the unit. This command is used to associate the "explosive potential" with the appropriate (real) assets (e.g. ammunition stacks).

Format:

SECONDARY EXPLOSIVE
secondary explosive name, associated asset1, ...

9. **TEMPORARY LOSSES/RETURN TO DUTY.** This command causes specified assets (personnel or equipment) to 'temporarily' disappear/reappear at specified times in an encounter. This command has been used, for example, in a detailed study in which an a priori decision to 'temporarily' remove/replace some assets at a point in the encounter was part of the scenario.

NOTE:

TEMPORARY LOSSES command is identical to LOSSES, except lost assets are put into a 'temporary storage area'.

RETURN TO DUTY command is identical to REINFORCEMENTS, except assets must come from the 'temporary storage area'. That is, the assets must have been prior TEMPORARY LOSSES.

TEMPORARY LOSSES can only remove assets which have survived to the time of removal. Thus, although an asset may be marked for TEMPORARY LOSS, it might not be put in the 'temporary storage area' if it had previously been killed. For such assets, RETURN TO DUTY has no effect.

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11. R. Sheroke, et al,*Programmer/Analyst Guide for the Army Unit Resiliency Analysis (AURA) Computer Simulation Model, Volume 2: AURA Source Code*, USA Ballistic Research Laboratory, BRL-TR-3103, (JUL 90), (UNCLASSIFIED).

Format:

TEMPORARY LOSSES
TIME, time of event
$asset name, number lost
$asset name, number lost
...
$asset name, number lost
$asset name, number lost
TIME, time of event
$asset name, number lost
$asset name, number lost

or

RETURN TO DUTY
TIME, time of event
$asset name, number returned
$asset name, number returned
...

where:

time is the (clock) time of reinforcement (REAL)
number is the number of assets 'temporarily' removed/returned (INTEGER)

10. **TIREDNESS.** This command enables the user to control the levels (in SLUNITs) at which an asset is allowed to stop working and rest. Recall: 1 SLUNIT = 1 minute of effective rest.

Format:

TIREDNESS
asset name
$MIN (REAL)
$MAX (REAL)
$DUR (REAL)
$CEI (REAL)
$INI (REAL)

where:

$MIN - minimum SLUNITs below which assets will be forced to rest (Default: 0.0)
$MAX - maximum SLUNITs above which assets may not rest (Default: (1520.0 - 0.01) = 1519.99)
$DUR - minimum duration of rest (Default: 240.0)
$CEI - ceiling on the number of cumulative SLUNITs (Default: 1520.0)
$INI - initial SLUNITs for asset at start of each replication (Default: 1520.0)

B. DEPLOYMENT INPUTS

The following data sets input parameters related to particular (geographical) deployment points. Note that this also includes data that define codes for any status that is location dependent (like MOPP posture) and also data which is associated to that status (such as degradation due to MOPP posture).

1. **DEGRADATION.** This command allows the user to associate a MOPP code number and a TOXIC KILL CRITERIA (T.K.C.) code number with a performance degradation value. When the code is evaluating the effectiveness of individuals in specified tasks, it degrades the contributions according to the current MOPP posture and the T.K.C. of the deployment point. Thus, the degradation of a job due to the wearing of MOPP is input via the T.K.C. and toxic posture (and alternate toxic posture, if used) (see DEPLOYMENT, p. 22 and T.K.C., p. 28).

Format:

DEGRADATION
MOPP code, tkc, dgf

where:

MOPP code	is defined under the MOPP command (see p. 24) (INTEGER) (Default: 4)
tkc	is defined under the T.K.C. command (see p. 28) (INTEGER) (Default: 1)
dgf	is the degradation factor for the specified MOPP posture and job difficulty (T.K.C.) (REAL)

2. **DEPLOYMENT.** This command indicates location, number, "kill criteria" and posture of assets. A supplementary continuation line may be used to indicate alternate postures and times-to-change-posture. This command is also used to locate places at which dummylink jobs would be done (see DUMMYLINK, p. 7). Each set of data defines a TARGET POINT.

Format:

DEPLOYMENT
asset name, x, y, nmbr, ckc, nkc, tkc, cpst, npst, tpst

where:

asset name	is "unique" name of asset or DUMMYLINK at target point
x, y	are coordinates in unit coordinate system (REAL)
nmbr	is the number of (identical) assets at the point (REAL)

ckc is the conventional kill criteria code (INTEGER) (see APPENDIX B of Volume 2)[12]
nkc is the nuclear kill criteria code (INTEGER)
tkc is the toxic kill criteria code (INTEGER) (see T.K.C., p. 28)
cpst is the conventional posture code (INTEGER)
npst is the nuclear posture code (INTEGER) (see SHIELDING, p. 27)
tpst is the toxic posture code (INTEGER) (see MOPP, p. 24)

Option 1:

Alternate posture

Format:

$cpst,npst,time1 or
$tpst,time2 or
$cpst,npst,time1,tpst,time2

where:

cpst is the alternate conventional posture (INTEGER)
npst is the alternate nuclear posture (INTEGER)
time1 is the mean time (intrvl) required to change to cpst,npst (REAL)
tpst is the alternate toxic posture (INTEGER)
time2 is the time (intrvl) needed to change to tpst (REAL)

NOTE 1:

If cpst, npst, and tpst are specified, conventional, nuclear and toxic posture change begins at arrival of first round.

NOTE 2:

Toxic posture change may also be initiated by the ALARM command (see p. 14).

Option 2:

MOPP ALL. This option provides a short cut to give all personnel the same alternate MOPP posture with the same mean time to change such that the individual times-to-change are normally distributed. The TIME SPREAD option, p. 25, can be used to vary the sigma associated with this distribution.

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12. Ibid.

Format:

MOPP ALL, tpst, time2

NOTE 3:

The MOPP ALL card can be inserted anywhere in the deployment input set. If used, it supersedes any individual alternate MOPP postures.

Option 3:

\OFFSET. This option allows adding specified values to the x and y coordinates of all deployment points which follow in the runstream. This option provides an easy method of displacing a section of a deployment. As denoted by the leading backslash, this is an embedded procedure command (see p. 6).

Format:

\OFFSET, x-displacement (REAL), y-displacement (REAL)

NOTE 4:

The offset generated within the DEPLOYMENT command is ADDITIVE to the offset generated by the \OFFSET command or by the \OFFSET card in the execution runstream.

3. **MOPP.** This command allows the user to define the toxic posture (MOPP) codes (used in DEPLOYMENT for initial and alternate toxic posture) and specify a penetration factor for each. The penetration factor is used to adjust the dosage received by an individual or contamination received by a piece of equipment for an asset in the specified toxic posture. This command is also used to set a number of options dealing with the assumption of alternate MOPP posture.

Format:

MOPP
verbal description (<13 characters), tpst, tfv, tfp

where:

tpst is the toxic posture code number (INTEGER)
tfv is the fraction of vapor dosage still received in posture (REAL)
Defaults: MOPP0 - MOPP2 = 1.0, MOPP3, MOPP4 = 0.0
tfp is the fraction of percutaneous dosage still received in posture (REAL)
Defaults: MOPP0=1.0, MOPP1=0.2, MOPP2=0.1, MOPP3=0.025, MOPP4=0.0

If tfp is not given, tfp is set to tfv.

NOTE:

Codes 0 - 4 default to "OPEN", "MOPP1", "MOPP2", etc., with penetrations decreasing from 1.0 to 0.0.

Options:

These optional commands enable the user to customize MOPP conditions throughout the AURA run.

Format:

ALL CLEAR,YES or ALL CLEAR,NO. This option automatically returns unit individuals to initial MOPP posture when the last contaminant evaporates or is removed by decontamination. Default: ALL CLEAR,YES

PROXIMITY, dist (REAL). This option allows specifying the (x and y) distance from a warhead within which an asset must be in order to "feel threatened" by an incoming round and change MOPP posture (see ROUND YES, immediately below). Default: dist = 1.E35

RECONSTITUTION,YES or RECONSTITUTION,NO. This option causes the unit status to be output for each reconstitution.
Default: RECONSTITUTION,NO

RECOVERY TIME, trcvr (REAL). This option inputs the time, in minutes (intrvl), needed to realize that contamination is no longer present and to resume initial MOPP posture. Default: trcvr = 30.0

ROUND,YES, tfalse (REAL) or ROUND,NO. This option controls whether individuals assume alternate MOPP posture upon any incoming round. If ROUND YES, the value tfalse is the (false alarm recognition) time, minutes (intrvl), needed to recognize that none of the incoming rounds were toxic and to return to initial MOPP posture. Default: ROUND,YES, tfalse = 10.0

NOTE:

ROUND,NO must be used when modeling the ALARM command.

TIME SPREAD, sigma (REAL). This option inputs the fractional standard deviation in time needed to change MOPP posture when MOPP ALL command is used. Default: sigma = 0.2

4. **\OFFSET.** This command reads x and y offset values which are added to the x and y coordinates of every deployment point before the analysis commences. This allows the user to model one generic deployment of a unit, centered around 0.,0. and displace the entire deployment to specific (battlefield) locations.

Format:

\OFFSET
x-offset (REAL), y-offset (REAL) in UNIT coordinate system

NOTE:

Offsets can also be input via the computer's normal input channel as part of program execution. In case of conflict, offsets input via the execution stream take precedence (see EXECUTION, p. 3). The offset input via this command or via the execution stream is * additive * to any offset input via the \OFFSET option under DEPLOYMENT (see p. 24).

5. **REST.** This command specifies the location at which personnel assets deploy when assigned to rest (see FATIGUE, p. 43). If no rest location is specified for an asset, it is assumed that the asset will rest at his duty station.

Format:

REST
asset name, x, y, ckc, nkc, tkc, cpst, npst, tpst

Option:

Alternate postures

Format:

$cpst,npst,time1
or
$tpst,time2
or
$cpst,npst,time1,tpst,time2

NOTE:

See DEPLOYMENT, p. 22, for definition of data. This input is identical to DEPLOYMENT except nmbr is omitted and asset name need not be unique.

6. **SHIELDING.** This command allows the user to define nuclear posture code numbers. Shielding associates a verbal description and a transmission matrix with the code number. (See Appendix B for default shielding values.)

Format:

SHIELDING
verbal description, npst, trns1, trns2, trns3, trns4

where:

npst is the code number (INTEGER, between 4-61) and the transmission factors are defined by:

trns1 = (n,n)
trns2 = (g,n) (usually = 0)
trns3 = (n,g)
trns4 = (g,g)

where:

n indicates neutron
g indicates gamma
(a,b) indicates dosage of type b in the posture due to an incident dosage of type a. (REAL)

NOTES:

If only trns1 is given, it is used for trns1 and trns4; trns2 and trns3 are set = 0. Nuclear posture codes 1, 2 and 3 are reserved for OPEN, OPEN-BUT-THERMALLY-SHIELDED and FOXHOLE, respectively. No vehicle can be associated with posture codes 1 - 3. Codes 4 and 5 default to APC and TANK; however, the user must associate any vehicular blast protection (see following option).

Option:

An asset (usually a vehicle) can be associated with nuclear posture codes 4 through 61. Doing so gives an individual in the posture the same blast criteria as the associated vehicle. That is, the personnel assets in the vehicle will be considered casualties when the vehicle becomes a casualty.

Format:

$associated asset name

7. **T.K.C. (TOXIC KILL CRITERIA).** This command allows the user to define the toxic kill criteria code numbers. T.K.C. associates with the code number a verbal description and a chemical dosage multiplier (used to simulate higher (or lower) than normal ratio of dose/dosage, as would be acquired by a person whose task required a higher (or lower) than normal breathing rate). The effect of the TOXIC KILL CRITERIA code number in general, and this option in particular, is to allow the user to indicate deployment points at which a difficult (or easy) job is being done. Any individual assigned to that deployment point inherits the criterion of the job (see also DEGRADATION, p. 22).

Format:

T.K.C.
verbal description (<13 characters), tkc, dm

where:

tkc is the toxic kill criteria code number (INTEGER, 1-20)
Default: 4

dm is the dosage multiplier (relative to breathing rate) (REAL)
Default: 1.0

C. WEAPON INPUTS

The following input parameters relate to weapon delivery system performance and weapon arrival events.

1. **ACQUISITION PROBABILITY.** This command inputs a single probability number which represents the probability that the unit has been acquired. This command also allows a change in probability via a change event. A random number is drawn against the current probability value and the acquisition status is redetermined at the beginning of every replication and upon every change event. Before every lethality event, acquisition status is checked: if in a non-acquired state, lethality events are skipped.

Format:

ACQUISITION PROBABILITY
pacqr

where:

pacqr is the target acquisition probability (REAL) (pacqr must be a value between 0.0 and 1.0 inclusive.) Default: 1.0

Option:

This option can be used to input an ACQUISITION PROBABILITY change event. This allows the user to simulate a point in time at which the probability of target acquisition changes, as would be caused by unit movement. It also causes a new random number to be drawn. Thus, to model independent attacks on parts of a separated unit, use of this option will cause acquisition probabilities to be uncorrelated.

Format:

time, pacqr

where:

time is the (clock) time at which the change in error occurs (REAL)

2. **AGENT.** This command associates a toxic agent type with a specific weapon.

Format:

AGENT
weapon name, atyp

where:

atyp is G, V, or H. Default: atyp = G

3. **CEP ERROR.** This command reads delivery errors expressed in circular error probable (CEP). (CEP ERROR is that radius within which one half of the rounds are expected to fall.)

Format:

CEP ERROR
weapon name, indcep, corcep, hob

where:

indcep is the independent round error, also known as the precision error (REAL) Default: 0.0

corcep is the volley-correlated circular error, also known as the mean point of impact (MPI) error (REAL) Default: 0.0

hob is the standard deviation in height-of-burst (REAL) Default: 0.0

IMPORTANT NOTE:

Values of errors > 0 result in errors being drawn from a Gaussian distribution having a shape parameter derived from the input error value. Values < 0 result in errors being drawn from a uniform distribution having a range parameter derived from the input error value. Positive and negative values may be mixed on the same card.

Option:

This option can be used to input a CEP ERROR change event. This allows the user to simulate a point in time at which the error in incoming fire changes, as would be caused by a change in location of the attack.

Format:

weapon name, time, indcep, corcep, hob

where:

time is the (clock) time at which the change in error occurs (REAL)

4. **CEP TLE.** This command inputs target location errors expressed as a circular error probable (CEP). (CEP TLE is that radius within which the target is expected to be one half of the time.)

Format:

CEP TLE
tlecep

where:
tlecep is the target location error, expressed as a circular error probable (REAL) Default: 0.0

NOTE:
See CEP ERROR, p. 30, for choice of distributions.

Option:
This option can be used to input a CEP TLE change event. This allows the user to simulate a point in time at which the error in target location changes, as may result from the use of different intelligence sources.

Format:

time, tlecep

where:
time is the (clock) time at which the change in error occurs (REAL)

5. **DELIVERY ERROR.** This command inputs weapon delivery errors as standard deviations or radii of uniform distributions in RANGE and DEFLECTION.

Format:

DELIVERY ERROR
weapon name, rind, rcor, dind, dcor, hob

where:
rind is the independent round error, also known as the precision error in range (REAL) Default: 0.0
rcor is the volley-correlated error in range, also known as the mean point of impact (MPI) error (REAL) Default: 0.0
dind is the independent error in deflection (REAL) Default: 0.0
dcor is the volley-correlated error in deflection (REAL) Default: 0.0
hob is the error in height-of-burst (REAL) Default: 0.0

NOTE:

See CEP ERROR, p. 30, for choice of distributions.

Option:

This option can be used to input a DELIVERY ERROR change event. This allows the user to simulate a point in time at which the error in weapon delivery changes, as may result from a variation in the weapon system to target range.

Format:

weapon name, time, rind, rcor, dind, dcor, hob

where:

time is the (clock) time at which the change takes place (REAL)

6. **INCOMING FIRE DIRECTION.** This command orients the incoming fire (RANGE) direction with respect to the unit coordinate system. See discussion of coordinate systems on p. 11.

Format:

INCOMING FIRE DIRECTION
incang

where:

incang is the angle (degrees) from the UNIT x direction to the RANGE direction (INTEGER, positive if counter-clockwise).
Default: incang = 0

Option 1:

Incoming fire direction change event.

Format:

time, incang

where:

time is the (clock) time at which the incoming fire direction changes (REAL).

Option 2:

The incoming fire direction can also be specified as a range of directions, in which case the code will randomly select, from a uniform distribution, a new direction within the specified range for each replication.

Format:

incang1, incang2

where:
incang1 and incang2 are the angles between which the incoming fire directions will lie (INTEGERS)

Option 3:
Incoming fire direction change event, specified over a range of angles.

Format:

time, incang1, incang2

7. **MISS DISTANCE.** This command inputs a fixed distance by which a weapon will miss its aim point. Rounds will be randomly located on a circle of radius 'miss distance' away from the designated burst point. Typically, DELIVERY ERROR or CEP ERROR commands would not be used in conjunction with MISS DISTANCE.

Format:

MISS DISTANCE
weapon name, mdis, hob

where:
mdis is the miss distance (REAL)
hob is the error in height-of-burst (REAL)

NOTE:
hob is optional. If used, see CEP ERROR, p. 30, for choice of distributions.

8. **RELIABILITY OF WEAPONS.** This command causes randomly selected rounds or volleys to fail according to a uniform distribution.

Format:

RELIABILITY OF WEAPONS
weapon name, rrnd, rvol

where:
rrnd is the single warhead reliability (REAL) (Default: 1.0)
rvol is the reliability of volley (REAL) (Default: 1.0)

NOTE: If only one value is given, it is assumed to be rrnd.

9. **ROUND.** This command inputs the parameters necessary to specify an attack by a single round.

Format:

ROUND
weapon name, time, apx, apy, apz

where:
time is the (clock) time-of-arrival of the round (REAL)
apx is the intended x-coordinate (unit coordinate system) (REAL)
apy is the intended y-coordinate (unit coordinate system) (REAL)
apz is the intended height-of-burst (REAL)

NOTE:
The apz variable is ignored when modeling either toxic or nuclear scenarios.

10. **TLE.** This command reads target location errors expressed as standard deviations.

Format:

TLE
tlex, tley

where:
tlex is the x-coordinate of the target location error (REAL)
Default: 0.0
tley is the y-coordinate of the target location error (REAL)
Default: 0.0

NOTE:
See CEP ERROR, p. 30, for choice of distributions.

Option:
This option can be used to input a TLE change event. This allows the user to simulate a point in time at which the error in target location changes, as would be caused by unit movement.

Format:

time, tlex, tley

where:
time is the (clock) time at which the change in error will occur (REAL)

11. **VOLLEY.** This command inputs parameters necessary to specify an attack by a volley of weapons. The intended pattern is assumed to be a line of the specified width and at the specified angle with respect to the incoming fire direction. A cluster-type munition (scatter about a single point) can be modeled by specifying a volley pattern width of 0.

Format:

VOLLEY
weapon name, time, papx, papy, papz, nrd, ang, width

where:

time is the (clock) time of the attack (REAL)
papx is the intended x-coordinate of the pattern midpoint (REAL)
papy is the intended y-coordinate of the pattern midpoint (REAL)
papz is the intended height-of-burst of the rounds (REAL)
nrd is the number of rounds in the volley (INTEGER)
ang is the angle (degrees) of the pattern line with respect to the incoming fire direction. (REAL)
width is the width of the pattern line (REAL)

NOTE:

The papz variable is ignored when modeling either toxic or nuclear scenarios.

Option:

This option, used after a normal volley data card (above), creates multiple volleys with the specified time between volleys, each one "stepped" in the specified direction by the specified distance. This option allows easy modeling of a moving barrage.

Format:
$ nvol, dtm, dir, dis

where:

nvol is the number of additional volleys (INTEGER)
dtm is the time-between-volleys (intrvl) (REAL)
dir is the angle (degrees) of movement of the intended pattern midpoint measured counter-clockwise from the x direction (in the unit coordinate system) (REAL)
dis is the distance between volley midpoints (REAL)

12. **WIND DIRECTION.** This command orients the wind (RANGE) direction with respect to the unit coordinate system. See discussion of coordinate systems on p. 11.

Format:

WIND DIRECTION
windang

where:
windang is the angle from the UNIT x direction to the RANGE direction (INTEGER, positive if counter-clockwise).
Default: windang = 0

Option 1:
This option permits the specification of a wind direction change event.

Format:

time, windang

where:
time is the (clock) time at which the wind direction changes (REAL)

Option 2:
The wind direction can also be specified as a range of angles, in which case a new wind direction is randomly selected, from a uniform distribution, within the specified range for each replication.

Format:

windang1, windang2

where:
windang1 and windang2 are the angles within which the wind direction will lie (INTEGERS)

Option 3:
This option enables the combination of options 1 and 2 by allowing the user to specify the time at which the range of wind direction angles will be selected.

Format:

time, windang1, windang2

13. **YIELD.** This command inputs the yield of nuclear weapons.

Format:

YIELD
weapon name, yld1, yld2

where:
yld1 is the blast and thermal yield in kilotons (kt) (REAL)
yld2 is the effective radiative and EMP yield in kt (REAL)

NOTE:
If only yld1 is given, it is used for both yld1 and yld2.

D. WEAPON EFFECTS

The following data establishes input and output parameters relating to weapon effects.

1. **CONVENTIONAL LETHALITY DATA.** This command causes the AURA code to read a conventional lethality data file via input unit #2. No further data is needed (see Appendix B of Volume 2 of the AURA Programmer/Analyst Guide[13] for the format of the conventional lethality data file).

Format:

CONVENTIONAL LETHALITY DATA

NOTE:
This command must be included when modeling a conventional scenario.

2. **DOSE PARAMETERS.** This command allows changing various parameters which control the personnel-response-to-dosage algorithms and the output report of dosages.

Format:

DOSE PARAMETERS
options

Option 1:
Set values for dosage "bins" for dosage distribution report in output.

Format:

DOSE BINS,b1,b2,b3,b4,...b10

where:
b1,...,b10 are the median values of each dosage bin. (REAL)
Defaults: 5.0, 75.0, 150.0, 300.0, 450.0, 530.0, 830.0, 1100.0, 1500.0, 4500.0 (Nuclear) (units are in rads)
.05, .10, .15, .25, .35, .45, .55, .65, .75, .85, 1.0 (Toxic) (units are normalized to casualty criteria)

---

13. Ibid.

NOTES:

There must be 10 increasing bin values. DO NOT input b1 = 0.0; b10 may = MAX DOSE, but may not exceed it.

Option 2:

Set maximum dosage to be considered an instant casualty.

Format:

MAX DOSE, maximum dosage value (REAL)
Defaults: 8000.0 Gy (Nuclear); 10.0 (Toxic)

Option 3:

Set probit slope to model the varying sensitivity of individuals to doses of various chemicals.

Format:

PROBIT, agent number (1,2,3) (INTEGER), probit slope value (REAL)

Defaults: (The defaults represent the case where all individuals exhibit the same response.)

Agent number	Agent type	Default slope
1	non-persistent	0.0
2	persistent	0.0
3	blistering	0.0

3. **INTRAVENOUS DOSES.** This command enables the user to modify the entry rate at which personnel absorb vapor and/or percutaneous doses from chemical weapons. The methodology (and defaults) behind this phenomena, known as route-of-entry, is described in Saucier's paper.[14] The defaults represent the case where the multiple route of entry model is off.

Format:

IV DOSE
options

---

14. R. Saucier, *A Methodology for Calculating the Probability of Response from Multiple Agent and Multiple Routes of Entry*, Studies and Analysis Office, US Army Chemical Research and Development Center, unpublished paper, (JUL 85), (UNCLASSIFIED).

Option 1:

This command enables the user to turn the multiple route of entry model on.

Format:

IVDOSE, ON or OFF. (Default: OFF)

Option 2:

Format:

INHALATION, einhal (REAL)

where:

einhal is the exponential parameter for transport efficiency of inhalation
Default: einhal = 1.0

Option 3:

Format:

PERCUTANEOUS, eperc (REAL)

where:

eperc is the exponential parameter for transport efficiency of percutaneous
Default: eperc = 1.0

4. **NUCLEAR VULNERABILITY DATA.** This command causes the AURA code to read a nuclear vulnerability data file via input unit #3. No further data is needed (see Appendix B in Volume 2 of the AURA Programmer/Analyst Guide[15] for the format of the nuclear vulnerability data file).

Format:

NUCLEAR VULNERABILITY DATA

NOTE:

This command must be used when modeling a nuclear scenario.

---

15. R. Sheroke, et al, *Programmer/Analyst Guide for the Army Unit Resiliency Analysis (AURA) Computer Simulation Model, Volume 2: AURA Source Code*, USA Ballistic Research Laboratory, BRL-TR-3103, (JUL 90), (UNCLASSIFIED).

5. **PERSISTENCE.** This command enables the user to modify the persistence time for chemical agents on specified assets from the standard (uniform) persistence time produced by the toxic dissemination code (NUSSE). The change is affected by specifying the ratio of time-to-evaporate/diffuse from the asset to time-to-evaporate as output by NUSSE.

Format:

PERSISTENCE
weapon name1
asset1, frc11
asset2, frc12
.....
assetJ, frcIJ
weapon name2
asset1,frc21
.....
assetJ, frcIJ
etc.

where:
frcIJ is the ratio of evap time for agent from weaponI on the assetJ to the NUSSE output evaporation time (REAL). Default: 1.0

NOTE:
TOXIC DISPERSION DATA command must precede this command.

6. **THERMAL.** This command allows the user to specify the atmospheric thermal transmissivity and the type of uniform being worn. These parameters affect the calculation of thermal casualties.

Format:

THERMAL
options

Option 1:
Thermal transmissivity

Format:

ATMOSPHERE, quality

where:
quality must be GOOD, AVERAGE, or POOR
Default: AVERAGE

Option 2:
Type of uniform

Format:

UNIFORM, type

where:
type must be SUMMER or WINTER
Default: SUMMER

7. **TOXIC DISPERSION DATA.** This command causes the AURA model to read a toxic dispersion data file via input unit #4. No further data is needed (see Appendix B in Volume 2 of the AURA Programmer/Analyst Guide[16] for the format of the toxic dispersion data file).

Format:

TOXIC DISPERSION DATA

NOTE:
This command must be used when modeling a chemical scenario.

16. Ibid.

E. INDIVIDUAL TASK INPUTS

The following input parameters model specific unit tasks and alterations to such tasks (e.g., task-dependent degradations).

1. **FATIGUE.** This command allows the user to specify that different jobs (LINKs) may be more or less demanding than others, both in terms of the need for personnel to be rested and the drain upon personnel who are engaged in the job.

Option 1:

Format:

FATIGUE
link name, rfr, rd

where:
rfr is the relative fatigue rate (REAL)
Default: 0.2639 SLUNITs/minute
rd is the relative demand-for-stored-rest (REAL)
Default: 1235.0 SLUNITs

Option 2:

Format:

FATIGUE
link name, rfr, rd, slpmn, slpmx

where:
slpmn is the minimum amount of sleep required by assets in link
Default: 240.0 SLUNITs
slpmx is the maximum amount of sleep permitted for assets in link
Default: 1520.0 SLUNITs

(See section IV.3 of Volume 1 for derivation of default values.)[17]

---

17. R. Sheroke, et al, *Programmer/Analyst Guide for the Army Unit Resiliency Analysis (AURA) Computer Simulation Model, Volume 1: AURA Methodology,* USA Ballistic Research Laboratory, DRAFT REPORT, (AUG 90), (UNCLASSIFIED).

2. **HEAT STRESS.** This command enables the user to specify values for the various meteorological and physiological conditions which can impact heat stress effects on personnel. The methodology used to calculate the effects of these conditions is based upon the Goldman-Givoni Model.[18]

Format:
HEAT STRESS
one letter, data (REAL)

These letters/data are:

T, start time, stop time of meteorological period
This is followed by the meteorological parameters for the period:
$T, ambient temperature (degrees Celsius) (Default: 20.0)
$H, relative humidity (0-100) percent (Default: 20.0)
$W, wind speed (Default: 3.0)
$MMI, maximum allowable metabolic rate - initial MOPP
(Default: 1.E35)
$MMA, maximum allowable metabolic rate - alternate MOPP
(Default: 1.E35)
R, (no data required) Triggers repeat of meteorological conditions
M, metabolic rate (watts) (Default: 250.0, i.e. light exercise
such as a rifleman on patrol)
This is followed by the names of links to which the
rate is applicable:
$link name
$link name
$etc.
C, mopp level, clo (clothing parameter) for this level
(Defaults: MOPP0 = 1.43; MOPP1, 2, and 3 = 2.07;
MOPP4 = 2.32)
I, mopp level, im/clo (clothing parameter) for this level
(Defaults: MOPP0 = 0.34; MOPP1, 2, and 3 = 0.22;
MOPP4 = 0.15)
GC, gamma (wind correction factor for clothing)
(Default: 0.26)

---

18. R.E. McNally, M.M. Stark, and D.T. Ellzy, *Verification and Usage of the Goldman-Givoni Model: Predicting Core Temperature and Casualty Generation in Thermally Stressful Environments*, Science Applications International Corporation under contract to the Medical Research Development Center, Contract No. MDA903-88-D-1000, (APR 1990), (UNCLASSIFIED).

GI, gamma (wind correction factor for im/clo)
(Default: 0.38)
S, skin temperature (degrees Celsius)
(Default: 36.0)
D, percent dehydration (usually 0.0-7.0%)
(Default: 0.0)
A, days of acclimatization (Default: 12.0)

NOTE 1:

Having determined the core temperature of a personnel asset, AURA compares that with a pre-selected critical temperature (Tc) for that asset group. If Tc has been exceeded, the asset at that target point (i.e. doing the job that was so demanding) becomes a casualty. The critical temperature is drawn from a cumulative log normal, with parameters mu = 39.5 and S.D. = 0.5198. AURA uses the Goldman-Givoni model[19] for calculation of HEAT STRESS effects.

NOTE 2:

Use of INTERNAL RECONSTITUTION TIMES or RECONSTITUTION EVENTS resets the HEAT STRESS parameters to initial values.

3. **LINKS.** This command inputs data on basic subtasks including:

1. relationships between number of effective assets allocated to an individual task and effectiveness of task performance;

2. limitations on numbers of entities (i.e., actual number of personnel or items of equipment assigned, regardless of relative worth of each entity) which may be assigned to task;

3. substitutes, i.e. assets which may be assigned to a task other than the task's HOMELINK assets (which are automatically assignable) (see HOMELINK, p. 8).

NOTE:

All LINKs to which assets may be assigned must be deployed, either through being a HOMELINK for an asset that is deployed or by being a specifically deployed DUMMYLINK (see DUMMYLINK, p. 7 and DEPLOYMENT, p. 22). However, also see note on DUMMYLINKS, p. 46.

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19. Ibid.

Format:

LINKS
link name, cap100, maxeff, entmax

where:

link name is any allowed name (see p. 5). If link name is also the name of an asset, this entry defines the HOMELINK for that asset.

cap100 is number of effective assets needed for maximum effectiveness (REAL)

maxeff is maximum effectiveness in percent (REAL)
Default: maxeff = 1.0

entmax is maximum number of items that may be assigned to LINK. entmax is taken as an absolute value unless an ASSOCIATED LINK is defined, in which case entmax is taken as the number per item in the ASSOCIATED LINK (See ASSOCIATED LINK, p. 48) (REAL) Default: entmax = 1.E35.

NOTE on DUMMYLINKS:

A DUMMYLINK without substitutes is allowed. (Such a construct can be used, for example, to provide a "sure path" through a COMPOUND LINK.) Such LINKs need not be deployed.

Option 1:

Substitutes. Substitutes are defined by sets of three cards.

Format:

$subnm1, subnm2, subnm3, ...
$E, eff1, eff2, eff3, ...
$T, tim1, tim2, tim3, ...

where:

subnmI is the name of the Ith substitute (need not be a unique name)

effI is the effectiveness of the Ith substitute (relative to normal assets implied in specifying cap100) (REAL)

timI is the time (intrvl) needed for the Ith asset to substitute (REAL)

NOTE:

It is essential that each substitute card be followed by an effectiveness card and a time card. If the number of substitutes exceeds the capacity of the first substitute card, additional substitutes may be specified by following the first set of three cards with other sets.

Option 2:

Specify lower bounds on LINK effectiveness.

Format:

$M, cap0, mineff

where:

cap0 is number of effective assets below which effectiveness is minimum (REAL) Default: cap0 = 0.0

mineff is minimum effectiveness in percent (REAL) Default: mineff = 0.0

Option 3:

Specify granularity (maximum amount of any asset) for allocation into LINK in any one installment. Useful, for example, to cause allocation scheme to consider other LINKs before totally allocating any asset to one LINK.

Format:

$G, grnlnk

where:

grnlnk is the maximum amount to be allocated in any one pass (REAL). Default: grnlnk = 0.5

Option 4:

Default Granularity. This option allows changing the default value for the LINK granularity (the maximum amount will be substituted into a LINK during any one pass of the allocation algorithm). This command changes the granularity for all LINKs which do not have a granularity specified via the $G option, no matter where the command is placed in the runstream.

Format:

GRANULARITY, new default (REAL)

Option 5:

Specify an ASSOCIATED LINK. An ASSOCIATED LINK is another subtask whose potential fulfillment controls the entities assignable to the current subtask. For example, if there can be only two operators per system X, this option can be used as follows: System X would be defined as a normal LINK. The operator LINK would be defined with 2.0 for the value of entmax on card 1 and System X as the associated LINK.

Format:
$A, associated LINK name

Option 6:

Specify an effectiveness level below which a substitution will not be made. This takes into account degradation by sublethal doses, fatigue, suboptimal training, and MOPP.

Format:
$Q, level (Real) Default: level = 0.1

4. **SUBLETHAL DOSE DEGRADATION.** This command associates specified LINKs with particular dose-time degradation sets which can be used, e.g., to degrade dosed individuals assigned to physically demanding jobs more severely than those in cognitive jobs. Two degradation sets are built into AURA which describe: a gunner (degradation set number 0), typical of most jobs and an ammunition loader (degradation set number -1), typical of a physically demanding job. The default for all LINKs (without use of this command) is degradation set 0. NOTE: Degradation code number -999 indicates no degradation.

Format:

SUBLETHAL DOSE DEGRADATION
LINK name, code number (INTEGER)

Option:

Read new degradation data from input unit #11. This option also allows reading additional degradation sets to which new degradation set numbers (1 - 5) are given. These sets are then available for association with specific LINKs.

NOTE:

Format for the degradation data in unit #11 is provided in Appendix B in Volume 2 of the AURA Programmer/Analyst Guide.[20]

Format:

READ11

5. **TIME DEPENDENT (LINK) DEGRADATION.** This command enables the user to predefine the level of degradation for links within specific time periods.

Format:
TIME-DEPENDENT (LINK) DEGRADATION
TIME, start time (REAL), stop time of period (REAL)
$link name, degradation factor (REAL)
$link name, degradation factor (REAL)
TIME, start time (REAL), stop time of next period (REAL)
$ ....

Option 1:

Degrades all links.

Format:
TIME, start time (REAL), stop time of period (REAL)
$ALL, degradation factor (REAL)
TIME, start time (REAL), stop time of next period (REAL)
$ ....

Option 2:

Degrades all links that have personnel in them.

Format:
TIME, start time (REAL), stop time of period (REAL)
$ALL PERSONNEL, degradation factor (REAL)
TIME, start time (REAL), stop time of next period (REAL)
$ ....
....

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20. R. Sheroke, et al, *Programmer/Analyst Guide for the Army Unit Resiliency Analysis (AURA) Computer Simulation Model, Volume 2: AURA Source Code*, USA Ballistic Research Laboratory, BRL-TR-3103, (JUL 90), (UNCLASSIFIED).

Option 3:

Repeat above sequence every 1440 minutes (24 hours).

Format:
REPEAT

F. UNIT FUNCTION INPUTS

The following data sets input parameters which model the functional structure of a unit (see FUNCTIONAL STRUCTURE, section II.2 in Volume 1 of the AURA Programmer/Analyst Guide[21]).

1. **CHAINS.** This command allows the (overall) concatenation of sets of operations (called SEGMENTS) to satisfy the requirements of missions, one CHAIN per mission. Segments may be any previously defined LINKs, CREWs, SUBCHAINs, ORLINKs or COMPOUND LINKs.

Format:

sg11, sg12, sg13, sg14, ..., sg1J
sg21, sg22, sg23, sg24, ..., sg2J
....
sgI1, sgI2, sgI3, sgI4, ..., sgIJ

where:
sgIJ is the Jth segment in CHAIN I.

Option:
A continuation line which begins with the word TIME (may be abbreviated to T) is interpreted as a set of (clock) times during which the preceding CHAIN is operant. Thus enabling the available missions for a unit to change during the encounter.

Format:

$T, str1, stp1, str2, stp2, ...,strI, stpI

where:
strI is the (clock) time that a CHAIN becomes operant (REAL)
stpI is the corresponding time that it ceases to be available (REAL)

---

21. R. Sheroke, et al, *Programmer/Analyst Guide for the Army Unit Resiliency Analysis (AURA) Computer Simulation Model, Volume 1: AURA Methodology*, USA Ballistic Research Laboratory, DRAFT REPORT, (AUG 90), (UNCLASSIFIED).

2. **COMPOUND LINKS.** This command inputs data for COMPOUND LINKs (CPLINKs), i.e. functional structures which are weighted summations of tasks (called cpparts). A cppart may be a simple LINK, a CREW, a SUBCHAIN or an ORLINK. NOTE: A COMPOUND LINK name MUST begin with the ! character.

Format:

COMPOUND LINK
compound link name1 (must begin with !)
cppart11, wt11
cppart12, wt12
....
cppart1J, wt1J
compound link name2
cppart21, wt21
....
compound link nameI
cppartI1, wtI1
....
cppartIJ, wtIJ

where:

"compound link nameI"	is of the form !xxxxx (e.g. !LOADING TECHNIQUE).
cppartIJ	is the name of the jth part of CPLINK
wtIJ	is the weight of cppart IJ (REAL)

NOTE:
The weights usually sum to 1.0 for any CPLINK. A warning message is printed if summation is not 1.0, but the run will proceed.

3. **CREW.** This command inputs data to define functional structures (called CREWs) that represent sets of subtasks that must work together to accomplish part of a mission. The relationship between tasks in a CREW are generalized parallel structures, as opposed to strict ANDs as are those in a SUBCHAIN (see SUBCHAIN p. 55). Individual crew jobs must be LINKs. Each crew position has two parameters, alpha (α) and beta (β), associated with it. Table 2 contains the general crew performance formula and typical values of alpha and beta for several 3 and 4 member crews. In addition, each crew has a parameter K.

NOTE: A CREW name must begin with the = character.

Table 2. General Crew Performace Formula:

$$\text{Crew Effectiveness} = \frac{K}{\sum_{i=1}^{n} \left(\frac{\alpha_i}{e_i}\right)^{\beta_i}}$$

where: n - number of crew members
e_i - effectiveness of the i_{th} crew member
and K, α_i, and β_i are constants. (see Table 2 below)

Crew	i	K	N	α_1	α_2	α_3	α_4	β_1	β_2	β_3	β_4
M60A3 TANK	1- tank cmdr 2- gunner 3- loader 4- driver	0.85511	4	0.20698	0.19297	0.28214	0.26697	0.98866	1.1181	1.2815	1.0046
IMPROVED TOW VEHICLE	1- Sqd leader 2- gunner 3- loader 4- driver	1.21568	4	0.15823	0.57907	0.26296	0.21568	1.0389	1.0137	0.96201	1.0000
M109 GUN	1- gunner 2- asst. gunner 3- chief of sect. 4- loader	0.87112	4	0.06623	0.06042	0.21749	0.52720	1.2502	0.67995	1.0037	1.1755
FIRE DIRECTION CENTER	1- Fire direct. officer 2- computer 3- horizontal control officer	0.96320	3	0.22923	0.35553	0.43305	-----	1.6017	0.81154	0.98212	-----

Format:

CREW
crew name1 (must begin with =)
N1, K1
LINK1, alpha1, beta1
LINK2, alpha2, beta2
crew name2
N2, K2
....

where:

"crew name"	is of the form =xxxxx (i.e. =GUN CREW).
Nj	is the number of members in the jth crew (INTEGER)
Kj	is the crew parameter for the jth crew (REAL)
lnkI	is the name of the Ith LINK in the crew
"alpI and betI"	are the parameters for the Ith task in the crew (REAL)
e_i	is calculated by AURA based upon the decisions of the commander model.

4. **ORLINKS.** This command inputs data to define functional structures (called ORLINKs) that represent mutually exclusive choices for the accomplishment of part of a mission. The choices, called "branches", may be SUBCHAINs, CREWs or simple LINKs. NOTE: An ORLINK name must begin with the + character.

Format:

ORLINKS
orlink name, br1, br2, br3, ...brI (name must begin with +)

where:

orlink name	is of the form +xxxx (i.e. +Communication).
brI, the Ith branch,	is the name of a LINK, CREW or SUBCHAIN

5. **SUBCHAINS.** This command inputs data to define functional structures (called SUBCHAINs) that represent sets of subtasks that must work together to accomplish part of a mission. The relationship between elements in a SUBCHAIN are simple ANDs: the value of a SUBCHAIN equals the value of its weakest member. The elements of a SUBCHAIN may be CREWs and/or simple LINKs. NOTE: A SUBCHAIN name must begin with the * character.

Format:

SUBCHAINS
subchain name, lnk1, lnk2, lnk3, ... (name must begin with *)

where:

"subchain name"	is of the form *xxxx (e.g. *FORKLIFT TEAM)
lnkI	is the name of the Ith LINK or CREW in the SUBCHAIN

G. PROGRAM CONTROLS

The following input parameters control the running of the code, the decision logic used, the outputs produced and scenario parameters such as the length of (clock) time of the encounter.

1. **DECISION RULES.** This command allows resetting certain default conditions and values that control the rules by which the allocation algorithm chooses assets for assignment into the various LINKs. The allocation algorithm (commander) normally considers versatility of the asset before considering the order of user listed assets on a substitution card (see LINKS, p. 45). In AURA, versatility is the ability of an asset to perform more than one job. This command allows choosing whether versatility or user-input-order is to be the first consideration (see ALLOCATION DECISION RULES, Volume 1 section IV.1.b).[22]

Format:

DECISION RULES
PRIORITY, first consideration

where:
first consideration is VERSATILITY (default) or ORDER

Option 1:
Significance. This option allows specifying the fractional improvement needed before the allocation algorithm will ignore differences in order and versatility (for example, signif = 0.5 means that an asset having 1.5 times the effectiveness of the current best choice will automatically become current-best-choice, regardless of versatility or order).

Format:

SIGNIFICANCE, signif

where:
signif is the required improvement (REAL). Default: signif = 0.005

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22. Ibid.

Option 2:

Sickness level. This option allows specifying the degraded level of performance (for example, due to sickness or fatigue) that an asset must show in order to be preempted in its HOMELINK by a substitute (for example, sicklv = 0.75 means that if a HOMELINK asset were at effectiveness 0.5 and a substitute were available at effectiveness greater than 0.67 (= 0.5 / 0.75), then the HOMELINK asset would be replaced in his job).

Format:

SICKLV, sicklv

where:

sicklv is the required degradation (REAL). Default: sicklv = 0.75

Option 2:

Finish repair. This option allows specifying the relative worth in finishing an ongoing NEEDED repair rather than starting another NEEDED repair. For example, fnshrp = 2.0 means that, if an ongoing repair has 0.6 of an item left to fix, the code will calculate the anticipated gain based upon receiving 1.2 (= 2.0 * 0.6) items. This would be compared to the anticipated gain from any other repair which might be initiated in order to solve a mission limitation. The repair which promises the most gain is the one selected by the optimization algorithm to add to the mission requirements to calculate the mission cost of (NEEDED) repair. Note that this parameter only influences NEEDED repairs, as defined on p. 18.

Format:

FINISH REPAIR, fnshrp

where:

fnshrp is the relative gain (REAL). Default: fnshrp = 2.0

2. **GO.** This command indicates that all data has been entered and the simulation and analysis should begin.

Format:
GO

3. **HEADING.** This command allows the user to write a message at the beginning of the AURA output and again at the beginning of the results. This message is in addition to any message entered via the computer normal input channel during execution.

Format:
HEADING
message

4. **INTERNAL RECONSTITUTION TIMES.** This command inputs a matrix of times (intervals) following a lethality or reconstitution event at which outputs are desired. Every lethality event (see ROUND, p. 34 and VOLLEY, p. 35) and reconstitution event (see RECONSTITUTION EVENTS, p. 67) cause the internal clock to reset. Then, at the end of interval 1, interval 2, etc., the code updates all time dependent factors, reallocates assets and compiles all statistics to be used in the final results. In this way, the user establishes the time points at which results will be reported.

Format:

INTERNAL RECONSTITUTION TIMES
tm1, tm2, tm3,.... (maximum, 47 times)

where:
tmI is the Ith time point (intrvl) after a lethality event (REAL)

5. **MODE.** This command controls certain choices in operation of the code.

Option 1:
CODE mode. Used in code development to track internal parameters.

Format:

MODE
CODE, ON or OFF (Default: OFF)

Option 2:
CULL mode. In CULL mode, incoming rounds are screened (in the ROUND and VOLLEY input routines) to predetermine if the round has a potential of affecting a target point. This allows using one, standard, large, scenario-wide threat in the runstreams for all targets in the scenario: AURA will assess only those weapon employments which might affect the unit being studied in each runstream. Those weapons "culled out" are those which are outside the range.

NOTE:

If running in CULL mode, weapon employment data (ROUND or VOLLEY) must be preceded by weapon characteristic data (DEPLOY, DELIVERY, TLE, NUCLEAR, CONVENTIONAL, or TOXIC.)

Format:

CULL, ON or OFF (Default: OFF)

Option 3:

DEBUG mode. Causes the code to process input data but not execute. Used to debug runstreams.

Format:

DEBUG, ON or OFF (Default: OFF)

Option 4:

PRIORITY mode. Changes the interpretation of COMPOUND LINKs. In PRIORITY mode, parts of COMPOUND LINKs (cpparts) are considered in order of entry AND failure to improve one cppart stops the optimization process. The following restrictions apply:

a. unit structure consists of a single COMPOUND LINK whose cpparts are all simple SUBCHAINs;
b. every LINK is modeled as a 0. - 1. step function (i.e. a job is either at 0% or else 100%);
c. all substitutes are 100% capable;
d. degradation of assets is not played;
e. only one asset may be assigned per job.

Format:

PRIORITY, ON or OFF (Default: OFF)

Option 5:

INDIVIDUAL DOSES. Causes AURA to separate all asset groups into individuals and give each one its unique sensitivity to doses and heat stress.

Format:

INDIVIDUAL DOSES, ON or OFF (Default: ON)

Option 6:

STOCHASTIC mode. Causes all lethality assessments to be stochastically determined. In STOCHASTIC mode, the AURA lethality routines draw random numbers against calculated probabilities to determine damage or kill. (In normal mode, fractional kills are tallied.)

Format:

STOCHASTIC, ON or OFF (Default: OFF)

Option 7:

TIME BEFORE ZERO. This option allows resetting the assumed time that has elapsed before start of analysis, thus limiting the substitutions that can be assumed for the time = 0.0 reconstitution. The infinite default time allows all needed substitutions to be made before commencement of analysis.

Format:

TIME BEFORE ZERO, time (intrvl) (REAL)

6. **OUTPUT.** This command controls the printing of optional outputs from an AURA run. The definition, interpretation and use of these outputs will be the subject of Volume 3 of the AURA Programmer/Analyst Guide. The results are averaged over all replications for every output command.

Option 1:

BINS. Reports the contents of all radiation accumulation bins for every asset at reporting times that fall within the specified intervals.

Format:

BINS, strt1, stp1, strt2, stp2, ... (Default: OFF)

where:

strtI is the start time (clock) for the Ith interval (REAL)
stpI is the ending time (clock) for the Ith interval (REAL)

Option 2:

CASUALTIES. Reports all casualties, contaminations, ETI episodes and expenditures as they occur. If WEAPON report is not ON, this option also describes incoming warheads which cause immediate casualties (see PARTICULAR ASSETS option, p. 64).

Format:

CASUALTIES, ON or OFF (Default: OFF)

Option 3:

CHAIN. Prints line-printer depiction of unit functional structure.

Format:

CHAIN, ON or OFF (Default: ON)

Option 4:

DEPDMP. Reports the precise deployment of all assets at reporting times that fall within the specified intervals.

Format:

DEPDMP, strt1, stp1, strt2, stp2, ... (Default: OFF)

where:

strtI is the start time (clock) for the Ith interval (REAL)
stpI is the ending time (clock) for the Ith interval (REAL)

Option 5:

DEPLOYMENT PLOT. Prints line-printer depiction of unit deployment, including initial wind and incoming fire directions (see SELECTIVE PLOT option, p. 66).

Format:

DEPLOYMENT PLOT, ON or OFF (Default: ON)

Option 6:

DOSE. Reports all nuclear or toxic doses as received (cumulated to the nearest reporting time) (see PARTICULAR ASSETS option, p. 64)

Format:

DOSE, ON or OFF (Default: OFF)

Option 7:

DUMP8. Causes reallocation information (time, effectiveness, weak LINKs, strongest CHAIN) to be written onto output unit #8 at every reporting time.

Format:

DUMP8, ON or OFF (Default: OFF)

Option 8:

DUMP9. Causes incoming weapon information, including actual burst points for every warhead in every replication to be written onto output unit #9. This information is used by the BRL graphical post-analysis utility programs to aid in analysis of results.

Format:

DUMP9, ON or OFF (Default: OFF)

Option 9:

ETIPCI. If ON, causes at-end average of nuclear dose effects (average performance degradations, Early Transient Incapacitation episodes and Permanent Incapacitation occurrences) to be printed. If FULL, also causes intermediate information to be written onto output unit #10.

Format:

ETIPCI, ON or FULL or OFF (Default: ON)

Option 10:

FATIGUE. If RECONSTITUTION (see p. 65) is ON or PARTIAL, this option prints out the fatigue status of all assets.

Format:

FATIGUE, ON or OFF (Default: OFF)

Option 11:

INPUT LISTING. Causes the code-interpreted input data to be printed at beginning of output.

Format:

INPUT LISTING, word1, word2, word3, ... (Default: OFF)

where:

word =	
ON	to turn on full beginning output (Default: ON)
OFF	to turn off all beginning output
EVENTS	to print event table
WEAPON	to print weapon identification table
ASSETS	to print asset identification table
NUCLEAR	to print nuclear-related parameters
TOXIC	to print toxic-related parameters
REPAIR	to print failure and repair parameters
LINKS	to print LINK definition table
FUNCTIONAL	to print substitution, SUBCHAIN, ORLINK and COMPOUND LINK status tables
DEPLOYMENT	to print deployment table

Option 12:

LETHALITY. Causes input units #2, #3 and/or #4 (conventional lethality file, nuclear vulnerability file and toxic dispersion file, respectively), if used, to be rewound and copied onto the end of the AURA output.

Format:

LETHALITY, ON or OFF (Default: ON)

Option 13:

NUCLEAR SUMMARY. Causes an at-end report detailing nuclear casualties from blast or thermal dosages.

Format:

NUCLEAR SUMMARY, ON or OFF (Default: OFF)

Option 14:

OPTIMIZE. Causes a highly detailed report of every step attempted in every optimal reallocation process which occurs during the specified time intervals.

Format:

OPTIMIZE, str1, stp1, str2, stp2, ..., iunwlk (Default: OFF)

where:

strI is the start time (clock) for the Ith interval (REAL)
stpI is the ending time (clock) for the Ith interval (REAL)
iunwlk is an optional flag to redirect this output (INTEGER)
iunwlk $>$ 0 = output on printer
iunwlk $<$ 0 = output written to unit #13
Default: iunwlk = 1 no optimization steps reported

Option 15:

PARTICULAR ASSETS. Restricts the assets to be included in casualty reports, dosages, contamination reports, etc.

Format:

PARTICULAR ASSETS, asset name1, asset name2, ... (Default: OFF)

NOTE:

Common asset names can be used; any number of assets can be included.

Option 16:

POSTURE. Causes a report of all posture changes. If ON, every individual is reported; if PARTIAL, group changes are reported (see PARTICULAR ASSETS option above).

Format:

POSTURE, ON or PARTIAL or OFF. (Default: OFF)

Option 17:

PRINT7. Causes all output to be sent to output unit #7. (Default: AURA output unit #6)

Format:

PRINT7, ON or OFF. (Default: OFF)

Option 18:

RANDOM NUMBER. Causes report of the random number seeds at the beginning of each replication.

Format:

RANDOM NUMBER, ON or OFF (Default: ON)

Option 19:

RECONSTITUTION. Causes output after every reconstitution. If ON, a complete matrix of assets assigned versus LINKs is produced. If PARTIAL, only a summary of results with a report of assignments into the weak LINK is given. If ONCE, a complete matrix of asset assignments is given for the initial arrangement only. If time intervals are specified, a complete matrix of asset assignments is reported for any reconstitution which occurs during the specified intervals.

Format:

RECONSTITUTION, ON or PARTIAL or ONCE or OFF. (Default: OFF)

or

RECONSTITUTION, str1, stp1, str2, stp2, ...

where:

strI is the start time (clock) for the Ith interval (REAL)
stpI is the ending time (clock) for the Ith interval (REAL)

Option 20:

REPAIR REPORT. If ON, causes a report of all repair activities at each reporting time. If FULL, also gives a complete status of damaged items available for repair at each time.

Format:

REPAIR REPORT, FULL or ON or OFF. (Default: OFF)

Option 21:

REPLICATION. Causes table of survivors versus time to be reported at the end of every replication.

Format:

REPLICATION, ON or OFF (Default: OFF)

Option 22:

SELECTIVE PLOT. Restricts the assets depicted in the lineprinter deployment plot (see DEPLOYMENT PLOT option, p. 61).

Format:

SELECTIVE PLOT, asset name1, asset name2, ... (Default: ON)

NOTE:

Common asset names can be used; any number of assets can be included. Default: all assets included.

Option 23:

SUMMARY. Gives an at-end sum of survivors versus time, with standard deviations of the averages over replications. This output eliminates the need to add up the final output results for several assets. The user need only give the assets a common name (see NAMES, p. 13) and request a summary on the common name via this option. Commonly used to summarize total casualties for PERSONNEL.

Format:

SUMMARY, common name1, common name2, ... (maximum, 6)

or

SUMMARY, OFF (Default: OFF)

Option 24:

TIMER. Allows user to measure the computer time used by various portions of an AURA run.

Format:

TIMER, opt (Default: OFF)

where opt is:

ON:	times major segments
OFF:	no timing
INPUT:	times the input and preprocessor algorithms
OPTIMIZATION:	times the various algorithms in the optimal allocation process
RECONSTITUTION:	times over-all reconstitution process (updating, inventory, optimization, etc.)

Option 25:

WEAPON. Causes a report of every weapon arrival (type, time, aim point, burst point).

Format:

WEAPON, ON or OFF (Default: OFF)

7. **RECONSTITUTION EVENTS.** This command causes a reset of the internal time clock to restart a series of output time points. It also resets HEAT STRESS parameters (see INTERNAL RECONSTITUTION TIMES, p. 58).

Format:

RECONSTITUTION EVENTS
time1, time2, ...

where:

timeI is the Ith (clock) time from which a series of reporting times will be generated (REAL)

8. **REPLICATIONS.** This command specifies the number of replications to be performed.

Format:

REPLICATIONS
number of replications (INTEGER)

9. **SEEDS (Random Number).** This command allows presetting the random number seeds before beginning a run. This command is particularly useful if one wishes to repeat one particular replication of a previous run, perhaps with special output options. Note that there are a number of random number sequences, each with its own seed, maintained in AURA.

Format:

SEEDS (RANDOM NUMBER)
sdnm, seedvalue

where sdnm is:

WEAPON, to set seed number (sdnm) 1 which primarily effects weapon delivery processes

OTHER, to set seed number (sdnm) 2 which effects processes not specifically seeded

FAILURE, to set seed number (sdnm) 3 which effects random failures

STOCHASTIC, to set seed number (sdnm) 4 which is used to select kills in stochastic mode (see MODE, p. 58).

HEAT CASUALTIES, to set seed number (sdnm) 5 which selects heat stress casualties

seedvalue is the desired seed (REAL)

10. **STOP.** This command indicates the end of the runstream file. The STOP command must be the last card of the input runstream.

Format:
STOP

11. **TRACE LINK USAGE.** This command causes reporting of specified LINKs being used or specified LINKs being weak. Useful as an aid to tracking down erratic or inexplicable LINK behavior.

Format:

TRACE
WEAK LINK, link name, rec
or
USES, link name, rec

where:

"link name" is the name of the link being traced

rec is the reconstitution number of interest (i.e. the reconstitution in which a use or weak LINK occurrence of the specified LINK is to be reported) (INTEGER)

or

rec can be the word ANY to report all such occurrences.

V. Current BRL Efforts in AURA Development

Current work on AURA includes the development of methodologies such as:

- Evaluation of capability/effectiveness of 'smart' munition weapons systems;

- Aiming methodologies for indirect fire weapon systems (FENDERKOV and the Battery Computer System (BCS) methodology);

- A more precise modeling of multiple agent chemical attacks.

In addition, work is being directed toward the automation of the AURA analysis process. The goal of the automation process is to make it feasible for one-sided unit level analysis to be made quickly, easily, and uniformly throughout the diverse Army analysis community, using the most current data and algorithms available from the various proponent agencies.

VI. SUMMARY

This manual has presented the current repertoire of commands for the Army Unit Resiliency Analysis (AURA) computer code. It is clear from the number and diversity of commands that the methodology is extremely flexible, with algorithms designed to model, in-depth, a large, broad, detailed spectrum of battlefield factors.

This manual has been organized to provide the user with the necessary command formats, parameters, and default values which may be used in the AURA model. Appendix A provides example input runstreams for a Nuclear, Chemical, and Conventional scenario. Appendix C provides a complete index of all AURA commands.

Not covered in this report is the method by which the user may vary the AURA inputs to model the various battlefield phenomena (such as combined weapon attacks). Volume 3 of the AURA Programmer/Analyst Guide will address these issues by providing a guide to conduct an AURA analysis - from data preparation through analysis of outputs and investigation of results - from an analyst's perspective.

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APPENDIX A

AURA Input Runstreams for Nuclear, Chemical and Conventional Scenarios

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The appendix is provided to illustrate and clarify the organization and format of AURA input runstreams. Contained within the appendix are examples of input runstreams representing the hypothetical mission of an Ammunition Supply Point (ASP) unit in a nuclear, conventional, and chemical scenario.

```
#THIS IS AN EXAMPLE OF AN AURA INPUT RUNSTREAM FOR UNIT MISSION IN A . UCLEAR
#SCENARIO.
#ALL LINES PRECEEDED BY A # SIGN ARE COMMENTS TO FACILITATE THE UNDERSTANDING
#OF THE INPUT COMMANDS.
REPERTOIRE #OR 'NAMES' COULD BE USED
WEAPONS
#
#THE NUCLEAR WEAPON USED IS NAMED KT30
#
KT30,NUCLEAR #OR NUKE CAN BE USED FOR NUCLEAR
FOS
#
#THE PERSONNEL AND EQUIPMENT REQUIRED FOR A MISSION.
#
FIREMEN,PERSONNEL
FIRETEAM,PERSONNEL
CRANE
FRKLFT6A,FORKLIFT6,FORKLIFT
FRKLFT6B,FORKLIFT6,FORKLIFT
.
.
.
TRACTOR10,TRUCK5T
WRECKER,TRUCK5T
8 STACKS
PROP STACKS
.
.
.
CRANE OPER,PERSONNEL
LIFT/LOAD OP,PERSONNEL
DUMMY MAINT,PERSONNEL
DUMMY SERVC,PERSONNEL
END
DEPLOYMENT
#
#THE DEPLOYMENT PARAMETERS OF THE ASSETS.
#
CRANE,  511 00, 1420.00,1., 1, 1, 1, 1, 1, 0
#
#ONE WAY TO CHANGE POSTURES FOR THE CONVENTIONAL, NUCLEAR, AND CHEMICAL
#SCENARIOS AT A SPECIFIED TIME.
#
$2,1,.5,4,.5
CRANE, 1356.00, 1739.50,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
.
.
.
PROP STACKS, 1322.68, 1675.60,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4, 5
B STACKS , 1405.80, 1661.40,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
.
.
.
TELEPHONE , 1088 14, 1860.15,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
TRUCK, 1087.24, 1859 02,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4, 5
.
.
.
FIREMEN  , 1551.43, 1073.64, -1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
FIRETEAM,1551.43,1073.64,-20.,1,1,1,1, 1, 0
$2,1,.5,4,.5
END
NUCLEAR VULNERABILITY DATA
#
#AURA READS A NUCLEAR VULNERABILITY FILE VIA INPUT UNIT NUMBER 3.
#
END
DELIVERY ERRORS
#
#DEFINE THE DELIVERY ERRORS OF WEAPON KT30
#
KT30,10.,140.,6 ,45.,0.
END
```

```
YIELD
#
#DEFINE THE YIELD OF WEAPON KT30.
#
KT30,100.
END
DOSE PARAMETERS
#
#DEFINE PARAMETERS WHICH CONTROL THE PERSONNEL-RESPONSE-TO-DOSAGE ALGORITHMS
#AND THE OUTPUT REPORT OF DOSAGES.
#
DOSE BINS,5.,77.,145.,300.,460.,540 ,840.,1100.,1480 ,4000.
#
#SET MAXIMUM DOSAGE TO BE CONSIDERED AN INSTANT CASUALTY.
#
MAX DOSE,6000.
END
THERMAL
#
#SPECIFY THE TYPE OF UNIFORM BEING WORN.
#
UNIFORM,SUMMER
END
SHIELDING
#
#DEFINE THE NUCLEAR POSTURE CODE NUMBERS.
#
TRACTOR10,4,0.7,0.0,0.0,0.4
WRECKER,5,.8,0.0,0.0,0.5
.
.
.
TRAILER12,6,1.0,0.0,0.0,1.0
END
ROUND
#
#INPUT THE PARAMETERS NECESSARY TO SPECIFY AN ATTACK BY A SINGLE ROUND
#PER AIMPOINT CHOSEN.  MPI ERRORS ARE DRAWN ONCE FOR EACH LINE OF
#INPUT FOR BOTH THE ROUND AND THE VOLLEY COMMANDS.  PRECISION OR ROUND
#TO ROUND ERRORS ARE DRAWN FOR EACH INCOMING ROUND.
#
KT30,0.,487.,1522.,0.0
KT30,0.,2915.,1722.,0.0
KT 30,0.,1530.,707.,0.0
EN D
L NKS
/
#THE LINK ORGANIZATION FOR A DEFINED MISSION.
#
FIREMEN,.5
$PERSONNEL
$T,1.
$E,1.
FIRETEAM,20.
$PERSONNEL
$T,1.
$E,1.
.
.
.
RECORD CLERK,8.,8.
$M,2.,25
$COMMO OPERS,TYPIST,RTFL CHIEF,OPERATOR,CRANE OPER,CRANE CHIEF
$T,120.,140.,70.,40.,40.,30.
$E,.9,.7,1.,1.,1.,1.
$CHECKERS
$T,8.
$E,1.
.
.
.
OPERATOR M,4.,4.
$NCO,COMMO OPERS,RECORD CLERK,MAINT STAFF,RECOV OPER,SERVC PERS
$T,120.,130.,50.,90.,70.,60.
$E,.8,.8,1.,1.,1.,1.
$LIFT/LOAD OP,CRANE OPER
$T,45.,25.
$E,1.,1.
```

```
.
.
.
A STACKS,6.
B STACKS,9.
PROP STACKS,9.
C STACKS,3.
D STACKS,5.66
E STACKS,14.
F STACKS,5.66
END
SUBCHAINS
#
#DEFINE FUNCTIONAL STRUCTURES THAT REPRESENT SETS OF SUBTASKS.
#
*1,FRKLFT6A,OPERATOR A
*2,FRKLFT6B,OPERATOR B
*3,FRKLFT6C,OPERATOR C
.
.
.
*14,MAINT LDR,AUTO TECH,TRACTOR5,TRAILER12,TRACTOR10,TRAILER25
*16,DUMMY MAINT,DUMMY SERVC
*16,B STACKS,PROP STACKS
END
ORLINKS
#
#DEFINE FUNCTIONAL STRUCTURES THAT REPRESENT MUTUALLY EXCLUSIVE CHOICE FOR
#THE ACCOMPLISHMENT OF PART OF A MISSION.
#
+1,*1,USERS A
+2,*2,USERS B
+3,*3,USERS C
.
.
.
+11,*11,USERS M
END
COMPOUND LINKS
#
#DEFINE FUNCTIONAL STRUCTURES WHICH ARE WEIGHTED SUMMATIONS OF PARTS.
#
$!MHE
+1,.063
+2,.063
+3,.063
.
.
.
D STACKS,.04
E STACKS,.07
F STACKS,.03
END
CHAIN
#
#THE FINAL CHAIN CONSTRUCT OF UNIT MISSION BEING MODELED.
#
CH AMMO INSP,AMMO CLERK,*13,CHECKERS,CRANE CHIEF,RTFL CHIEF,!MHE,!AMMO
END
REPAIR
#
#DEFINE RELATIVE PARAMETERS FOR THE REPAIR OF DAMAGED ITEMS.
#
FORKLIFT
$*15,2,1.,180.,90 ,2685.,1685.
CRANE
$*15,2,1.,180.,' J.,2685.,1685.
.
.
.
STACKS
$FIREMEN,1,1.,1400.,360.,1550.,1074.
GENERAL REPAIR
$*14,2
$FIRETEAM,1
END
INTERNAL RECONSTITUTION TIMES
#
#INPUT A MATRIX OF TIMES, FOLLOWING A LETHALITY EVENT OR RECONSTITUTION EVENT,
#AT WHICH OUTPUTS ARE DESIRED.
#
```

```
15.,30.
END
OUTPUT
#
#INPUT THE DESIRED OUTPUT COMMANDS.
#
BINS,1.5,3.7,19.0,100.5,1000
CASUALTIES,ON
CHAIN,OFF
DEPLOYMENT,ON
DOSE,ON
SUMMARY,PERSONNEL
DEPDMP,1.5,3.7,19.0,100.5,1000.
LETHALITY,ON
ETIPCI,ON
NUCLEAR SUMMARY,ON
RECONSTITUTION,PARTIAL
RANDOM NUMBER,OFF
END
REPLICATION
#
#INPUT THE DESIRED NUMBER OF REPLICATIONS.
#
75
END
RECONSTITUTION EVENT
#
#RESETS THE INTERNAL TIME CLOCK TO RESTART A SERIES OF OUTPUT TIME POINTS.
#
0.,60.,1440.
END
HEADING
#
#WRITE A MESSAGE AT THE BEGINNING OF THE AURA OUTPUT.
#
ASP1B   AMMUNITION SUPPLY POINT
END
GO
STOP
```

```
#THIS IS AN EXAMPLE OF AN AURA INPUT RUNSTREAM FOR UNIT MISSION IN A
#CONVENTIONAL SCENARIO.
#
REPERTOIRE
WEAPONS
#
#THE CONVENTIONAL WEAPON USED IS NAMED THRT13.
#
B SECONDARY,SECONDARY
THRT13,CONVENTIONAL
FOS
#
#THE PERSONNEL AND EQUIPMENT REQUIRED FOR A MISSION.
#
FIREMEN,PERSONNEL
FIRETEAM,PERSONNEL
CRANE
FRKLFT6A,FORKLIFT6,FORKLIFT
FRKLFT6B,FORKLIFT6,FORKLIFT
.
.
.
TRACTOR10,TRUCK5T
WRECKER,TRUCK5T
B STACKS
PROP STACKS
.
.
.
CRANE OPER,PERSONNEL
LIFT/LOAD OP,PERSONNEL
DUMMY MAINT,PERSONNEL
DUMMY SERVC,PERSONNEL
END
DEPLOYMENT
#
#THE DEPLOYMENT PARAMETERS OF THE ASSETS.
#
CRANE,  511.00, 1420.00,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
CRANE, 1356.00, 1739.50,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
.
.
.
PROP STACKS, 1322.68, 1675.60,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
B STACKS  , 1405.80, 1661.40,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
.
.
.
TELEPHONE , 1088.14, 1860.15,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
TRUCK, 1087.24, 1859.02,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
.
.
.
FIREMEN  , 1551.43, 1073.64, -1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
FIRETEAM,1551.43,1073.64,-20.,1,1,1,1, 1, 0
$2,1,.5,4,.5
END
CONVENTIONAL LETHALITY DATA
#
#AURA READS A CONVENTIONAL LETHALITY FILE VIA INPUT UNIT NUMBER 2.
#
END
SECONDARY EXPLOSIVE
#
#IDENTIFIES SOME ASSETS AS BEING POTENTIAL SOURCES OF SECONDARY EXPLOSIONS.
#
B SECONDARY,B STACKS
END
DELIVERY ERRORS
#
#DEFINE THE DELIVERY ERRORS OF WEAPON THRT13.
#
THRT13,10.,140.,6.,45.,0.
END
```

```
VOLLEY
#
#INPUT THE PARAMETERS NECESSARY TO SPECIFY AN ATTACK OF AT LEAST TWO
#ROUNDS PER AIMPOINT CHOSEN.  THERE ARE 4, 8, OR 12 ROUNDS FIRED PER
#AIMPOINT IN THIS SCENARIO.
#
THRT13,0.,487.,1522.,0.,4,0.,140.
THRT13,0.,487.,1522.,0.,4,0.,140.
THRT13,0.,2615.,1522.,0.,12,0.,220.
.
.
.
THRT13,0.,1530.,1772.,0.,12,0.,220.
THRT13,0.,1530.,707.,0.,8,0.,140.
END
LINKS
#
#THE LINK ORGANIZATION FOR A DEFINED MISSION.
#
FIREMEN,.5
$PERSONNEL
$T,1.
$E,1.
FIRETEAM,20.
$PERSONNEL
$T,1.
$E,1.
.
.
.
RECORD CLERK,8.,8.
$M,2.,25
$COMMO OPERS,TYPIST,RTFL CHIEF,OPERATOR,CRANE OPER,CRANE CHIEF
$T,120.,140.,70.,40.,40.,30.
$E,.9,.7,1.,1.,1.,1.
$CHECKERS
$T,8.
$E,1.
.
.
.
OPERATOR M,4.,4.
$NCO,COMMO OPERS,RECORD CLERK,MAINT STAFF,RECOV OPER,SERVC PERS
$T,120 ,130.,50.,90.,70.,60.
$E,.8,.8,1.,1.,1.,1.
$LIFT/LOAD OP,CRANE OPER
$T,45.,25.
$E,1.,1.
.
.
.
A STACKS,6.
B STACKS,9.
PROP STACKS,9.
C STACKS,3.
D STACKS,5.66
E STACKS,14.
F STACKS,5.66
END
SUBCHAINS
#
#DEFINE FUNCTIONAL STRUCTURES THAT REPRESENT SETS OF SUBTASKS.
#
*1,FRKLFT6A,OPERATOR A
*2,FRKLFT6B,OPERATOR B
*3,FRKLFT6C,OPERATOR C
.
.
.

*14,MAINT LDR,AUTO TECH,TRACTOR5,TRAILER12,TRACTOR10,TRAILER25
*15,DUMMY MAINT,DUMMY SERVC
*16,B STACKS,PROP STACKS
END
ORLINKS
#
#DEFINE FUNCTIONAL STRUCTURES THAT REPRESENT MUTUALLY EXCLUSIVE CHOICE FOR
#THE ACCOMPLISHMENT OF PART OF A MISSION.
#
+1,*1,USERS A
+2,*2,USERS B
```

```
+3,*3,USERS C
.
.
.
+11,*11,USERS M
END
COMPOUND LINKS
#
#DEFINE FUNCTIONAL STRUCTURES WHICH ARE WEIGHTED SUMMATIONS OF PARTS.
#
$!MHE
+1,.063
+2,.063
+3,.063
.
.
.
D STACKS,.04
E STACKS,.07
F STACKS,.03
END
CHAIN
#
#THE FINAL CHAIN CONSTRUCT OF UNIT MISSION BEING MODELED
#
CH AMMO INSP,AMMO CLERK,*13,CHECKERS,CRANE CHIEF,RTFL CHIEF,!MHE,!AMMO
END
REPAIR
#
#DEFINE RELATIVE PARAMETERS FOR THE REPAIR OF DAMAGED ITEMS.
#
FORKLIFT
$*15,2,1.,180.,90.,2685.,1685.
CRANE
$*15,2,1.,180.,90.,2685.,1685.
.
.
.
STACKS
$FIREMEN,1,1.,1400.,360.,1550.,1074.
GENERAL REPAIR
$*14,2
$FIRETEAM,1
END
INTERNAL RECONSTITUTION TIMES
#
#INPUT A MATRIX OF TIMES, FOLLOWING A LETHALITY EVENT OR RECONSTITUTION EVENT,
#AT WHICH OUTPUTS ARE DESIRED.
#
15.,30.
END
OUTPUT
#
#INPUT THE DESIRED OUTPUT COMMANDS.
#
CASUALTIES,ON
CHAIN,OFF
DEPLOYMENT,ON
SUMMARY,PERSONNEL
DEPDMP,1.5,3.7,19.0,100.5,1000.
LETHALITY,ON
RECONSTITUTION,PARTIAL
REPAIR REPORT,FULL
RANDOM NUMBER,OFF
END
REPLICATION
#
#INPUT THE DESIRED NUMBER OF REPLICATIONS.
#
50
END
RECONSTITUTION EVENT
#
#RESETS THE INTERNAL TIME CLOCK TO RESTART A SERIES OF OUTPUT TIME POINTS.
#
0.,60.,1440.
END
HEADING
#
#WRITE A MESSAGE AT THE BEGINNING OF THE AURA OUTPUT.
#
```

```
ASP1B   AMMUNITION SUPPLY POINT
END
GO
STOP
```

```
#THIS IS AN EXAMPLE OF AN AURA INPUT RUNSTREAM FOR UNIT MISSION IN A
#CHEMICAL SCENARIO.
#
REPERTOIRE
WEAPONS
#
#THE CHEMICAL WEAPON USED IS NAMED CHEMSHELL.
#
CHEMSHELL,TOXIC
FOS
#
#THE PERSONNEL AND EQUIPMENT REQUIRED FOR A MISSION.
#
FIREMEN,PERSONNEL
FIRETEAM,PERSONNEL
CRANE
FRKLFT6A,FORKLIFT6,FORKLIFT
FRKLFT6B,FORKLIFT6,FORKLIFT
.
.
.
TRACTOR10,TRUCK5T
WRECKER,TRUCK5T
B STACKS
PROP STACKS
.
.
.
CRANE OPER,PERSONNEL
LIFT^ OAD OP,PERSONNEL
DUMMY MAINT,PERSONNEL
DUMMY SERVC,PERSONNEL
END
DEPLOYMENT
#
#THE DEPLOYMENT PARAMETERS OF THE ASSETS.
#
CRANE,  511.00, 1420.00,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
CRANE, 1356.00, 1739.50,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
.
.
.
PROP STACKS, 1322.68, 1675.60,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
B STACKS  , 1405.80, 1661.40,1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
.
.
.
FIREMEN   , 1551.43, 1073.64, -1., 1, 1, 1, 1, 1, 0
$2,1,.5,4,.5
FIRETEAM,1551.43,1073.64,-20.,1,1,1,1, 1, 0
$2,1,.5,4,.5
END
T.K.C.
#
#ALLOWS THE USER TO INDICATE DEPLOYMENT POINTS AT WHICH A DIFFICULT OR EASY
#JOB IS BEING PERFORMED.
#
PERSONNEL,2,2.
.
.
.
USER,1,3.
END
CEP ERROR
#
#READ THE DELIVERY ERRORS EXPRESSED IN CIRCULAR ERROR PROBABLE, CODE CONVERTS
#TO A STANDARD DEVIATION.
#
CHEMSHELL,60.,60.,0.
END
CEP TLE
#
#INPUT THE TARGET LOCATION ERRORS EXPRESSED IN CIRCULAR ERROR PROBABLE.
#
60.
END
```

```
INCOMING FIRE DIRECTION
#
#ORIENTS THE INCOMING FIRE DIRECTION WITH RESPECT TO THE UNIT COORDINATE
#SYSTEM
#
90
END
WIND DIRECTION
#
#ORIENTS THE WIND DIRECTION WITH RESPECT TO THE UNIT COORDINATE SYSTEM.
#
45
END
DOSE PARAMETERS
#
#SET MAXIMUM DOSAGE TO BE CONSIDERED AN INSTANT CASUALTY.
#
MAX DOSE,6.
#
#SETS PROBIT SLOPE TO MODEL THE VARYING SENSITIVITY OF INDIVIDUALS TO DOSES
#OF VARIOUS CHEMICALS.
#
PROBIT,1,.245
END
IV DOSE
#
#ENABLES USER TO CONTROL THE INTRAVENOUS DOSE COMMAND ACTIVITY.
#
IVDOSE,OFF
END
CONTAMINATED USAGE
#
#ALLOWS USE OF SELECTED ITEMS OF EQUIPMENT WHEN IT IS CONTAMINATED.
#
ALL
END
TOXIC DISPERSION DATA
#
#AURA READS A TOXIC DISPERSION DATA FILE VIA INPUT UNIT NUMBER 4.
#
END
PERSISTENCE
#
#ENABLES THE MODIFICATION OF THE PERSISTENCE TIME FOR CHEMICAL AGENTS ON
#SPECIFIED ASSETS FROM THAT PRODUCED BY NUSSE.
#
CHEMSHELL
FRKLFT,3.5
END
FATIGUE
#
#DEFINES SPECIFIC JOBS AS MORE DEMANDING THAN OTHERS.
#
TREMEN,0.4555,1189.
END
HEAT STRESS
#
#ALLOWS THE SUBSTITUTION OF SPECIFIC VALUES FOR VARIOUS METEOROLOGICAL
#CONDITIONS THAT CAN IMPACT HEAT STRESS EFFECTS ON PERSONNEL.
#
C,4,1.56
I,4..56
S,39.0
DELIVERY ERRORS
#
#DEFINE THE DELIVERY ERRORS OF WEAPON CHEMSHELL.
#
CHEMSHELL,10.,140.,6.,45.,0.
END
VOLLEY
#
#INPUT THE PARAMETERS NECESSARY TO SPECIFY AN ATTACK OF AT LEAST TWO
#ROUNDS PER AIMPOINT CHOSEN.
#
CHEMSHELL,0.,487.,1522.,0.,4,0.,140.
CHEMSHELL,0.,487.,1522.,0.,4,0.,140.
CHEMSHELL,0.,2615.,1522.,0.,12,0.,220.
.
.
.
CHEMSHELL,0.,1530.,1772.,0.0,12,0.,220.
```

```
CHEMSHELL,0.,1530.,707.,0.0,8,0.,140.
END
AGENT
CHEMSHEL'-'3
END
LINKS
#
#THE LINK ORGANIZATION FOR A DEFINED MISSION.
#
FIREMEN,.5
$PERSONNEL
$T,1.
$E,1.
FIRETEAM,20.
$PERSONNEL
$T,1.
$E,1.
.
.
.
OPERATOR M,4.,4.
$NCO,COMMO OPERS,RECORD CLERK,MAINT STAFF,RECOV OPER,SERVC PERS
$T,120.,130.,50.,90.,70.,60.
$E,.8,.8,1.,1.,1.,1.
$LIFT/LOAD OP,CRANE OPER
$T,45.,25.
$E,1.,1.
.
.
.
A STACKS,6.
B STACKS,9.
PROP STACKS,9.
C STACKS,3.
D STACKS,5.66
E STACKS,14.
F STACKS,5.66
END
SUBCHAINS
#
#DEFINE FUNCTIONAL STRUCTURES THAT REPRESENT SETS OF SUBTASKS.
#
*1,FRKLFT6A,OPERATOR A
*2,FRKLFT6B,OPERATOR B
*3,FRKLFT6C,OPERATOR C
.
.
.
*14,MAINT LDR,AUTO TECH,TRACTOR5,TRAILER12,TRACTOR10,TRAILER25
*15,DUMMY MAINT,DUMMY SERVC
*16,B STACKS,PROP STACKS
END
ORLINKS
#
#DEFINE FUNCTIONAL STRUCTURES THAT REPRESENT MUTUALLY EXCLUSIVE CHOICE FOR
#THE ACCOMPLISHMENT OF PART OF A MISSION.
#
+1,*1,USERS A
+2,*2,USERS B
+3,*3,USERS C
.
.
.
+11,*11,USERS M
END
COMPOUND LINKS
#
#DEFINE FUNCTIONAL STRUCTURES WHICH ARE WEIGHTED SUMMATIONS OF PARTS.
#
$IMHE
+1,.063
+2,.063
+3,.063
.
.
.
D STACKS,.04
E STACKS,.07
F STACKS,.03
END
```

```
CHAIN
#
#THE FINAL CHAIN CONSTRUCT OF UNIT MISSION BEING MODELED.
#
CH AMMO INSP,AMMO CLERK,*13,CHECKERS,CRANE CHIEF,RTFL CHIEF,!MHE,!AMMO
END
DEGRADATION
#
#ASSOCIATE A MOPP CODE NUMBER AND A T.K.C. CODE NUMBER WITH A PERFORMANCE
#DEGRADATION VALUE.
#
0,1,1.
0,2,1.
0,3,1.
:
.
.
4,7,.4
4,8,.3
END
REPAIR
#
#DEFINE RELATIVE PARAMETERS FOR THE REPAIR OF DAMAGED ITEMS.
#
FORKLIFT
$*15,2,1.,180.,90.,2685.,1685.
CRANE
$*15,2,1.,180.,90.,2685.,1685.
.
.
.
STACKS
$FIREMEN,1,1.,1400.,360.,1550.,1074.
GENERAL REPAIR
$*14,2
$FIRETEAM,1
END
OUTPUT
#
#INPUT THE DESIRED OUTPUT COMMANDS.
#
CASUALTIES,ON
CHAIN,OFF
DEPLOYMENT,ON
DOSE,ON
SUMMARY,PERSONNEL
DEPDMP,1.5,3.7,19.0,100.5,1000.
LETHALITY,ON
RECONSTITUTION,PARTIAL
REPAIR REPORT,FULL
END
REPLICATION
#
#INPUT THE DESIRED NUMBER OF REPLICATIONS.
#
100
END
RECONSTITUTION EVENT
#
#RESETS THE INTERNAL TIME CLOCK TO RESTART A SERIES OF OUTPUT TIME POINTS.
#
0.,60.,*40.
END
INTERNAL RECONSTITUTION TIMES
#
#INPUT A MATRIX OF TIMES, FOLLOWING A LETHALITY EVENT OR RECONSTITUTION EVENT,
#AT WHICH OUTPUTS ARE DESIRED.
#
15.,30.,45.,60.,120.
END
HEADING
#
#WRITE A MESSAGE AT THE BEGINNING OF THE AURA OUTPUT.
#
ASP1B   AMMUNITION SUPPLY POINT
END
GO
STOP
```

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APPENDIX B

Index of Default Values for AURA Input Commands and Output Options

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The following tables list the default values for all AURA input commands and output options. They are separated into four categories which are: non-scenario dependent, chemical scenario dependent, nuclear scenario dependent, and conventional scenario dependent. Within each of these categories they are separated into input commands and output options and listed alphabetically. In the following tables, some of these have a default value of "OFF". In this case, the code will not model this parameter unless it is included in the AURA input file. Some of the parameters whose defaults are "OFF" also have default values for the parameters associated with them. These defaults will not be used by AURA unless the command or option is included in the AURA input file.

NON-SCENARIO DEPENDENT COMMANDS

INPUT COMMANDS	DEFAULTS
ACQUISITION PROBABILITY	
target acquisition probability	1.0
CEP ERROR	
precision error	0.0
mean point of impact error	0.0
standard deviation in height of burst	0.0
CEP TLE	
target location error, expressed as circular error probable	0.0
CHAINS	This is required in every scenario
CREW	OFF
COMPOUND LINKS	OFF
DECISION RULES	
PRIORITY, VERSATILITY or ORDER	VERSATILITY
SIGNIFICANCE, required fractional improvement needed	0.005
SICKLV, sickness degradation level	0.75
FINISH REPAIR, relative gain for finishing a needed repair	2.0
DELIVERY ERROR	
precision error in range	0.0
mean point of impact error in range	0.0
precision error in deflection	0.0
mean point of impact error in deflection	0.0
error in height of burst	0.0
DEPLOYMENT	This required in every scenario
EXPENDABLE	OFF
FAILURE RATE	OFF
FATIGUE	OFF
relative fatigue rate	0.2639 SLUNITs/minute
relative demand for stored rest	1235.0 SLUNITs
minimum amount of sleep required by assets	240.0 SLUNITs
maximum amount of sleep permitted for assets	1520.0 SLUNITs
GO	This is required in every scenario
GRANULARITY	
largest increment per allocation step	1.0
HEADING	OFF

NON-SCENARIO DEPENDENT DEFAULTS

INPUT COMMANDS	DEFAULTS
HEAT STRESS	
ambient temperature	20.0 degrees Celsius
relative humidity	20.0%
wind speed	3.0 meters/second
maximum allowable metabolic rate, initial MOPP	1.E35
maximum allowable metabolic rate, alternate MOPP	1.E35
metabolic rate	250.0 watts
MOPP0 clothing parameter for clo	1.43
MOPP1-MOPP3 clothing parameter for clo	2.07
MOPP4 clothing parameter for clo	2.32
MOPP0 clothing parameter for im/clo	0.34
MOPP1-MOPP3 clothing parameter for im/clo	0.22
MOPP4 clothing parameter for im/clo	0.15
gamma wind correction factor for clo	0.26
gamma wind correction factor for im/clo	0.38
skin temperature	36.0 degrees Celsius
percent dehydration	0.0%
days of acclimatization	12.0
INCOMING FIRE DIRECTION	
angle of incoming fire direction	0
INTERNAL RECONSTITUTION TIMES	0
LINKS	This is required in every scenario
maximum effectiveness	1.0 (100%)
maximum number of items that can be assigned to a link	1.E35
number of effective assets below which effectiveness is minimum	0.0
minimum effectiveness	0.0 (0%)
maximum amount to be allocated in any one pass	0.5
effectiveness level below which a substitution will not be made	0.1 (10%)
MISS DISTANCE	OFF
MODE	
CODE, ON or OFF	OFF
CULL, ON or OFF	OFF
DEBUG, ON or OFF	OFF
PRIORITY, ON or OFF	OFF
INDIVIDUAL DOSES, ON or OFF	ON
STOCHASTIC, ON or OFF	OFF
NAMES	This is required in every scenario
\OFFSET	OFF
ORLINKS	OFF

NON-SCENARIO DEPENDENT COMMANDS

INPUT COMMANDS	DEFAULTS
OUTPUT	OFF
RECONSTITUTION EVENTS	0
REINFORCEMENTS/LOSSES	OFF
RELIABILITY OF WEAPONS	
single warhead reliability	1.0
reliability of a volley of warheads	1.0
REPAIR	OFF
MAXIMUM NUMBER, maximum # of repairs at one time	50
REPERTOIRE	This is required in every scenario
REPLICATIONS	This is required in every scenario
REST	OFF
ROUND	OFF
SEEDS (Random Number)	OFF
STOP	This is required in every scenario
SUBCHAINS	OFF
TEMPORARY LOSSES/RETURN TO DUTY	OFF
TIME DEPENDENT (LINK) DEGRADATION	OFF
TIREDNESS	OFF
minimum SLUNITs below which assets will be forced to rest	0.0 SLUNITs
maximum SLunits above which assets may not rest	1519.99 SLUNITs
minimum duration of rest	240.0 SLUNITs
ceiling on the number of cumulative SLunits	1520.0 SLUNITs
initial SLunits for asset at start of each replication	1520.0 SLUNITs
TLE	
x-coordinate of the target location error	0.0
y-coordinate of the target location error	0.0
TRACE LINK USAGE	OFF
VOLLEY	OFF
WIND DIRECTION	
angle of the wind direction	0

NON-SCENARIO DEPENDENT DEFAULTS

OUTPUT OPTIONS	DEFAULTS
CASUALTIES	OFF
CHAIN	ON
DEPDMP	OFF
DEPLOYMENT PLOT	ON
DUMP8	OFF
DUMP9	OFF
FATIGUE	OFF
INPUT LISTING	ON
LETHALITY	ON
OPTIMIZE	OFF
PARTICULAR ASSETS	OFF
POSTURE	OFF
PRINT7	OFF
RANDOM NUMBER	ON
RECONSTITUTION	OFF
REPAIR REPORT	OFF
REPLICATION	OFF
SELECTIVE PLOT	ON
SUMMARY	OFF
TIMER	OFF
WEAPON	OFF

CHEMICAL SCENARIO DEFAULTS

INPUT COMMANDS	DEFAULTS
AGENT	
agent type (G, V, or H)	G
ALARM	OFF
CONTAMINATED USAGE	OFF
Must MOPP, ON or OFF	OFF
DEGRADATION	OFF
MOPP code	4
toxic kill criteria code number	1
DOSE PARAMETERS	
DOSE BINS, b1, b2, b3, . . ., b10	.05,.10,.15,.25,.35,.45,.55,.65,.75,.85,1.0
MAX DOSE	10.0
PROBIT	OFF
agent number agent type	default probit slope
1 non-persistent	0.0
2 persistent	0.0
3 blistering	0.0
INTRAVENOUS DOSES	
IVDOSE, ON or OFF	OFF
INHALATION, einhal	1.0
PERCUTANEOUS, eperc	1.0
MOPP	OFF
fraction of vapor dosage	MOPP0-MOPP2=1.0, MOPP3=0.0, MOPP4=0.0
fracton of percutaneous dosage	MOPP0=1.0, MOPP1=.2, MOPP2=.1, MOPP3=.025, MOPP4=0.0
ALL CLEAR, YES or NO	YES
PROXIMITY, distance	1.E35
RECONSTITUTION, YES or NO	NO
RECOVERY TIME, time to realize no contamination	30.0 (minutes)
ROUND, YES, false recognition time or ROUND, NO	ROUND,YES, 10.0 (minutes)
TIME SPREAD, fraction of time needed to change MOPP posture	0.2
PERSISTENCE	
ratio of evaporation time	1.0
SUBLETHAL DOSE DEGRADATION	Performance degradation of a physically demanding task (i.e. gunner)
T.K.C. (TOXIC KILL CRITERIA)	
toxic kill criteria code number	4
dosage multiplier	1.0
TOXIC DISPERSION DATA	Required in this scenario

NUCLEAR SCENARIO DEFAULTS

INPUT COMMANDS			DEFAULTS
DOSE PARAMETERS			
DOSE BINS, b1, b2, b3, ... b10			5.0,75.0,150.0,300.0,450.0,530.0,830.0,1100.0,1500.0, 4500.0
MAX DOSE, maximum dosage value			8000.0
NUCLEAR VULNERABILITY DATA			Required for this scenario
SHIELDING			
posture	posture number	(a,b)	Fraction of dosage of type b in the posture due to an incident dosage of type a
open	1		
		(neutron,neutron)	1.0 (100%)
		(neutron,gamma)	0.0
		(gamma,neutron)	0.0
		(gamma,gamma)	1.0
open-thermally shielded	2		
		(neutron,neutron)	1.0
		(neutron,gamma)	0.0
		(gamma,neutron)	0.0
		(gamma,gamma)	1.0
foxhole	3		
		(neutron,neutron)	0.3
		(neutron,gamma)	0.0
		(gamma,neutron)	0.0
		(gamma,gamma)	0.3
armored personnel carrier	4		
		(neutron,neutron)	0.9
		(neutron,gamma)	0.0
		(gamma,neutron)	0.0
		(gamma,gamma)	0.9
tank	5		
		(neutron,neutron)	0.5
		(neutron,gamma)	0.0
		(gamma,neutron)	0.0
		(gamma,gamma)	0.5
SUBLETHAL DOSE DEGRADATION			Performance degradation of a physically demanding task (i.e. gunner)
THERMAL			
ATMOSPHERE, quality (POOR, AVERAGE, or GOOD)			AVERAGE
UNIFORM, type (SUMMER or WINTER)			SUMMER
YIELD			Required in this scenario

CONVENTIONAL SCENARIO DEFAULTS

INPUT COMMANDS	DEFAULTS
CONVENTIONAL LETHALITY DATA	Required in this scenario
SECONDARY EXPLOSIVE	OFF

OUTPUT OPTIONS

CHEMICAL SCENARIO DEFAULTS

	DEFAULTS
DOSE	OFF

NUCLEAR SCENARIO DEFAULTS

BINS	OFF
DOSE	OFF
ETIPCI	ON
NUCLEAR SUMMARY	OFF

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APPENDIX C

Index of AURA Input Commands and Output Options

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The following table is an alphabetical listing of all current AURA input commands and output options with the corresponding page of the report which describes them.

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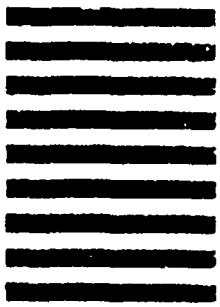

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