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USERS GUIDE: ADVANCED REACTIVE ELECTRONIC SIMULATION (ARES) Version 1.12

by

P. N. Pham J. P. Ridder P. E. Pace

March 2001

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NAVAL POSTGRADUATE SCHOOL Monterey, California

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I. INTRODUCTION

Advanced Reactive Electronic Warfare Simulation (ARES) Version 1.12 was created at the Naval Research Laboratory (NRL) under a project sponsored by the Office of Naval Research (ONR) titled *Distributed and Networked C2W Technology* (FY98-FY00). The simulation is used to determine the optimum command and control warfare/electronic attack (C2W/EA) configurations of assets including placement of platforms and system selection (jammer or receiver or both) for important mission scenarios leading to a better understanding of the minimum requirements for suppression of enemy air defense (SEAD) operations. *ARES* is currently being applied to the Analysis of Alternatives (AoA) in order to assist in generating candidate multi-component alternatives.

Written in C++, ARES is a pulse level simulation that models the complex interaction of multiple radar systems being acted upon by multiple airborne electronic attack (AEA) aircraft, considering target aircraft radar cross section (RCS) and altitude, terrain masking effects, both standoff jamming and self protection jamming effects, and network connection effect. **Its** features include an object-oriented scenario workbook allowing the users to build a battlefield scenario and a search procedure based on a genetic algorithms (GA) for optimizing configurations of what the core and peripheral components of the AEA architecture should be [Ref. 1 and 2].

Inputs to ARES consist of an order of battle that denotes the locations of the players to be modeled, parametric data representing the operating characteristic of those players, network connections between those players, and run-time analysis parameters supplied by the users. ARES is designed to work with the Multi-Service Force Deployment (MSFD) threat laydown, although non-MSFD scenarios may also be created. **If** using the MSFD, the laydown file may be imported directly into **ARES**, where it may be filtered to reduce the large number **of** objects to only those that are **of** interest. The imported objects are initially static, possessing a geographical location and little else. It is then up to the users to create the systems and signature attributes that will make these static players active.

As illustrated in Figure 1-1, an ARES player is based on a single model that can be comprised **of** various systems. The difference between a player and a model is the difference between the concrete and the abstract. For example, EA-6B ICAP III is a model. EA-6B tail number ABC at location **XYZ** is a player. When a player assumes the role **of** a particular model, it receives all **of** the parametric **data** defined by the model. [Ref. 1]

In ARES, systems that combine to define a model are built out **of** multiple lower level components and can take the **form of** a radar, an ESM system, or a jammer. For the radar systems, the lower level components are **as** shown in Figure 1-2. The ESM systems have the same components **as** the radar systems minus the transmitter, while the jammer systems consist **of** only the transmitter.

ARES is available in two **forms:** Graphical User Interface (GUI) and parallel. **ARES' GUI runs** on a personal computer (PC) **and** its primary application is for setting up scenarios and post processing. ARES' parallel version runs over a cluster **of** Intel based Linux machines with Message-Passing Interface (MPI) and provides capability to execute multiple iterations simultaneously, significantly reducing processing time for complex scenarios.

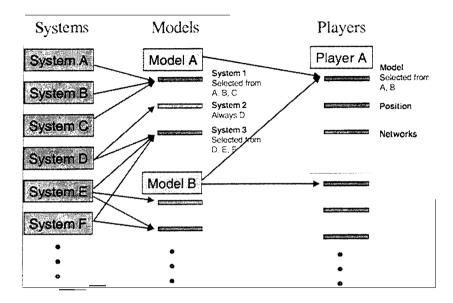


Figure 1-1. ARES Design Architecture. From Ref. 1.

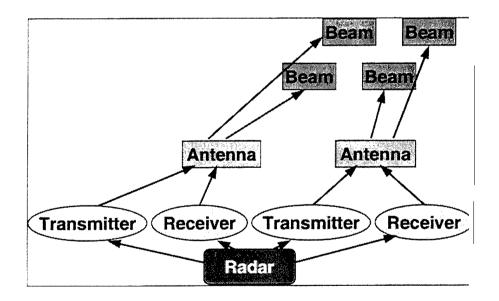


Figure 1-2. Radar System's Component. From Ref. 1.

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II. GETTING STARTED WITH ARES GUI

To effectively use **ARES**, the users must have some familiar with Windows **NT** operating system. This includes how to open and close Windows application, and how to use a mouse for selection.

A. HARDWARD AND SOFTWARE REQUIREMENTS

Using virtual memory, ARES with GUI is designed to run on any IBMTM compatible machine that will support Windows **NT** version **4.0** with Service Pack **3** or higher. However, execution times will vary greatly depending on the application and hardware. The platform running *ARES* GUI should, at a minimum, possess the following:

PROCESSOR	CLOCK SPEED	RAM	HDD CAPCITY	SCREEN RESOLUTION
PENTIUM III	500MHz	256Mbytes	2GBytes	1024 x 768, <i>true</i> color

TYPICAL: Installs all components except for files needed **to** execute *ARES* in parallel over a network.

<u>COMPACT</u>: Installs all files except the parallel files and examples.

<u>CUSTOM</u>: Allows the users to customize the installation. Choose Custom if the users want to install the parallel files.

When software installation completes, **ARES** can be launched either from the Start menu, My Computer, or Windows Explorer. When ARES is first launch, a "Splash" screen is visible for few seconds, followed by ARES startup window, shown in Figure 2-1, where the users can open a new or existing scenario.

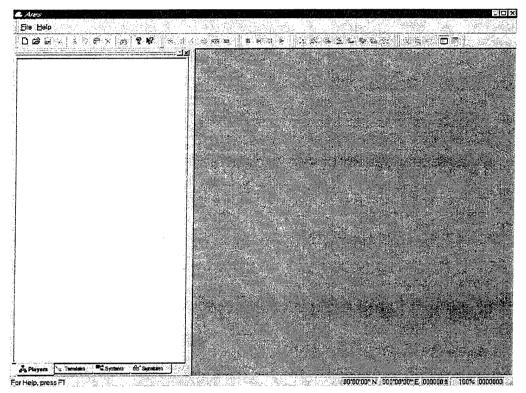


Figure 2-1. ARES Startup Screen

1. Opening Scenarios

To open an existing scenario, the users can select **Open** from the **File** drop-clown menu or left-click the $\stackrel{\textcircled{}}{=}$ icon. In the file selection dialog **box** that appears, the users can browse to the directory where the desired document resides and select it by double clicking on the file name. Upon doing this, the users are presented with a window screen labeled with the document's name. This window is the **ARES** main window containing

the tools that the users work with to build, execute, and plot result for a scenario. Figure 2-2 is a look at **ARES** window **as** it appears with a sample file opened.

To open a file recently saved in *ARES*, the users can click on the name of the file from The Most Recently Used list. This list appears at the bottom of the **File** menu, just above the **Exit** selection. and contains the up to four names of the files that have been opened most recently in **ARES**.

2. Create New Scenarios

Creating a new scenario requires the users to either left-click the **D** button on the tool bar or choose **New** from the **File** menu. Upon doing this, *ARES* opens a fresh GUI window with a temporary name of "Ares1" **as** filename.

C. EXPLORING THE SCREEN

As illustrated in Figure 2-2, *ARES* main window typically consists of the following components:

1. Title Bar

Extended across the top of the window, the title bar displays the application and document title that the users are working on. Like any other title bar in Windows application, the users can click it to reposition the *ARES* window, or resize the window by grabbing any of the **ARES** window's edges. The three Application Control Buttons **ARES** window control icon found at the right end of the title bar allow the users **to**, from left to right, minimize, maximize/restore (toggle between *ARES* filling up the entire Windows Desktop, and floating the *ARES* window on the Desktop), and shut down *ARES*. Clicking on the Application icon at the far left of the title bar invokes a

drop-down menu, which simply duplicates the function of the Application Control Buttons.

2. Menu Bar

Located under the title bar, it contains a list of menu heading, with each main heading leading to a drop-down menu, described in Chapter **III**. The three Document Control Buttons at the right end of the menu bar allow the users to, from left to right, reduce the view window to an icon in the view window, maximize the view window to full screen size or returns view window to its last non-maximized position, or close the **ARES**. The icon to the left of File replicates the functions of the three Document Control Buttons via a drop-down menu.

3. Toolbar

Below the main Menu Bar is the Toolbars, containing shortcuts providing quick, one-click access to commonly used commands in the menus. Features of ARES toolbar buttons are described in Chapter IV.

4. Workspace

The workspace is the area of the main window where the users create, edit, execute, and analyze scenario. It consists of two split windows: view window to the right and control bar window to the left. There are three view windows in **ARES**: Edit, Execute, and Chart. Each view is linked to a different control bar and provides different functions, **as** described in Chapter V through XIV. By default, ARES automatically opens the document in Edit View window.

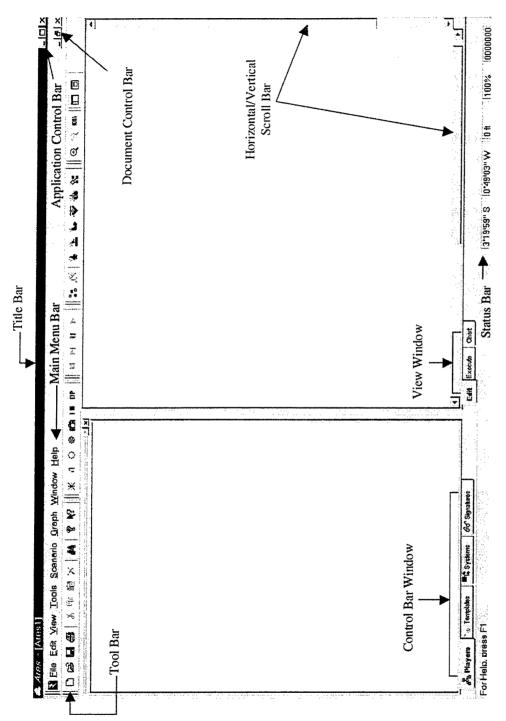


Figure 2-2. Sample of ARES Main Window

5. Status Bar

The status bar, which appears along the bottom of the window presents five panes of information. As described in Chapter VI, the information presented in these panes differs depending on whether there is an object currently selected in either the view window or in the Players tab of the associated control bar window. This bar is only active from the Edit view window.

6. Vertical/Horizontal Scroll Bar

Used to pan the current viewing window and view other areas of window that do not fit on the screen. Panning is useful when using a zoomed-in-view. At the end of each scroll bar, pointing in opposite direction, are scroll arrows. They point in the direction that the window moves over. Clicking the arrow with left mouse button moves the window a small amount in that direction. For more rapid scrolling, click and hold the mouse button down on the scroll arrow.

III. MAIN MENU BAR

ARES Menu Bar consists *a* eight headings as illustrated in Figure 3-1. Clicking on each heading pulls down a menu, with each of the sub-headings described in the following sections. Note that if a command is unavailable in the current view, it appears grayed out.

File Edit View Tools Scenario Graph Window Help

Figure 3-1. Main Menu Bar

A. FILE MENU COMMANDS

The **File** drop-down menu, as shown in Figure **3-2**, contains commands necessary *to* invoke the standard I/O operations. The individual menu items are described below.

	New	Ctrl+N
	<u>C</u> pen	Ctri+O
	Close	
	ImportMSFD	
	Export to ASCI	
	Import from ASC	
	ExportPlayer In	fo
	Export ayer II	10.
j.	Seve	Ctrl+S
	Save <u>A</u> s	
in a J	Coge Selver.	raar oʻnin ana sonoo
	Print	Ctrl+P
	Print Window	
2	Print Preview	
	Print Setup	
jan.	Ascent Flip	
	Egit	

Figure 3-2. File Drop-Down Menu

New: Creates a new ".jam" document in **ARES** and assigns an incremented, temporary as the filename. This command can also be activated without accessing the drop-down menu by pressing Ctrl and N keys simultaneously on the keyboard.

Open: Calls a file selection dialog allowing the users to load an existing **ARES** (.jam) document in a new window. Multiple documents can be opened at once. The users can switch among the multiple open documents via the Window menu or document tabs. The uses can also invoke this command without accessing the drop-down menu by pressing Ctrl and O keys simultaneously on the keyboard.

Close: Closes all windows containing the active **ARES** ".jam" document and prompts the users to save changes to the document before closing it. If a document is closed without saving, all changes made since the last time the users saved it is lost.

Import MSFD: Imports a Multi-Service Force Deployment (MSFD) file into the active ARES document. Upon invocation of this command, the users are prompted to open **an MSFD** file (.msf). Once the file is selected, the users are warned to set a filter before opening the file (see Section E). Since MSFD files typically contain hundreds of thousands of objects, this is highly recommended.

The MSFD import function displays the objects according to their MSFD Unit Subordination Code in the Players pane of the Scenario Workbook.

Export to ASCII: Prompts the users for the name of an ASCII text file to write the scenario ".jam" file. This file may later be transferred to Linux cluster for parallel processing (*see* Appendix D).

Import from ASCII: Prompts the users for the name of an ASCII text file for loading. This file may be the scenario created with Linux cluster.

Export Player Info: Prompts the users for the names of an ASCII text file to extract the information of all players participating in the scenario. The extracted

information is intended to provide a general purpose ASCII listing of the scenario and includes sequence number, player name, player's position in latitude and longitude, sequence number of the command and control superior, Electronic Intelligence Notations (ELNOTs) of any emitters, and lethal range of any weapons.

Save: Saves the active document to its current name and directory. The users can also invoke this command without accessing the drop-down menu by pressing Ctrl and *S* keys simultaneously on the keyboard.

Save As: Calls a file selection dialog box allowing the users to save the active ".jam" document to a new name and directory.

<u>Page Setup</u>: Sets up the print layout for a graph in *ARES* Chart view window.

Print: Prints the content display of the current view window. This command also can be invoked without accessing the drop-down menu by pressing Ctrl and **P** keys simultaneously on the keyboard.

<u>Print Window</u>: Prints the viewable part of the map display in the Edit view window. This command is not accessible from the Execute and Chart view.

Print Preview: Displays the active document **as** it would appear when printed. When the users choose this command, the main window will be replaced with **a** print preview window in which one or two pages will be displayed in their printed format. The print preview toolbar offers the users options to view either one or two pages at a time; move back and forth through the document; zoom in and out of pages; and initiate **a** print job.. **<u>Print Setup</u>**: Presents a Print Setup dialog box where the users can select a printer and a printer connection.

Exit: Ends the ARES session and prompts the users to save documents with unsaved changes. Closing document can also be done by clicking on the right most Application Control Button.

B. EDIT MENU COMMANDS

The Edit menu, as shown in Figure 3-3, contains the functions necessary to modify/manipulate an object currently selected in either the view window or in the Players tab and locate an object on the tree structure displayed in Players tab. The individual menu items are described below.

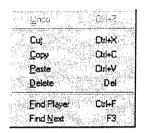


Figure 3-3. Edit Drop-Down Menu

Lindo: Reverses the last editing action, if possible. This command also can be invoked without accessing the drop-down menu by pressing Ctrl and Z keys simultaneously on the keyboard.

Cut: Removes the currently selected object in either the view window or in the Players tab from the document and put it on the clipboard. Cutting data to the clipboard replaces the contents previously stored there. This command is unavailable if there is no object currently selected. The users can also invoke this command without accessing the drop-down menu by pressing Ctrl and X keys simultaneously on the keyboard.

<u>**Copy</u>**: Copies the selected object in either the view window or in the Players tab onto the clipboard. Copying data to the clipboard replaces the contents previously stored there. This command is unavailable if there is no object currently selected. The user can also invoke this command without accessing the drop-down menu by pressing Ctrl and C keys simultaneously on the keyboard.</u>

Paste: Inserts a copy of the clipboard contents at the insertion point on the Players tab tree structure. This command is unavailable if the clipboard is empty, The users can also invoke this command without accessing the drop-down menu by pressing Ctrl and V keys simultaneously on the keyboard.

Delete: Permanently removes the currently selected object in either the view window or in the Players tab of the associated control bar window from the document. This command is unavailable if there is no object currently selected. The users can also invoke this command without accessing the drop-down menu by pressing Del key on the keyboard.

Find Plaver: Displays a dialog box as shown in Figure **3-4** allowing the users to locates a player on the tree structure displayed in Players tab that matches the search criteria as described below. This command also can be invoked without accessing the drop-down menu by pressing Ctrl and F keys simultaneously on the keyboard.

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Player	Prowler 1	C Site
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an an an an an Araba an Araba. An Araba	그는 '' 정말 정갑 것 같다. 감당	「手」「そうと」としても認識で語語に対
	nr I	Model

Figure **3-4.** Find Player Dialog Box

- <u>Site</u>: Searches for matches among the names displayed on the tree in the Players tab of the Scenario Workbook described in Chapter XII.
- <u>Sequence</u>: Searches for a uniquely matching sequence number that defined on the player's Identification Property page described in Chapter XII.
- <u>Model</u>: Searches for players matching the model name specified.

Find Next: Repeats the previous Find Player search. This command also can be invoked without accessing the drop-down menu by pressing F3 key on the keyboard.

C. VIEW MENU COMMANDS

The View menu, as shown in Figure 3-5, contains the functions necessary to manipulate the view window display. The individual menu items are described below.

Import Terrain
Remove Telen
Zoam <u>I</u> n
Zaom <u>O</u> ur
<u>Z</u> oom 100%
Overview Window
Overview Window Control Bar
- 영화 중 12 전망가지, 것도 가지, 그렇게 가장 등 가장 등 가장 않았다.
Control Bar

Figure 3-5. View Drop-Down Menu

Import Terrain: Calls a file selection box allowing the users to select a ".lan" terrain file for map display in **ARES** Edit view window. **ARES** uses terrain in all of its LOS calculations.

<u>Remove Terrain</u>: Deletes the terrain map display from **ARES** Edit view window.

Zoom In: Zooms into a point on a map view in ARES Edit view window. Once Zoom In is selected, successive clicks of the mouse will magnify by a factor of **2**.

Zoom Out: Zooms out of a point on a map view in *ARES* Edit view window. Once Zoom Out is selected, successive clicks **of** the mouse will de-magnify by a factor of **2** until normal magnification is restored.

Zoom 100%: Restores map view in *ARES* Edit view window to normal magnification.

Overview Window: Opens an overview window, which provides a view of the entire scenario. The overview window also allows panning. This command is not accessible from the Execute and Chart view.

<u>Control Bar</u>: Allows the users to display or hide the control bar relevant to the current view. In the Edit view, this will display or hide the Scenario Workbook. In the Execute view, this will display or hide the Runtime Control bar. In the Chart view, this will display/hide the Post-proc Control bar.

Show Hidden: This command is a form **of** "declutter" button and allows the users to show all players which have been previously flagged to hide in ARES under the Players tab. This command is not accessible from the Execute and Chart view.

<u>Show SIMDIS Players</u>: Allows the users to hide/show those players that have been flagged to be hidden from **SIMDIS** under the Players tab [Ref. 3]. This command is not accessible from the Execute and Chart view.

D. TOOLS MENU COMMANDS

The Tools menu, as shown in Figure 3-6, contains the commands necessary to modify the appearance of an object and tool bar menu. The individual menu items are described below.

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S & S / S	MOCON'S		igne -	1.1

Figure 3-6. Tools Drop-Down Menu

Options: Displays the options dialog box, shown in Figure 3-7, which has four

primary features described below.

• IEE: This box allows the users to specify whether a particular force in the scenario is friend, foe, or neutral. This affects only the color with which that force is displayed (Friend: blue, Foe: red, Neutral: grey). Double clicking a force letter will display the IFF dialog box as shown in Figure **3-8** from which the users can make their selection.

Options				1999) 1997	
-1FF			Function	hilmans-	
이 지하는 것이다.	orce Friend or foe			1.00	
			1506aa	AS 🗐	
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S IC	Neutral Foe			BC 🦾	
E	Neutral		999000 T	BD	
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Figure 3-7. Options Dialog **Box 28**

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	C Friend
	C Foe
	Neutral
	TOK]

Figure 3-8. IFF Dialog Box

• <u>Function Bitmaps</u>: This box allows the users to change the default bitmap for a given function code. This affects only the bitmap with which an object of a given function code is displayed. Double clicking on a bitmap will display the Bitmap dialog box as shown in Figure **3-9** from which the users can make their selection.

Select Bitmap		×
·····		graa saasa
	Lance	

Figure 3-9. Bitmap Diaglog Box

- <u>Grid</u>: This box allows the users to change the default grid line spacing. Also, the users may choose to not display grid lines by de-selecting the check box.
- <u>Colors</u>: Pushing either the Background or Grid button displays a dialog as shown in Figure 3-10 to change the color of these two displayed items.

Customize: Displays the Customize dialog box, as shown in Figure 3-11, allows

the users to change the appearance of tool bar menu.

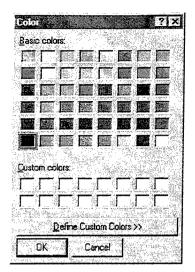


Figure 3-10. Color Selection Dialog Box

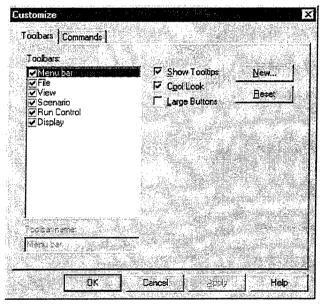


Figure 3-11. Toolbars Customize Dialog Box

E. SCENARIO MENU COMMANDS

The Scenario menu, as shown in Figure 3-12, contains the commands necessary to

modify/create scenario in ARES. The individual menu items are described below.



Figure 3-12. Scenario Drop-Down Menu 30

Eilter: Initiates a process to reduce the number of objects in a scenario that begins by displaying the filter dialog as shown in Figure **3-13.** After selecting the properties of the objects the users wish to keep, pushing the "OK" button will result in the deletion of all objects that do not meet these criteria. Since the deleted objects can't be recovered, it is recommended that the scenario be saved prior to filtering. This command is not accessible from the Execute and Chart view.

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To: 99999929	C		AT BC	
T Year 3	E		BD BE	
Latitude	G		S 8M	
From:	H		BR BS	
90 d 0 m 0 s S 👻	J K		CE CM	
To:	L		CT	
90 d 0 m 0 s N 💌	N		DC	
Longitude	P		DG	
From:			DR	
180 d 0 m 0 s W 🕶			EC	
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Keep only those superiors that have j	participating	ubordina	tes 🔅	

Figure **3-13.** Filter Dialog **Box**

<u>Add Plaver</u>: Displays a pop-up menu as shown in Figure 3-14 for creating a new, neutral object of selected type at the geographic center of the scenario. Choosing any item from this menu presents a dialog box listing available models of the chosen type

for selection. These models must have been previously created on the Templates tab of the Scenario Workbook (see Chapter XI).

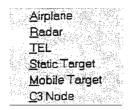


Figure 3-14. Add Player Pop-Up Menu

<u>Convert</u>: Displays the Player Type dialog as shown in Figure 3-15 allowing the users to convert the selected object from one type to another. This command is not accessible from the Execute and Chart view.

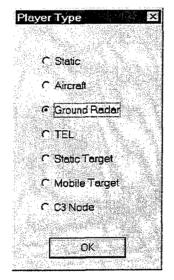


Figure 3-15. Player Type Selection Dialog Box

F. GRAPH MENU COMMANDS

The Graph menu, as shown in Figure 3-16, contains several commands necessary to format the appearance of **a** graph in *ARES* Chart view window (see Chapter XIV). The individual menu items are described below.

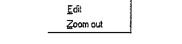


Figure 3-16. Graph Drop-Down Menu

Edit: Displays the Chart Explorer dialog, similar to Figure 3-17, with which the users can customize the appearance of the graph to produce a presentation quality product by changing the font, title, legend, chart type, and several other features.

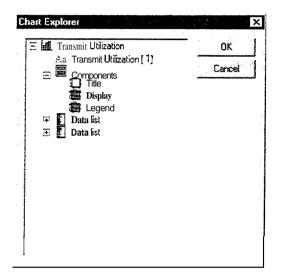


Figure 3-17. Chart Explorer Dialog Box

Zoom Out: Zooms out of a graph that has been zoomed in using the mouse. Selecting zoom out once will zoom out one level. Repeated zoom out's may be required to restore the full display.

G. WINDOW MENU COMMANDS

The Windows menu, as shown in Figure 3-18, contains several commands that help the users organize windows on the screen. The individual menu items are described below.



Figure 3-18. Window Drop-Down Menu

<u>New Window</u>: Creates a new window for the same document in **ARES**. This may be useful if the users wish to simultaneously open multiple views of the same document.

<u>Cascade</u>: Organizes several open documents in the form of a cascade.

Tile: Organizes several open windows as tiles.

Tabs: Organizes several open documents using tabs for quick easy way to switch among documents.

Arrange Icons: Arranges minimized window icons along the bottom of the view window frame. This is probably the least used and most unimportant command in all of **ARES.**

H. HELP MENU COMMANDS

The Help menu, **as** shown in Figure 3-19, allows the users to view the *ARES* copyright notices and online help. The individual menu items are describes below.

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Figure 3-19. Help Drop-Down Menu

Help Topics: Opens the *ARES* help file and offers the users an index to topics on which the users can get help.

<u>About ARES</u>: Opens the dialog, as shown in Figure **3-20**, which contains the current version number as well as contact information.

About Ares			X
à	A irborne Reactive Electronic warfare S imulation		4
U.	Version 1.12 S. Naval Research Laboratory,	1997-2000	
	Contact info: Jeffrey P Ridder Ph: (202)767-5981. E-mail: ridder@nrl.navy	/mil	
	OK		

Figure 3-20. About **ARES** Dialog **Box**

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IV. TOOL BAR MENU

ARES tool bar, as shown in Figure 4-1, consists of thirty-four icon buttons organizing into five build-in toolbars. Features of each toolbar are summarized in the following sections. Note that if a command is unavailable in the current view, its button appears greyed out.

A. FILE BAR COMMANDS

The File built-in toolbar, shown in Figure 4-2, contains eleven icon buttons which are shortcuts to commonly used menu commands for file handling, editing object, and activate help. Function associated with individual button is summarized in Table 4-1.

D626 % E 8 × 4 ? %

Figure 4-2. File Build-In Toolbar

B. DISPLAY BAR COMMANDS

The Display build-in toolbar, shown in Figure 4-3, is comprised of **six** icons buttons associated with display controls. The individual button commands are described in Table 4-2.



Figure 4-3. Display Build-In Toolbar

TOOL BAR	COMMAND
	New: Creates a new document.
2	Open: Opens an existing document.
	Save: Saves an opened document using the same file name.
8	Print: Prints a document.
X	<u>Cut</u> : Deletes the currently selected object in either the view window or in the Players tab from the document and moves it to the clipboard.
	<u>Copy</u> : Copies the selected object in either the view window or in the Players tab onto the clipboard.
	Paste: Pastes data from the clipboard contents at the insertion point on the Players tab tree structure.
	Delete: Permanently deletes the currently selected object in either the view window or in the Players tab from the document.
A	Find Player: Displays a dialog box as shown in Figure 3-4 allowing the users to locates an object on the tree structure displayed in Players tab that matches a defined search criteria
ୢୄୡୢ	About ARES: Displays information about this application.
f	Help Topics: Offers the users an index to topics on which the users can get help.

Table **4-**I. File Toolbar Button Summary

C. RUN CONTROL BAR COMMANDS

The Run Control built-in toolbar, shown in Figure 4-4, consist of four buttons

allowing the users to start or stop scenario execution. Individual button associated

function is detailed in Table 4-3.

■ 🖉 🛛 🕨

Figure 4-4. Run Control Build-In Toolbar

TOOL BAR	COMMAND
 *** **	Display Networks: Toggles On/Off the display of drawn lines representing networks connecting players on the map in Edit view window. The line color corresponds to the network as defined on the Templates Tab of the Scenario Workbook.
ĩ	<u>Display Waypoints</u> : Toggles On/Off the display of drawn lines connecting the waypoints of any mobile players in the scenario in Edit view window. The line color is assigned on the Waypoints Property page for the player.
्. ०	Display Radar Ranges: Toggles On/Off the display of circles representing reference detection range for each radar in Edit view window. The reference range is defined on the Radar Properties page available under the Systems Tab.
	Display Lethal Ranges: Toggles On/Off the display of crosshatched circles representing a reference lethal range for each weapon system in Edit view window. The reference range is defined on the Edit Weapon page available under the Templates Tab.
	<u>Power</u> Density Snapshot: Toggles On/Off the display of the computed jamming power density contours results on the Edit view windows.
18	Display Color Bar: This option is not currently implemented.
DP	Display Parameters: Allows the users to set the reference RCS and altitude that are used by ARES to scale the displayed threat and detection range rings.

. . . .

 Table 4-2. Display Toolbar Button Summary

TOOL BAR	COMMAND					
 <u>Stops Execution</u>: Terminates a run in progress. Once terminated, cannot be restarted. This shortcut command is not accessible from Edit and Chart view. 						
×	Stop After Iteration: Terminates a run in progress after the current iteration is complete. Once terminated, the run cannot be restarted. This shortcut command is not accessible from the Edit and Chart view.					
I	Pause: Pauses a run in progress. A paused run can be resumed by selecting the pause command a second time. This shortcut command is not accessible from the Edit and Chart view.					
a second a	Run: Executes a run This shortcut command is not accessible from the Edit and Chart view.					

Table **4-3.** Run Control Toolbar Button Summary

D. SCENARIO BAR COMMANDS

The Scenario built-in toolbar, shown in Figure 4-5, contains eight icon buttons, which are shortcuts to commonly used menu commands necessary for creating scenario. The individual button functions are explained in Table 4-4.

Figure 4-5. Scenario Build-In Toolbar

E. VIEW BAR COMMANDS

The View built-in toolbar, shown in Figure 4-6, consists of five buttons. These buttons are short cut to commonly used viewing control commands. Functions associated with the individual button are described in Table 4-5.

Q Q 1000 [[] []

Figure 4-5. View Build-In Toolbar

TOOL BAR	COMMAND
	Filter: Initiates the filter dialog box as shown in Figure 3-13 in which the users can selectively reduce the number of objects in a scenario. After selecting the properties of the objects the users wish to keep, pushing the "OK" button will result in the deletion of all objects that don't meet these criteria. Since the deleted objects can't be recovered, it is recommended that the scenario be saved prior to filtering.
Å	<u>Convert</u> : Displays the Player Type dialog box as shown in Figure 3-15 allowing the users to convert an object from one type to another.
	Add Player Airplane: Create a new, neutral object of type "airplane" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available airplane models. These models must have been previously created on the Templates tab of the Scenario Workbook.
	Add Player Radar: Create a new, neutral object of type "radar" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available radar models. These models must have been previously created on the Templates tab of the Scenario Workbook.
1	Add Player TEL: Create a new, neutral object of type "TEL" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available radar models. These models must have been previously created on the Templates tab of the Scenario Workbook.
7	Add Static Target: Create a new, neutral object of type "static" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available static target models. These models must have been previously created on the Templates tab of the Scenario Workbook.
े 	Add Mobile Target: Create a new, neutral object of type "mobile" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available mobile target models. These models must have been previously created on the Templates tab of the Scenario Workbook.
	Add Player C3 Node: Create a new, neutral object of type "C3 Node" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available C3 node models. These models must have been previously created on the Templates tab of the Scenario Workbook.

Table 4-4. Scenario Toolbar Button Summary

TOOL BAR	COMMAND
	Zoom In: Zooms into a point on a map view. Once Zoom In is selected, successive clicks of the mouse will magnify by a factor of 2.
anna -	Zoom Out: Zooms out of a point on a map view. Once Zoom Out is selected, successive clicks of the mouse will de-magnify by a factor of 2 until normal magnification is restored.
1002	Zoom 100%: Resets magnification to normal.
	<u>Control Bar</u> : Shows/hides the control bar relevant to the current view. In the Edit view, this will display the Scenario Workbook. In the Execute view, this will display the Runtime Control bar. In the Playback view, this will display the Playback Control bar.
	<u>Overview Window</u> : Shows/hides the overview window which provides a view of the entire scenario. The overview window also allows panning.

Table 4-4. View Toolbar Button Summary

V. EDIT VIEW WINDOW

The Edit view window is the first of the three views available for an *ARES* document, and is probably the view the users spend most of the time in. It is activated by selecting the "Edit" tab along the bottom of the current document's view window frame. By default, it is automatically started when a new or existing file is opened in **ARES**. In this view, a map view is displayed with the geographical location of all of the objects in the scenario. Whenever the Edit view is active, the Scenario Workbook, which consists of four tabs, is displayed in the Control Bar window, along with the status bar extending across the bottom of the *ARES* window.

There are many features to be aware of in the Edit view. The first of these are the display functions available to the users via the Display Toolbar. The buttons on this toolbar may be used to display networks, waypoints, radar range rings, and lethal ranges.

Another feature available from the Edit view is the Overview window. The overview presents a miniature window with a view of the entire scenario, and can be used to pan the larger edit view. The Edit view also supports a zoom capability via the View bar. The current zoom level is displayed on the status bar.

The objects displayed in the Edit view window is selected by clicking on them once with the left mouse button. When selected, the object and all of its subordinates are highlighted in yellow. Since the Edit view and the Scenario Workbook are synchronized, the selected object is also highlighted and displayed on the Players tab of the Scenario Workbook. Double-clicking an object from the Edit view opens it for editing. The result of this action is the same as double-clicking the object from the Players tab of the Scenario Workbook. The Edit view also supports standard cut, copy, paste, and delete functions. These commands may be accessed by right-clicking on an object in the view window in addition to the Edit drop-down menu and File toolbar menu. Note that cut, copy and delete operate on all selected (highlighted in yellow) objects.

A. STATUS BAR DISPLAY

As mentioned in Chapter II, the status bar displayed from the Edit view presents five panes of information, which differs depending on whether an object is currently selected or not in either the view window or in the Players tab of the Scenario Workbook.

1. No Object Selected

If there is no object selected, then the status bar appears as in Figure 5-1. The first three panes display the latitude, longitude, and height above the ground in feet of the mouse cursor and update continuously as the mouse is moved over the map view. When there is no terrain displayed, the third pane shows 'O ft' for height level. The fourth pane displays the current zoom level. The fifth pane displays the number of objects currently selected. Obviously, when no objects are selected this pane shows "O".

```
25103'17" S 100'55'26" W 0 t 100% 0000000 ,
```

Figure 5-1. Status Bar Display With No Object Selected

2. Object Selected

When an object is selected the status bar appears as in Figure 5-2. The first two panes display the distance and bearing of the mouse cursor from the selected object. The

fourth pane displays the current zoom level. The fifth pane displays the number of objects currently selected.

79.2 nmi-137 4'100%1Figure 5-2. Status Bar Display With A Selected Object

B. SCENARIO WORKBQOK CONTROL BAR WINDOW

The Scenario Workbook, as shown in Figure 5-3, is where most scenario creation and editing activities takes place. It is displayed when the "Edit" view is active. It contains four tabs and in general, scenarios are created by working from right to left. That is, radar cross-sections (RCS's) and antenna patterns are created first in the Signatures tab. Second, systems are created in the Systems tab. These systems can use an antenna pattern that was created in the Signatures tab. Third, templates are created in the Templates tab. The Templates tab includes the models and the networks. For example, a model might represent an F/A-18. The F/A-18 model may use the F/A-18 signature created on the Signatures tab, and the APG-65, ALR-67(v)2, and ALQ-126B created on the Systems tab. Finally, the active players are created in the Players tab based on the models and networks created on the Templates tab. If an MSFD file was imported, then the static players may be converted to active players as the appropriate templates are created. Descriptions of the Signatures, Systems, Templates, and Players tabs are detailed in Chapter VI through XII respectively.

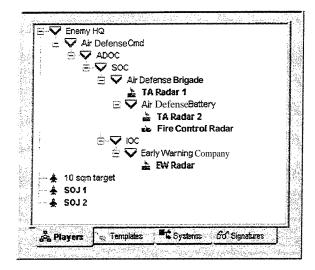


Figure 5-3. Scenario Workbook Control Bar Window

VI. SIGNATURES TAB COMMANDS

The "Signatures" tab of the Scenario Workbook displays all radar-cross-sections (RCS's) and antenna patterns available to objects in the scenario. The signatures are listed in alphabetical order, as similarly shown in Figure 6-1.

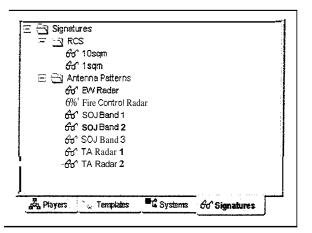


Figure 6-1. Sample of Signatures Tab Hierarchy

A. TREE OPERATIONS

The tree presented in the Signatures tab supports two basic operations. These are described as follows:

1. Right-Clicking a Folder

Right-clicking either the "RCS" or "Antenna Patterns" folder presents the users with a context-sensitive menu **as** shown in Figure 6-2. The two operations of interest are

Add and Import.

Add: Creates of a new signature object. The new object is initially blank and must be edited prior to use.

Import: Prompts the users to select a text file to open. The data in the text file will then be imported into a newly created signature. The signature text files may be

created by **Export** from another scenario. Or, if the users understand the format of the text file, the users can create signature files in other programs that can be imported into ARES.

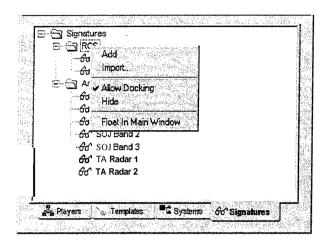


Figure 6-2. Folder Pop-Up Menu in Signatures Tab

2. Right-Clickinga Signature

Right-clicking on an object in either folder presents the users with a context-sensitive menu as shown in Figure 6-3. There are three operations of interest. These are **Open, Export**, and **Delete.**

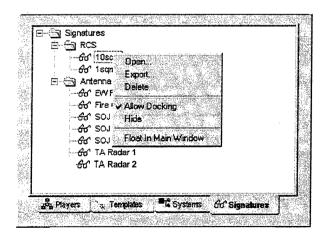


Figure 6-3. Signature Pop-up Menu

Open: Opens the signature for editing. See Section B for further details in editing a signature.

Export: Prompts the users for the name of a text file to write the signature data into. This file may later be imported into another scenario, or it may be read into other programs for editing (e.g., Microsoft Excel).

Delete: Permanently removes the selected signature being from the scenario.

B. EDITING A SIGNATURE

Either double-clicking the object in the Signatures tab or by right-clicking and selecting **Open** from the pop-up menu opens a dialog page for editing. The dialog page for both the **RCS's** and the antenna patterns is identical with the exception of the dialog heading. A sample **RCS** dialog page is provided in Figure 6-4. As shown, the dialog page contains six fundamental blocks of information. These are described in detail below.

Linits: As described below, a unit of the values entered into the grid is different for the **RCS's** and the antenna patterns.

- <u>RCS</u>: The units of the values in the **RCS** table are square meters.
- <u>Antenna Pattern</u>: The units of the values in the Antenna Pattern table are decibels relative to the mainbeam gain. For antenna patterns, azimuth and elevation angles of (0, 0) correspond to the mainbeam. In many cases, this will be 0, although it may deviate from this if the users have multiple frequency tables and the mainbeam gain varies with frequency. Typically, the sidelobe values will be negative.

Name: A text string that is used to identify this signature table throughout ARES. It will be displayed on the Signatures tab, and is used in other lists **as** well. The users will want to use a concise, but descriptive name for the signatures. <u>Classification</u>: The users can select the classification level of the signature from the drop-down list. The classification is used only for reference in the dialog.

Standard Deviation: A non-zero Sigma field will apply Gaussian noise to the sidelobe level with a standard deviation equal to the defined value. This will be applied only to azimuth and elevation angles as specified in the Applies to Az Greater Than and Applies to El Greater Than fields.

<u>Andes</u>: The elevation angles are entered in degrees **and** cover the range from -90 to +90. The azimuth angles are also entered in degrees and cover the range from 0 to 360. The users can define the elevation and azimuth angles to be whatever the users want. ARES will linearly interpolate between the values entered regardless of angular resolution.

If an azimuth or elevation angle falls outside the range of the table, **ARES** will not linearly extrapolate outside the range. Rather, it simply uses the last value entered on the table to represent all values outside the range. For example, if the users enter data for azimuth angles from 30 to 330 degrees and an **ARES** calculation requires data from an angle of 350 degrees (at a given elevation), ARES will use the value at 330 degrees.

Add Frequency: This button adds a new table to the signature. The value of the frequency that this table represents can be edited by double-clicking on the tab for the new table. The frequency values are represented in MHz. Similar to the Angles above, ARES will interpolate between the tables based on the frequency, but will not extrapolate. It will use the values from the table closest in frequency to represent values outside the frequency range. For example, in the figure above, the table for 10,000MHz

is used to represent all values above 10,000 MHz. Also, if only one table is available, then **ARES** uses that table to represent all values regardless of frequency. In this case, it is not necessary to edit the frequency value on tab.

<u>Remove Current</u>: This button permanently deletes the currently active table from the signature.

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				· .				Appli	as to E	l greater l	th an (dec):	· .	•••	0
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Add Freq	uency	Remove Currer	1			OK									

Figure 6-4. **RCS** Dialog Page

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VII. SYSTEMS TAB COMMANDS

The "Systems" tab of the Scenario Workbook displays radar, electronic support measure (ESM), and electronic countermeasure (ECM) systems available to radar and airplane models in the scenario. The systems are listed in alphabetical order by type. **A** sample of Systems Tab hierarchy is shown in Figure 7-1.

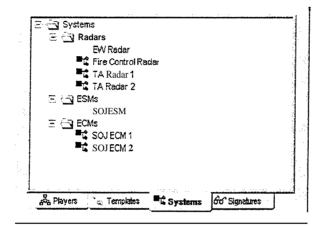


Figure 7-1. Sample of Systems Tab Hierarchy

A. TREE OPERATIONS

The tree presented in the Systems tab supports two basic operations. These are described as follows:

1. Right-Clicking a Folder

Right-clicking the **Radars, ESMs,** or **ECMs** folder presents the users with a context-sensitive menu as shown in Figure 7-2. The two operations of interest are **Add** and **Import.**

Add: Creates **a** new system object. The new object initially has no components (e.g., antennas, transmitters, etc.) and must be edited prior to use.

Import: Prompts the users to select a system file (*.rdr, *.esm, or *.ecm) to open. The data in the system file will then be imported and result in the creation of a new system object. The system files may be created by **Export** (see below) from this or another scenario. System files cannot be created outside of **ARES**.

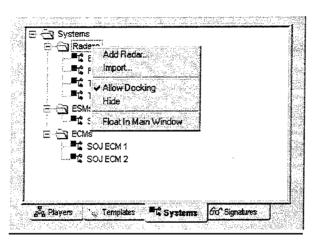


Figure 7-2. Folder Pop-Up Menu in Systems Tab

2. Right-Clicking a System

Right-clicking on an object in any folder presents the users with a context-sensitive menu as shown in Figure 7-3. There are four operations of interest. These are **Open, Export, Delete,** and **Duplicate.**

Open: Opens the system for editing. Detailed descriptions on editing a radar, an ESM, and an ECM are provided in Chapter VIII, IX, and X respectively.

Export: Prompts the users for the name of **a** system file to write the system object into. This file may later be imported into another scenario. These files are compatible only with **ARES**.

Delete: Permanently removes the selected system from the scenario.

Duplicate: Replicates the selected system onto the tree structure. The new system appears in the tree with the old name plus " {copy)".

E Radars		
Fire TAF	Open Export	
E-MS E-MS E-MS E-MS E-MS E-MS	Duplicate Allow Docking	
SOJ	NUMBER OF THE OWNER OWNE	

Figure 7-3. System Pop-Up Menu

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VIII. EDITING A RADAR

A radar system in the Systems tab is opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 8-1 which features seven pages: **Properties**, **Resources**, **Antennas**, **Transmitters**, **Receivers**, **Modes**, and **Report**. To build a radar system, the users have to create all of its components and then describe their operation using the **Modes** page. If this system is to participate on a network, the users can identify the information it can provide to a network on the **Report** page.

A. PROPERTIES

The Radar Properties page, as shown in Figure 8-1, contains six fundamental blocks of information. These are described in detail below.

Name: A text string that is used to identify the radar throughout **ARES**. It is displayed under the Radar folder on the Systems tab, and is used in other lists as well. It is imperative that the users define a concise, but descriptive name for the radar.

<u>Classification</u>: Is used only for reference in the dialog and is selected from the drop-down list.

<u>Reference</u>

- <u>ELNOT</u>. This is the Electronic Intelligence (ELINT) Notation identifier for this radar. This field is not used for anything in **ARES**. It is provided only for reference.
- <u>Detection Range</u>: This field is used for displaying a reference radar range on the Edit view window. This information can be found in the "System Information" section of the EWIRDB (Tree Number 00000000153).

Receivers Properties) Resources	Modes Antennas	Report Transmitters
Name: <mark>EW Rad</mark>		Classification:	
-Reference		Detection Range (n.	mi): 141
-Tracking •	Blip-Scan 🤇 🤇	Probability of Dete	ection
-Establish		Maintain	
Blips:	3	Blips:	
Scans:	4	Scans:	43
Pd:	US	Pd	05
	사람이 안 하는 것 같은 것 같은 것이 가지 않는 것 같이 가 있다.	28. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	a birth right which the birth reaction of the

Figure 8-1. Sample of Radar Properties Dialog Page

Tracking: This block is where the users define whether radar tracking is based on Probability of Detection (Pd) or the Blip-Scan ratio. It is up to the users to determine which criteria is more appropriate. However, Blip-Scan ratio is generally more appropriate for reflecting "real-world", while Pd is more appropriate for calibrating the radars. The range at which detection occurs is much more uncertain for the blip-scan model than for the Pd model.

<u>Track Establishment</u>: This block is where the users indicate the criteria that **ARES** uses for the radar to establish an active track of a target. Based on the selection in the Tracking block, this is expressed in terms of the blip-scan ratio, the number of blips out of a requisite number of scans, or the probability at which detection occurs.

Typically, a value of 3 out 4 is used for blip-scan ratio and 0.5 in case of probability of detection.

<u>Track Maintenance</u>: This block is where the users specify the blip-scan ratio or the probability of detection required to maintain the active status of an already established track, based on the selection in the Tracking block. If the defined threshold is not achieved, then the track is dropped. Typically, a value of 1 out **4** is used for blip-scan ratio. In case of probability of detection, a value of 0.5 is used.

B. RESOURCES

This page, shown in Figure 8-2, is an optional advanced feature in *ARES* and is designed for special application in GA. Unless the users are knowledgeable about the defined system, this page can be ignored. In general, this page allows the users to specify the size, weight, and support requirements for the radar, which in turn is used for consideration in GA system selection process. If the GA develops a solution where the systems require more resources (the sum of their required resources) than the allowed maximum values for the platform **as** defined in the GA constraints page from the Templates page, then the GA will simply "turn off" that platform (i.e., not use it).

C. ANTENNAS

The Radar Antennas page contains a list of all antennas associated with this radar. A sample of the Radar Antennas page is shown in Figure 8-3. Below this list are four buttons described **as** follows:

Receivers	1	Modes	Report	
Properties	Resources	Antennas	Trensmi	tter
- Platform P	lesources Required]		
We	eight (lbs):		٥	
Va	lume (cu-inch):		0	
- Lo Po	wer (kW):		ō	
		· · · · · · · · · · · · · · · · · · ·	-	
그는 그가 안에서 우리하는	oling (KW):		1	
				/ 88

Figure 8-2. Sample of Radar Resources Dialog Page

Add: Adds new, but blank antennas object to the radar. It will be shown in the list as "New Antenna" and will immediately be opened for editing.

Edit: Opens the currently selected antenna for editing. Alternatively, double-clicking the antenna in the list will also open the antenna.

Delete: Permanently deletes the currently selected antenna from the radar object.

Duplicate: Creates a copy of the currently selected antenna. It will be listed with the same name as the copied antenna plus " (copy)".

Re	adar						(a) a substantia (x)
	Receiv Properties) Resources	Modes	Antennas		Report Transmitters
	Ĩ	Aain					
					e ont and story d		
	Add		Edit		Delete		Duplicate
		ОК	Canc	el	≜pp;	× 1	Help

Figure 8-3. Sample of Radar Antenna Dialog Page

1. Editing an Antenna

With **an** antenna selected on the Radar Antennas page, double-clicking or selecting **Edit** presents the users with a radar antenna dialog containing two tabs as depicted in Figure 8-4. Description of each tab is as follows.

a. Properties

This page, as shown in Figure 8-4, contains several antenna properties to be edited as described below. Note that operating modes are edited in another dialog.

Name: A text string identifying this antenna in lists.

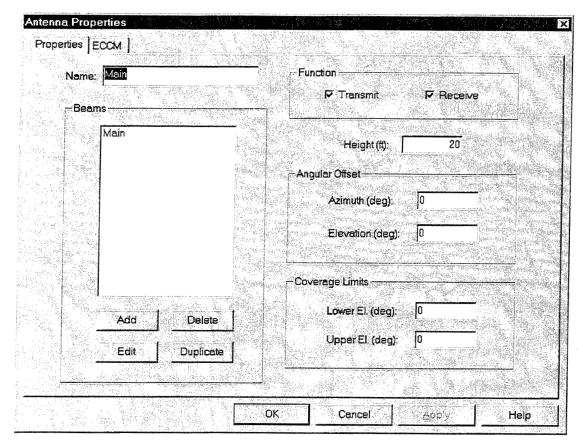


Figure 8-4. Sample of Antenna Properties Dialog Page

Function: Check the transmit and/or receive boxes as appropriate. To reduce execution time, for example, the users may wish to represent some radars as being transmitters only (i.e., they transmit signals to the environment, but the users may not care whether they make detections). In this case, the users would select the transmit box, but not the receive **box**.

Height: This is the height of the antenna above ground level (AGL) and is used in calculations to determine line-of-sight(LOS). This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 00000001223).

Angular Offset: The angular offset is used for describing the mounting of this antenna relative to the local "front". For example, a side-looking radar mounted on the right side of an aircraft would have an azimuth offset of **90** degrees. A rear facing radar would have an azimuth offset of **180** degrees. The angular offset does not describe scan or aiming sector. It is simply an offset relative to the platform on which the antenna is mounted.

Coverage Limits: Defines the antenna elevation scan coverage angle in degrees. The specified values are used in determine just how far the antenna can be steered in order to keep track of its targets when dynamic steering of the antenna is selected on the Antenna Modes page. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 00000001223).

Beams: This block lists the beams associated with this antenna and provides four "action" buttons.

- <u>Add</u>: This button adds a "New Beam" to the list and opens it for editing.
- <u>Edit</u>: This button opens a beam for editing. Double-clicking the beam in the list has the same effect.
- <u>Delete</u>: This button permanently removes the currently selected beam from the antenna.
- <u>Duplicate</u>: This button creates a copy of the currently selected beam. It will appear in the list with the name of the copied beam plus " (copy)".

With a beam selected on the Beams list, double-clicking or selecting **Edit** presents the users with the Beam Properties dialog containing several properties to be edited as defined below. Note that operating modes are edited in another dialog. A sample of Beam Properties dialog is provided in Figure 8-5.

-Gain and Beamwidth		- Gain and Beamwidth	
Mainbeam Gain (dB):	30	Mainbeam Gain (dB):	30
Azimuth Beamwidth (deg):	4	Azimuth Beamwidth (deg);	4
, Elevation Beamwidth (deg):	50	Elevation Beamwidth (deg),	50
Sidelobes		-Sidelobes	alaan da taabaa alaan da taabaa ah
○ No Sidelobes		C No Sidelobes	Karena
Attach Pattern:		 Attach Pattern: Monoral 	
EW Radar State State State		EWRadarik, Mr. 2000, Status	

Figure 8-5. Sample of Antennas Beam Properties Dialog Page

Name: This is a text string identifying this beam in lists.

Transmit / Receive: ARES allows the users to specify beam properties for both transmit and receive. It selects the appropriate properties based on context. For example, an ESM **looking** at a radar uses the transmit properties **of** the beam, while **a** radar receiver uses the receive properties. This information can be found in the "Transmit and Receive Ant" section of the **EWIRDB** (Tree Number 00000001223).

• <u>Mainbeam Gain</u>: This is the gain (in dB) associated with this beam. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 00000001223). If it is not given, this value can be

calculated using equation below where 8, and θ_e are the 3-dB azimuth and elevation beamwidths in radians.

$$G \cong \frac{4\pi}{\theta_a \theta_e} \tag{8.1}$$

• <u>Azimuth / Elevation Beamwidth</u>: This is the 3-dB azimuth and elevation beamwidths in degrees of this **beam**. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223).

Sidelobes: For both transmit and receive, the users have the option of identifying a particular antenna pattern to associate with this beam, or the users can choose to have no pattern. The patterns available to the users are those that were created under the Signatures tab. For this reason, the users should create the signatures before create the systems. If the users choose no sidelobes, ARES uses 0 dBi (isotropic) to represent all values outside of the mainbeam.

b. ECCM

This page, shown in Figure 8-6, is an optional advanced feature in ARES and is designed for special application in coherent sidelobe cancellers. Unless the users are knowledgeable about the subject, this page can be ignored. In general, this page allows the users to define each row to represent one auxiliary antenna (one cancellation loop) with the following parameters:

<u>Aux Az / El FOV</u>: This field specifies the azimuth and elevation field of view (FOV) for each auxiliary antenna.

Az / El Offset: This field specifies the azimuth and elevation boresight angles of the auxiliary antenna relative to the antenna boresight.

<u>Cancellation</u>: This field specifies the amount of the cancellation ratio by which the jamming noise of any high duty cycle jammer that is within FOV of the auxiliary antenna is reduced. The cancellation algorithm takes into account the number of jammers and the number of auxiliary antennas that have the jammers within their field of view to compute the amount of cancellation applied against each jammer.

Coherent Sidelobe Cancellers;					in contra da An contra da	
	Aux Az FOV (deg)	Aux El FOV (deg)	Az Offset (deg)	El Offset (deg)	Cancellation (dB)	
1					D	
2 3						
3 4		1				
5					1449 - 223 - 241 - 2429 - 2489 - 2487 - 2497 - 2497 - 2497 - 2497 - 2497 - 2497 - 2497 - 2497 - 2497 - 2497 - 2 -	
6						
7						
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14						Militari

Figure 8-6. Sample of Antennas ECCM Dialog Page

D. TRANSMITTERS

The Radar Transmitters page contains a list of all transmitters associated with this radar, as similarly shown in Figure 8-7. Below this list are four buttons described below.

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	Main			
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Add	1	Edit	Delete	Duplicate
	1]
	OK .	Cancel	Apply -	Help

Figure 8-7. Sample of Radar Transmitters Dialog Page

Add: Adds a new, but blank transmitter object to the radar. It will be shown in the list as "New Transmitter" and will immediately be opened for editing.

Edit: Opens the currently selected transmitter for editing. Alternatively, double-clicking the transmitter in the list will also open the transmitter.

Delete: Permanently deletes the currently selected transmitter from the radar object.

Duplicate: Creates **a** copy of the currently selected transmitter. It will be listed with the same name as the copied transmitterplus " (copy)".

1. Editing a Transmitter

With a transmitter selected on the list, double-clicking or selecting **Edit** presents the users with the Transmitter Properties dialog contains several properties to be edited. Note that operating modes are edited in another dialog. A sample of the Transmitter Properties dialog is provided in Figure 8-8.

Name: Main				
Peak Power (kW);	800	Transmission Line L	oss (dB):	1
	- Frequency Co	verage		
	From:	150 MHz		
	To:	200 MHz		
	éci anterna usec in	by this transmitter.		

Figure 8-8. Sample of Radar Transmitter Properties Dialog Page

Name: A text string identifying the transmitter in lists.

<u>**Peak Power:**</u> Defines the peak pulse power in kilowatt to be used for this transmitter. A single-pulse signal-to-noise (S/N) is computed using this value. Combined with number of integrated pulses (pre- or post-detection) as determined by the illumination time based on the scan, the resulted calculation is used to determine the

probability-of-detection. ARES uses a Marcum-Swerling model to determine probability-of-detection. This information can be found in the "Signal Power" section of the EWIRDB (Tree Number 00000000011).

Transmission Line Loss: The effective radiated power (ERP) of the radar is determined using the peak power, antenna gain, and this value of transmission line loss (in **dB**). This information can be found in the "Signal Power" section of the EWIRDB (Tree Number 00000000011).

Freauency Coverage: Defines the operating frequency range of this transmitter (in MHz). A radar could have several transmitters, each covering a different frequency range. This information can be found in the "Pulsed RF" section of the EWIRDB (Tree Number 000000013132).

Antenna: Single-click to select an antenna to be used by this transmitter. The antennas listed are those that were created on the Antennas page and that have the Transmit property selected. Double-clicking has no effect in this list.

E. RECEIVERS

The Radar Receivers page, **as** shown in Figure 8-9, contains a list of all receivers associated with this radar. Below this list are four buttons described below.

Add: Adds a new, but blank receiver object to the radar. It will be shown in the list **as** "New Receiver" and will immediately be opened for editing.

Edit: Opens the currently selected receiver for editing. Alternatively, double-clicking the receiver in the list will also open the receiver.

Delete: Permanently deletes the currently selected receiver from the radar object.

Duplicate: Creates a copy of the currently selected receiver. It will be fisted with the same name as the copied receiver plus " (copy)".

Radar Properties	Resources	Antennas	Transmitters
Receivers		odes	Report
Main			
Add	Edit	Delete	Duplicete
OK	Cancel		Help

Figure 8-9. Sample of Radar Receivers Dialog Page

1. Editing a Receiver

With a transmitter selected on the list, double-clicking or selecting **Edit** presents the users **with** the Receiver Properties dialog contains several properties to be edited. Note that operating modes are edited in another dialog. A sample of the Receiver Properties dialog is provided in Figure 8-10.

Name: A text string identifying the transmitter in lists.

Frequency Coverage: Defines the operating frequency range of this receiver (in MHz). A radar could have several receivers, each covering a different frequency range.

This information can be found in the "Pulsed RF" section of the EWIRDB (Tree Number 000000013132).

System Parameters:

- <u>Noise Figure</u>: Enter the noise figure of the receiver (in **dB**). This information can be found in the "IF' section of the EWIRDB (Tree Number 00000000 1513).
- <u>System Losses</u>: This is quite often used **as** a "fudge factor". The users should probably start by entering the receive line loss (if known) and work from there. This is a good parameter to tweak for matching the reported radar detection range.
- <u>False Alarm Rate</u>: The false alarm rate determines the signal-to-noise threshold for this radar. If unknown, a good rule of thumb is to use 1 pulse per microsecond (10[°]).

Antenna: Single-click to select an antenna to be used by this receiver. The antennas listed are those that were created on the Radar Antennas page and that have the Receiver property selected. Double-clickinghas no effect in this list.

Transmitter: Single-click to select the transmitter paired to this receiver. This tells the receiver model which signal to process. If there are many possible receivers for a single transmitter, simply create several receivers and have each select the same transmitter. The transmitters listed are those that were created on the Transmitters page. Double-clicking has no effect in this list.

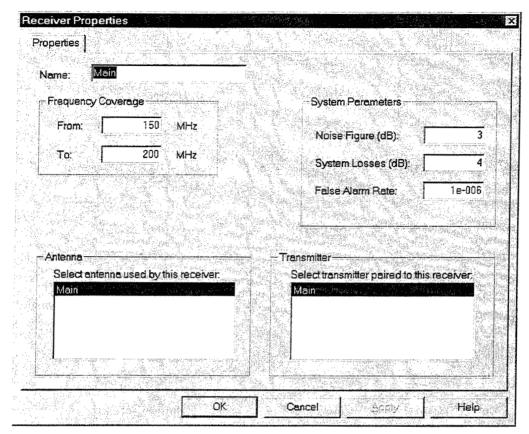


Figure 8-10. Sample of Radar Receiver Properties Dialog Page

F. MODES

The Radar Modes page, **as** similarly shown in Figure 8-11, contains **a** list of all modes associated with this radar. Below this list are four buttons described below.

Add: Adds a new, but blank mode object to the radar. It will be shown in the fist **as** "New Mode" and will immediately be opened for editing.

Edit: Opens the currently selected mode for editing. Alternatively, double-clicking the mode **in** the list will also open the mode.

Delete: Permanently deletes the currently selected mode from the radar object.

Duplicate: Creates a copy of the currently selected mode. It will be listed with the same name as the copied mode plus " (copy)".

Radar Proper Re	ties cceivers	Resources] Modes	Antennas	1	Transmitter Report	s
	Search						
Adi		Edrt		Delete	·	Duplicate	
	OK	can	cel	_ ≜ ≈piy		Help	

Figure 8-11. Sample of Radar Modes Page

1. Editing a Mode

With a mode selected on the list, double-clicking or selecting **Edit** presents the users with the Radar Mode Properties dialog appears as in Figure **8-12**, There are four pages, one for each component type (antenna, transmitter, and receiver) and a Properties page.

a Mode Properties

The Radar Mode Properties page, shown in Figure **8-12**, contains several properties for the users to specify.

adar Mode Properties Properties Antennas Transmitte	rs Receivers	
Name: St	sarch	Dires and a specific of a
Targets Tracked:	1000 🚔	
- Mode Type	Illumination Time-	
C Search	-	3600
C Height Find	On (sec):	5000
C Acquisition	Out of (sec):	3600
CITrack	Carditaec)	
OK Can	el <u>Appi</u> y	Help

Figure 8-12. Sample of Radar Mode Properties Dialog Page

Name: A text string identifying the mode.

Targets Tracked: This is an arbitrary number defined by the users to represent the maximum number of target this mode can track. The only time this number will matter is if the radar has a tracking mode where multiple targets could be tracked simultaneously (Track While Scan).

Mode Type: Select the radio button indicating the function of this mode. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 00000001223).

<u>Illumination Time</u>: This feature is reserved for future use and currently not implemented.

b. Antenna Modes

The Radar Mode Antenna page presents a list of all antennas created on the Radar Antennas page, as similarly shown in Figure 8-13.

Radar Mod	Properties			×
Properties	Antennas T	ransmitters] Re	ceivers	I
	Main			-
	an fill in () within 10 and an interaction	diddiadag yn yw yn ar yn a	11 A - 1/42	
				a shekarar Markarar
	I .			
	ОК	Cancel	écopiy .	Help

Figure 8-13. Sample of Antenna Mode List Page

Double-clicking a mode name on the list opens the Antenna Mode Properties dialog, as shown in Figure 8-14, for editing the antenna's behavior of the selected mode.

State: Select the radio button indicating whether the users want this antenna to be active or inactive for this mode.

Aimpoint:

• <u>Azimuth</u>: The azimuth aimpoint is significant only for sector scanning radars. It is no impact on circular scans. If this radar is to be attached to an aircraft, then the azimuth aimpoint is ignored since the aircraft will take the aimpoint to be the direction the aircraft is heading (plus azimuth offset).

- <u>Elevation</u>: The elevation aimpoint is significant for all radars. The current position of the beam in elevation is taken to be the elevation aimpoint plus the position of the beam relative to boresight. For example, for a radar with an elevation sector scan of 9 degrees and an elevation beamwidth of 1 degree, setting the elevation aimpoint to 5 degrees will ensure coverage from the horizon (elevation angle of 0) to 10 degrees. For another example, a circular scanning radar with a 20 degree elevation beamwidth aimed -10 degrees from antenna boresight requires an elevation angle of 0 degrees to cover from the horizon to 20 degrees.
- Dynamic Az / El Aimpoint Steering: If these are selected, ARES will dynamically point the sector scanning radars toward a target assigned by a superior communication, command, and control (C3) node.

tenna Mode Properties		e gang kanalan dan bi
State	- Scan C Fixed	
Aimpoint		
Azimuth (deg).	Circular	
Elevation (deg). 5	Clockwise	
	Counter-Clockwise	
Dynamic Az-Aimpoint Steering		
C Dynemic El. Aimpoint Steering	C Raster	
Beams	C Horizontel bars	
Mein	C vertical bars	
	Number of Bars:	
	Azimuth Sector (deg).	<u></u>
	Elevation Sector (deg):	
	Sweep Rate (deg/sec):	18
OK		

Figure 8-14. Sample of Antenna Mode Properties Dialog Page

Scan:

• **<u>Fixed</u>**: The antenna does not move.

- <u>Circular</u>: The antenna moves in the direction selected at the Sweep Rate specified. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 00000001223).
- <u>Raster</u>: The antenna will raster scan a specified volume of space. The users specify the number of horizontal or vertical bars and the size of the sector to be swept. The actual volume covered by the scan is equal **to** the sector plus the beamwidth. If only one bar is specified, then the scan will be bi-directional on that bar. The antenna moves at the sweep rate specified. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223).
- <u>Sweep Rate</u>: This is the ratio of scan sector in degree divided by scan period in seconds. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 00000001223).

Beams: The beams belonging to this antenna are listed. They can be edited by double-clicking their entry in the list. Upon doing this, the users are presented with the Beam Modes dialog as shown in Figure 8-15.

State: Select the radio button indicating whether the users want

this beam to be active or inactive for this mode.

Polarization: Select the radio button indicating all the polarization applicable to this mode from the list. If more than one is selected, ARES will randomly choose a polarization for each iteration. This information can be found in

the "Tx / Rx Ant Polarization" section of the EWIRDB (Tree Number 00000001213).

Scan Relative to Antenna:

- <u>Fixed</u>: The beam exhibits no scanning relative to the antenna. The users can specify an azimuth and elevation angle of this beam relative to the antenna boresight.
- <u>Random</u>: If random scanning is selected, ARES will randomly scan the beam throughout the specified azimuth and elevation sector, pausing at each step for the specified beam dwell.

Vertical: If vertical scanning is selected, ARES will scan the beam unidirectionally from the bottom of the elevation sector. The beam covers the elevation sector using the specified number of beam positions, dwelling at each for the specified time. For example, if a radar has a 3.6 degree azimuth beamwidth and the antenna has a circular scan with a 10 second scan period, then the azimuth beam dwell = 3.6/360*10 = 100 ms. Superimposed on that is an elevation scan to cover a 30 degree sector with a 2 degree elevation beamwidth. To cover the entire elevation sector, the elevation scan over 28 degrees must be completed in 100 ms, meaning that the elevation scan rate will be 280 degrees/sec. To enter this in **ARES**, the vertical scan on the beam would be used. The elevation sector is 28 degrees. The number of beam positions = sector / elevation beamwidth = 30/2 = 15. The beam dwell is then 100 ms/15 = 6.667 ms. By superimposing a vertical beam scan with a circular antenna scan, the users can create "sawtooth" scan patterns which are used by many radars. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 00000001223).

State © On © Off			
-Polarization			
☐ Vertical	🖉 Rolariza	ion (e fixed, chacse one of rand	
✓ Horizontal	C Folerizel	ion changes to reduce interere	76 6
☐ Slant Right	1 AN AGUNA SER LUNDON	ion changes pulse to suise	
☐ Slant Left	C Holenzet	ion changes every	seconds
	c Receiva	seme sense as vensmit	
T RHC	् ೧ Receive	coocsté sense ofransmit	
⊑⊔нс	C Receive	cense umelateo to transmit	
Azimuth Angle	e from Antenne	Boresight (deg):	0
	de from Antenr	na Boresight (deg):	0
Elevation Ang			
Elevation Ang	, 		Section and
		El Sector (deg):	
C Rendom		El Sector (deg):	
C Rendom Az Sector (de			

Figure 8-15. Sample of Beam Mode Dialog Page

c. Transmitter Modes

The Radar Mode Transmitter dialog presents a list of all transmitters created on the Radar Transmitters page, as depicted in Figure 8-16. To edit a transmitter's behavior for this mode, double-click its name on the list, whereupon the users are presented with the Modulation dialog **as** shown in Figure 8-17.

ladar Mode Properties		Transmitters	Receivers]			N.
	Main					
						: -
		·····				
	ОК	Cancel		iply .	Help	

Figure 8-16. Sample of Transmitter Mode List Page

State: Select the radio button indicating whether the users want this transmitter to be active or inactive for this mode.

Freauencies: This information can be found in the "Pulsed RF" section

of the EWIRDB (Tree Number 00000013132).

• <u>Continuous</u>: Selecting this button informs **ARES** that the transmitter can choose any frequency across its entire frequency range for this mode.

• <u>Channelized</u>: Selecting this radio button informs ARES that the transmitter will only use frequencies from the list below. The users add the frequencies to the list (at least one frequency must be in the list).

<u>RF Agility</u>: This information can be found in the "Pulsed RF" section of

the EWIRDB (Tree Number 00000013132).

- <u>Fixed</u>: If this button is selected, this transmitter will not change frequency during this mode.
- <u>Pulse-Group to Pulse-Group</u>: If this button is selected, then the transmitter will change frequencies after every pulse-group. The number of pulses in the pulse-group is defined by the inline edit/spin-control.
- <u>Periodic</u>: Periodic agility will result in the transmitter changing frequency at fixed intervals. The change period (in seconds) is defined by the inline edit control. The Equipment Switch Time must also be entered. This is the amount of time (in seconds) that the transmitter will be off-line while the frequency is being switched. For example, if the change period is 60 seconds and the switch time is 10 seconds, then the radar will transmit on a frequency for 50 seconds followed by 10 seconds of dead time, then transmit again on a new frequency. The next frequency selected depends on whether **Continuous** or **Channelized** frequencies were selected. If continuous, then the next frequency will be chosen at random from anywhere in the band. If channelized, then the next frequency will be the next one in the list.
- <u>Manual</u>: If this button is selected, then the radar will change frequency in response to jamming. The Decision Time is the amount of time the operator takes to decide whether to change frequency once jamming is perceived. This time will vary by +/ 50%. The J/N Threshold is the amount by which the jamming noise (J) must exceed the background noise (N) before it will be recognized by the operator **as** jamming. The Equipment Switch Time is the amount of time (in seconds) that the transmitter will be off-line while the frequency is being switched. The next frequency selected depends on whether **Continuous** or **Channelized** frequencies were selected. If continuous, then the next frequency will be chosen at random **frcm** anywhere in the band. If channelized, then the next frequency will be the next one in the list.

Continuous Wave: Selecting this box informs ARES that this is a

continuous wave (CW) signal and does not require pulse width and pulse repetition interval (PRI) to be specified.

Pulse: If this is a pulsed signal, then specify the pulse width (in microseconds) here. Modulation on pulse (MOP) can also be specified here. The choices are no MOP, chirp (enter the chirp slope), or phase coded (enter the number of bits). The MOP parameters entered here are not used to compute processing gain. However, they may be used to tag a signal **as** having these properties (for example, in a message). These information can be found in the "Pulsed RF and Pulsed Signal Shape" sections of the EWIRDB (Tree Numbers 000000013132 and 00000001311).

PRI: If this is a pulsed signal, then the users have three choices for entering the pulse repetition interval (PRI). The pulses will be generated at the times specified by the PRI entered. This information can be found in the "PRI/PGRI" section of the EWIRDB (Tree Number 00000001312).

- <u>Stable</u>: Enter the stable PRI to be used by this mode.
- Jitter: Enter the average PRI and the percent random deviation.
- <u>Stagger</u>: Enter the legs of a single frame. The PRI legs will be used in the order that the users enter them. When the end of the list is reached, the frame will repeat itself **from** the top.

d. Receiver Modes

The Radar Mode Receiver dialog presents a list of all receivers created on the **Radar** Receivers page, **as** shown in Figure **8-18.** To edit a receiver's behavior for this mode, double-click its name on the list. A dialog page **as** show in Figure **8-19** is presented allowing the users to design the receiver **as** required.

State		- RF Agility	
ে On ে Off			
		C Fixed	
requencies		C Pulse-group to pulse-group:	pulses.
Continuous		C Penodic: secon	ds.
Channelized		Manual decision time:	60 seconds.
Frequencies:	<u>dx++</u>	J/N Threshold (dB)	10
150 160	× .		
170		Equipment switch time:	10 seconds
180			
		- PR	
Continuo	is wave	Stable: 5000 n	
			nicrosec
ulse	2000 Barrier	C Jitter: +/-	*
	10 microsec		
Pulsewidth:		Stadder Marken Stadder	TAPP PROVIDENTS / INSWERD, WITH THAT IS NOT
Pulsewidth:		Stagger	
€ No MOP		PRJs:	
	MHz		
€ No MOP			
€ No MOP	MHz		

Figure 8-17. Sample of Transmitter Modulation Dialog Page

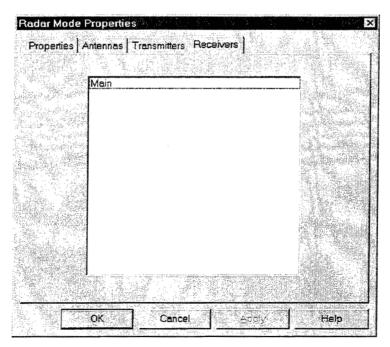


Figure 8-18. Sample of Receiver Mode Dialog Page

Receiver Mode Properties	
C On C Off	
IF or Doppler Bandwidth (MHz):	0.15
Pulse Compression Gain (dB):	
- Signal Type	
Pulse	
Number of Pulses Integrated:	10000
Pre-Detection integrationGain	(dB): 0
C Doppler	
Coherent Integration Time (use	
Post-Datection Integration Gair	n(d8):
ОК]

Figure 8-19. Sample of Receiver Mode Properties Dialog Page

State: Select the radio button indicating whether the users want this receiver to be active or inactive for this mode.

IF or Doppler Bandwidth: For a pulsed signal, enter the intermediate frequency (IF) 3-dB bandwidth for the receiver (in MHz). Typically, this is proportional to 1/pulsewidth. For a CW radar, enter the size of the Doppler filters. These information can be found in the "IF" and "Multiple Pulse Processing" sections of the EWIRDB (Tree Numbers 000000001513 and 00000001515).

Pulse Compression Gain: Enter the amount of pulse compression processing gain (e.g., chirp or phase code) credited to this radar. If given, this information can be found in the "Single Pulse Processing" sections of the EWIRDB (Tree Number 000000001514).

Signal Type:

(1) <u>Pulse</u>. Select the radio button indicating the receiver employs

pulsed processing.

- <u>Number of Pulses Integrated</u>: Enter the number of pulses to be integrated by the radar receiver in this mode. **ARES** uses the lesser of this number and the number of pulses generated during the illumination time of the radar, which is the product of pulse repetition frequency (PRF) times beam dwell. If the users want all pulses to be integrated, enter a large number. If given, this information can be found in the "Multiple Pulse Processing" sections of the EWIRDB (Tree Number 00000001515).
- <u>Pre-Detection Internation Gain</u>: Enter the amount of pre-detection integration gain credited to this radar. **ARES** will boost the pulse S/N ratio by the specified amount. If given, this information can be found in the "Multiple Pulse Processing" sections of the EWIRDB (Tree Number 00000001515) if given.

(2) <u>Doppler</u>. Select the radio button indicating the receiver

employs Doppler processing.

- <u>Coherent Integration Time</u>: Enter the amount of time interval this radar integrates over. This information can be found in the "Multiple Pulse Processing" sections of the EWIRDB (Tree Number 000000001515) if given.
- <u>Post-Detection Internation Gain</u>: Enter the amount of post-detection integration gain credited to this radar. ARES will boost the pulse S/N ratio by the specified amount. This information can be found in the "Multiple Pulse Processing" sections of the EWIRDB (Tree Number 000000001515) if given.

G. REPORT

The Radar Report page, **as** shown in Figure **8-20**, contains a list of information that can be transmitted by this radar over a network. If the **Publish** radio button is

selected, then players using this radar will offer the selected information to any networks

of which it is a member (see Chapter XII). The information offered is described below.

Radar Andrea Andrea	
Properties Resources Receivers	Antennas Transmítters Modes Report
C Do Not Publish To Network	ĺ
C Publish To Network	
T Player ID (8)	Distance (1 word)
	r.
Transmit Time (1 wo	rd) Grad Speed (1 word)
Attitude (1 word)	Track Number (16)
T Azimuth (1 word)	Track Quality (4)
OK Canc	el <u>Apply</u> Help

Figure 8-20. Sample of Radar Publish Dialog Page

<u>Plaver ID</u>: This is an 8-bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source *of* the information.

System Type: This is a 4-bit parameter identifies the type of the player to the network. Select this if the users want each packet to contain a field identifying the source of the infomation.

<u>Plaver Position</u>: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying the player's current position.

Transmit Time: This is a single word that identifies the time at which the packet was created. Select this if the users want each packet to have a time-stamp indicating the age-of-the information to its recipients.

<u>Altitude</u>: This is a single word representing the altitude of the track which is being reported in this packet. Selecting this parameter implies that the radar has the ability to resolve and report altitude (i.e., it is either a 3-D radar or a height-finder).

Azimuth: This is **a** single word representing the azimuth angle of the reported track.

<u>Distance</u>: This is a single word representing the distance of the reported track.

Elevation: This is a single word representing the elevation angle of the reported track.

Heading: This is a single word representing the heading of the reported track. Selecting this parameter implies that the radar has the ability to resolve and report the heading of the track.

Speed: This is a single word representing the **speed** of the reported track. Selecting this parameter implies that the radar has the ability to resolve and report the speed of the track.

Track Number: This is a 16-bit parameter representing the locally assigned track number.

Track <u>Quality</u>: This is a 4-bit parameter representing the quality of the track.

H. MULTI BEAM RADAR CONSIDERATION

For radar with simultaneous multi-beams, there are two approaches to modeling. Typically, multi-beam radar can discriminate either in frequency or direction of arrival which beam the target is being returned from. In case of each beam is **a** different frequency, the approach is to model the radar **as** a collection of separate antennas, one for each beam. In case the **beams** are stacked in elevation, the radar can be modeled **as** one antenna consisted of multiple beams, each with different aimpoint and scan sector.

For radars with two sequential beams, the users should cut the scan rate in half in order to preserve the scan period. This results in twice the number of pulses on target. The users can accommodate this by either adding **3** dB of system losses or limiting the number of pulses integrated to the appropriate number. The number of pulses integrated is product of PRF times beam dwell.

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IX. EDITING AN ESM SYSTEM

An ESM system in the Systems tab may be opened for editing by either double-clicking the object or 'by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 9-1 which features six pages: **Properties, Resources, Antennas, Receivers, Modes,** and **Publish**. To build an ESM system, the users will have to create all of its components and then describe their operation using the **Modes** page. If this system is to participate on a network, the users can identify the information it can provide to a network on the **Publish** page.

Properties Resources Antennas	Receivers Mode	s Report
Name:	Classification: \overline{I}	
-Track Establishment		· · · · · · · · · · · · · · · · · · ·
Pulse detection criteria for track	establishment	
← Total Number of Pulses:	I	Delay (sec)
Pulse Train (m out of n) m: 3 : n.		0.2
Track Maintenance -		
Pulse detection criteria for track	maintenance:	
← Totel Number of Pulses:		Age Out (sec)
Pulse Train (m out of n) m: 3 ⁺ / _→ n:		60
OK Can	zel 📔 🛓 Asialy	Help

Figure 9-1. Sample of ESM Properties Dialog Page

A. PROPERTIES

The ESM Properties page, as shown in Figure 9-1, contains four fundamental blocks of information. These are described in detail below.

Name: This is a text string that is used to identify the ESM throughout ARES. It is displayed under ESM folder on the Systems tab, and will be used in other lists **as** well. It is imperative that the users define a concise, but descriptive name for ESMs.

<u>Classification</u>: The users can select the classification level of the **ESM** from the drop-down list. The classification is used only for reference in the dialog.

<u>**Track Establishment:**</u> This block is where the users indicate the criteria that ARES will use for the ESM to establish an active track of a target. The users can choose a criteria based on the total number of pulses received from an emitter, or based on m-out-of-n pulses detected in a pulse train. The total number of pulse criteria will count the pulses over multiple dwells, while the pulse-train criteria will examine only the pulses in a single dwell.

The delay is a fixed amount of time that the users specify to account for processing delays before this track can be declared.

<u>**Track Maintenance:**</u> This block is where the users specify the criteria to maintain the active status of an already established track. If the criteria is not met, then the track will not be updated.

The age-out is the amount of time that must elapse since the last update before a track will be declared inactive. For example, with **an** age-out of 60 seconds, if an emitter was last seen (i.e., its track maintenance criteria **was** last met) at T = 1500 seconds, then the track will be declared inactive at T = 1560 seconds unless updated again before that time.

B. RESOURCES

This page, shown in Figure 9-2, is an optional advanced feature in ARES and is designed for special application in GA. Unless the users are knowledgeable about the defined system, this page can be ignored. In general, this page allows the users to specify the size, weight, and support requirements for the ESM system, which in turn is used for consideration in GA system selection process. If the GA develops a solution where the systems require more resources (the sum of their required resources) than the allowed maximum values for the platform **as** defined in the GA constraints page from the Templates page, then the GA will simply "turn **off**" that platform (i.e., not use it).

C. ANTENNAS

The ESM Antennas page, as shown in Figure **9-3**, contains a list of all antennas associated with this ESM system. Below this list are four buttons described below.

Add: Adds a new, but blank antenna object to the ESM. It will be shown in the list **as** "New Antenna" and will immediately be opened for editing.

Edit: Opens the currently selected antenna for editing. Alternatively, double-clicking the antenna in the list also opens the antenna.

Delete: Permanently deletes the currently selected antenna from the ESM object.

Duplicate: Creates a copy of the currently selected antenna. It will be listed with the same name as the copied antenna plus " (copy)".

roperties	Resources Antenna	s Receivers	Modes Repo	۳ ۱
-Pla	tform Resources Req	uired		
	Weight (lbs):	1		
	Volume (cu-inch):	T.	0	
	Power (kw):		0	
	Cooling (KW)		0	
				Services States

Figure 9-2. Sample of ESM Resources Dialog Page

1. Editing an Antenna

With an antenna selected on the list, double-clicking or selecting **Edit** presents the users with a Properties page contains several properties to be edited. A sample of **ESM** Antenna Properties page is provided in Figure 9-4.

Name: A text string identifying this antenna in lists.

Scan Rate: This is the ratio of scan sector in degrees divided by scan period in seconds. At present, ESMs that scan do so with a circular pattern only; hence the users should use 360 degrees for scan sector.

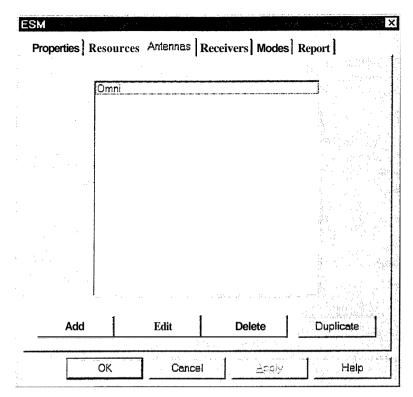


Figure 9-3. Sample of ESM Antennas Dialog Page

Angular Offset: The angular offset is used for describing the mounting of this antenna relative to the local "front". For example, a side-looking radar mounted on the right side of an aircraft would have an azimuth offset of 90 degrees. A rear facing radar would have an azimuth offset of 180 degrees. The angular offset does not describe scan or aiming sector. It is simply an offset relative to the platform on which the antenna is mounted.

Edit Beam: Button, when depressed, opens a dialog, shown in Figure **9-4**, that contains several properties to be edited as defined below.

Properties	
Properties	9 nž (
Name: Omni	
Scan Rate (deg/sec): 0	
-Angular Offset	
Azimuth (deg):	
	1972)
Elevation (deg): 0	
	89.88
n de la serie de la constant de la filipe de marcha de la serie de la serie de la serie de la serie de la serie Notes de la serie de la constant de la serie de la s	
EditBeam	
CONDEGU	
	nići Slavu
OK	na da Galeira
۲	

Figure 9-4. Sample of ESM Antenna Properties Dialog Page

Name: This is a text smng identifying this beam in lists.

Transmit / Receive: ARES allows the users to specify beam properties

for receive.

• <u>Mainbeam Gain</u>: This is the gain (in dB) associated with this beam. If it is not given, this value can be calculated using equation below where θ_a and θ_e are the 3-dB azimuth and elevation beamwidths in radians.

$$G \equiv \frac{4\pi}{\theta_a \theta_e} \tag{9.1}$$

• <u>Azimuth / Elevation Beamwidth</u>: This is the 3-dB azimuth and elevation beamwidths in degrees of this beam.

Sidelobes: The users have the option of identifying a particular antenna pattern to associate with this beam, or the users can choose to have no pattern. **The** patterns available to the users are those that were created under the Signatures tab. For this reason, the users should create the signatures before create the systems. If the users

chooses no sidelobes, ARES uses 0 dBi (isotropic) to represent all values outside of the mainbeam.

D. RECEIVERS

The Receivers page, as shown in Figure 9-6, contains a list of all receivers associated with this ESM system. Below this list are four buttons described below.

operties			in sand i Taga ang ang
ame: New Beam			
Transmit-		Receive	
- Gain and Beamwidth		-Gainand Beamwidth	
Mainbeam Gain (dB):		Mainbeam Gain (dB):	0
Azimuth Beamwidth (deg):		Azimuth Beamwidth(deg):	360
Elevation Beamwidth (deg) :		ElevationBeamwidth(deg):	180
- Sidelobes		Sidelobes	
 No Sidelobe: Attach Patient: 		 No Sidelobes Attach Pattern. 	
EW/Redsr		EW Rader	
	OK		

Figure 9-5. Sample of ESM Antennas Beam Properties Dialog Page

Add: Adds a new, but blank receiver object to the ESM. It will be shown in the list as "New Receiver" and will immediately be opened for editing.

Edit: Opens the currently selected receiver for editing. Alternatively, double-clicking the receiver in the list also opens the receiver.

Delete: Permanently deletes the currently selected receiver from the ESM object.

Duplicate: Creates a copy of the currently selected receiver. It will be listed with the same name as the copied receiver plus " (copy)".

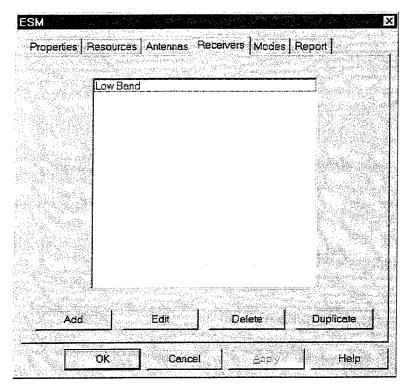


Figure 9-6. Sample of ESM Receiver List Dialog Page

1. Editing a Receiver

With a receiver selected on the list, double-clicking or selecting **Edit** presents the users with a Receiver Properties dialog containing two pages as depicted in Figure 9-7. Description of each page is as follows.

a. Properties

This page, as shown in Figure 9-7, contains several receiver properties to be edited as described below.

Name: This is a text string identifying this receiver in lists.

<u>Receiver Type</u>: Select the radio button indicating the type of this receiver. A superhet will have one filter, while a channelizer is effectively multiple filters (like multiple superhets).

Receiver Properties Properties Sensitivity	
Name: Low Band	
Frequency Coverage	
From: 50 MHz	:IF 10
To: 500 MHz	
-Receiver Type	a martine and a second seco
Superhet	Video: X∳€
C Channelizer. Channels	-
Simultaneous Measurements 1 🛨	
Dynamic Range (dB): 45	Antenna Antenna used by this receiver. Omni
	OK Cancel Help

Figure 9-7. Sample of ESM Receiver Properties Dialog Page

Simultaneous Measurements: Defines the number of simultaneous measurements that ARES internal receiver model can process in pulse-on-pulse situations. For example, if a receiver is specified to handle only 1 simultaneous measurement and two filters have a pulse simultaneously, then only one of the pulses will be measured and the other is lost.

Dvnamic Range: Determines the range of signal strenght that the receiver can "see". For example, if the sensitivity is -100 dBm and the dynamic range is 60 dBm, then signals between -100 and -40 dBm will be received.

IE: Defines the instantaneous bandwidth of the front end receiver.

Video: Defines the bandwidth of the detector. The narrower this is, the more sensitive the receiver but at the cost of minimum detectable pulsewidth.

Antenna: Single-click to select an antenna to be used by this receiver. The antennas listed are those that were created on the ESM Antennas page. Double-clicking has no effect in this list.

b. Sensitivity

This page, as shown in Figure 9-8, contains eight properties of which **six** are editable **as** described below.

Frequency: This is an arbitrary frequency defined by the users representing an independent variable for the sensitivity calculation.

NE: Defines the noise figure at this frequency.

Bn: Defines the noise bandwidth for this ESM. Usually this is the same as the video bandwidth.

SNR: Defines the threshold signal-to-noise-ratio for this ESM.

Install Gain / Loss: Defines any pertinent installation gains or losses (e.g., due to amplifiers, long lengths of coax., etc.)

Mainlobe Gain: This value is internally calculated by ARES.

Calculated Sensitivity: This value is internally calculated by ARES.

User Sensitivity: The user sensitivity is the number that **ARES** will actually use for the selected ESM. The users can edit this column to overide the other calculations on this page.

E. MODE

The Modes page, **as** similarly shown in Figure 9-9, contains a list of all modes associated with this ESM system. Below this list are four buttons described below.

Add: Adds a new, but blank mode object to the ESM. It will be shown in the list as "New Mode" and will immediately be opened for editing.

Edit: Opens the currently selected mode for editing. Alternatively, double-clicking the mode in the list will also open the mode.

Delete: Permanently deletes the currently selected mode from the ESM object.

Duplicate: Creates a copy of the currently selected mode. It will be listed with the same name **as** the copied mode plus " (copy)".

A	8	Ć	D	. E	F	G	H	Ľ
Frequency	NF	Bn	SNR	Install	Mainlobe	Calculate	User	
(MHz)	(dB)	(MHz)	(dB)	Gain/Loss	Gain (dB)	d	Sensitivity	ŀ
		an a	na la participa Vicini	(dB)	n ne sen ange Na sen angerog Na sen angerog	Sensitivity	(dBm)	100
50.00	15.00	2.00	18.00	-10.00	0.00	-67.99	-67.99	
82.14	15.00	2.00	18.00	-10.00	0.00	-67.99	-67.99	
114.29	15.00	2.00	18.00	-10.00	0.00	-67.99	-67.99	
146.43	15.00	2.00	18.00	-10.00	0.00	-67.99	-67,99	
178.57	15.00	2.00	18.00	-10.00	0.00	-67.99	-67.99	
21071	15130	200	18.00	-10.00	0.00	-67.99	-67.99	
242.86	15.00	2.00	18.00	-10.00	0.00	-67.99	-67.99	ř.: r
275.00	15.00	2 00	18.00	-10.00	0.00	-67.99	-67.99	ľ,
30714	15.00	2 00	18.00	-10.00	0.00	-67.99	-67.99	
339.29	15.00	2 00	18.00	-10.00	0.00	-67.99	-67.99	30
371 43	15.00	200	1800	-10.00	0.00	-67.99	-67.99	
403 57	1500	2 00	18.00	-10.00	0 .0 0	-67.99	-67.99	
435 71	15.00	2013	18.00	-10.00	0.00	-67.99	-67.99	j) J
46786	1500	2.00	18.00	-10.00	0.00	-67.99	-67.99	þ
50C.00	15.00	2.00	18.00	-10.00	0.00	-67.99	-67.99	Ż
				· · · · · · · · · · · · · · · · · · ·	Errorl	Error	Errorl	
	1	1	Í		Errorl	Error	Error!	
	[Errorl	· Error!	Errorl	
					Errorl	Error	Errorl	
	ļ				Errorl	Errori	Error	
					Errorl	Error!	Errorl	
					Error!	Error!	Error!	
TPT\ 10 /					Errod	Error	Frond	<u>, 1</u>

Figure 9-8. Sample of ESM Receiver Sensitivity Dialog Page

ESM	811		e Care	× Picket X
Properties F	Resources	Antennas Rece	ivers Modes R	eport
- •	·		1	•
	Binomial Search 20			
• • •				
Add		Edit	Delete	Duplicete
·	OK	Cancel	<u>A</u> psiy	Help

Figure 9-9. Sample of ESM Modes Dialog Page

1. Editing a Mode

With a mode selected on the list, double-clicking or selecting **Edit** presents the users with the ESM Mode Properties dialog appears as in Figure 9- 10. There are three pages **as** described below.

a. Mode Properties

The ESM Mode Properties page contains only a single entry for the users to specify the name of the mode.

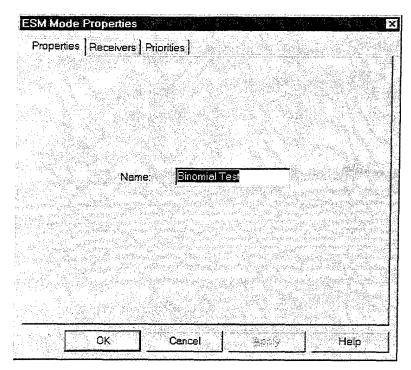


Figure 9-10. Sample of ESM Modes Properties Dialog Page

b. Receiver Modes

The ESM Modes Receiver page, as similarly shown in Figure 9-11, contains a list of all receivers associated with this ESM system. With a receiver selected on the list, double-clicking presents the users with the Receiver Tune Schedule dialog, as appeared in Figure 9-12, which contains 10 properties to be defined as described below.

<u>RF Low / High:</u> Defines the tuning frequency coverage for the receiver to "open" and collecting data.

Az High / Low: Defines the instantaneous azimuthal coverage for this tune.

Delta Sensitivity: Defines the enhancements to the sensitivity that were not included on the reciever sensitivity page.

ESM Mode				
Properties	Receivers Prio	rities	11.1 - De 1 - 1	
	Low Band			
	na an a		···· ··· ·	
	ОК	Cancel	4priv	Heip

Figure 9-11. Sample of ESM Modes Receivers Dialog Page

Sensitivity: This is internally determined by **ARES**.

Polarization: Single-click opens a pull-down menu allowing the users to select the polarization for the select tune. Tuning co-pol will result in 0 dB loss. Cross-pol will result in 25 dB loss.

Shadow Time: Defines the minimum amount of time that the receiver is tied up to measure a pulse, starting from the leading edge of that pulse. This is important in assessing pulse-on-pulse conditions. The users can use the Poisson distribution to assess the probability that two pulses overlap. **As** long as they do not overlap within the shadow time, there is no pulse-on-pulse condition.

Dwell: Defines the duration of time that the receiver is actually "open" and collecting data. It is typically set long enough to guarantee that intercept will happen

within a given length of time, but not so long duty cycle constraints are at risk. For example, if detection criteria is that 3 out of **4** pulses must be intercepted in a pulse train, then the dwell must be equivalent to at least 3 PRI of the emitters of interest in order to guarantee that 3 pulses were intercepted in a given collection.

<u>Revisit</u> **Time:** Defines the amount of time that passes before this tune will take another dwell. Presumably, during the period of time that elapses between dwells the receiver is **off** making dwells of other tunes in the schedule.

The dwell time and revisit time go hand in hand. For each tune, the duty cycle equals the dwell time divided by the revisit time. So, a larger duty cycle would be expected to result in faster detection. Summing the duty cycles for all of the tunes give the overall receiver duty cycle.

c. Priorities

The ESM Modes Priorities dialog, shown in Figure 9-13, is used to define which ESM detections should *go* to the front of the queue for transmission via a network. It consists of two columns of which one is editable as described below.

Radar: Contains a list of radar systems created under Systems Tab of which the operating frequency is within the selected ESM receiver frequency coverage.

<u>Priority</u>: Defines the network transmission priority for the ESM detection of the listed radars. A priority can be assigned by single-click the cell to activate the pull-down menu for selection. There are **3** types of priority **as** decribed below.

- <u>High</u>: Signifies first in the queue to be transmitted.
- <u>Normal</u>: Signifies second in the queue to be transmitted.

RF Low (MHz)	RF High (MHz)	Az Low (deg)	Az High (deg)		Sensitivity (dBm)	Polarization	Shadow Time (nsec)	Dwell (msec)	Revisit Time (sec)
50	60	0	360	0	-67.99	Horizontal	100	1	0.225
60	70	0	360	0	-67.99	Horizontal	100	1	0.225
70	8þ	0	360	0	-67.99	Horizontal	100	1	0.225
80	90	0	360	0	-67.99	Horizontal	100	1	0.225
90	100	0	360	0	-67.99	Horizontal	100	1	0.225
100	110	0	360	0	-67.99	Horizontal	100	1	0.225
110	120	0	350	0	-67.99	Horizontal	100	1	0.225
120	130	3	360	0	-67.99	Horizontal	100	1	0.225
130	140	0	360	0	-67.99	Horizontal	100	1	0.225
140	150	0	360	0	-67.99	Horizontal	100	1	0.225
150	160	0	360	0	-67 99	Horizontal	100	1	0 225
160	170	0	360	0	-67 99	Horizontal	100	1	0.225
170	180	0	360	0	-67 99	Horizontal	100	1	0.225
180	190	0	360	0	-67.99	Horizontal	100	1	0.225
190	200	0	360	0	-67.99	Horizontal	100	1	0.225
200	210	0	360	0	-67.99	Horizontal	100	1	0.225
210	220	С	360	0	-67.99	Horizontal	100	1	0.225

• <u>Low</u>: Signifies last in the queue to be transmitted.

Figure 9-12. Sample of ESM Modes Receivers Tune Schedule Dialog

F. REPORT

The Report page, as shown in Figure **9-14**, contains a list of information that can be transmitted by this ESM over a network. If the **Publish** radio button is selected, then players using this ESM will offer the selected information to any networks of which it is a member (see Chapter XII). The information offered is described below.

Properties Re	ceivers Priorities		
	Radar	Priority	
1. E	W Radar	Normal	
		High Normal	
		Low	
1		doctoria contra inf	

Figure 9-12. Sample of ESM Modes Receivers Tune Schedule Dialog

<u>Player ID</u>: This is an 8-bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

System Type: This is a 4-bit parameter identify the type of the player to the network.

Player Position: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying the player's current position.

Transmit Time: This is a single word that identifies the time at which the packet was created. Select this if the users want each packet to have a time-stamp indicating the age-of-the information to its recipients.

<u>Altitude</u>: This is a single word representing the altitude of the detected emitter which is being reported in this packet. Selecting this parameter implies that the ESM has the ability to resolve and report altitude.

Average PRI: This is a single word representing the average **PRI of** the reported emitter.

Azimuth AOA: This is a single word representing the azimuth angle of arrival of the reported emitter.

<u>Classification</u>: This is 32-bit parameter uniquely identifying the classification of the reported emitter.

Elevation AOA: This is a single word representing the elevation angle of arrival **of** the reported emitter.

EMOP This is a single word representing the frequency modulation on pulse (e.g., chirp) of the reported emitter.

Freauency: This is a single word representing the frequency of the reported emitter. If there are multiple frequencies, then one word will be generated per frequency.

Latitude: This is a single word representing the latitude of the reported emitter.

Longitude: This is a single word representing the longitude of the reported emitter.

Mode: This is 8-bit parameter uniquely identifying the mode of the reported emitter.

On/Off State: This is a single word representing the status of the reported emitter (on or **off)**.

<u>Phase MOP</u> This is a single word representing the phase coded waveforms (e.g. barker code) of the reported emitter.

PRI: This is a single word representing the PRI of the reported emitter. If there are multiple PRI, then one word will be generated per PRI.

<u>Pulse Width</u>: This is a single word representing the pulse width of the reported emitter.

SEI: This is a 32-bit parameter representing the unique identification of the emitter (if the receiver has SEI capability).

<u>SEI Match Number</u>: This is a single word representing the quality of the identification.

<u>SEI Parameters</u>: This is **16** words representing the uniquely computed coefficients that were used to determine identification.

<u>**Track Number:**</u> This is a 16-bit parameter representing the locally assigned track number.

Track Quality: This is a 4-bit parameter representing the quality of the track.

SM a state of the state of	
Properties Resources Antennas R	eceivers Modes Report
C Do Not Publish To Network	
Publish To Network	T Latitude (1 word)
F Player D(8)	Longitude (1 word)
🗔 SystemType (4)	Mode (8)
Player Position (3 words)	☑ On/Off State (1)
F Transmit Time (1 word)	F PhaseMOP (1 word)
Altitude (1 word)	PRI (1 word)
₽ Average PRI (I word)	₽ Pulse Width (1 word)
Azimuth AOA (1 word)	ſ¯ SEI (32)
Classification (32)	SEI Match Number(1 word)
${ m F}$ Elevation AOA (1 word)	SEI Parameters (16 words)
FMOP (1 word)	🔽 Track Number (16)
Frequency(1 word)	T Track Quality(4)
Cancel	Help

Figure 9-14. Sample of ESM Publish Dialog Page

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X. EDITING AN ECM SYSTEM

An ECM system in the Systems tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 10-1 which features five pages: **Properties, Resources, Transmitters, Modes,** and **Publish**. To build an ECM system, the users will have to create its components and then describe their operation using the **Modes** page. If this system is to participate on **a** network, the users can identify the information it can provide to a network on the **Publish** page.

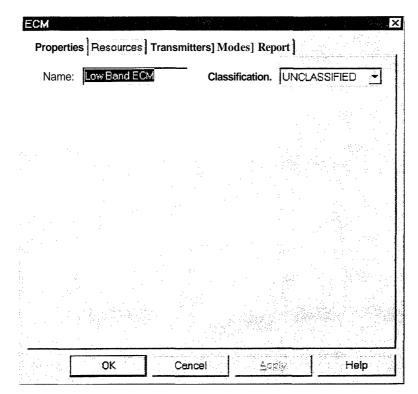


Figure 10-1. Sample of ECM Properties Dialog Page

A. PROPERTIES

The ECM Properties page, as shown in Figure 10-1, contains two fundamental blocks of information. These are described in detail below.

Name: This is a text string that is used to identify the ESM throughout **ARES**. It is displayed under ESM folder on the Systems tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for ESMs.

<u>Classification</u>: The users can select the classification level of the ESM from the drop-down list. The classification is used only for reference in the dialog.

B. RESOURCES

This page, shown in Figure 9-2, is an optional advanced feature in **ARES** and is designed for special application in GA. Unless the users are knowledgeable about the defined system, this page can be ignored. In general, this page allows the users to specify the size, weight, and support requirements for the ECM system, which in turn is used for consideration in GA system selection process. If the GA develops a solution where the systems require more resources (the sum of their required resources) than the allowed maximum values for the platform **as** defined in the GA constraints page from the Templates page, then the GA will simply "turn **off** that platform (i.e., not use it).

C. TRANSMITTERS

The Transmitters page, shown in Figure 10-3, contains a list of all transmitters associated with this ECM system. Below this list are four buttons described below.

Add: Add a new, but blank transmitter object to the ECM. It will be shown in the list **as** "New Transmitter" and will immediately be opened for editing.

Edit Opens the currently selected transmitter for editing. Alternatively, double-clicking the transmitter in the list also opens the transmitter.

Delete: Permanently deletes the currently selected transmitter from the ECM object.

ECM	2		11111149		×
Properti	es Resources	Transmitters]]	Modes Report		
	Platform Resour	rces Required-			
	Weight (hs).		ja Ja	
	Togrit	<i>ww</i> .	• in in hyperate		
	Volume (cu-inch):	D		
	Power(k	WA -	0		
	FOWER	••;.	1	3	
	Cooling(k₩):	0		
1. 		· · · · · · · · · · · · · · · · · · ·			
· [ОК	Cancel	1 <u>5</u> 25	Help	
. L					

Figure 10-2. Sample of ECM Resources Dialog Page

Duplicate: Creates a copy of the currently selected transmitter. It will be listed with the same name as the copied transmitter plus " (copy)".

1. Editing a Transmitter

With a transmitter selected on the list, double-clicking or selecting **Edit** presents the users with the Transmitter Properties dialog contains several properties to be edited. **A** sample of ECM Transmitter Properties page is provided in Figure 10-4.

ECM			X
Properties Resources	Transmitters Mode	s Report	
Low Banc	Jammer		
		-	
		-	
		i i	
n for a standard for an ann an Anna an Anna ann an Anna Anna Anna			and Construction States
an a			
Add 1			
	Edit D	elete C	uplicate
OK	Cancel	Apply	Help
		A SCHERK CONTRACTOR	a icih

Figure 10-3. Sample of ECM Transmitters Dialog Page

Name: This is a text string identifying the transmitter in lists.

<u>Peak Power</u>: Defines the peak power (in kilowatt) of the transmitter. The ERP will include the antenna gain.

<u>Max # of Spots</u>: Defines the number of frequencies that can be jammed.

Max # of Beams: Defines the number of beams this transmitter can form.

<u>Frequency Coverage</u>: Defines the operating frequency range of **this** transmitter (in MHz).

Antenna:

• <u>Gain</u>: This is the gain (in dB) associated with this transmitter. If it is not given, this value can be calculated using equation below where θ_a and θ_e are the 3-dB azimuth and elevation beamwidths in radians.

$$G \cong \frac{4\pi}{\theta_a \theta_e} \tag{10.1}$$

- <u>Azimuth / Elevation Beamwidth</u>: This is the **3-dB** azimuth and elevation beamwidths in degrees of this transmitter.
- <u>Azimuth / Elevation Offset</u>: The angular offset is used for describing the mounting of this antenna relative to the local "front". For example, a side-looking radar mounted on the right side of an aircraft would have an azimuth offset of **90** degrees. A rear facing radar would have an azimuth offset of 180 degrees. The angular offset does not describe scan or aiming sector. It is simply an offset relative to the platform on which the antenna is mounted.
- <u>Azimuth / Elevation Coverage</u>: Defines the angular coverage of the transmitter. Emitters outside of the coverage angles cannot be jammed.
- <u>Polarization</u>: Single-click opens a pull-down menu allowing the users to select the polarization associated with this transmitter. Tuning co-pol will result in 0 dB **loss**. Cross-pol will result in 25 dB loss.
- <u>Arrav (1/N^2)</u>: Selection indicates that jammer is an element of an active arrays that can form multiple beams simultaneously to cover more threat types, but at the cost of an ERP reduction proportion to 1/N², where N is the number of beams.
- <u>Az Beam Stearing</u>: If selected, then the jammer will update the azimuth stearing of the beam to point at the emitters of interest.
- <u>El Beam Stearing</u>: If selected, then the jammer will update the elevation stearing of the beam to point at the emitters of interest.
- <u>Stear Beams in Turns</u>: Selecting this option indicates the beam is able to track the emitters while the aircraft is turning. If the beam does not track in the turns, then emitters will become uncovered when the jammers are turning.
- <u>Apply Cos(Theta)</u>: Applies to electronically steared beams of which the gain will degrade with the cosine of the angle from the boresight of the antenna.
- <u>Sidelobes</u>: The users have the option of identifying a particular antenna pattern to associate with this transmitter, or the users can choose to have no pattern. The patterns available to users are those that were created under the Signatures tab. For this reason, the users should create the signatures before create the systems. If the users chooses no sidelobes, ARES uses **0** dBi (isotropic) to represent all values outside of the mainbeam.

Name: Low Band Jammer Power (W): 199.52623149				of Spots:	1를 1를
-Frequency Coverage					
Erom. 5	0 MHz		το [500 MHz	
Antenna					
Gain (dB)		0	No Sid	elobes	
Azimuth Beamwidth (deg):		360	C Attach I	Pattern:	
Elevation Beamwidth (deg)		180	EW Rede	X.	
Azimuth Offset (deg):		0			288 1982
Elevation Offset (deg)		0			
Azimuth Coverage (deg):		0			
Elevation Coverage (deg):		0	***		
Polarization:			A A		
☐ Array (1/N ² 2)					
🔽 Az Beam Stearing	Stear Beam li	nTurns			
F El Beam Stearing	Apply Cos(Th	eta)			

Figure 10-4. Sample of ECM Transmitter Properties Dialog Page

D. MODES

The ECM Modes page, as shown in Figure 10-5, contains a list of all modes associated with this ECM system. Below this list are four buttons described below.

Add: Adds a new, but blank mode object to the ECM. It will be shown in the list as "New Mode" and will immediately be opened for editing.

Edit: Opens the currently selected mode for editing. Alternatively, double-clicking the mode in the list also opens the antenna.

Delete: Permanently deletes the currently selected mode from the ECM object.

Duplicate: Creates a copy of the currently selected mode. It will be listed with the same name as the copied mode plus " (copy)".

ECM		
Properties F	Resources Transmitters Modes Report	
		and the second second
	Pre-emptive Only Reactive Only	
-		
Add	Edit Delete	Duplicate
· •		
	OK Cancel Áppyr	Help

Figure 10-5. Sample of ECM Modes Dialog Page

1. Editing a Mode

With a mode selected on the list, double-clicking or selecting **Edit** presents the users with the ECM Mode Properties dialog containing three pages as depicted in Figure 10-6. Description of each page is as follows.

a. Properties

The ECM Mode Properties page, shown in Figure 10-6, contains only a single entry for the users to specify the name of the mode.

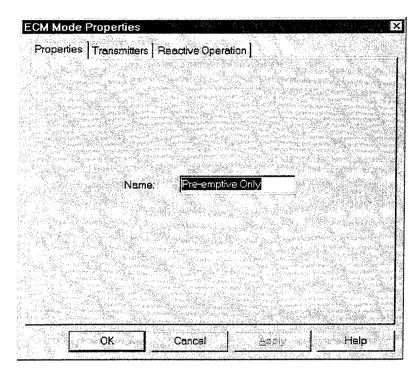


Figure 10-6. Sample of ECM Mode Properties Dialog Page

b. Transmitters

The ECM Mode Transmitters, as similarly shown in Figure 10-7, presents a list of all transmitters created on the ECM Transmitters page of which the users can select for appointing preemptive assignment (i.e. standoff jamming assignment). With a transmitter selected **on** the list, double-clicking presents the users with the Assignment Schedule dialog, as appeared in Figure 10-8, which contains four properties to be defined as described below.

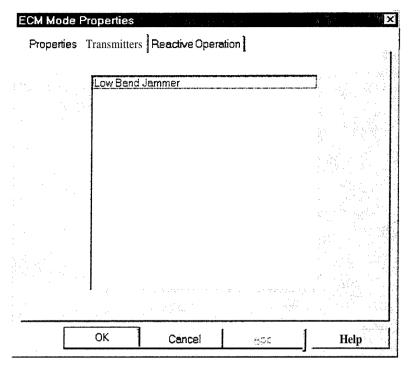


Figure 10-7. Sample of ECM Mode Transmitters Dialog Page

<u>Aimpoint</u>: Defines the aimpoint of the jammer in latitude and longitude.

Low / High Freauency: Defines the jamming frequency coverage of the transmitter.

Dutv Cycle: Select the radio button indicating the duty cycle of this transmitter, which in turn is used to determine whether coherent sidelobe cancellers will impact this jammer.

Technique Gain: Button, when depressed, opens a dialog, shown in Figure 10-9, consist of two columns described as followed:

	Letitude	20.00'00.0" S	Lon	igitude: 100.	00'00.0" W	
	Low Frequency (MHz)	High Frequency (MHz)	Duty Cycle	Technique Gain		
1	150	Lénnar an Canada an C 2	C Low € High	Gain		an a
	n an an an ann an Anna an Anna Anna Anna Anna			an a		
		친구 없는 것을 가장하는 것이 없는 것이 없다.				

Figure 10-8. Sample of ECM Transmitters Assignment Schedule Dialog Page

Radar: Contains **a** list of radar systems created under Systems **tab**

of which the operating frequency is within the selected transmitter frequency coverage.

Technique Gain: Defines the amount **of** the modulation gain to be added to straight noise gain for jamming against a particular radar.

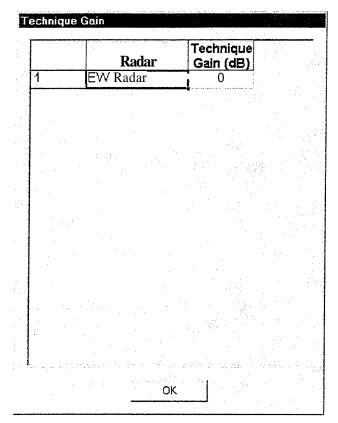


Figure 10-9. Sample of ECM Technique Gain Dialog Page

c. Reactive Operation

The ECM Reactive Operation page, **as** shown in Figure 10-10, is where the users can appoint and coordinate reactive assignment. It contains four fundamental blocks of information as described in detail below.

(1) <u>Information Sources</u>. This is **a** table listing all the sources that

the jammer could potentially use to make ${\bf a}$ jamming decision.

Source: A listing of all possible ESM systems (as defined under the ESMs folder).

Acceut?: Determines how information from this source will be

treated.

- <u>Reauired</u>: Signifiesjammer cannot jam until this source has reported.
- <u>Okav</u>: Signifies jammer will use information from this source to make jamming assignments.
- <u>Ignored</u>: Signifies this source is of no consequence and can be disregarded.

nformation So			RAAdivation
Source Onboard	Accept?		RA's
Low Band ES	Required		_
	Required Okay	an di Sena an a	
	Ignored		-Network Coordination
			RA's Not Coordinated
nformation Re	quired:		C RA's Coordinated
Information	Occurrence	es 🔔	
Ave. PRI	0		
Az. AoA	-1		
Classification	.1		
EL AnA			

Figure 10-10. Sample of ECM Reactive Operation Dialog Page

(2) Information Reauired. This is a table listing all the parameters that the jammer could potentially use to make a jamming decision. Inherently jammer will not jam until it have received the number of reports of each parameter indicated by the users. For example, if Classification = 1, Frequency = 1, and Az. AoA = 2, then the jammer cannot do anything until it has heard classification from at least one source, frequency from one source, and azimuth angle of arrival from at least two sources.

(3) <u>Network_Coordination</u>. Select the radio button indicating whether the reactive assignment is coordinated by the network for this transmitter. If

Network coordination is selected, then the jammer will factor the decisions of other jammers into its decision.

(4)<u>RA Activation</u>. Button, when depressed, opens a dialog, shown in Figure 10-11, consisting of 11 property columns to be edited. These are described as followed:

Radar: This column lists all radars created under Systems tab of which the operating frequency is within the selected ECM transmitter frequency coverage.

<u>RA Activate</u>: Select the radio button indicating whether the users

want this reactive jamming assignment to be active or inactive for this radar.

Techniuue: Select the radio button indicating how gain is

determined by the jammer.

- <u>Noise</u>: If selected, then the quality of the jamming above noise is determined by the Technique Gain column.
- <u>Coherent</u>: Signifies the jammer techique gain will be equivalent to the radar's processing gain.

<u>Strategy</u>: Select the radio button indicating how old jamming spots will be treated by jammer.

- <u>Following</u>: Signifies the jammer will "age out" old jamming spots.
- <u>Trailing</u>: Signifies the jammer will leave old spots in place (no age out).

Noise Techniuue Gain: Defines the amount of the modulation

gain above straight noise for jamming against a particular radar.

Spot Size: Defines the bandwidth of the noise.

Duty Cycle: Select the radio button indicating the duty cycle for this transmitter mode, which in turn is used strictly to determine whether sidelobe cancellers are effective.

Test Geo-Eligibility: Single-click on the cell opens a pull-down

menu of selection **as** described below.

- <u>False</u>: The jammer responds regardless of where the emitter is.
- <u>Rel. to Ownship</u>: The jammer responds only to emitters that are within the given range radius to the jammer. **This** radius is given by the range field.
- <u>Rel. to <u>Lat/Long</u>: The jammer responds only to emitters that are within the given range radius to a point on the ground **as** given by the latitude and longitude fields.</u>

<u>Range</u>: Defines the range radius at which only emitters within this

range is jammed.

Latitude: Defines the latitude of a point on the ground at which

only the emitters within the given range radius of this point are jammed.

Longitude: Defines the longitude of a point on the ground at which only emitters within the given range radius of this point are jammed.

E. REPORT

The Publish page, depicted in Figure 10-12, contains a list of information that can be transmitted by this ECM system over a network. If the **Publish** radio button is selected, then players using this ECM system will offer the selected information **to** any networks of which it is a member (see Chapter XII). The information offered is described below.

RA Activated Not Activate Activated	Noise		Gain (dB)	(MHz)	Duty Cycle	Test Geo-Eligibility	Range (n.mi.)	Latitude	Longitude
C Activated		Following			C Low	False		00°0000 0" S	000°00'00 C
	C Coherent	<u>C</u> Trailing	0	0	High		0	<u>S.</u>	
						False Rel. to Ownship	5 A.		
						Rel. to Lat/Lon:		. i i i i i i i i i i i i i i i i i i i	1.11
								in the second second	
									Augusta da
					1.1		i.		t i verter og
								. '	
									la de la composición Contra transmission
								e e e e e e e e e e e e e e e e e e e	
								14	
									. 1 . 4 5 1
									
									•
	· · ·				ОК				

Figure 10-11. Sample of ECM Reactive Assignment Schedule Dialog Page

<u>Plaver ID</u>: This is an 8 bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

System Type: This is a 4-bit parameter identify the type of the player to the network.

Plaver Position: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying player's current position.

Transmit Time: This is a single word that identifies the time at which the packet was created. Select this if the users wane each packet to have a time-stamp indicating the age-of-the information to its recipients.

<u>**Track Number</u>**: This is a 16bit parameter representing the locally assigned track number.</u>

Engaged/Disengaged: This is a I-bit parameter identify if the track is engaged or disengaged.

C Do Not Public	<u>b To Network</u>	
C Publish To N	etwork .	
	Player ID (8)	
	Г [™] System Type (4)	
	Player Position (3 words)	
	🔽 Transmit Time (1 word)	
	🖉 Track Number (16)	
	🗹 Engage/Disengage (1)	

Figure 10-12. Sample of ECM Publish Dialog Page

XI. TEMPLATES TAB COMMANDS

The "Templates" tab of the Scenario Workbook displays all models available to create players in the scenario. The models are listed in alphabetical order by system type. **A** sample of the Templates Tab hierarchy is shown in Figure 11-1.

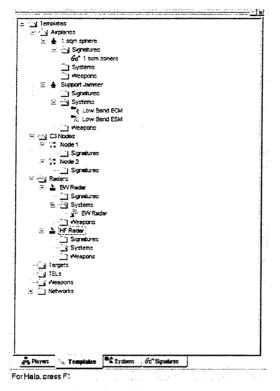


Figure 11-1. Sample of Templates Tab Hierarchy

A. TREE OPERATIONS

The tree presented in the Templates tab supports several basic operations. These are described as follows:

1. Right-Clicking a Model Folder

Right-clicking a model folder presents the users with a context-sensitive menu as shown in Figure 11-2. The operation of interest is **Add** which creates a new template

object of the select model type. The new object initially has no components (e.g., systems, signatures, weapons, etc.) and must be edited prior to use.

C V Templates E J Arplan Add Airplane ... 2. 4 15 - S Allow Docking Hide Float in Main Window Sil] Signatures Systems 1 Low Bond ESM 1 Weepons "1 C3 Not Reders EN Rodor] Signatures Systems T Amancas argets 🔆 New Mode Signatures TELS Signatures <u>_____</u> New Mode Signature (Crics 12 Jammer and Players Templates Systems for Signalares For Help, press F1

Figure 11-2. Model Folder Pop-Up Menu

2. Right-Clicking a Model

Right-clicking on an object in any folder presents **the** users with a context-sensitive menu as shown in Figure 11-3. There are three operations of interest. These are **Open, Delete, Duplicate,** and **GA Constraint.**

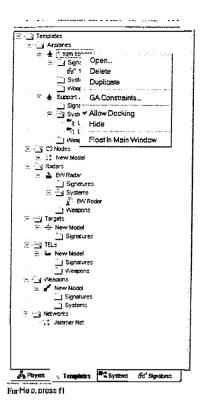


Figure 11-3. Model Pop-Up Menu

Open: Opens the model for editing. Detailed descriptions on editing each individual model are provided in the subsequent sections.

Delete: Permanently removes the selected model from the scenario.

Duplicate: Replicates the selected model onto the tree structure. The new system appears in the tree with the old name plus " (copy)".

<u>GA Constraint</u>: This is an optional advanced feature in **ARES** and can be omitted by the users. In general, selecting this option invokes a dialog as shown in Figure 11-4 allowing the users to specify the resources available on the chosen platform in term of size, weight, and support requirements. If the Constraint Platform Resources field is checked, ARES will consider these parameters as the maximum values allowed for the platform in **GA** system selection process. If the GA develops a solution where the systems require more resources (the sum of their required resources) than the allowed maximum values for the platform, then the GA will simply "turn off" that platform (i.e., not use it).

GA Constraints Platform Resources Available Weight (lbs); Volume (curinch); O Power (kW): O Cooling (kW):
Volume (cu-inch): 0 Power (kW): 0
Power (KW):
Cooling (kW): 0
Constrain Platform Resources
<u>να οκ</u>

Figure 11-4. GA Constraints Dialog

3. Right-Clicking a Component Folder

Righr-clicking a component folder presents the users with a context-sensitive menu as shown in Figure 11-5. The operation of interest is **Attach** which opens a dialog allowing the users to select the appropriate component systems belonging to the model. Any model may be assigned an unlimited number of systems.

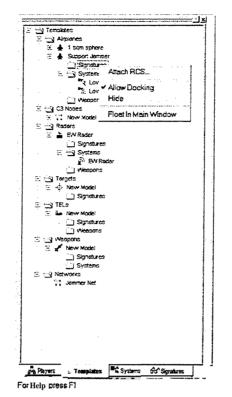


Figure 11-5. Component Folder Pop-Up Menu

4. Right-Clicking a Component Folder

Right-clicking a component presents the users with a context-sensitive menu **as** shown in Figure 11-6. The three operations of interest are **GA Selection, No GA** Selection, and Detach System.

<u>GA Selection</u>: Opens a dialog allowing the users to identify all of the alternate systems that could populate that location on the model for **GA** optimization process. When a component is flagged for **GA** selection, the model name is changed to red.

No GA Selection: Deselects the system for GA selection.

Detach System: Permanently removes the selected component from the model.

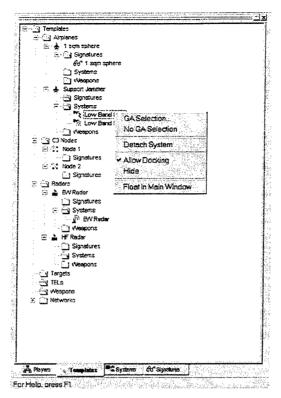
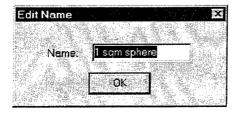


Figure I 1-6. Component Pop-Up Menu

B. EDITING AN AIRPLANE MODEL

An airplane model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 11-7 which contains only a single entry for the users to specify the name that is used to identify the model throughout ARES. It is displayed under Radars folder on the Templates tab, and will be used in other fists as well. It is imperative that the users define a concise, but descriptive name for the model.



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Figure 11-7. Model Edit Name Dialog

C. EDITING A C3 NODE MODEL

A C3 Node model in the Templates tab represents an integrated air defense system (IADS) network model and may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 11-8 which contains five properties to be defined **as** described below.

Edit	t C3 Node Name: New	Model	Command Auth	Ority
	Max Tgt Tracks:	0	Max Engagements	s []
: (Decision Delays	Target As	ssignment	Target Engagement
	Mean:	0 Mean:		Mean:
service and service services	Sigma:	0 Sigma:		Sigma:
			ОК	

Figure 11-8. Edit C3 Node Dialog

Name: This is a text string that is used to identify the C3 Node throughout **ARES.** It is displayed under C3 Node folder on the Templates tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for the model.

<u>Command Authority</u>: If selected, then this C3 node will make decisions to engage weapons.

Max Tgt Track: This is the maximum number of targets that this C3 node can track at one time.

<u>Max Engagement</u>: This is the maximum number of target engagements that the C3 node can manage simultaneously.

Decision Delay:

- Track Reporting: This is a delay (in seconds) that will be applied at this node when forwarding track reports to other players.
- <u>Target Assignment</u>: This is the delay (in seconds) that will be applied at this node when assigning targets to other players (requires command authority).
- <u>Target Engagement</u>: This is the delay (in seconds) that will be applied at this node when giving target engagement commands (requires command authority).

D. EDITING A RADAR MODEL

A radar model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears **as** in Figure 11-7 which contains only a single entry for the users to specify the name that is used **to** identify the model throughout ARES. It is displayed under Radars folder on the Templates **tab**, and will be used in other lists **as** well. It is imperative that the users define a concise, but descriptive name for the model.

E. EDITING A TARGET MODEL

A target model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears **as** in Figure 11-7 which contains only a single entry for the users to specify the name that is used to identify the model throughout

ARES. It is displayed under Targets folder on the Templates tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for the model.

F. EDITING A TEL MODEL

A Transporter Erector Launcher (TEL) model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open.** In either case, the users are presented with a dialog that appears **as** in Figure **11-7** which contains only a single entry for the users to specify the name that is used to identify the model throughout *ARES*. It is displayed under TELs folder on the Templates tab, and will be used in other lists **as** well. It is imperative that the users define a concise, but descriptive name for the model.

G. EDITING A WEAPON MODEL

A weapon model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears **as** in Figure **11-9** which contains four properties to be defined **as** described below.

Name: This is a text string that is used to identify the weapon throughout ARES. It is displayed under Weapons folder on the Templates tab, and will be **used** in other lists **as** well. It is imperative that the users define a concise, but descriptive name for the model.

Home-on-Jam: If selected, then this weapon can home on jammers within its lethal envelope if that jammer is jamming the target tracking radar for this missile.

Weapon Type: Select the radio button indicating the class of this weapon.

Parameters:

- <u>Min / Max Range</u>: Defines the minimum and maximum lethal ranges of the weapon in nautical mile.
- <u>Min / Max Altitude</u>: Defines the minimum and maximum altitudes of the targets that can be engaged by this weapon.

Edit Weapon	공항 전문 전자 거리에 가운 것 같은 것이 같이 많이 다.	र नहीं हैं हुएत हैं की में 🗙
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and the second		
and a state of the		en antes de la companya de la companya Companya de la companya de la company
Name: New Model	T Home-On	-Jam
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		and the second
-Weapon Type	Parameters	
한 출연을 통하게 많았다. 동네는 것 같아?	돈은 집에 많은 것 않았다. 그는 것이 아파 생활한	장 그 같은 것 같은 것 같아?
		n Chân
C SAM	Min Range (n.mi.):	UCCU
2485 명화 <u>- 188</u> 8 명화 문화 문화		~
CASM	Max Range (n.mi.):	0
생활 그렇게 것 이가 한 것 그렇지?	그는 그 나는 것을 많이 한 같을 것 같다.	
c plants		
C Bomb	Min Altitude (ff)	0 20 2
금 활동 여기가 전쟁을 하고 있었다.	말할 때 이 가지는 것을 가려면 것을 가지 않는 수요? 방법에	
CARM	전통의 모퉁감을 걸고 가지 않았다. 그 그는 없겠 <mark>~~~</mark>	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
I AFIM	Max Altitude (ft)	0.000
o <u>1. Kozolikoska dinke – Ma</u> ri	있는 1997년 1998년 1998년 1998년 1999년 1999년 1998년 199 1999년 1999년 1998년 1998년 1998년 1998년 1998년 1998년 1998년 199	
동생 방법에서는 것은 것에서 가지 같아? 것 같아요.		
영화 수밖에 가지 않는 것을 못 속 것이다.	OK I	
, 영영, 영상, 영상, 영상, 영상, 영상, 영상, 영상, 영상, 영상	A TANK AND A STREET	지수는 사람들에서
말 모두 없는 것같은 그리고 말했다. 않는		

Figure 11-9. Edit Weapon Dialog

H. EDITING A NETWORK MODEL

A network model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears **as** in Figure 11-10 which contains three properties to be defined **as** described below.

Name: This is a text string that is used *to* identify the network throughout ARES. It is displayed under Networks folder on the Templates tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for the model.

Color: Opens a dialog allowing the users to select the line color corresponds to the network connecting players on the map in Edit view window.

<u>Wire / Wireless</u>: Select the radio button representing the connection type of this network. Wired networks do not perform line-of-sight or range checks, while wireless networks will employ line-of-sight and range checks.

Network			
Name:	Jammer Net		
Color:			
	CWire		
	Wireless		
	ОК		

Figure 11-10. Network Dialog

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XII. PLAYERS TAB COMMANDS

The "Players" tab of the Scenario Workbook displays all instantiated objects in the scenario in a hierarchical tree format. The tree presentation may be used to represent a command and control hierarchy. If importing an MSFD file, the tree will be created for the users automatically using the Unit Subordination Codes embedded in the MSFD file. The Players tab supports standard cut, copy, paste, and delete functions. These commands operate on all selected (highlighted in yellow) objects and may be accessed via the Edit drop-down menu and File toolbar menu.

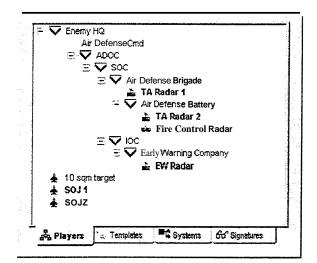


Figure 12-1. Sample of Players Tab Hierarchy

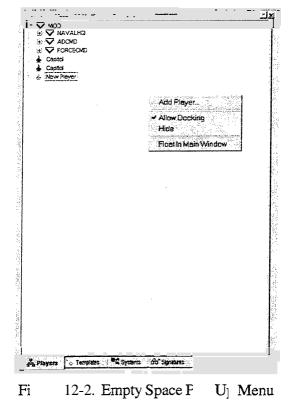
A. TREE OPERATIONS

The tree presented in the Players tab supports several basic operations. These are described as follows:

1. Right-Clicking Open Area

Right-clicking the open area of the Players window presents the users with a context-sensitive menu as shown in Figure 12-2. The operation of interest is Add Player which displays a pop-up menu as shown in Figure 3-14 for creating a new, neutral object 139

of selected type at the geographic center of the scenario to the top level of the tree structure. Choosing any item from this menu presents a dialog box listing available models of the chosen type for selection. These models must have been previously created on the Templates tab of the Scenario Workbook. Alternatively, this command may be accessed via the Scenario drop-down menu and Scenario toolbar menu.



2. Rij Player

Right-clicking **a** player of "static" type presents the users with a context-sensitive menu as shown in Figure **12-3**. There are **12** operations of interest as described below.

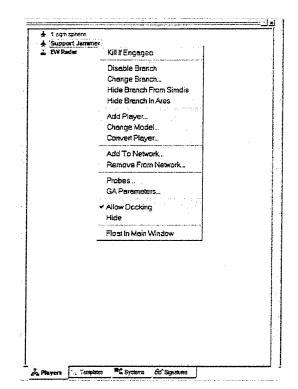


Figure 12-3. Player Pop-Up Menu

a. Kill **F** Engaged

This command is displayed only when the players is not of "static" type. This is a form of kill removal. If this is selected, then this player will stop playing (i.e., be killed) if it is ever engaged by **a** weapon.

b. Enable / Disable Branch

This command allows the users to select whether a player will participate in a scenario. This option was put in so that the users could have one large scenario, then simply disable the players that are not relevant for a particular run. When a player is disabled, it will appear in a darker color on the map.

c. Change Branch

This command invokes the dialog as shown in Figure 12-4 and applies the selected command globally to all players that are members of the branch.

Change Branch			NER TRACK
	Random Radius:		n.mi.
같은 이 가는 가슴 생활했다. [11] - 이 가는 가슴 생활했다.	90 I. 90 S. 40 S.		
	Probes Off		
2013년 - 11일 - 11일 - 12일 - 12일 12일 - 12일 - 12 12일 - 12일 - 12			
19 - See 2두	Probes On		
			가 있는 것이 같은 것을 알려졌다. 사람과 같은 것 같은 것
	Systems Off		
	ОК	1	

Figure 12-4. Change Branch Dialog

d. Hide Branch From SIMDIS

If selected, this player will not appear in any SIMDIS graphics [Ref. 37.

e. Hide Branch in ARES

If selected, this player will not appear in ARES map view (a sort of "declutter" button).

f. Add Player

Selecting this command displays a pop-up menu as shown in Figure **3-14** for creating a new, neutral object of selected type at the geographic center of the scenario to the next lower level of the tree structure. Choosing any item from this menu presents a dialog box listing available models of the chosen type for selection. These models must have been previously created on the Templates tab of the Scenario Workbook. Alternatively, this commands may be accessed via either the Scenario drop-down menu or the Scenario toolbar menu.

g. Change Model

Selecting this command displays a dialog box listing available models of the chosen type for selection.

h. Convert Player

Selecting this command displays the player **type** dialog **as** shown in Figure **3-15** allowing the users to convert the selected object from one type to another. Alternatively, this commands may be accessed via either the Scenario drop-down menu or the Scenario toolbar menu.

i. Add to Network

This command is displayed only when the players is not of "static" type and presents a dialog box listing available network for selection. These networks must have been previously created on the Templates tab of the Scenario Workbook. A player can participate on an unlimited number of networks.

j. Remove from Network

This command is displayed only when the players is not of "static" type. Selecting this option presents a dialog box listing available networks of which the player is a member for participation removal.

k. GA Parameters

Selecting this command invokes the Genetic Algorithm dialog which features two pages, **GA Parameters and GA Constraints**, containing properties to be defined for GA simulation. This command is displayed only if the player is not "static" type and is identified **as** belonging to the friendly force in the player's Identification property page described in Section B. When a player is flagged for GA selection, its name is displayed in red.

<u>GA Parameters</u>: As shown in Figure 12-5, this page contains two block of information described below.

(1) <u>Search Space</u>: Allows players to define the search space that

GA optimization is based on.

- <u>Existence</u>: If checked, then the GA will determine whether this player exists or not (i.e., whether it is needed).
- <u>Altitude</u>: If checked, then the GA will select the appropriate operating altitude for the player.
- <u>Latitude and Longitude</u>: If selected, then the GA will select the appropriate operating latitude and longitude for the player.
- <u>Model</u>: If selected, then the GA will select which type of model this player is.

(2) <u>Cost</u>: Defines the relative cost of the player. This feature is

obsolete and can be ignored.

GA Constraints: This page, shown in Figure 12-6, consists of three

properties to be edited **as** followed:

- <u>Minimum</u>: This is the lower bound of the search space for this parameter
- <u>Maximum</u>: This is the upper bound of the search space for this parameter
- <u>Increment</u>: If the search space is discrete, then this is a positive number defining the size of the **"grid"**. If the users want a continuous search space, then enter 0.

1. Probes

This command is displayed only when the players is not of "static" type and presents a dialog allowing the users to select parameters of interest for post-processing analysis. In general, the dialog is a combination of several pages: the Player page, individual page for each system associated with player's model, and the Network page if the player is participated on the network. Description of each page is detailed **as** followed. When a probe is set, the selected player's name is displayed in bold letter.

Genetic Algorithm		×
GA Parameters GA Constraints		े
-Search Space		
☐ Existence		
ピ Altitude	}	1
Latitude and Longitude [Model List.]		
Cost: 1		
•		
OK Cancel	Help	

Figure 12-5. GA Parameters Dialog

Parameter	Minimum	Maximum	Increment
Altitude	0	100000	1000
Latitude	-90	90	1
Longitude	-180	180	1

Figure 12-6. GA Constraints Dialog

The Player page, as shown in Figure 12-7, contains two fundamental

blocks of information as described in detail below.

(I) Scalar. Scalar probes are written in iteration/value pairs.

• <u>Number of Targets Engaged</u>: Outputs the number of targets engaged for the current iteration for this player.

(2) <u>Vector</u>. Vector probes are written in time/value pairs.

- <u>Target Assignment</u>: Outputs information concerning targets assigned for this player.
- <u>Target Engagement</u>: Outputs infomation concerning targets engaged for this player.

Scal	8 .		
	Scalar output is recorded in iteration/v	alue pairs	
	<u> Number Of Tergets Engaged</u>		
-Vect			
	Vector output is recorded in time/value	pairs	
	Target Assignment		
	Target Engagement		
	Track Reporting		
	1 Hack reporting		

Figure 12-7. Player Probe Dialog

The **ECM** page, as shown in Figure 12-8, contains two fundamental blocks of information as described in detail below.

Probes Player	Low Band ECM Low Band ESM	
		n mini i promini kultura (n. 1990) - Ali
1	Scalar output is remrded in iteration/value pairs	· · · ¥
	Active time (seconds)	
	${f F}$ Utilization (% jamming time when active)	2
I	✓ Jamming time (seconds)	
ł		
Vect	or	
I	Vector output is recorded in time/value pairs	
ļ	F Mode change	ł
	F Jamming initiated	
	☑ Jamming dropped	;
I		
<u>.</u>		d
		Help

Figure 12-8. ECM Probe Dialog

(1) Scalar. Selecting any option in this block creates an output file

labeled "S_*.txt" containing the identified post-processing output for the select player.

- <u>Active Time</u>: **Outputs** the total on time of the jammer associated with the selected player.
- <u>Utilization</u>: Outputs the percentage of time the jammer associated with the selected player is actively jamming.
- Jamming Time: Outputs the total jamming time of the jammer associated with the selected player.

(2) <u>Vector</u>. Selecting any option in this block creates an output file

labeled "V_*.txt" containing the identified post-processing output for the select player.

- <u>Mode Change</u>: Outputs the time instances when a ECM mode change occurred.
- <u>Jamming. Initiated</u>: Outputs the time instances when jamming is initiated against a particular radar.
- <u>Jamming</u>. **Dropped**: Outputs the time instances when jamming is dropped against a particular radar.

The ESM page, as shown in Figure 12-9, contains two fundamental blocks

of information **as** described in detail below.

(1) <u>Scalar</u>. Selecting any option in this block creates an output file

labeled "S_*.txt" containing the identified post-processing output for the select player.

- <u>Active Time</u>: Outputs the total on time of the ESM associated with the selected player.
- <u>Utilization</u>: Outputs the computed percentage of time the ESM is sampling the environment.
- <u>Tracking Time</u>: Outputs the total time the ESM associated with the selected player is actively tracking.
 - (2) <u>Vector</u>. Selecting any option in this block creates an output file

labeled "V_*.txt" containing the identified post-processing output for the select player.

- <u>Mode Change</u>: Outputs the time instances when a ESM mode change is detected.
- <u>Tracking Initiated</u> Outputs the time instances when tracking is initiated against a particular radar.
- <u>Tracking: Dropped</u>: Outputs the time instances when tracking is dropped against a particular radar.
- <u>Acquired / Lose LOS</u>: Outputs the time instances when **LOS** is acquired or dropped against a particular radar.

- <u>Pulse Density</u>: Outputs the pulse density processed by the ESM system associated with the selected player at any time instances.
- <u>Signal Density</u>: Outputs the signal density detected by the ESM system associated with the selected player at any time instances.
- <u>Pulse Descriptor Word</u>: Selecting this option creates an output file labeled "P_*.txt" containing pulse train data. Be careful when requesting pulse descriptor words (PDW's) since it is easy to flood the data disk. Consider requesting PDW "snapshots" by use of vector start and vector end.

–Scal	Low Band ECM Low Band		
	Scalar output is recorded i	in iteration/value pairs	
	Active time (seconds)		
	✓ Utilization (% sampling)	time when active)	*******
	Tracking time (semnds		
-Vect	DI		
	Vector output is recorded in	n time/velue pairs	
***	F Mode change	Pulse Density	
l	Track initiated	Signal Density	
1	Track dropped	Pulse Descriptor Wards	
-	F Acquire/Lose LOS		

Figure 12-9. ESM Probe Dialog

The <u>**Radar**</u> page, as shown in Figure 12-10, contains two fundamental blocks of information as described in detail below.

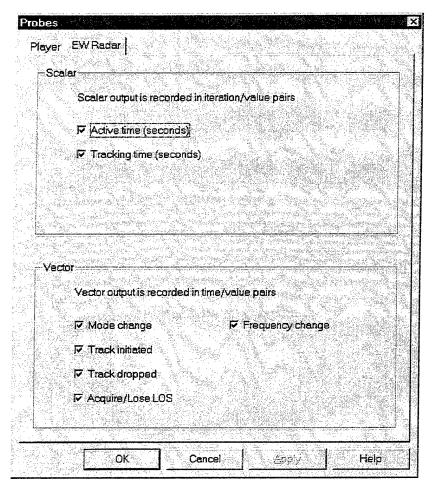


Figure **12-10.** Radar Probe Dialog

(1) Scalar. Selecting any option in this block creates an output file

labeled "S_*.txt" containing the identified post-processing output for the select player.

- <u>Active Time</u>: Outputs the total illumination time of the radar associated with the selected player.
- <u>Tracking Time</u>: Outputs the total time of the radar associated with the selected player is actively tracking a target.

(2)<u>Vector</u>. Selecting any option in this block creates an output file

labeled "V_*.txt" containing the identified post-processing output for the select player.

• <u>Mode Change</u>: Outputs the time instances when radar initiates a mode change.

- <u>Tracking Initiated</u>: Outputs the time instances when a radar initiates track against a particular target.
- <u>Tracking Dropped</u>: Outputs the time instances when a radar drops track against a particular target.
- <u>Acquired / Lose LOS</u>: Outputs the time instances when LOS is acquired or dropped against a particular target.
- <u>Frequency Change</u>: Outputs the time instances when a radar initiates a frequency change.

The Network page, as shown in Figure 12-11, contains two fundamental

blocks of information **as** described in detail below.

(1) <u>Scalar</u>. Selecting any option in this block creates an output file

labeled "S_*.txt" containing the identified post-processing output for the select player.

- <u>Transmit Utilization</u>: Outputs the percentage of time that this player was in the process of transmitting data on the given network for this iteration.
- <u>Max Oueue Size</u>: Outputs the maximum amount of data that was in the queue for this network.
- <u>Average Oueue Delay</u>: Outputs the average delay that a packet experienced on this network for this player.
- <u>Max Queue Delay</u>: Outputs the maximum delay that a packet experienced.
 - (2) <u>Vector</u>. All vector data is time/value pairs and appears in the

V_*.txt file for the player.

- <u>Packet Statistic on Receive</u>: Outputs the time the packet was received **as** well **as** the delay incurred from the time it was first entered into the sending player's queue.
- <u>Packet Statistic on Transmit</u>: Outputs the time the packet was transmitted **as** well **as** the delay incurred at this node (i.e., the time of transmission minus the time the packet was entered into the queue).

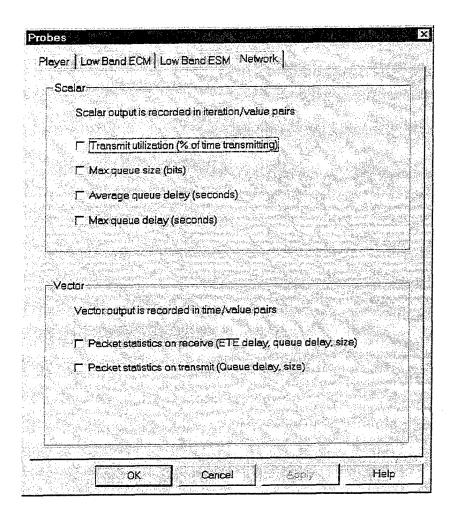


Figure 12-11. Network Probe Dialog

B. EDITING A PLAYER

Double-clicking an object from the Players tab of the Scenario **Workbook** opens a dialog for editing. The result of this action is the same as double-clicking the object from the Edit view. In general, the dialog is a combination of several pages as described below.

1. Identification

The Identification page, shown in Figure 12-12, is displayed for every player and contains several properties to be defined as described below.

Site: This is a text string that is used **to** identify the player in ARES. It is imperative that the users define a concise, but descriptive name for player.

Sequence: This is a numeric string that is uniquely identify the player to ARES. Players in the scenario can be assigned the same name, but different sequence number for identification.

Eorce: This box allows the users to specify **frcm** a drop-down whether the selected player is friend, foe, or neutral. This affects only the color with which that force is displayed (Friend: blue, Foe: red, Neutral: grey).

Status: This information is contained in the MSFD files and is not used in ARES.

Function: This **can** be used for filtering purposes. When the users use the **ARES** filter function, it will ask the users for function codes to keep.

<u>Time Frame</u>: This can be used for filtering purposes.

2. Position

This page, shown in Figure 12-13, is displayed when the selected player is of "static" type and allows the users to specify the position of the player in term of latitude and longitude.

Publish Subscribe ESM Identification Waypoints	Subscribe Redar	Subscribe ECM
Site ID Site: Support Jammer Sequence: 1100 Force: A • Status: Type: Function: Player ID Type: Aircraft Model: Support Jammer	Subordination Group: Corps: Division: UDI: UDC: UnitType: Brigade: Battalion:	Time Frame □ Year 1 □ Year 2 □ Year 3 Bitmap Bitmap ↓ Lock
Model: Support Jemmer	Company	Lock

Figure 12-12. Player's Identification Properties Dialog

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Figure 12-13. Player's Position Dialog

3. Waypoints

The Waypoints page, shown in Figure 12-14, is displayed when the selected player is of any type other than "static" and contains several properties allowing the users to specify the route leg of the player, **as** described below.

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Figure 12-14. Player's Waypoints Dialog

Latitude: This input field is used to identified the desired latitude location of the player. Valid format for this field is DD.MMSSFF where D=degrees, M=minutes, S=seconds, and F=fraction of second. The toggle button to the right of the latitude data entry field is used to specify the reference with respect to the equator.

Longitude: This input field is used to identify the desired longitude location of the player. Valid format for this field is DD.MMSSFF where D=degrees, M=minutes, S=seconds, and F=fraction of second. The toggle button to the right of the longitude **data** entry field is used to specify the reference with respect to the true north.

<u>Random Radius</u>: Any number greater than zero in this field results in the player appearing somewhere within a circle equal to the specified radius and centered on the waypoint latitude and longitude.

Altitude: This field specifies the player altitude in feet that ARES will use to evaluate detection coverage. The toggle button to the right of the altitude data entry field is used to specify the reference for computing the altitude measurements for analysis, AGL (Above Ground Level) and MSL (Mean Sea Level).

Marker: Specifies what type of point this is.

- <u>Waypoint</u>: If this marked **as** a waypoint, then the platform will pass through this point.
- <u>Orbit</u>: If this is marked **as** an orbit point, then the platform will orbit this point at a radius determined by the platform speed and G's in the turn. It will orbit this point for a period of time indicated in the delay columns.

<u>Speed</u>: This field specifies the player traveling speed in knots between waypoints.

<u>**G's in Turn:**</u> This field specifies the players G limit during turn. This impacts the bank angle and time to *turn* through a waypoint.

Delav in Minutes: If specified in the first row and marked **as** waypoint, this is the time in minutes at which this player will enter the scenario and begin moving. If this is an orbit point, then this is the time that the platform will orbit this point.

Delay in Seconds: If specified in the first row and marked as waypoint, this is the time in seconds at which this player will enter the scenario and begin moving. If this is an orbit point, then **this** is the time that the platform will orbit this point.

<u>Color Box</u>: Clicking the cell displays a dialog to change the color of the drawed line connecting the selected player's waypoints.

4. System

This page is displayed for each system associated with the model that the player is based on. The dialog page for radar, ESM, and ECM is identical with the exception of the dialog heading. A sample ECM dialog page is provided in Figure 12-15. As shown, the dialog page contains four fundamental blocks of information. These are described in detail below.

Minutes: Defines the time in minutes at which the mode will be activated.

Seconds: Defines the time in seconds at which the mode will be activated.

Mode: Single-click on the cell allows the users to specify a particular mode from the drop-down list to be activated. The modes available to the users are those that were created under the Systems tab for the selected system.

Dynamic Mode Selection: Selecting this option activates a dialog box listing modes available to the chosen system for selection to be dynamically activated when cued to do so by a C3 node player. The mode available to the users are those that were created under the Systems tab for the selected system.

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Figure 12-15. Sample of the Player's ECM System Dialog

5. Publish

The Publish page, as shown in Figure 12-16, is displayed only when the players is a network participant. It contains seven fundamental blocks of information to be specified for network transmission. These are described in detail below.

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Figure 12-16. Player's Publish Dialog

ON / OFF: Select the radio button indicating whether the player is active on this

network (transmit and receive).

Network: Clicking the cell displays a drop-down menu listing networks of which

the selected player is a member for selection to transmit information on.

Location and ID Reports: Provides the users with options to control the frequency that updates Location and ID reports of this player to other participants on the network. If the transmission to be done at a fixed interval, the users must also specify the priority for message handling. Depending on the priority, network places the packet into 1 of 3 queues. High priority is to be processed first. If there is bandwidth left over, network processes normal priority second. If there is still bandwidth left over, it processes low priority packets last.

<u>Comm Parameters</u>: Allows the users to specify the parameters for network communication.

- <u>Word Size</u>: Specifies the word size in number of bits.
- <u>Range</u>: The distance over which this player can fling a packet on this network.
- <u>Data Rate</u>: Specifies transfer rate in bits per second.
- <u>Multiplier</u>: Models the increase in word size to account for error correction coding and repeated transmissions by the communication device (i.e., the packet size will be increased by the multiplier entered here).

ESM Detection Reports: Provides the users with options to control the frequency that updates ESM Detection Reports of this player to other participants on the network. When Transmits Only New/Changed Information radio button is selected, the network will broadcast only when there is new information to report. If the transmission to be done at a fixed interval, the users must also specify the priority and scheme for information update. Depending on the priority, network places the packet into 1 of 3 queues. High priority is to be processed first. If there is bandwidth left over, network

processes normal priority second. If there is still bandwidth left over, it processes low priority packets last.

- <u>Partial Update</u>: Periodically broadcast just enough information to let the world the know the status of information transmitted before.
- <u>Full Update</u>: Rebroadcast everything periodically. This is selected if the users require high transmission reliability and cannot be certain of successful transmission each and every time.

Radar Detection Reports: Provides the users with options to set the priority for network transmission of radar detection update message. Depending on the priority, network places the packet into 1 of 3 queues. High priority is to be processed first. If there is bandwidth left over, network processes normal priority second. If there is still bandwidth left over, it processes low priority packets last.

Relays: Select the radio button indicating whether the users want the selected network to remit information to another network specified by the users and of which the player is a member.

6. Subscribe ESM

The Subscribe ESM page, **as** shown in Figure 12-17, is displayed only when the player is a network participant. It contains a list of information that can be requested by this player from a network. If the **Subscribe** radio button is selected, players will issue a request **to** receive the selected information from the network specified by the users and of which it is a member. Other players on the same network will transmit the requested information only if they possess an ESM system that offers this information on their Report page. A request for information by a player on their Subscribe page is no

guarantee that they will actually have their request fulfilled. The information requested is described below.

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Player Position (3 words)	Π Mode (8)	
Transmit Time (1 word)		T On/Off Stat	te (1)
L. Altitude (1 word)		Phase MO)P(1 word)
Average PPI (1 word]		F PRI (1 word)
T Azimuth AOA (1 ward)		Pulse Widt	h (1 word)
Classification (32)		ſ⊤ SEI(32)	
T Elevation AOA(1 word)		T SEI Match I	Number (1 word)
FMO? (1 word)		T SEI Parame	eters (16 words)
Frequency (1 word)		Track Num	ber (16)
T Latitude (1 word)	- 	☐ Track Qual	hy (4)
ОК	1	Cancel	Apply Help

Figure 12-17. Player's Subscribe ESM Dialog

<u>Plaver ID</u>: This is an 8-bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

<u>Player Position</u>: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying the player's current position.

<u>Transmit Time</u>: This is a single word that identifies the time at which the packet was created. Select this if the users want each packet to have a time-stamp indicating the age-of-the information to its recipients.

<u>Altitude</u>: This is a single word representing the altitude of the detected player which is being reported in this packet. Selecting this parameter implies that the ESM has the ability to resolve and report altitude.

Average PRI: This is a single word representing the average PRI of the reported emitter.

Azimuth AOA: This is a single word representing the azimuth angle of arrival of the reported emitter.

<u>Classification</u>: This is 32-bit parameter uniquely identifying the classification of the reported emitter.

Elevation AOA: This is a single word representing the elevation angle of arrival of the reported emitter.

FMOP: This is a single word representing the frequency modulation on pulse (e.g., chirp) of the reported emitter.

Frequency: This is a single word representing the frequency of reported emitter. If there are multiple frequency, then one word will be generated per PRI. Latitude: This is a single word representing the latitude of the reported emitter.

Longitude: This is a single word representing the longitude of the reported emitter.

Mode: This is 8-bit parameter uniquely identifying the mode of the reported emitter.

On/Off State: This is a single word representing the status **of** the reported emitter (on or **off)**.

<u>Phase MOP</u> This is a single word representing the phase coded waveforms (e.g. barker code) of the reported emitter.

PRI: This is a single word representing the **PRI of** the reported emitter. If there are multiple **PRI**, then one word will be generated per **PRI**.

<u>Pulse Width</u>: This is a single word representing the pulse width of the reported emitter.

SEI: This is a 32-bit parameter representing the unique identification of the emitter (if the receiver has **SEI** capability).

<u>SEI Match Number</u>: This is a single word representing the quality of the identification.

SEI Parameters: This is 16 words representing the uniquely computed coefficients that were used to determine identification.

Track Number: This is a 16-bit parameter representing the locally assigned track number.

Track Quality: This is a 4-bit parameter representing the quality of the track.

7. Subscribe Radar

The Subscribe Radar page, **as** shown in Figure 12-18, is displayed only when the players is a network participant. It contains a list of information that can be requested by this player **from** a network. If the **Subscribe** radio button is selected, players will issue a request to receive the selected information from the network specified by the users and of which it is a member. Other players on the same network will transmit the requested information only if they possess a radar system that offers this information on their Report page. A request for information by a player on their Subscribe page is no guarantee that they will actually have their request fulfilled. The information requested is described below.

<u>Player ID</u>: This is an 8 bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

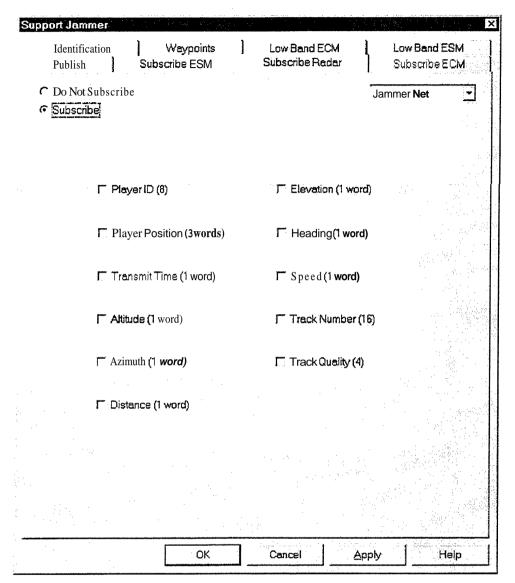


Figure 12-18. Player's Subscribe Radar Dialog

<u>Plaver Position</u>: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying the player's current position.

Transmit Time: This is a single word that identifies the time at which the packet was created. Select this if the users want each packet to have a time-stamp indicating the age-of-the information to its recipients.

<u>Altitude</u>: This is a single word representing the altitude of the track which is being reported in this packet. Selecting this parameter implies that the radar has the ability to resolve and report altitude (i.e., it is either a 3-D radar or a height-finder).

Azimuth: This is a single word representing the azimuth angle of the reported track.

<u>Distance</u>: This is a single word representing the distance of the reported track.

Elevation: This is a single word representing the elevation angle of the reported track.

Heading: This is a single word representing the heading of the reported track. Selecting this parameter implies that the radar has the ability to resolve and report the heading of the track.

Speed: This is a single word representing the speed of the reported track. Selecting this parameter implies that the radar has the ability to resolve and report the speed of the track.

Track Number: This is a **16** bit parameter representing the locally assigned track number.

Track Quality: This is a 4-bit parameter representing the quality of the track.

8. Subscribe ECM

The Subscribe **ECM** page, as shown in Figure 12-19, is displayed only when the players is a network participant. It contains a list of information that can be requested by this player from a network. If the **Subscribe** radio button is selected, players will issue a request to receive the selected information from the network specified by the users and of which it is a member. Other players on the same network will transmit the requested information only if they possess an ECM system that offers this infomation on their Report page. A request for information by a player on their Subscribe page is no guarantee that they will actually have their request fulfilled. The information requested is described below.

<u>Plaver ID</u>: This is an 8 bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

<u>Plaver Position</u>: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying player's current position.

Transmit Time: This is a single word that identifies the time at which the packet **was** created. Select this if the users want each packet to have a time-stamp indicating the age-of-the information to its recipients.

Track Number: This is a 16bit parameter representing the locally assigned track number.

Engaged/Disengaged: This is a 1-bit parameter identify if the track is engaged or disengaged.

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Figure 12-19. Player's SubscribeECM Dialog

The Execute view is the second of the three views available for a document. It is activated by selecting the "Execute" tab along the bottom of the current document's frame. This view displays a screen for text output which provides feedback from an executing scenario, as shown in Figure **13-1**. In Execute view executing scenario commands are accessed via the Run Control Toolbar.

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Figure 13-1. Sample of Execute View Window

A. RUNTIME CONTROL BAR WINDOW

The Runtime Control **Bar** are where execution parameters editing activities takes place. It is displayed whenever the Execute view is active and features three tabs, as shown in Figure 13-2, representing three processing algorithms as described below.

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Figure 13-2. Basic Runtime Control Bar Window

1. Basic

Executing from this page invokes the conventional algorithm in ARES for computing complex interaction of multiple radar systems being acted upon by multiple airborne ECM aircraft, considering target aircraft radar cross section and altitude, terrain masking effects, both standoff jamming and self protection jamming effects, and network connection effect. As shown in Figure 13-2, input parameters *to* the Basic processing are organized into five fundamental blocks of information described as follows.

<u>**Time Control:**</u> Allows the users to define the number of trials, the execution time interval, and time step.

Scalar Output: Allows the users to define the start and end time for exporting scalar data specified in Robes dialog.

Vector Output: Allows the users to define the start and end time for exporting vector data specified in Probes dialog.

Run Options: Allows the users to select the model and set LOS Update rate.

- <u>High Fidelity</u>: The high fidelity model will use ESMs that will actually sample the environment in time according to the tune schedule specified by their current mode.
- <u>Low Fidelity</u>: The low fidelity model will use ESMs that will declare detection against radars for which they have sufficient sensitivity to detect their backlobe emissions. This model does not follow the tune schedule and, therefore, is more computationally efficient at the expense of accuracy.
- LOS Update Rate: Typically this value is set to 1/time step in Hz.

<u>SIMIDIS</u>: The users have the option of exporting data that can be read into SIMIDIS for high-performance visualization. Selecting this box activates the "SIMIDIS Settings" button with which the users can access a dialog to select what to have output to SIMIDIS, **as** shown in Figure 13-3. When ARES is executed, an output file with an extension of "**.asi**" is created for use with SIMIDIS software, a product of NRL ENEW Division [Ref. 3].

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Figure 13-3. SIMDIS Settings Dialog

2. GA

Executing from this page invokes the Genetic Algorithm to produce an optimized configuration of what the core and peripheral components of the AEA architecture should be. To effectively utilize this function, knowledge of the GA concept is required. A detailed description of GA theory can be found in the text written by David Goldberg [Ref. 2]. As shown in Figure 13-4, there are six input parameters to be specified for the process. The definition of each parameter is as follows:

Generations: Defines the number of generations to execute the GA.

Population Size: Defines the number of individuals in the GA population.

<u>Pcrossover</u>: Defines the probability that any individual will experience genetic crossover in the creation of children.

<u>Pmutation</u>: Defines the probability that any gene in an individual will mutate.

ť

<u>Elitism</u>: If on, the GA will employ elitism.

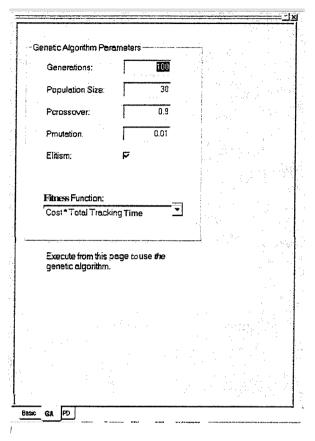


Figure 13-4. GA Runtime Control Bar Window

Fitness Function: Contains a list of six **MQE** objective function values for selection to compute an optimal **GA** solution. The definition of each objective function is **as** follows:

- <u>Cost * Total Tracking Time</u>: This function is obsolete and can be ignored.
- <u>Total Tracking: Time</u>: Minimize the cumulative tracking time of the strike aircraft by the ground emitters which have been flagged **as** being probed.
- <u>Emitters Detected</u>: Maximize the percentage of the ground emitters detected by the airborne ESM systems.
- <u>Target Engagements</u>: Minimize the number of **SAM** engagements of strike interceptor. Two criteria have to be met to be considered a successful engagement: 1) the strike aircraft has to be tracked by the tracking mode of the radar, and 2) the strike aircraft has to be within the *SAM* engagement envelope. An engagement is considered to occur the first time these

conditions are met. Intermittent engagements or additional engagements by the same threat are not considered to be an engagement.

- <u>Time Targets Engaged</u>: As depicted in Figure 13-5, this minimizes the amount of time the strike aircraft are engaged by the SAM systems.
- <u>Sum Time Targets Engaged</u>: As depicted in Figure 13-5, this minimizes the cumulative sum of the individual **SAM** engagement times of the strike aircraft.

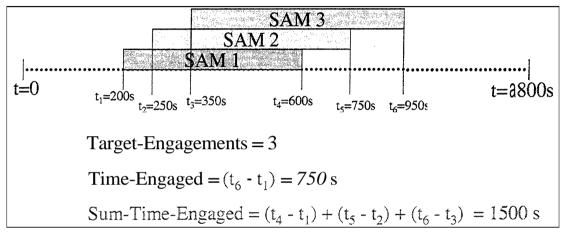


Figure 13-5. MOEs Graphical Explanation

3. PD

Executing from this page invokes the algorithm to produce jamming power density map. The users can then display the results on the Edit view. As shown in Figure 13-6, there are four input parameters required €or the process. The definition of each parameters is as follows:

<u>Resolution</u>: This is the resolution of the grid that **will** produce the power density map (i.e., the pixel size).

<u>Period</u>: This is the time period for taking "snapshots" of the power density. For example, if the Period is 30 seconds, then power density contours will be produced every **30** seconds of simulated time.

Elevation: This is the elevation at which the power density should be measured. **A** value of zero here will show the power density measured on the surface of the terrain. If the users want to represent what a typical radar antenna would see, then enter a value around 15 feet (average height of a radar antenna).

Set Frequencies: Button, when depressed, opens a dialog allowing the users to specify the frequency ranges over which to collect power density maps. For example, if the users enter 150 - 200 MHz as a frequency range, then ARES will create a power density map of all jammer power that falls within 150-200 MHz.

								3
- J	lamming P	ower Dens	ity Param	eters				
	Resolu	ton (deg):		0			. '	
	Period	(sec):	<u> </u>	0		i. Ali takan		
	Elevatio	on (ft AGL):		0,				
							n in the State of the second	
		SetFre	quencies]				
	jammin	e from this p g power de	insity mep	\$	· · · ·			

Figure 13-6. PD Runtime Control Bar Window

XIV. CHART VIEW WINDOWS

The Chart view is the last of the three views available for a document. It is activated by selecting the "Chart" tab along the bottom of the current document's frame. This view displays graphs of post-processed run output based on selection from the Post-proc Control Bar described in the following sections.

A. POST-PROC CONTROL BAR WINDOW

The Post-proc Control Bar is where the users can select a particular post-processed performance parameters for output. It is displayed whenever the Chart view is active and features four tabs as describe below.

1 Radar

The Radar page, shown in Figure 14-1, lists nine chart options available for evaluating radar performance. These options are divided into two fundamental blocks **as** described below. For each option, the data available for plotting are those that were flagged for output on the Radar Probes dialog under the Players tab.

Single Iteration: Displays the selected performance parameter for a specified iteration.

- <u>Multi-Radar Detection History</u>: Presents dialogs for specifying the radar systems, target site, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the detection performance over time for every specified radar systems against the elected target site.
- <u>Multi-Radar Detection Histomam</u>: Presents dialogs for specifying the radar systems, target site, time interval, iteration, and iteration of interest, in addition to number of bins. *ARES* then displays a clustered column chart in the Chart view window illustrating the detection distribution over time for every radar systems specified by the users. In general, histogram chart provides two purposes. One is to give a feeling for the degree to which a

platform is detectable at any point in time. The second is that the area under the histogram is equivalent to the total tracking time MOE.

- <u>Single-Radar Detection History</u>: Presents dialogs for specifymg a radar systems, time interval, and iteration of interest. **ARES** then displays a clustered bar chart in the Chart view window illustrating the detection performance over time for the selected radar system.
- <u>Single-Radar Detection Histomam</u>: Presents dialogs for specifying a radar systems, time interval, and iteration of interest, in addition to number of bins. **ARES** then displays a clustered column chart in the Chart view window illustrating the detection distribution over time for the selected radar system. In general, histogram chart provides two purposes. One is to give a feeling for the degree to which a platform is detectable at any point in time. The second is that the area under the histogram is equivalent to the total tracking time MOE.

<u>All Iteration</u>: Displays the selected performance data for all iterations.

- <u>Single Radar Frequency Change</u>: Presents dialogs for specifying the radar systems and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when frequency changes occur over time for the identified radar system.
- <u>Single Radar Mode Change</u>: Presents dialogs for specifying the radar systems and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when mode changes occur over time for the identified radar system.
- <u>Single Radar Acquire LOS</u>: Presents dialogs for specifying the radar systems and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when the target LOS is first acquired by the identified radar system.
- <u>Single Radar Detection Ranges</u>: Presents dialogs for specifying the radar systems and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating the range in nautical miles at which the target is first detected by the identified radar system.
- <u>Multiple Radar Detection Ranges</u>: Presents dialogs for specifying the radar systems and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating the range in nautical miles at which first detection occurs for every identified radar systems.

Export Data: Prompts the users for the name of a text file to write the selected performance data into. This file may be read into other programs for further analysis (e.g., Microsoft Excel).

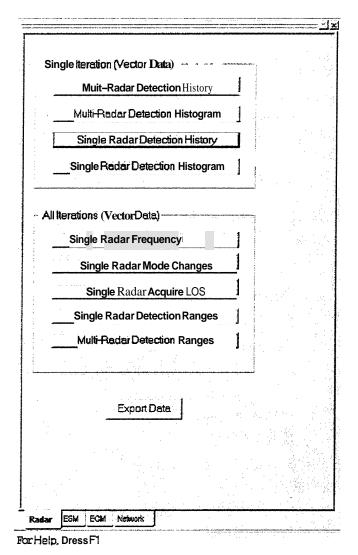


Figure 14-1. Radar Post-proc Control Bar

2. ESM

This ESM page, shown in Figure 14-2, presents seven charting options available for evaluating an ESM performance. These options are divided into two fundamental blocks as described below. For each option, the data available for plotting are those that were flagged for output on the ESM Probes dialog under the Players tab for the selected player.

<u>Single Iteration</u>: Displays the selected performance parameter for a specified iteration.

- Multi-ESM Detection History: Presents dialogs for specifying ESM systems, target site, time interval, and iteration of interest. **ARES** then displays a clustered bar chart in the Chart view window illustrating the detection performance over time for every identified ESM system.
- Single ESM Detection History: Presents dialogs for specifying an ESM system, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the detection performance over time for the identified ESM system.
- <u>Multi-ESM Signal Density</u>: Presents dialogs for specifying ESM systems, target site, time interval, and iteration of interest. **ARES** then displays a clustered bar chart in the Chart view window illustrating the signal density over time for every identified ESM system.
- Multi-ESM Pulse Density: Presents dialogs for specifying ESM systems, target site, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the pulse density over time for every identified ESM system.

<u>All Iteration</u>: Displays the selected performance parameter for all iterations

specified in the Basic Runtime Control Bar.

- <u>Single ESM Acquire LOS</u>: Presents dialogs for specifying an ESM system and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when first **LOS** acquisition **occurs** over time for the identified ESM system.
- <u>Multiple ESM Time-of-Detect</u>: Presents dialogs for specifying ESM systems, target site, and time interval of interest. **ARES** then displays a scattered plot in the Chart view window indicating when first LOS acquisition occurs over time for every identified ESM system.
- <u>Single ESM Time-of-Detect</u>: Presents dialogs for specifying **an** ESM system and time interval of interest. ARES then displays a scattered plot in the Chart

view window indicating when first detection occurs over time for the identified ESM system.

Export Data: Prompts the users for the name of a text file to write the selected performance data into. This file may be read into other programs for further analysis (e.g., Microsoft Excel).

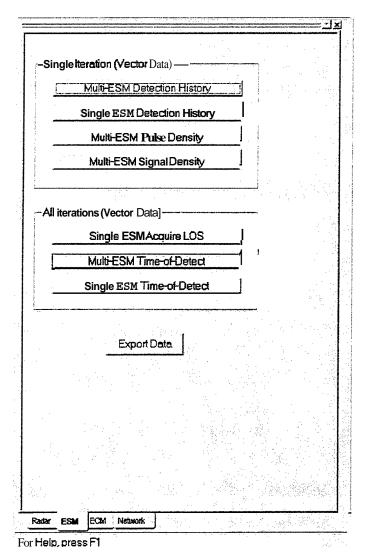


Figure 14-2. ESM Post-proc Control Bar

3. ECM

The ECM page, shown in Figure 14-3, presents four charting options for evaluating the ECM performance. These options are divided into two fundamental blocks as described below. For each option, the data available for plotting are those that were flagged for output on the ECM Probes dialog under the Players tab for the selected player.

Single Iteration: Displays the selected performance parameter for a specified

iteration.

- <u>Multi-ECM Jamming Histow</u>: Presents dialogs for specifying ECM systems, target site, time interval, and iteration of interest. **ARES** then displays a clustered bar chart in the Chart view window illustrating the jamming performance over time for every ECM systems specified by the users.
- <u>Single ECM Jamming Histow</u>: Presents dialogs for specifying an ECM system, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the jamming performance over time for the identified ECM system

All Iteration: Displays the selected performance parameter for all iterations

specified in the Basic Runtime Control Bar.

- <u>Multiple ECM Time-of-Jam</u>: Presents dialogs for specifying ECM systems, target site, and time interval of interest. **ARES** then displays a scattered plot in the Chart view window indicating when jamming first occurs over time for every identified ECM system.
- <u>Single ECM Time-of-Jam</u>: Presents dialogs for specifying an **ECM** system and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when jamming first occurs over time for the identified ECM system.

Export Data: Prompts the users for the name of a text file to write the selected

performance data into. This file may be read into other programs for further analysis

(e.g., Microsoft Excel).

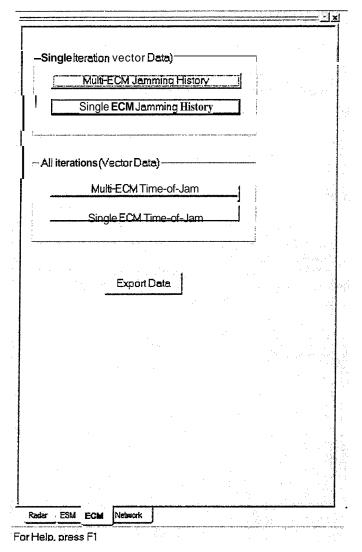


Figure 14-3. ECM Post-proc Control Bar

4. Network

This page, **as** shown in Figure 14-4, allows the users the opti n to elect a network performance parameter for charting. These parameters must have been previously flagged on the Network Probes dialog from the Players tab for the selected player.

Single Iteration: Displays the selected performance parameter for a specified iteration.

- **<u>Tk</u>** Oueue Delay: Presents dialogs for specifying a system, time interval, and iteration of interest. **ARES** then displays a chart in Chart view window illustrating the amount of time each packet spent waiting in a queue before transmission.
- **<u>Tk</u>** Packet Size by **Priority**: Presents dialogs for specifying a system, time interval, and iteration of interest. **ARES** then displays a chart in Chart view window illustrating the size of each packet transmitted, grouped by the priority of the packet.
- <u>**Tx** Packet Size by Type</u>: Presents dialogs for specifying a system, time interval, and iteration of interest. *ARES* then displays **a** chart in Chart view window illustrating the size of each packet transmitted, grouped by the type of packet.
- <u>**Tx** Utilization</u>: Presents dialogs for specifying a system, time interval, and iteration of interest. **ARES** then displays a chart in Chart view window illustrating a moving average of the percentage of time this player was in the process of transmitting a packet for each network.
- <u>Rx End-to-End Delay by **Priority**</u>: Presents dialogs for specifying a system, time interval, and iteration of interest. **ARES** then displays a chart in Chart view window illustrating the latency of each packet grouped by priority.
- <u>Rx ETE Delay by Classification</u>: Presents dialogs for specifying a system, time interval, and iteration of interest. **ARES** then displays a chart in Chart view window illustrating the latency of each packet grouped by the information contained in the packet.
- <u>Rx Total Oueue Delay by Priority</u>: Presents dialogs for specifying a system, time interval, and iteration of interest. **ARES** then displays a chart in Chart view window illustrating the portion of the latency incurred in queues grouped by priority.
- <u>Rx Utilization</u>: Presents dialogs for specifying a system, time interval, and iteration of interest. **ARES** then displays a chart in Chart view window illustrating a moving average of the percentage of time this player was in the process of receiving a packet for each network.
- <u>Rx Packet Size by **Priority**</u>: Presents dialogs for specifying a system, time interval, and iteration of interest. ARES then displays a chart in Chart view window illustrating the size of each packet grouped by priority.
- <u>Rx Packet Size by Type</u>: Presents dialogs for specifying a system, time interval, and iteration of interest. **ARES** then displays a chart in Chart view window illustrating the size of each packet grouped by type.

<u>All Iteration</u>: Displays the selected performance parameter for all iterations

specified in the Basic Runtime Control Bar.

- <u>**Tx** Utilization by Network</u>: Presents dialogs for specifying a player and time interval of interest. ARES then displays a chart in Chart view window illustrating the transmit utilization for each iteration grouped by network.
- <u>**Tx** Average Queue Delay</u>: Presents dialogs for specifying a player and time interval of interest. ARES then displays a chart in Chart view window illustrating the average queue delay for each iteration.
- <u>Tx Max Oueue Delay</u>: Presents dialogs for specifying a player and time interval of interest. ARES then displays a chart in Chart view window illustrating the maximum queue delay for each iteration.
- <u>**Tx** Max Queue Size</u>: Presents dialogs for specifying a player and time interval of interest. **ARES** then displays a chart in Chart view window illustrating maximum queue size for each iteration.

r 8	ngle lieration (Vector Data)
-	
-	Tx Packet Size by Priority
	Tx Packet Size by Type
	Tx Utilization (Moving Average)
	Pax End-to-End Delay by Priority
	Rx ETE Delay by Classification (ESM)
	Rx Total Queue Delay by Priority
	Rx Utilization (Moving Average)
	Px Packet Size by Priority
ir T	Px Packet Size by Type
ا سبت	
- AI	Iterations (Scalar Data)
j.	Tx Utilization by Network
	Tx Average Queue Delay
ļ.	Tx Max Queue Dèley
	Tx Max Queue Size

Figure 14-4. Network Post-proc Control Bar

APPENDIX A. MULTI-BEAM RADAR EXAMPLE

This appendix presents a modeling example of a complex radar with multiple beams. For demonstration, Fan Song E is selected. The parameters for the radar are summarized in Table B-1. These parameters are basically obtained from Jane's database online at <u>www.ianesonline.com</u>. Parameters that are needed but not given in the database are then either calculated or estimated. These are **as** shown on the **ARES** dialog samples (Figures B-1 through B-24). To test the model, a scenario was set up as shown Figure B-25 to determine the detection range. The simulation results are shown in Figure B-26 for 10 iterations with the end time of 3600 seconds.

Vertical antenna				
Frequency	5,010-5,090 MHz			
Azimuth Beamwidth	7.5°			
Elevation Beamwidth	1.5°			
Scan Type	Vertical Sector			
Scan Sector	7.5°/rev			
Scan rate	15.5-17 revlsec			
Horizontal antenna				
Frequency	4,910 x 4,990 MHz			
Azimuth Beamwidth	1.5°			
Elevation Beamwidth				
Scan Type	Horizontal Sector			
Scan Sector	7.5°/rev			
Scan rate	15.5-17 rev/sec			
Т	ransmitter			
Peek power	1,500kW			
PRI	694 – 1200 µs			
Syster	n Performance			
Unambiguous range	75-150 km/40.5-81 nmi			

Table B-1. Fan Song E Parameters from Jane's Database

Receivers		Modes	Report
Properties	Resources	Antennas	Transmitten
Name: Fan Son	E	Classification	UNCLASSIFIED
Reference			
ELNOT:		Detection Range (n	mi.): 55
Tracking	llip-Scan 🕻	Probability of Det	ertion
	mp-ocar ·		EENDIT
C		a de la constante de la constan	
-Establish		Maintain	
Establish Blips:	<u>3</u> ∰ ₹	Maintain Blips:	_1 <u></u>
	4 4	Blips: Scans:	
Blips:	4 4	Blips	<u>1世</u> <u>4世</u>
Blips:	4 4	Blips: Scans: fault	

Figure B-1. Fan Song E Radar Properties Dialog

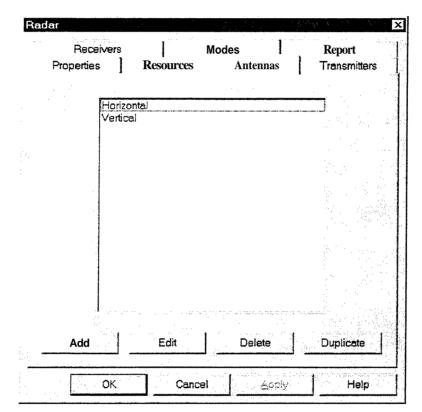


Figure B-2. Fan Song E Radar Antenna Dialog

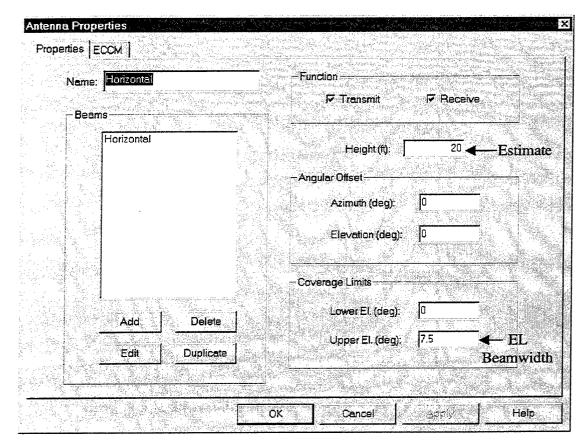


Figure B-3. Fan Song E Radar Horizontal Antenna Properties Dialog

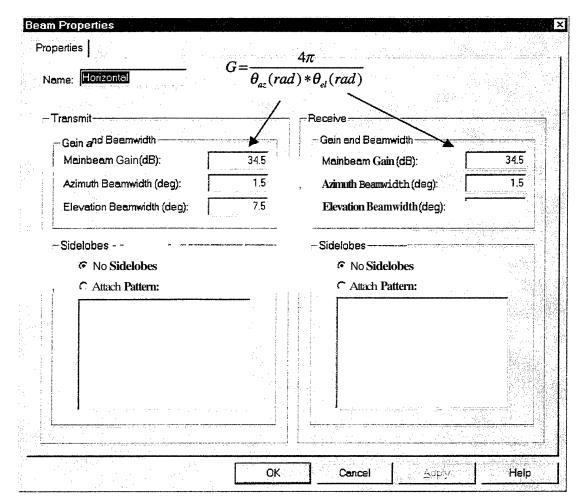


Figure B-4. Fan Song E Radar Horizontal Beam Properties Dialog

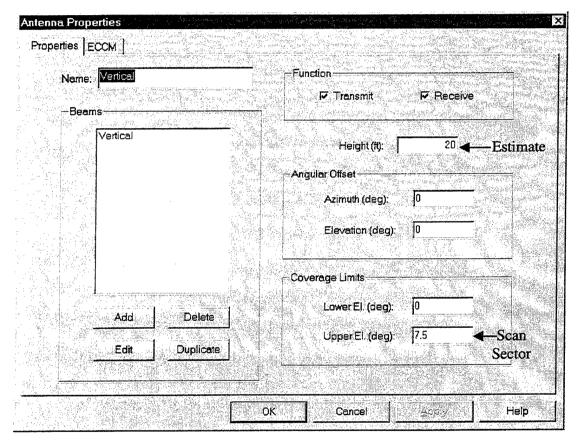


Figure B-5. Fan Song E Radar Vertical Antenna Properties Dialog

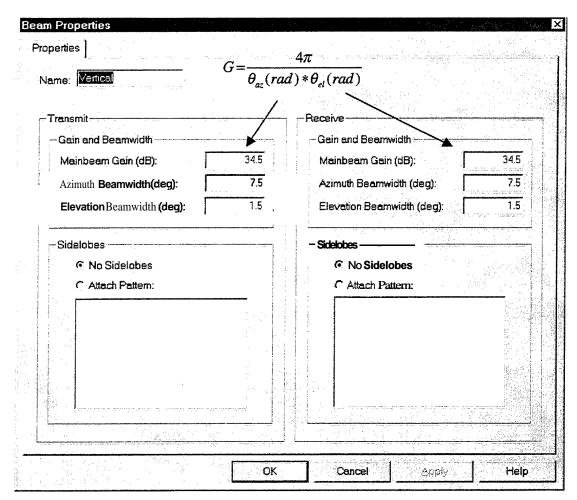


Figure B-6. Fan Song E Radar Vertical Beam Properties Dialog

Radar - Contractor - Contractor - Contractor	<u>A state of the second s</u>
Receivers Modes	l Report
Properties Resources Anto	annas Transmitters
Horizontal Vertical	
Venica	
Add Edit De	lete Duplicate
OK Cancel	

Figure **B-7.** Fan Song E Radar Transmitters Dialog

Transmitter Properties				×
Properties				
Name: Hor	izontal	· · · · · · · · · · · · · · · · · · ·	n an	
Peak Power (KW):	1500	Transmission Line Loss	s(dB):	7 ³
	-FrequencyCov	erage	Est	imate
	From:	4910 MHz		
	То:	4990 MHz		
Antenna		.	د الله . ۱۹۹۵ - ۲۰۱۹ ۱۹۹۵ - ۲۰۱۹ - ۲۰۱۹ ۱۹۹۵ - ۲۰۱۹ - ۲۰۱۹ - ۲۰۱۹	
	elect antenna used l orizontal	by this transmitter:		
	ertical			
	· · · · · · · · · · · · · · · · · · ·			
	ОК	Cancel	<u>A</u> galy	Help

1 5

Figure B-8. Fan Song E Radar Horizontal Transmitter Properties Dialog

		the second s	
Peak Power (KW).	1500	Transmission Line Los	s (dB): 3
	-Frequency Cov	erage	Estimate
	From:	5010 MHz	
	To:	5090 MHz	
Antenr	19	그는 그릇 때 이는 것이 작품에 걸 것입지 중 운영이었다.	
- 김영영과 - 동그의 입장 중에서 영화 등 것이다.	승규 선생님은 전문을 가지 않는 것이 없다.	ki ki ka ki	
	Select antenna used t	by this transmitter	
: 	승규 선생님은 전문을 가지 않는 것이 없다.	ay this transmitter.	
: 	Select antenna used t Horizontal	ay this transmitter.	
: 	Select antenna used t Horizontal	ay this transmitter	
: 	Select antenna used t Horizontal	y this transmitter	
: 	Select antenna used t Horizontal	ay this transmitter.	

Figure B-9. Fan Song E Radar Vertical Transmitter Properties Dialog

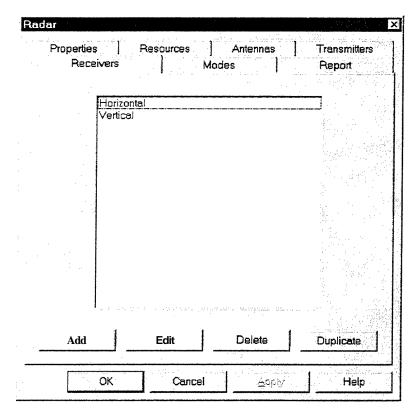


Figure **B-10.** Fan Song E Radar Receivers Dialog

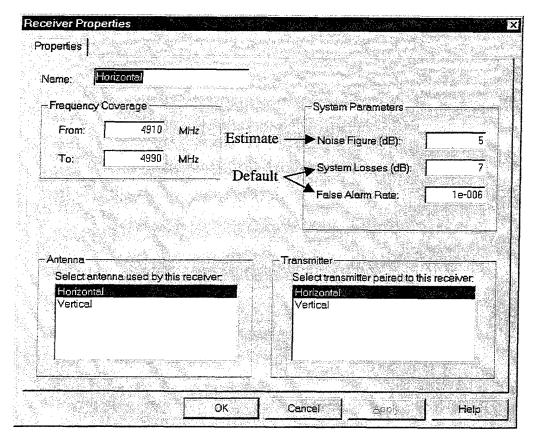


Figure B-11. Fan Song E Radar Horizontal Receiver Properties Dialog

qləH	Cancel	DK				
		يتسبك والمحمد		<u></u>		÷
	lanizontel Verticel		5		Horizontel Vertical	
receiver	ranimer paired to this Select transmitter paired to this	1	eviscei vir	p.Kq pəsn eu	Antenna-	
				· · ·		
900-a r	Felse Alem Rate:					
<u>.</u>] :(gp) sessoໆ ພats/S	Default <	ZHM) :oT	
<u>9</u>	Noise Figure (dB):	Estimate -	2HM	0109	From:	
			· ·		Frequency Cc	· · ·
aga sa				(Ca)	lame: Ver	N
in de la construction services constructions services constructions de la construction de	n an				seities	ыЧ

Figure B-12. Fan Song E Radar Vertical Receiver Properties Dialog

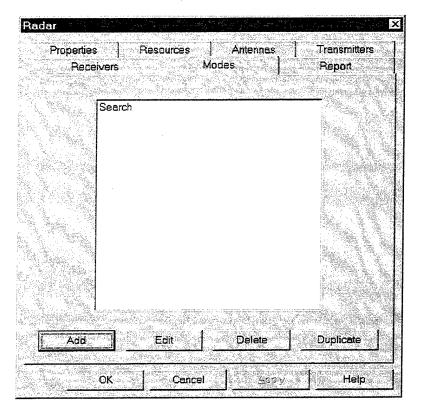


Figure B-13. Fan Song E Radar Modes Dialog

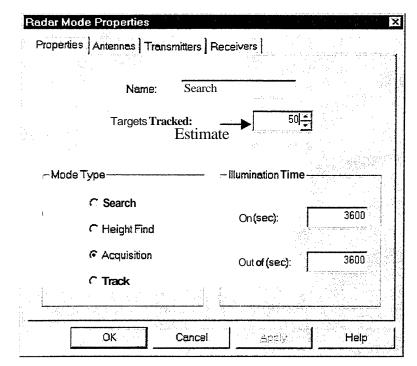


Figure B-14. Fan Song E Radar Mode Properties Dialog

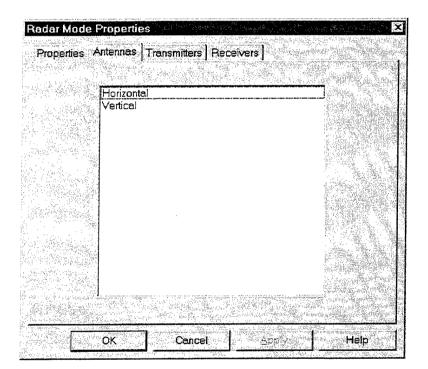


Figure B-15. Fan Song E Antennas-Radar Mode Properties Dialog

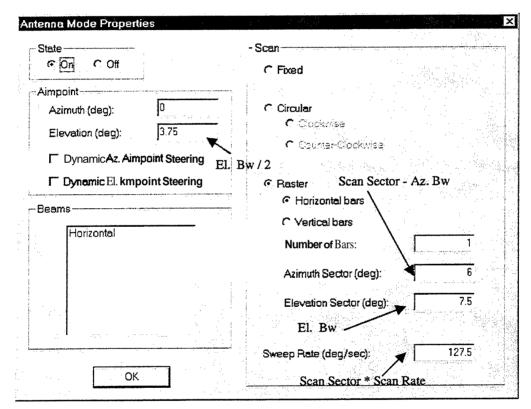


Figure B-16. Fan Song E Horizontal Antenna Mode Properties Dialog

am Mode Propertie	S	
State		
Polerization	Estimate	
Vertical	· Polarization is fixed, choose one at a	
T Horizontal	C Polarization shanges to reduce inter	
C Slant Right	C Polarization changes ause to oulse C Polarization changes every	— secands
☐ Slant Left		
I RHC	 C Receive same sense as transmit C Receive approprie sense of transmit 	
	$m{c}$ Receive sense unrelated to trensmit	
Scan Relative to A	itenna	
🕫 Fixed 🖌	Estimate	
Azimuth Angl	e trom Antenna Boresight (deg): 💦 🗡	
Elevation An	gle from Antenna Boresight (deg):	
C Random		
Az Sector (de	g): El Sector (deg):	Free Constant
C Vertical Scan	Beam Dwell (ms):	
	Beam Positions:	
1. See 2. See 1. See 2. See		•

Figure **B-17.** Fan Song E **Horizontal Beam** Mode Dialog

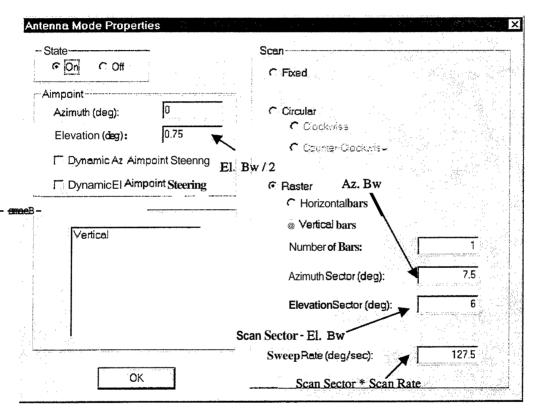


Figure B-18. Fan Song E Vertical Antenna Mode Properties Dialog

State	
ତ ତିମ ତି ତିମ	것 같은 것이 같아요. 그는 것 같아요. 그는 것 같아요. 가슴을 가려야 한 것이 같이 가슴을 가지 않는 것 같아요. 같이 많을 것 같아요. 같이 많을 것 같아요. 같이 많을 것 같아요. 것 같아요.
Polarization	Estimate
🗆 Vertical	C Poletization is fixed, choose one at random
F Horizontal	C Polenzation changes to reduce interference
☐ Slant Right	C Polenzation changes bulse to pulse C Polenzation changes sivery Seconds
🗂 Slant Left	
	 Receive seméreense as transmit Receive opposite sense of transmit
LHC	 Receive uppresse serve or duration Receive serve unrelateoria transmit.
Scan Relative to Ar	ntenna Estimate
Fixed 4	
Azimuth Angl	le from Antenna Boresight (deg): D
Elevation Any	igle from Antenna Boresight (deg): 0
C Random	
Az Sector (de	eg): El Sector (deg):
C Vertical Scan	Beam Dwell (ms):
	Beam Positions:
The second s	

Figure B-19. Fan Song E Vertical Beam Mode Dialog

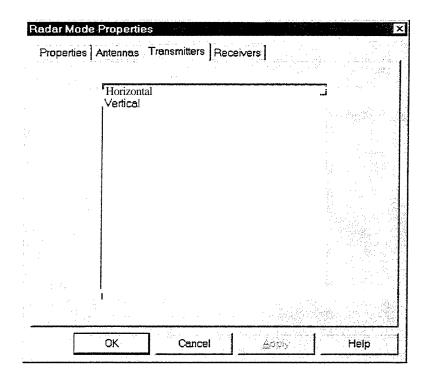


Figure B-20. Fan Song E Transmitters-Radar Mode Properties Dialog

State	- RF Agility		
ି ତିନ୍ତି ଦି ଓ ମିଳୁ କରି			
Frequencies	C Pulse-group to pulse-group:		
C Continuous	C Periodic seconds		
Channelized	C Manual decision time:		
Frequencies: $\square \times + +$	J/N Threshold (dB):		
4920 4940 Estimate 4960 4980	Equipment switch time: seconds.		
	- PRI		
Continuous Wave	PRI Stable: 694 microsec		
C Continuous Weve	Stable: 694 microsec		
	Stable: 694 microsec C Jitter: +/- 26		
ulse	 Stable: 694 microsec ⊂ Jitter: +/- ∞ C Stagger. 		
ulse Pulsewidth: 0.4 microsec © No MOP	Stable: 694 microsec C Jitter: +/- 26		
ulse Pulsewidth: 0.4 microsec No MOP Chirp: MHz	 Stable: 694 microsec ⊂ Jitter: +/- ∞ C Stagger. 		
ulse Pulsewidth: 0.4 microsec © No MOP	 Stable: 694 microsec ⊂ Jitter: +/- ∞ C Stagger. 		

Figure B-21. Fan Song E Horizontal Modulation Dialog

Modulation	
State	RF Agility Fixed
– Frequencies	C Pulse-group to pulse-group:
Continuous	C Periodic seconds.
Channelized	C Manual decision time: seconds.
Frequencies: $\square \times $	J/N Threshold (dB):
5060 5080	Equipment switch time: seconds.
· · · · ·	- PRI
Continuous Wave	Steble: 694 microsec
Pulse	⊂ Jitter. +/- 8%
Pulsewidth: 0.4 microsec	€ Stagger:
C No MOP	PRIs:
C Chirp: MHz	
C Phase code bits	
ОК	

Figure B-22. Fan Song E Vertical Modulation Dialog

Properties Antennas Transmith	ers Heceivers	
Horizontal		
Vertical		

Figure B-23. Fan **Song** E Receivers-Radar Mode Properties Dialog

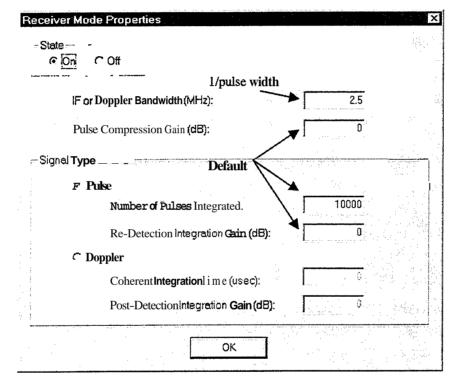


Figure 3-24. Fan Song E Horizontal and Vertical Receiver Mode Properties Dialog

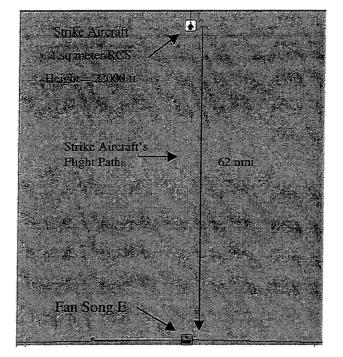
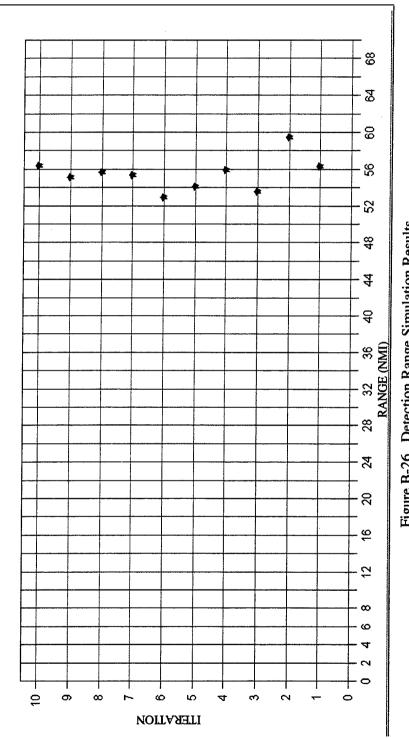


Figure B-25. Detection Range Simulation Scenario





......

LIST OF REFERENCES

- 1. J. P. Ridder, "Technology Selection in ARES", Event and Date unknown.
- 2. Goldberg, D. E., *Genetic Algorithms*, 1st ed., Addison-Wesley, 1999.
- 3. Naval Research Laboratory, ENEWS, Code 5705, SZMDZS 6.2.8 The Advanced Analysis & Display Tool User's Guide, 1 June 1999.

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