## OPERATOR HANDBOOK

# GUIDANCE ON ADAPTABLE PARAMETERS

# DOPPLER METEOROLOGICAL RADAR WSR-88D

OFFICE OF PRIMARY RESPONSIBILITY:
NATIONAL WEATHER SERVICE RADAR OPERATIONS CENTER



PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF
COMMERCE, THE AIR FORCE, THE NAVY, AND TRANSPORTATION

**31 March 2004**

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| Page No. | *Change No. | Page No. | *Change No. |
|---|---|---|---|
| Cover Page | 0 | 13-1 - 13-2 | 0 |
| Title Page | 0 | 14-1 - 14-4 | 0 |
| A | 0 | 15-1 | 0 |
| i-x | 0 | 15-2 Blank | 0 |
| x | 0 | 16-1 | 0 |
| 1-1 - 1-9 | 0 | 16-2 Blank | 0 |
| 1-10 Blank | 0 | | |
| 2-1 - 2-4 | 0 | | |
| 3-1 - 3-15 | 0 | | |
| 3-16 Blank | 0 | | |
| 4-1 - 4-5 | 0 | | |
| 4-6 Blank | 0 | | |
| 5-1 - 5-45 | 0 | | |
| 5-46 Blank | 0 | | |
| 6-1 - 6-6 | 0 | | |
| 7-1 - 7-22 | 0 | | |
| 8-1 - 8-69 | 0 | | |
| 8-70 Blank | 0 | | |
| 9-1 - 9-5 | 0 | | |
| 9-6 Blank | 0 | | |
| 10-1 - 10-11 | 0 | | |
| 10-12 Blank | 0 | | |
| 11-1 - 11-7 | 0 | | |
| 11-8 Blank | 0 | | |
| 12-1 - 12-5 | 0 | | |
| 12-6 Blank | 0 | | |

*Zero in this column indicates an original page.

**TABLE OF CONTENTS**

## TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

**Paragraph** **Page**

## LIST OF ILLUSTRATIONS

## LIST OF ILLUSTRATIONS

## LIST OF ILLUSTRATIONS

## LIST OF ILLUSTRATIONS

# LIST OF TABLES

**Table** **Page**

# Chapter 1
# Overview

## 1.1 Introduction

The WSR-88D system was designed such that modifications to the hardware and software adaptable parameter settings can change their operating characteristics. These changes allow for system optimization based on meteorological, climatological, and regional variations, as well as user preferences.

Recognizing the rapidly changing operational environment and the Federal Meteorological Handbook Number 11 (FMH-11) update cycle, the Doppler Radar Meteorological Observations Working Group (DRMO-WG) chairman initiated the development of more responsive and user oriented adaptable parameters guidance documents. The WSR-88D Guidance on Adaptable Parameters Handbook Series, RPG, RDA, and PUP documents were designed to meet these requirements.

## 1.2 Policy

As mandated by the DRMO-WG, the WSR-88D Guidance on Adaptable Parameters Handbook, RPG has primacy in the area of RPG adaptable parameter guidance and supersedes all other adaptable parameter guidance, memos, and pamphlets issued prior to its publication. This handbook may be supplemented by agency or regional memoranda to clarify policy pertaining to parameters under Unit Radar Committee (URC) and Agency level of authority.

This document, as directed by FMH-11, Part A, serves to identify the specific adaptable parameters that fall under each Level of Change Authority (LOCA). It also defines the Radar Product Generator (RPG) system baseline adaptable parameter settings required to support the national radar network and provides guidance on certain URC and Agency level parameter changes, including parameter impacts and implications.

## 1.3 Levels of Change Authority (LOCA) Philosophy

A hierarchy has been established to ensure maximum flexibility while maintaining data and operational integrity of the WSR-88D units. This hierarchy is divided into three distinct levels: Unit Radar Committee (URC) for changes that only affect the operation of their particular WSR-88D unit, Radar Operations Center (ROC) to address engineering, meteorological, and scientific parameters, and Agency to control parameters that only affect local operations. Each level controls those engineering, operational, and meteorological parameters that best apply to its level of expertise and responsibility.

The definition for each LOCA is provided in Chapter 2. Additionally, Chapter 2 lists each RPG adaptable parameter designated with a LOCA of URC or Agency and provides a cross-reference location into the appropriate chapter.

## 1.4 Document Design Characteristics

The "WSR-88D Guidance on Adaptable Parameters Handbook, Volume 4, RPG", is designed to facilitate ease of use. The handbook is divided into chapters in a pattern matching what is viewed on the Human Computer Interface (HCI) screen of the RPG in the RPG Control/Status window.

Each major adaptable parameters subject area is addressed as a separate chapter. When there are additional subsets, such as Algorithms, those subsets are divided into sections, matching the display or the pull down menus that are used in the respective windows.

At the top of the RPG Control/Status window is a VCP XXX icon in the elevation radials extending from the radome. Click on this icon to bring up the VCP Control window for VCP Definitions. See Figure 1-1.

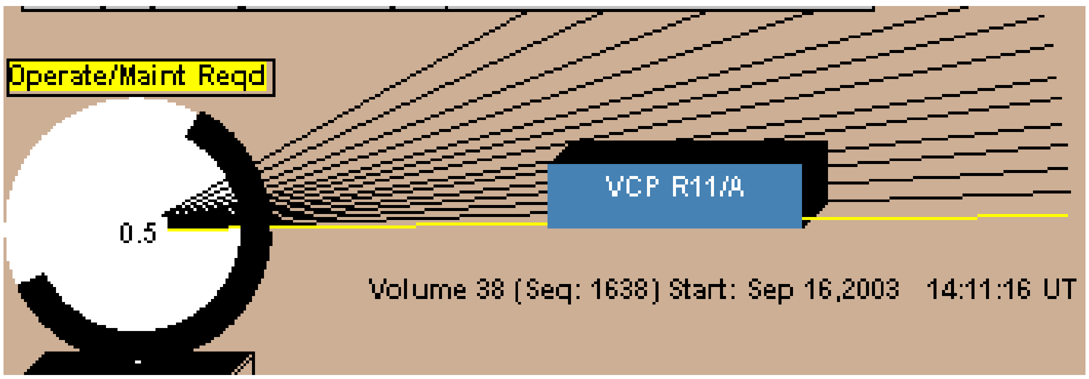



Figure 1-1. VCP Icon

When the RPG Products Icon (See Figure 1-2) is clicked, the RPG Products window (See Figure 1-3) appears and identifies five major areas of Adaptation Data. These are: Alert/Threshold, Generation List, Load Shed Products, Selectable Parameters, and Algorithms.

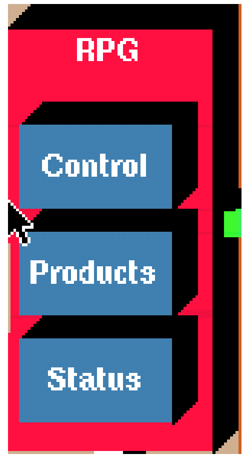



Figure 1-2.  RPG Icon

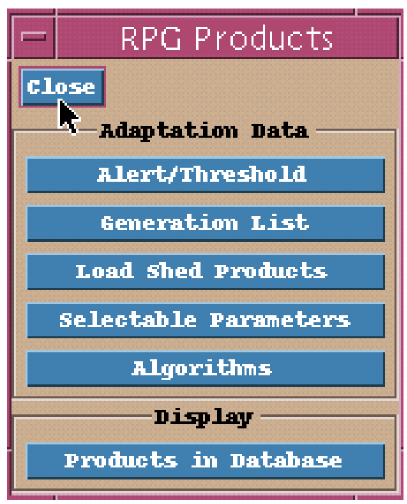



Figure 1-3.  RPG Products Window

Next, inside the USERS icon, there are the Comms and Products buttons.  The Comms button is used to select the Product Distribution Comms Status window, while the Products button is used to select the RPG Product Distribution Control window.  See Figure 1-4.

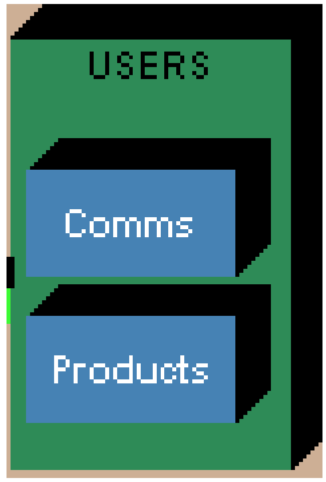



Figure 1-4.  USERS Icons

Below the USERS icon is the Precip Cat: Text string that brings up the Precipitation Status window.  See Figure 1-5.

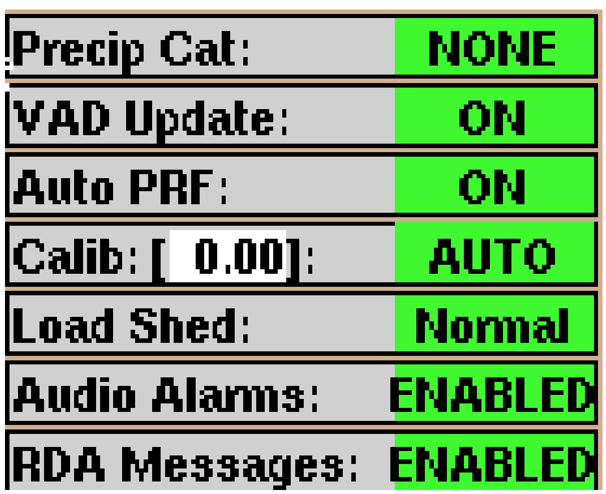



Figure 1-5.  Precip Cat:

Along the far right hand side is the Applications Icons.  The Clutter Regions, Bypass Map Editor, Environmental Data, and HCI Properties (Passwords) windows are available from their respective icons.  See Figure 1-6.

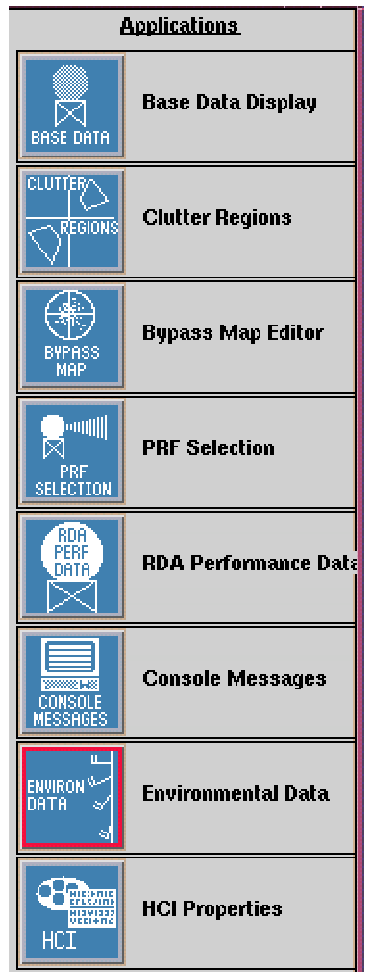



Figure 1-6.  Applications Icons

All windows are displayed as initially seen in the HCI. Several of the windows contain additional information that is available through vertical scroll bars on the right hand margin and/or horizontal scroll bars on the bottom margin.  This additional information is not presented as figures in this handbook but are available to the user in the HCI when the additional information/listings/edit fields are needed.

### 1.4.1   Indicating LOCA Parameters

When adaptable parameters are under LOCA control, a padlock will appear in the upper right hand corner of the window.  Click on the padlock and a Password window will appear with the LOCAs that affect that window.  See Figure 1-7.

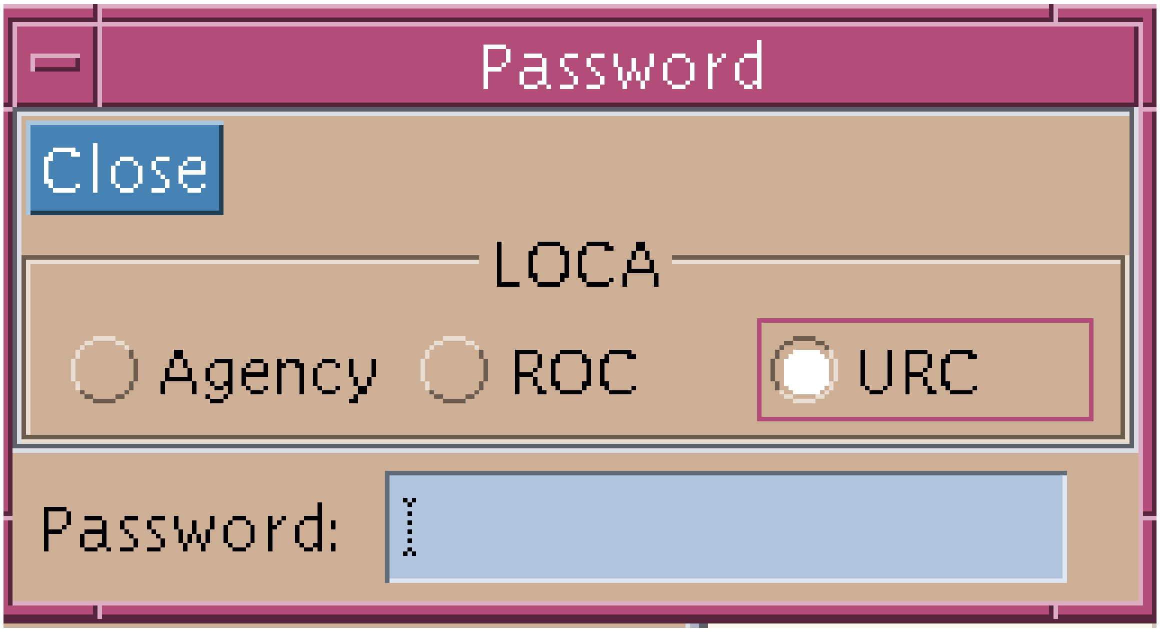



Figure 1-7. Password

Click on the LOCA and the editable field for that LOCA will appear in white lettering. An example is found in Figure 1-8. Enter in the correct password for that LOCA and the padlock becomes open, turns to red, and identifies the LOCA. The editable field(s) then become sensitized, the background will turn to a light blue and the digits turn to black.

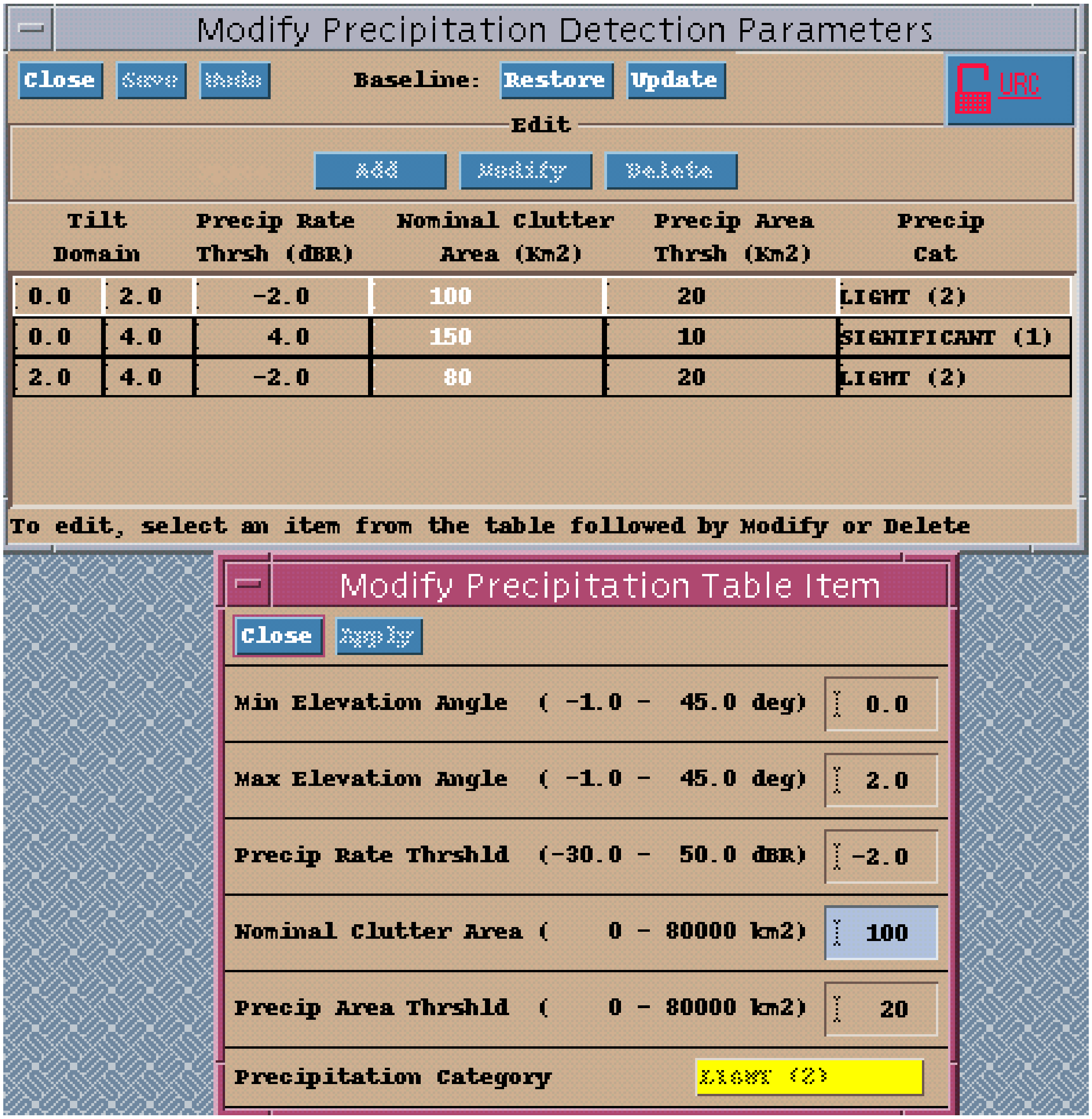



Figure 1-8.  Example of Edit Field

For the purpose of this handbook, all the windows that have editable URC fields will have the URC LOCA clicked so the values show up as white letters/numbers.  The operator may look at the other editable fields by clicking on the ROC or Agency button in the Password window, but will not be able to edit them unless the ROC or Agency password is known.

### 1.4.2 Supplemental Information

When information concerning a possible impact that changes to these parameters will have on the system or algorithm performance, a brief explanation is provided. When additional references are available, pertinent papers and articles are cross-referenced.

## 1.5 Adaptable Parameter Change Process

### 1.5.1 Emergency Changes

An emergency change request can be called into the WSR-88D Hotline and processed to the APWG chairperson as a Request for Technical Information (RTI).

### 1.5.2 Urgent Changes to ROC Controlled Adaptation Data Values

Under certain conditions, in order to best support local warning and forecast capabilities, individual sites may need to change the value of site-specific parameters which are controlled at an ROC LOCA. The need for change may result from local knowledge of radar performance or of other geographic, seasonal, and/or climatological effects. The timeliness of these changes may preclude the normal configuration change process procedures. In these cases, the site may submit an immediate parameter change request to the ROC using the following guidelines:

Requests may only be made by the Chairperson of the URC with the concurrence of the URC voting members. These requests will be made in writing to the Director of the ROC. The ROC will send a copy of the change request to the AFWA/ XPPM, HQ NWS W/OSO112, and FAA NEXRAD Focal Point.

The Adaptable Parameter Working Group (APWG) technically evaluates the waiver parameter change request within 2 working days of receipt and then responds to the ROC Director.

The ROC Director, who is the signatory authority for delegating to sites the responsibility to make changes to ROC level parameters, responds in writing to the originator of the waiver parameter change request using standard agency procedures. In addition, the Director will deliver copies of the response to ROC Configuration Management (CM) and to the agency WSR-88D focal points.

The requesting site can implement the change upon approval from the ROC Director.

### 1.5.3 Routine Changes to ROC Controlled Adaptation Data

The triagencies may request routine changes to ROC-controlled adaptable parameter values. General guidance for DOC (NWS) and DOD Requests for Change (RC) is provided below.

NWS-originated parameter RC will first require the requesting office to submit its request to their regional headquarters WSR-88D focal point. If approved, the regional headquarters will forward the RC to the NWS NEXRAD Committee (NNC) for review. The NNC will forward approved requests to the ROC by memo to the ROC Director, for the attention of the ROC CM Section.

DOD-originated parameter RC should be submitted on AF FM 3215, C4 Systems Requirement Document. The form is submitted for base approval, MAJCOM approval, then AFW approval. If approved at all levels, AFWA/XPPM will submit the CSRD as a RC to the ROC Director, for the attention of the ROC CM section.

RCs received by the ROC Director are forwarded to the ROC CM Section for processing into the Configuration Change Request (CCR) format. The CCR is forwarded to the APWG for their review and recommendation. If approved by the APWG, a recommendation is then forwarded to members of the ROC Configuration Control Board and to the ROC Director, who will approve or disapprove the recommended change. If the Director approves the change, the ROC CM Section will implement the change.

# Chapter 2
# Levels of Change Authority

## 2.1 Authority Definitions

### 2.1.1 Unit Radar Committee (URC)

The URC is authorized to change the values of WSR-88D adaptable parameters and establish adaptation parameter policy for the principal users within the URC, insofar as these changes affect only the operation of the URC's WSR-88D system. Changes that a single URC are authorized to implement are identified in Table 2-1 and Table 2-2 and may include the "fine tuning" needed to meet local operational requirements, seasonal changes, and local climatological characteristics.

### 2.1.2 Radar Operations Center (ROC)

The ROC through the APWG is authorized to determine the general validity and range of adaptable parameter values for changes that involve technical and scientific characteristics of WSR-88D data acquisition and algorithmic processing. In addition, the ROC shall be authorized to determine, specifically, the values of the aforementioned default adaptable parameter values for WSR-88D equipment owned by DOD, DOT, and DOC. Since the APWG shall remain subordinate to the NEXRAD Program Management Committee (PMC), the ROC level of change authority shall reflect the PMC's position on triagency policy in WSR-88D operations.

### 2.1.3 Agency

The DOD, DOT, and DOC, are authorized to change the values of adaptable parameters and establish WSR-88D adaptation parameter policy in order to meet their agency-specific mission requirements and criteria. Changes that a single agency are authorized to implement are identified in Table 2-3 and may involve user passwords and certain telecommunications settings.

## 2.2 URC LOCA Adaptable Parameters

Table 2-1 provides a listing of the RPG adaptable parameters under the change authority of the URC. Section numbers are provided identifying where additional information about the parameter can be found in this document.

Table 2-1. URC LOCA Adaptable Parameters

| Parameter | Section |
|---|---|
| Alert Processing | 4.1 |
| Base Velocity Product Data Levels | 7.8 |
| Clutter Suppression Region Definitions | 12.1.1 |
| Combined Shear Domain (Resolution) | 8.3 |
| Combined Shear Threshold (Combined Shear) | 8.3 |
| Combined Shear Filter Number of Points | 8.3 |
| Combined Shear Elevation Cut to Process | 8.3 |
| Current Volume Coverage Pattern (VCP) Definition | 3.2 |
| Hail Height (0 Degrees Celsius) | 14.3 |
| Hail Height (-20 Degrees Celsius) | 14.3 |
| Hydromet Adjustment Bias Flag | 8.6 |
| Hydromet Preprocessing Max % Likelihood of Clutter | 8.7 |
| Hydromet Preprocessing Number of Exclusion Zones | 8.7 |
| Hydromet Preprocessing - Exclusion Zones (1-20) | 8.7 |
| Hydromet Preprocessing Area with Reflectivity Exceeding Significant Rain Threshold | 8.7 |
| Hydromet Preprocessing Reflectivity Representing Significant Rain | 8.7 |
| Layer Composite Reflectivity - Lowest Height | 7.2 |
| Maximum Number of Cells in STI Alphanumeric Product | 7.1 |
| Maximum Number of Cells in SS Alphanumeric Product | 7.1 |
| Maximum Number of Cells in Hail Alphanumeric Product | 7.1 |
| Maximum Number of Cells in STI Attributes Table | 7.1 |
| Maximum Number of Cells in Combined Attributes Table | 7.1 |
| Maximum Number of Cells in Hail Attribute Table | 7.1 |
| MDA Minimum Reflectivity | 8.9 |
| MDA Overlap Display Filter | 8.9 |
| MDA Minimum Display Filter Rank | 8.9 |

Table 2-1. URC LOCA Adaptable Parameters

| Parameter | Section |
|---|---|
| Nominal Clutter Area (Precipitation Detection) | 11.3 |
| One and Three Hour Precipitation Product Data Levels | 7.3 |
| RPG Control - Default Weather Mode | 16.1 |
| Storm Cell Component - Threshold Max Cell Based Vil | 8.13.2 |
| Storm Cell Tracking Default Storm Direction | 14.3 |
| Storm Cell Tracking Default Storm Speed | 14.3 |
| Storm Total Precipitation Product Data Levels | 7.6 |
| Velocity Azimuth Display (VAD) Beginning Azimuth | 8.18 |
| Velocity Azimuth Display (VAD) Ending Azimuth | 8.18 |
| Velocity Azimuth Display (VAD) Slant Range | 8.18 |
| Velocity Dealiasing - Multi-PRF - Range Unfold Power Difference | 8.20 |
| Velocity Dealiasing - Multi-PRF - Fix Trip Minimum Bin | 8.20 |
| Velocity Dealiasing - Multi-PRF - Fix Trip Maximum Bin | 8.20 |
| URC Level Password | 15.1 |

## 2.3 ROC-Level Adaptable Parameters Delegated to URC LOCA

To enable the field to "fine-tune" certain algorithm parameters, the ROC has delegated the change authority of selected parameters to the URC LOCA. The adaptable parameters in this category may only be modified in accordance to the guidance provided in this document. The limits of the URC authority and the range of allowable parameter selections are clearly defined in the Delegated Authority Restrictions subsection for each parameter. Table 2-2 provides a listing of the specific parameters delegated to the URC LOCA.

Table 2-2. ROC-Level Change Authority Delegated to URC-Level

| Parameter | Section |
|---|---|
| Hail Detection POSH Offset | 8.4 |
| Hydromet Rate Max Precipitation Rate (MXPRA) | 8.8 |
| Hydromet Rate Z-R Multiplier Coef (CZM) | 8.8 |
| Hydromet Rate Z-R Exponent Coef (CZP) | 8.8 |
| Mesocyclone Minimum Number of Pattern Vectors (TPV) | 8.10 |

Table 2-2. ROC-Level Change Authority Delegated to URC-Level - Continued

| Parameter | Section |
|---|---|
| Tornado Detection Algorithm (TDA) Minimum Reflectivity Threshold | 8.17.1.1 |
| Tornado Detection Algorithm (TDA) Maximum Pattern Vector Range | 8.17.1.2 |
| Tornado Detection Algorithm (TDA) Minimized Adaptable Parameter Set | 8.17.2.2 |
| Tornado Detection Algorithm (TDA) Maximum # of Elevated TVSs | 8.17.1.3 |
| VAD and RCM Height Selections | 7.7 |

## 2.4 Agency LOCA Adaptable Parameters

Table 2-3 provides a listing of the RPG adaptable parameters under the change authority of the Agency. Section numbers identify where additional parameter information can be found in this document.

Table 2-3. Agency LOCA Adaptable Parameters

| Parameter | Section |
|---|---|
| Agency Level Password | 15.1 |
| Dial-In User Configuration Table | 9.2.1 |
| Dial-In User Disconnect Override Privileges | 9.2.1 |
| Dial-In User ID | 9.2.1 |
| Dial-In User Maximum Connect Time Limit | 9.2 |
| Dial-In User Port Password | 9.2.1 |

# Chapter 3
# Volume Coverage Pattern (VCP) Definitions

## 3.1 Changing VCPs

The WSR-88D system supports two sets of volume coverage patterns. The "local" set is stored on the RDA hard drive and is not modifiable. The local set will not contain the new VCPs 12 and 121 until the Open Systems RDA is available. The "remote" set of VCPs is stored on the RPG hard drive in adaptation data.

Local VCPs 11 and 21 are defined with predominantly PRF selection #5 while remote VCPs 11 and 21 are defined with predominantly PRF selection #4. With different PRF selections defined for the local and remote sets the operator can change the unambiguous range of the velocity data by simply switching between the local and remote VCPs. Additionally, the signal-to-noise ratio (SNR) threshold for the remote VCPs will allow more weak returns to be processed and displayed.

The VCPs 12 and 121 are only stored as a remote set in the RPG. Their PRF selections can only be modified by making the VCP 12 or 121 the active VCP, then going into the PRF Selection (Modify Current VCP) window and making changes. This will only change the current PRF selections. Once the VCPs are downloaded again either from the RPG or the RDA, the PRF selections will be restored to the baseline values.

To invoke one of the remote VCPs, download the desired VCP to the RDA. This is done by clicking on the VCP button and pulling up the VCP Control window. See Figure 3-1.

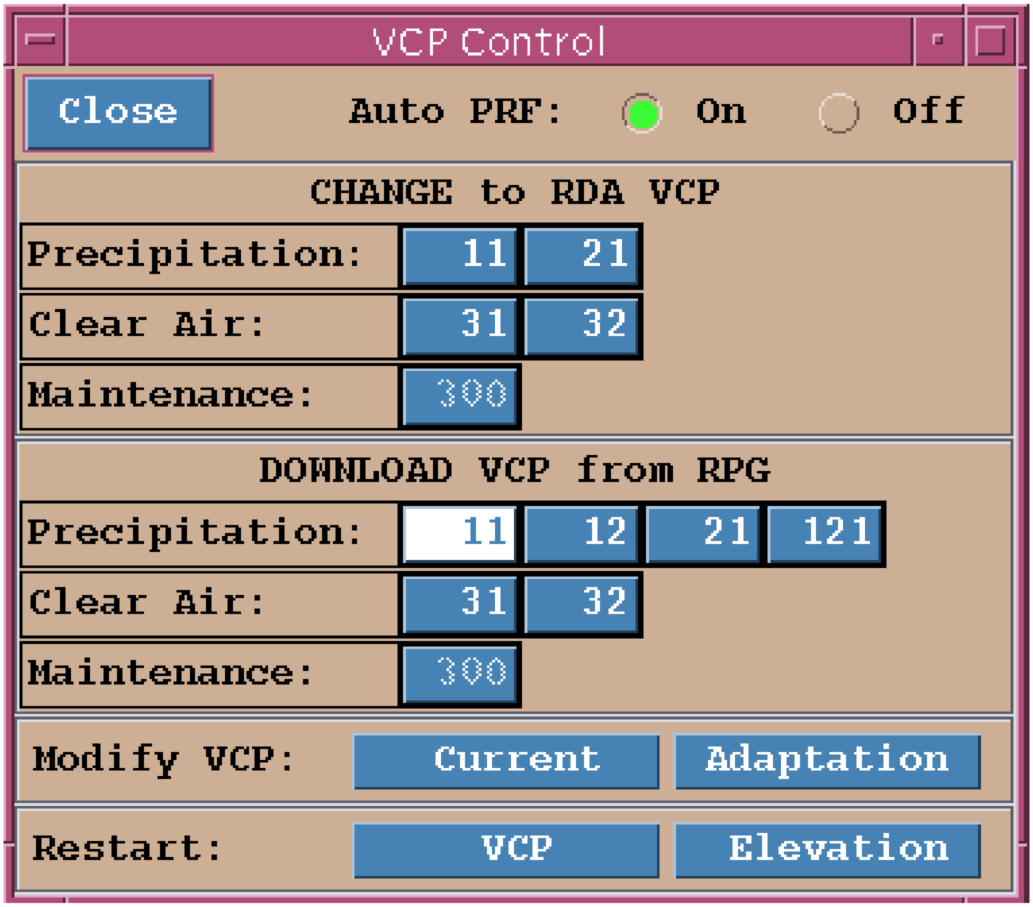



Figure 3-1. VCP Control

## 3.2 Range-Folded Data and VCPs

Doppler velocity estimates of some weather echoes may be obscured by range-folded data due to second-trip ground clutter or overlaid multiple-trip echoes. The operator can temporarily change the Pulse Repetition Frequency (PRF) to change the unambiguous range. Alternately, an operator can simply download VCP 121, the Multiple-PRF Dealiasing Algorithm (MPDA) scanning strategy with elevation angles matching VCP 21. Use VCP 121 when there are echoes in all quadrants and at various ranges from the radar as the simplest and easiest way to reduce range-folded data. While using VCPs 11, 12, and 21, operators can change the PRF for one or more sectors and one or more elevation angles. To modify the current VCP as a temporary change, edit the graphic edit screen (Figure 3-2) or the data table (Figure 3-3).

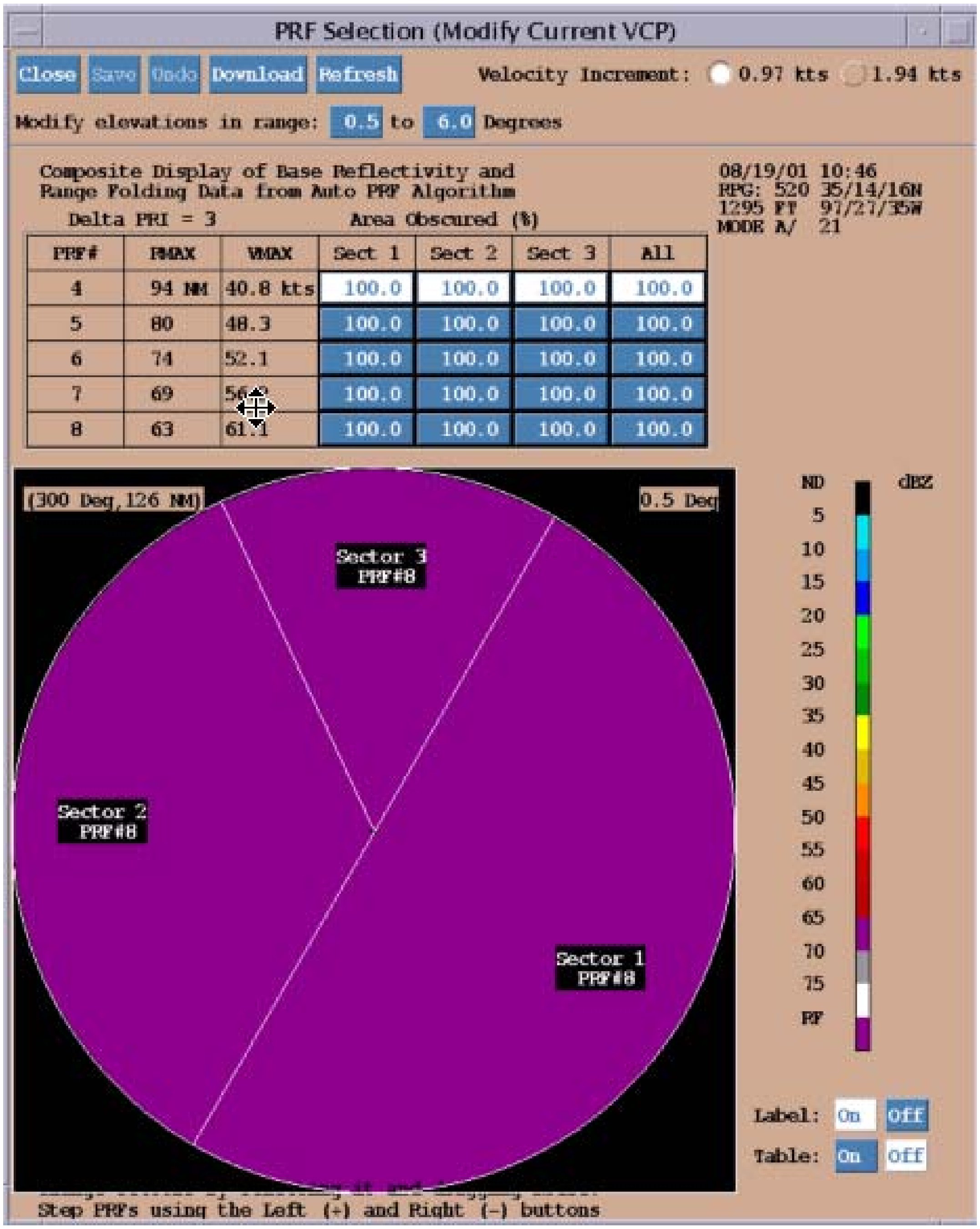



Figure 3-2. PRF Selection (Modify Current VCP)

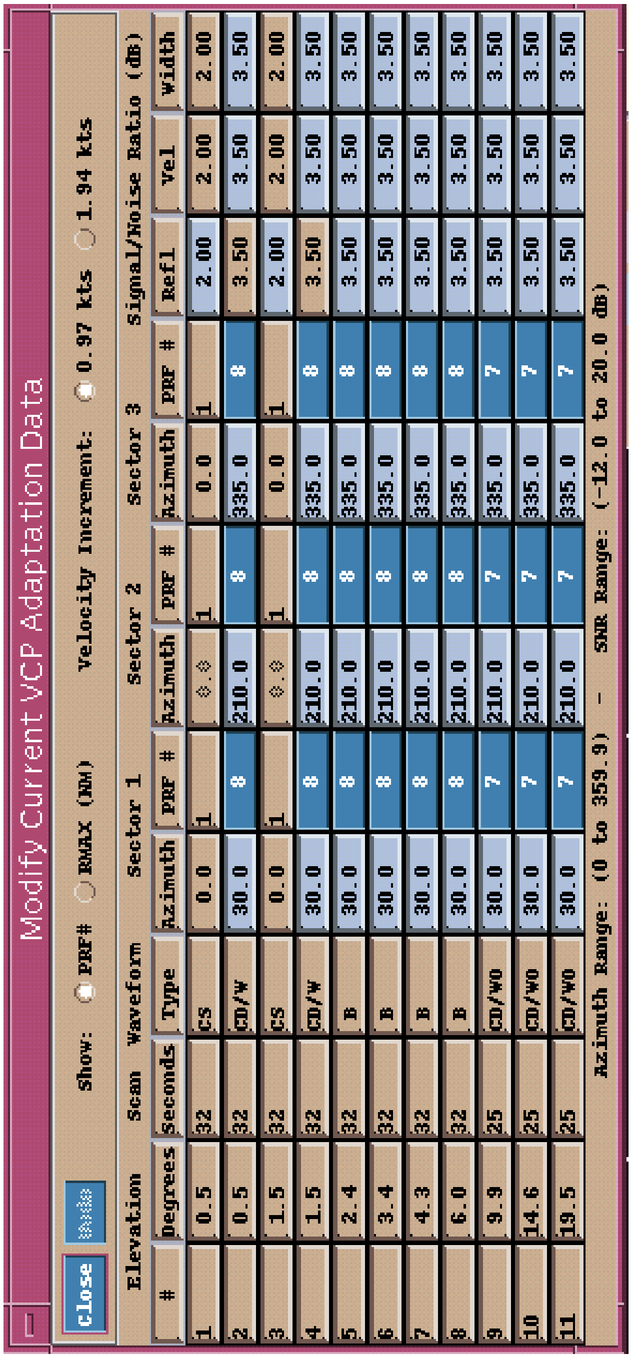



Figure 3-3. Modify Current VCP Adaptation Data

## 3.3 Modify VCP Adaptation Data

In the VCP Control window, next to the bottom line, is the Modify VCP: Adaptation button. Click on the Adaptation button and the Modify VCP Adaptation Data window appears. See Figure 3-4 as an example. The window is password protected and is editable at the ROC level only. Seven windows are selectable for any remote VCP.

### 3.3.1 Modify VCP 11

Remote VCP 11 is defined with a PRF selection #4 (unambiguous range of 94 nm) through 6.2 degree elevation, while the local VCP 11 (stored on the RDA hard drive) is defined with PRF selection #5 (unambiguous range of 80 nm). See Figure 3-4.

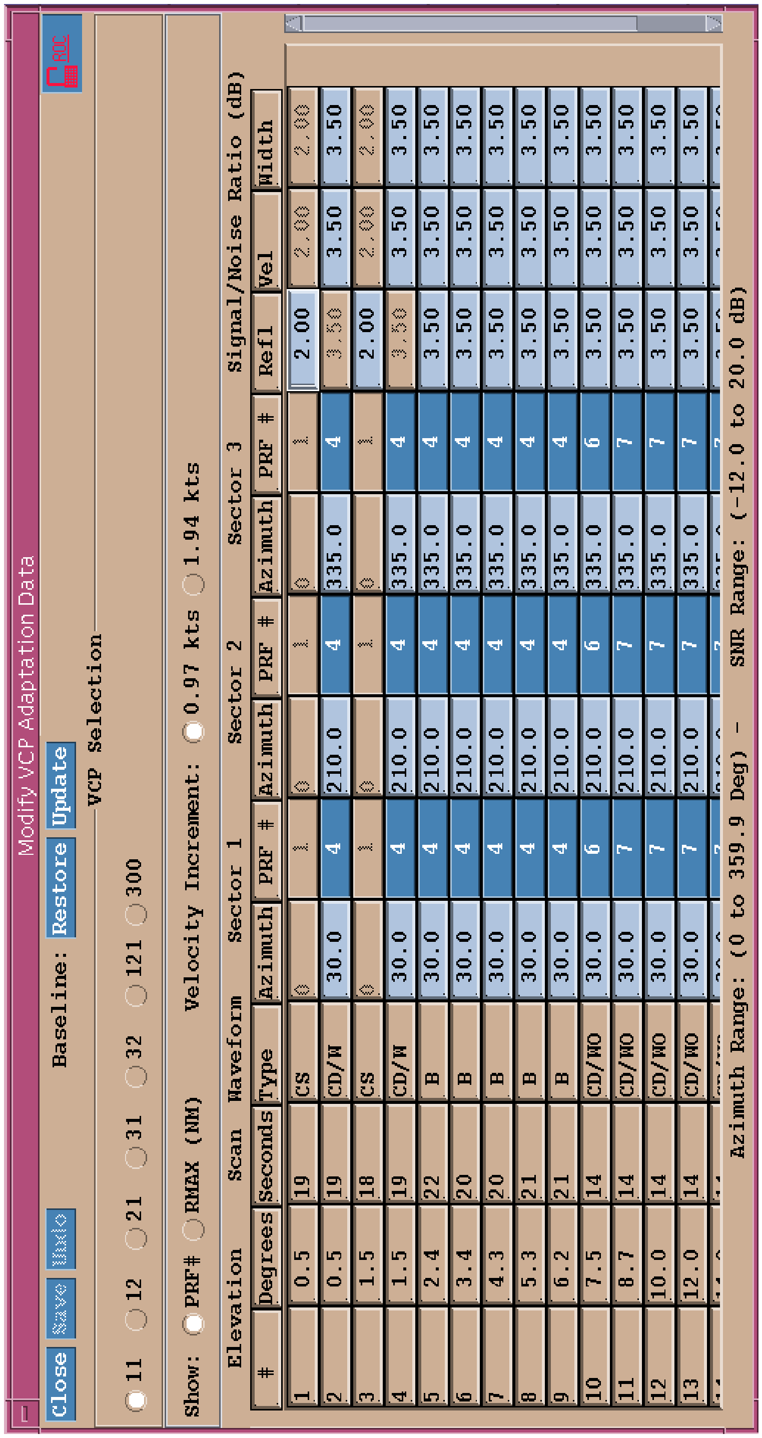



Figure 3-4. Modify VCP Adaptation Data - VCP 11 - Screen 1 of 2

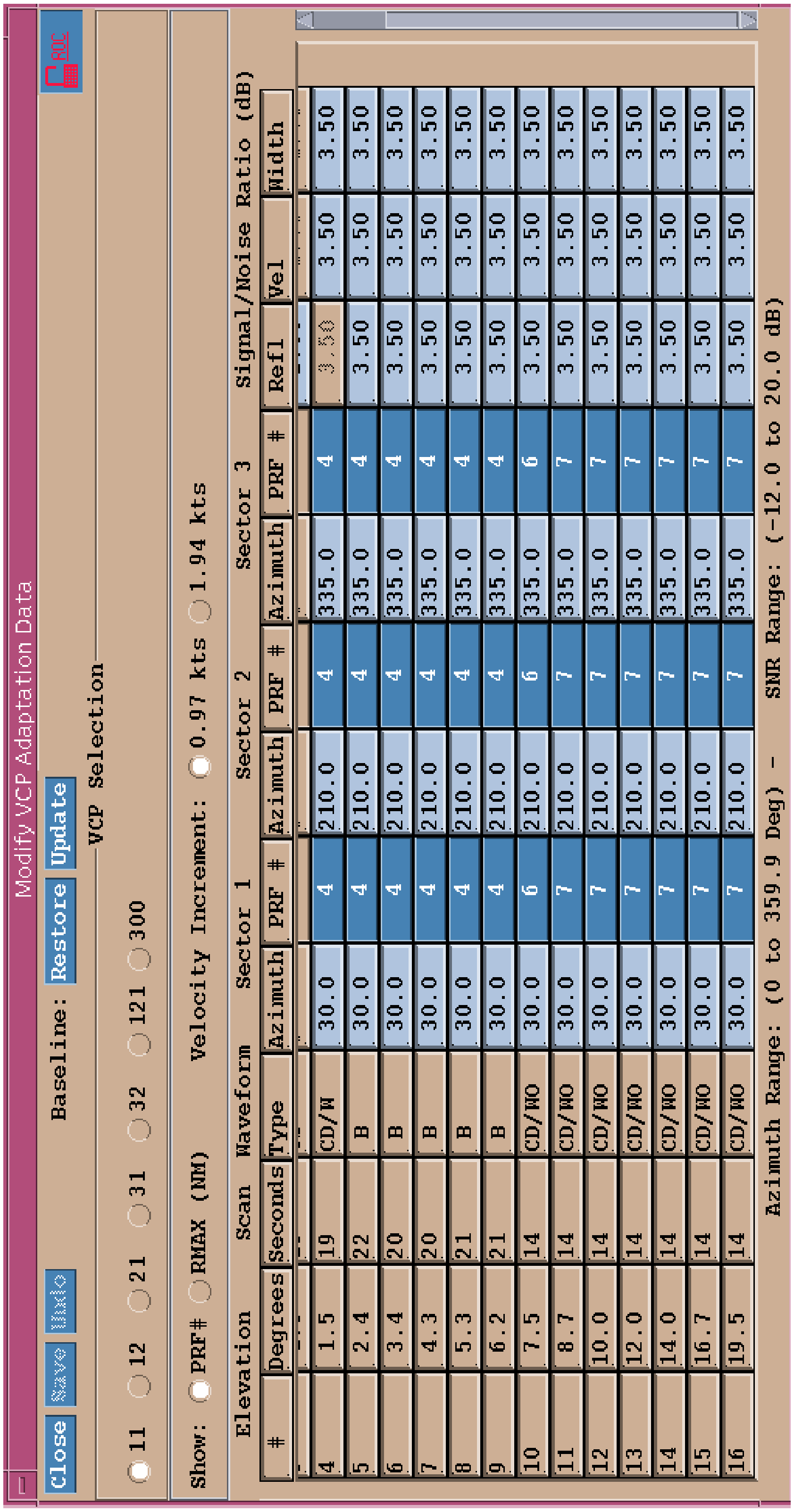



Figure 3-5. Modify VCP Adaptation Data - VCP 11 - Screen 2 of 2

### 3.3.2 Modify VCP 12

Remote VCP 12 is defined with PRF selection #5 (unambiguous range of 94 nm) through 5.1 degrees elevation. There is no local version of VCP 12 until ORDA is fielded. See Figure 3-6.

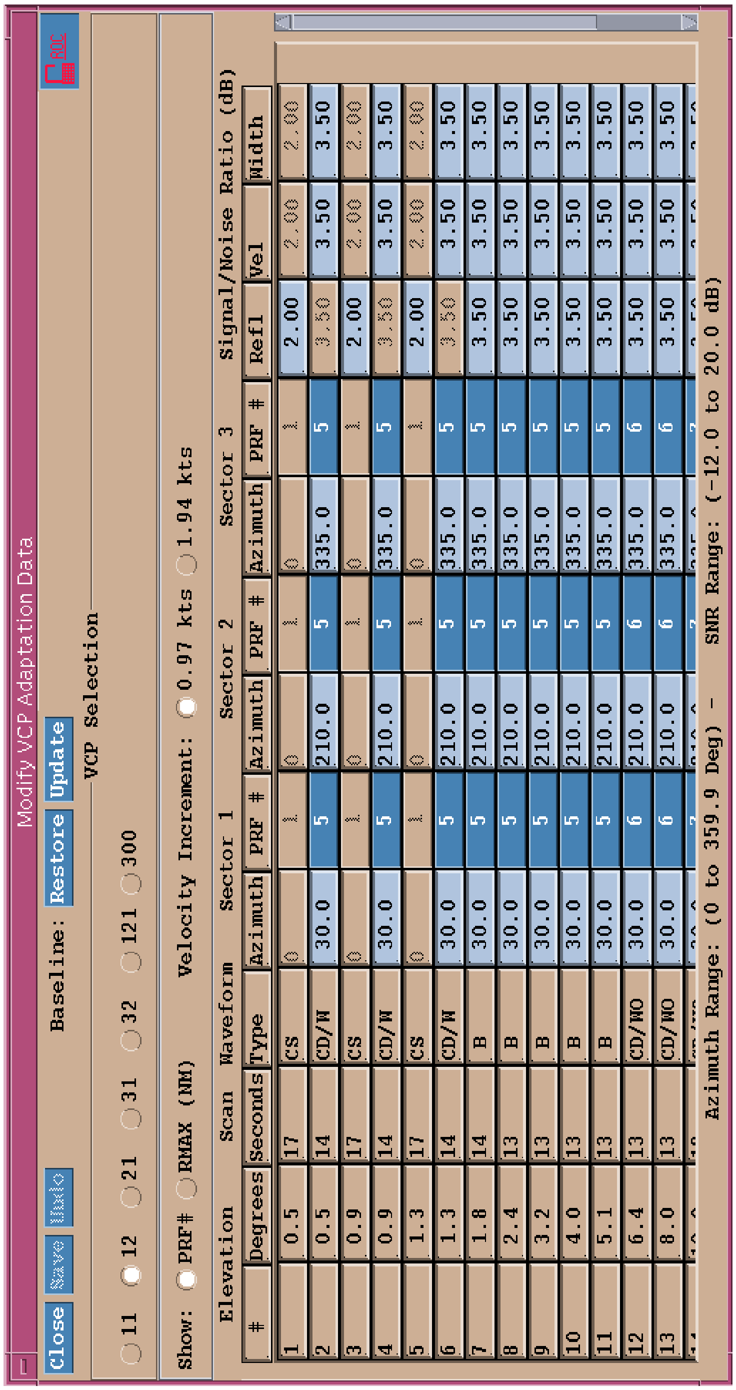



Figure 3-6. Modify VCP Adaptation Data - VCP 12 - Screen1

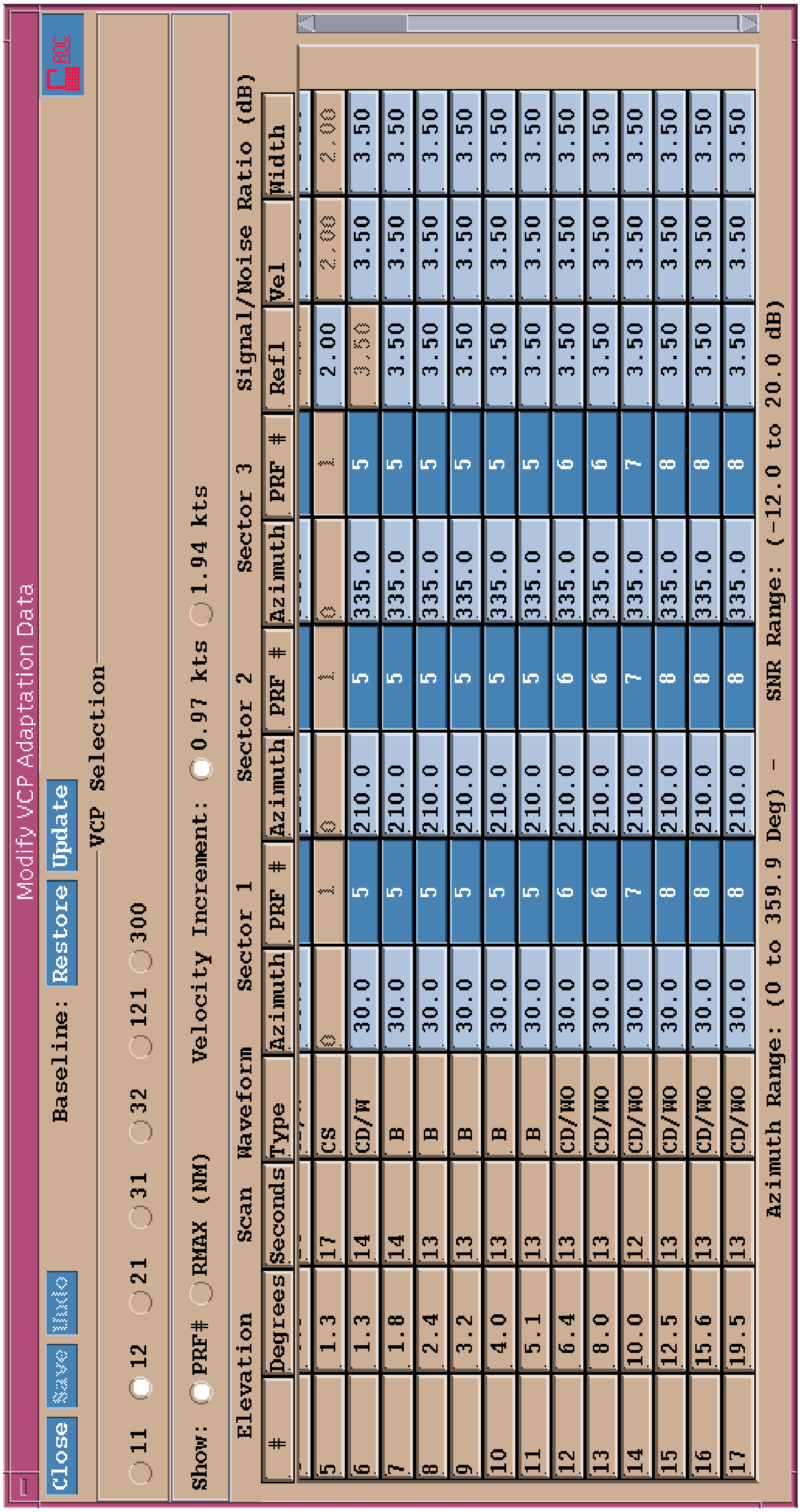



Figure 3-7. Modify VCP Adaptation Data - VCP 12 - Screen 2

### 3.3.3 Modify VCP 21

Remote VCP 21 is defined with a PRF selection #4 (unambiguous range of 94 nm) through 6.0 degrees elevation, while the local VCP 21 (stored on the RDA hard drive) is defined with PRF selection #5 (unambiguous range of 80 nm). See Figure 3-8.

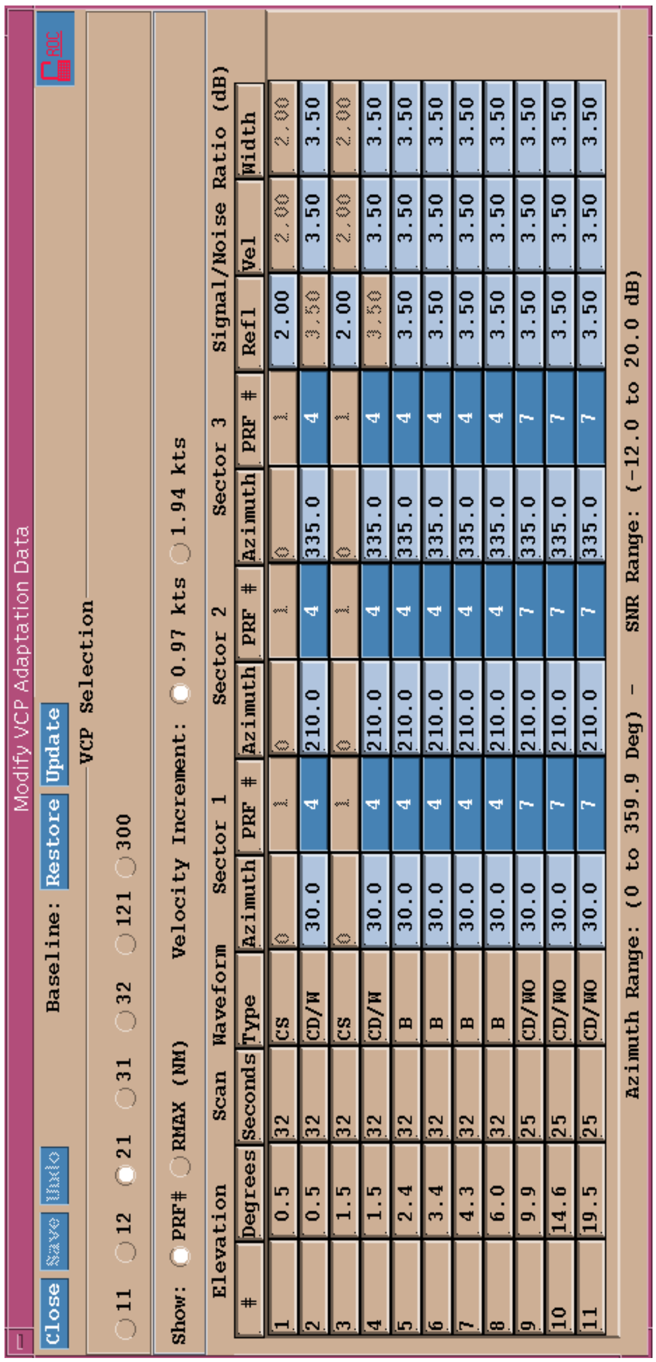



Figure 3-8. Modify VCP Adaptation Data - VCP 21

### 3.3.4 Modify VCP 31

The PRF selections for VCP 31 are not editable. See Figure 3-9.

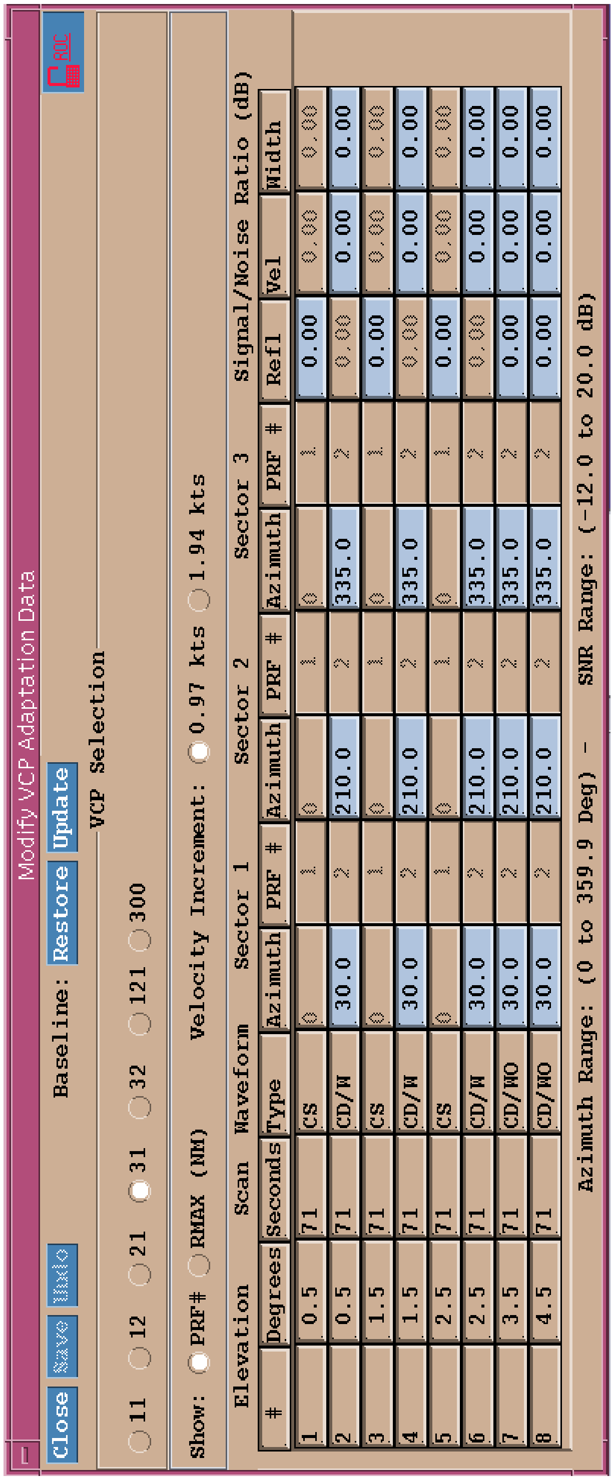



Figure 3-9. Modify VCP Adaptation Data - VCP 31

### 3.3.5 Modify VCP 32

Remote VCP 32 has the same PRF selections as the local VCP 32. See Figure 3-10.

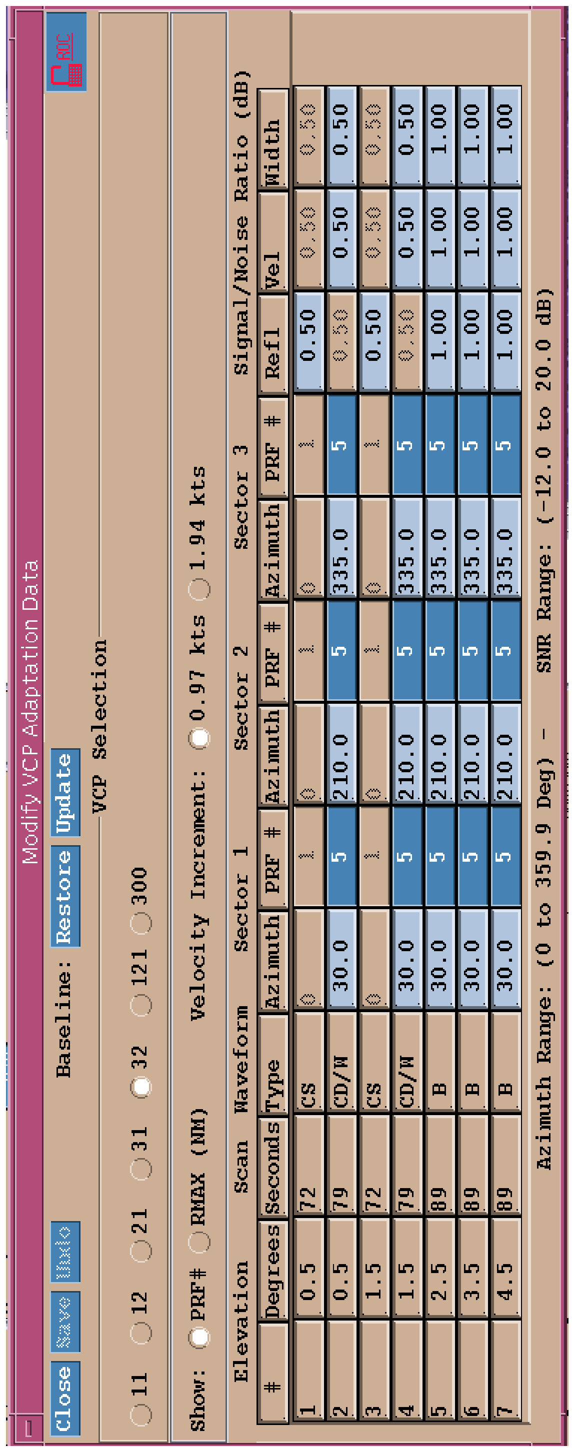



Figure 3-10. Modify VCP Adaptation Data - VCP 32

### 3.3.6 Modify VCP 121

The Remote VCP 121 collects data at nine unique elevation angles in every five minutes using a total of 20 sweeps. Multi-PRF Dealiasing Algorithm (MPDA) is applied to the first 5 elevation angles while Velocity Dealiasing Algorithm (VDA) is used for the remaining four higher elevation angles. The scanning sequence is defined in Figure 3-11, Modify VCP Adaptation Data - VCP 121.

The veldeal task has been modified to include not only the legacy VDA but also the MPDA. The main veldeal task, on activation, determines the Volume Coverage Pattern (VCP) number of the incoming data. Based on the VCP number it then calls either the VDA or MPDA buffer control modules. The respective buffer control modules process the incoming raw base data until an end of elevation or an end of volume condition is detected and veldeal becomes inactive. VCP 121, when downloaded from the RPG to the RDA, causes the veldeal task to initiate the MPDA processing. This VCP has the same elevation angles as VCP 21, but completes a volume scan every 5 rather than 6 minutes.

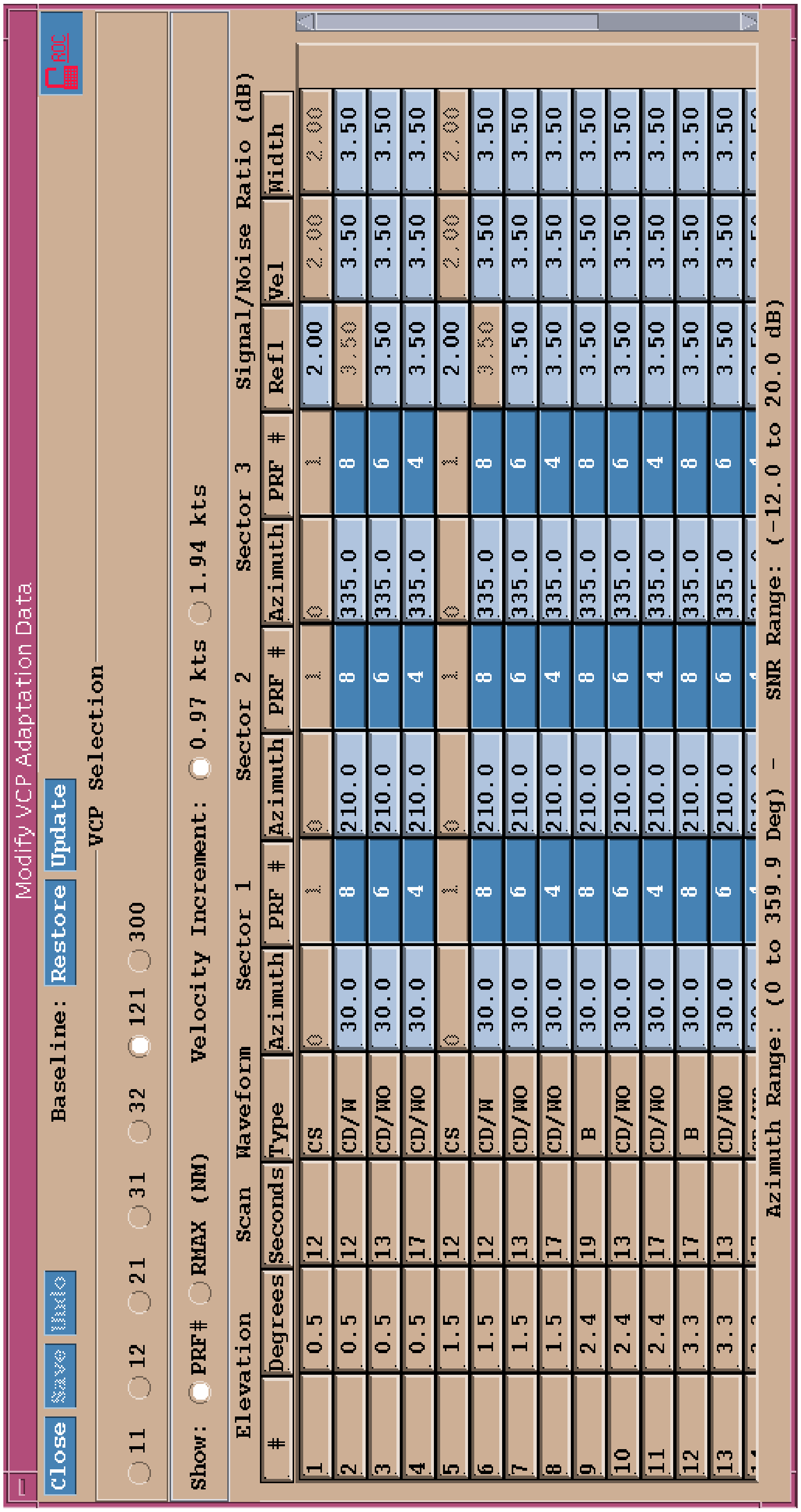



Figure 3-11. Modify VCP Adaptation Data - VCP 121 - Screen 1 of 2

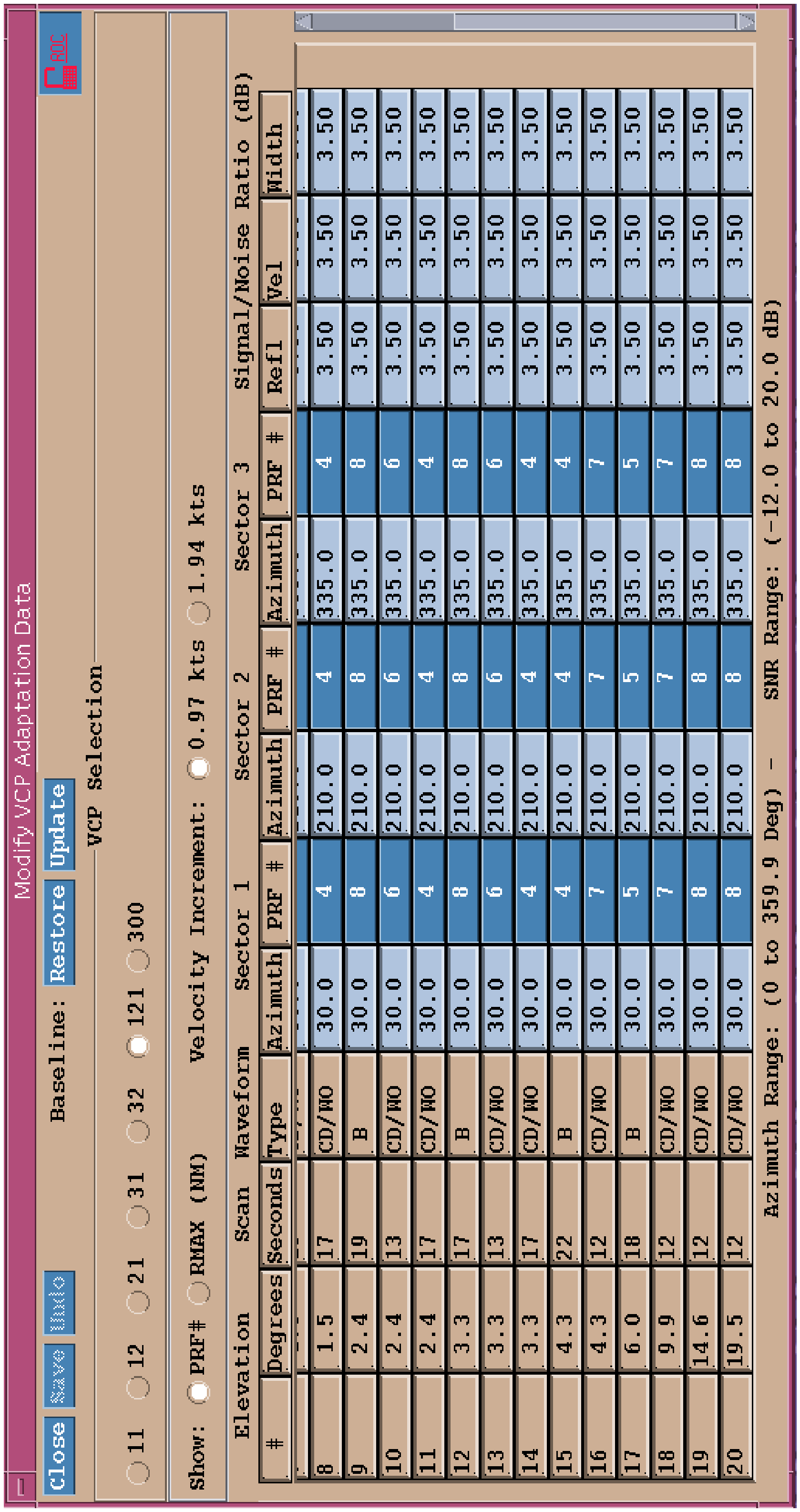



Figure 3-12. Modify VCP Adaptation Data - VCP 121 - Screen 2 of 2

### 3.3.7 Modify VCP 300

The Remote VCP 300 is used during maintenance for diagnostic purposes and is not an operational VCP. See Figure 3-13.

**NOTE**

This function is not applicable with a DRS Weather Systems, Inc RDA.

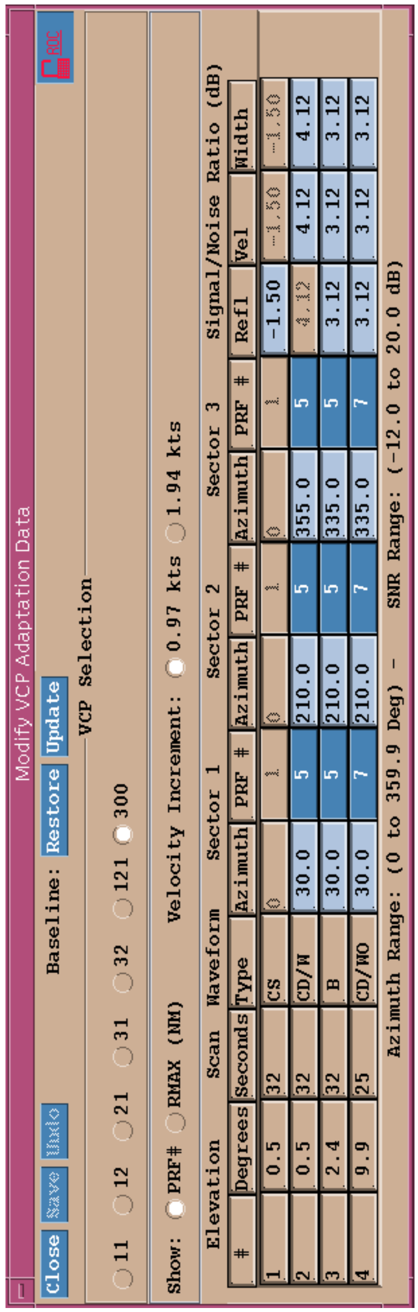



Figure 3-13. Modify VCP Adaptation Data - VCP 300

# Chapter 4

# RPG Products - Alert/Threshold

## 4.1 Alert Processing

The WSR-88D alerting function will search data fields and algorithm output data to identify any phenomena selected as an alert criteria within the area designated by any associated user. The exception is the MAX 1HR PRECIP alert which is not restricted to the alert area definition. Upon detection of alert criteria being met, the alerting function notifies the affected associated user(s) and, if specified, will generate and automatically distribute an alert-paired product to the appropriate associated user(s).

## 4.2 Alert Thresholds

The Alert Thresholds are divided into three groups of products: Grid, Volume and Forecast. These three windows are displayed as Figure 4-1, Figure 4-2, and Figure 4-3. All three are displayed with the URC LOCA clicked and the editable fields are white letters/numbers.

Within each of these groups are the category of the products and up to six thresholds (Th1 through Th6) that can be defined. Individual threshold values should be selected to meet the local requirements of all Associated Users. All alert processing functions search the data fields out to 124 nm for each alert category except for the following eight alert categories:

- Grid Velocity - The base velocity data field is only searched to 62 nm.
- Grid Composite Refl. - The Composite reflectivity data field is processed out to 186 nm.
- Volume VAD - Only the lowest VWP height is used to trigger this alert.
- Volume TVS - A TVS must be identified within 62 nm to trigger this alert.
- Volume Max Storm Refl - The storm cell can be out to 248 nm.
- Volume Storm Top - The storm cell can be out to 248 nm.
- Forecast TVS - The forecasted position of the storm cell containing the TVS must fall within 62 nm.
- Forecast Max Storm Refl - The forecasted position of the storm cell can be out to 248 nm.

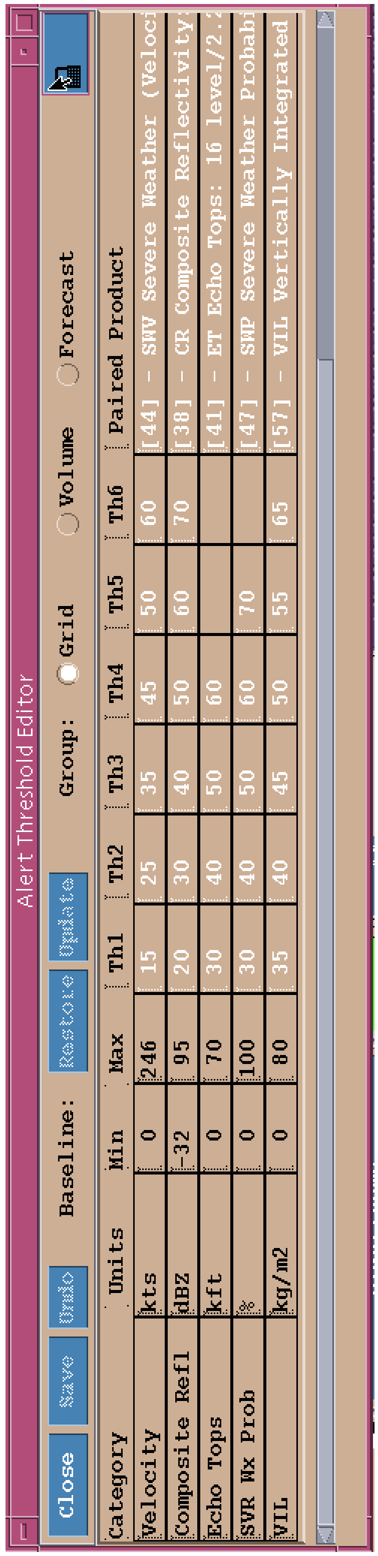



Figure 4-1. Alert Threshold Editor - Grid

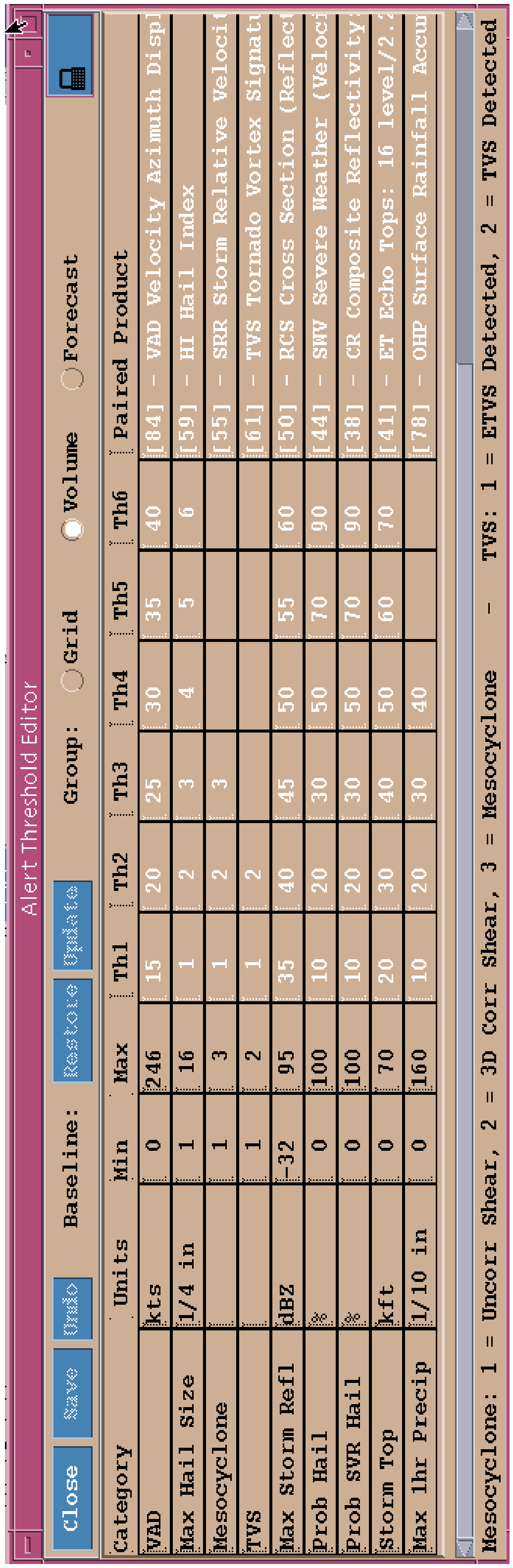



Figure 4-2. Alert Threshold Editor - Volume

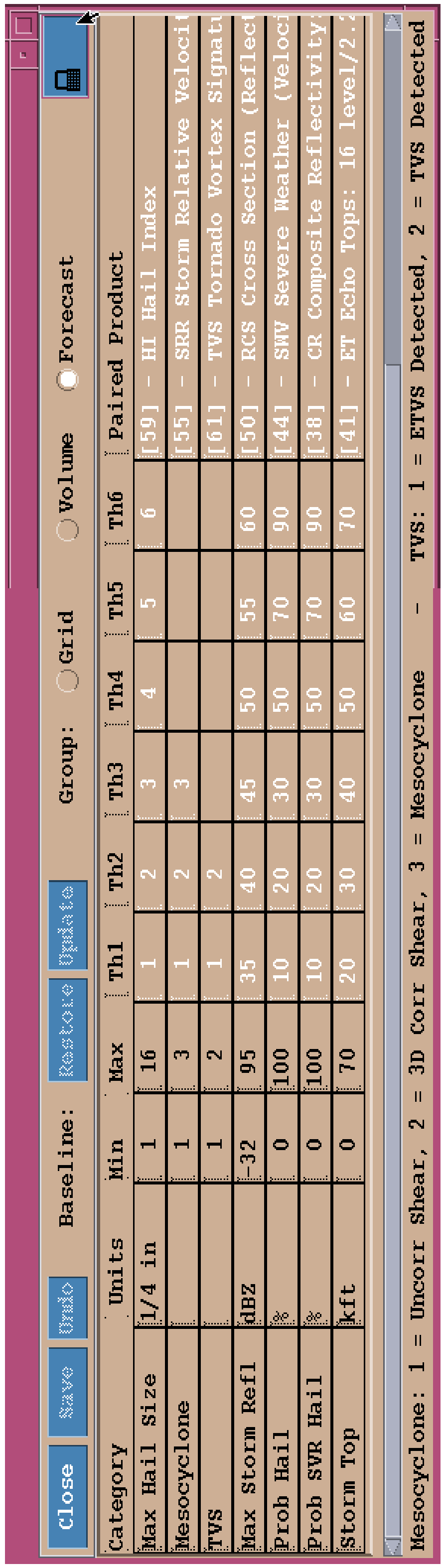



Figure 4-3. Alert Threshold Editor - Forecast

## 4.3 Product Alert Pairing

When an alert is identified for any associated user, the alert processing function will initiate a one-time request for the paired product specified in the Paired Product column of the Alert Threshold Editor.

Once the URC password has been successfully entered, a pull down menu is then available for selecting an appropriate paired product. The pull down menus vary from one product to another. Some have the entire list of products available. Others, such as elevation based products, have a shorter list with just similar elevation based products available.

There are some products that are not available as a paired product for any alert category. These include:

- CLR, #132, Clutter Likelihood Reflectivity
- CLD, #133, Clutter Likelihood DopplerSO
- SO, #136, Superob: NCEP Winds Model Initialization
- ULR, #137, User Selectable Layer Composite Reflectivity
- DSP, #138, Digital Storm Total Rainfall Accumulation
- MRU, #139, Mesocyclone Rapid Update
- MD, #141, Mesocyclone Detection Algorithm Product
- TRU, #143, Tornado Rapid Update

# Chapter 5
# RPG Products - Generation List

## 5.1 Product Generation List Windows

The product generation list is available in four separate tables under the RPG Product Generation Table Editor window. The information provided in these windows ensures product generation to support the requirements of the National Archives (Archive Level III) and all non-associated and other users. Associated user product availability is not affected by these windows.

### 5.1.1 Current Generation List.

Open the window from the RPG Products, Generation List button, and the Current Table is displayed as the default. See Figure 5-1.

Just the top portion of the Current window is shown - Products 16 through 32 - as an example. Use the scroll bar on the right hand side of the window to display the entire table. For a complete listing of the default generation lists for the precipitation, clear air, and maintenance modes, continue on in this chapter.

There are five columns that are editable by the site. These are Generation (Gen), Archive (Arc), Storage (Sto), Minutes of Storage ((mins)), and Elevation Cuts (Elev/Cut(s)). These are not password protected and can be changed at any time.

The Current list is maintained in memory and is used to determine the RPG's contribution to the master product generation and distribution list for the current volume scan. This listing is temporary and is replaced each time the RPG is rebooted or the weather mode changes.

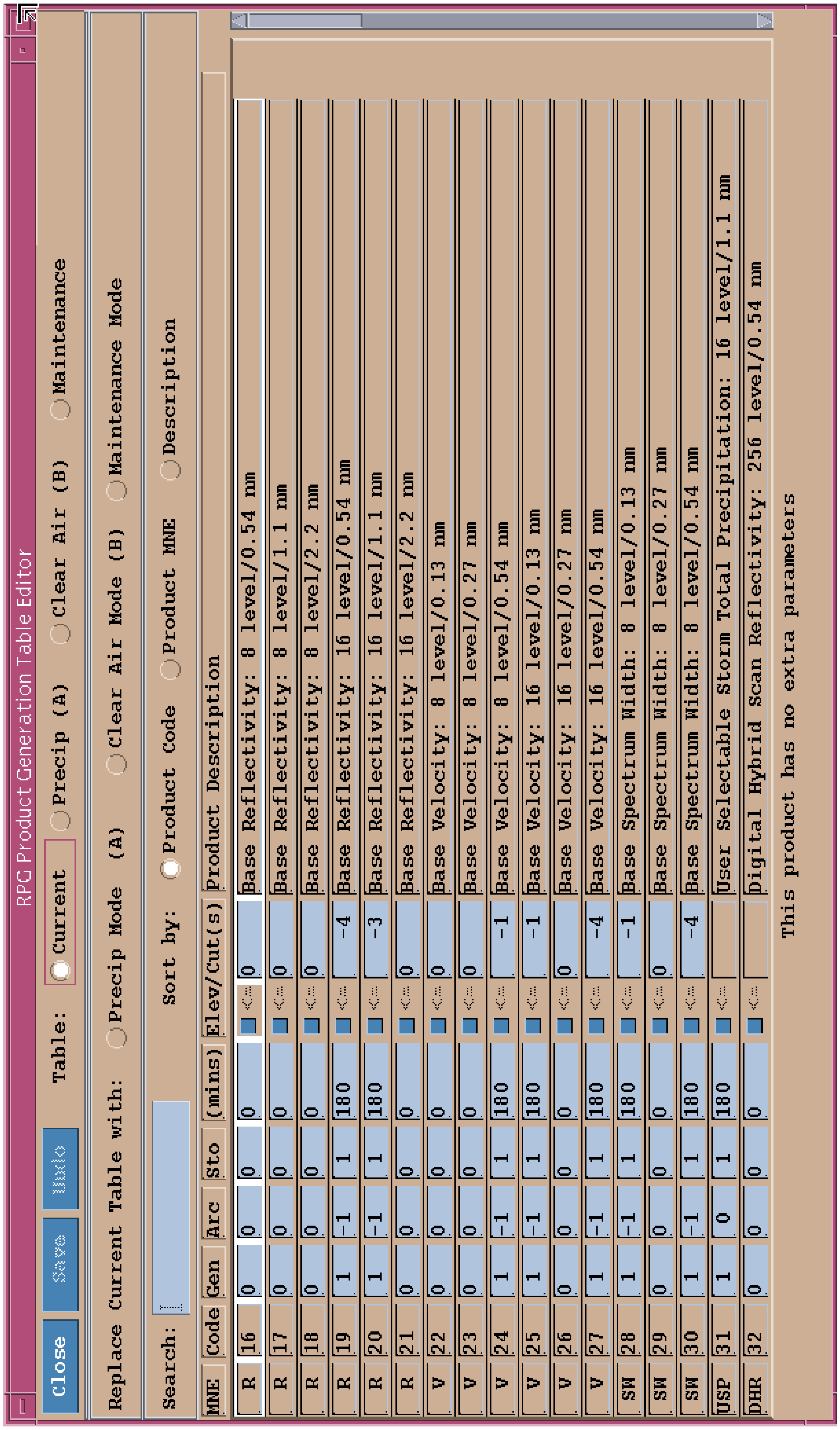



Figure 5-1. RPG Product Generation Table Editor - Current

### 5.1.2 Precip Mode A Generation List.

Click on the Precip (A) Table option and the window changes to the RPG Product Generation Table Editor (Precipitation Mode) and is password protected at the ROC level. See Figure 5-2, Figure 5-3, Figure 5-4, and Figure 5-5.

This list specifies, as a minimum, the product generation, archive, and availability requirements defined in FMH-11, Part A, Table 7-1. This list is password protected at the ROC level and cannot be modified at the user site. This list will automatically be invoked upon RPG restart or weather mode change from Clear Air Mode (B) to Precipitation Mode (A). Additional products may be added for generation and non-associated user distribution by the site adding to the Current generation list as a temporary addition, but the baseline listing remains under the ROC jurisdiction and control.

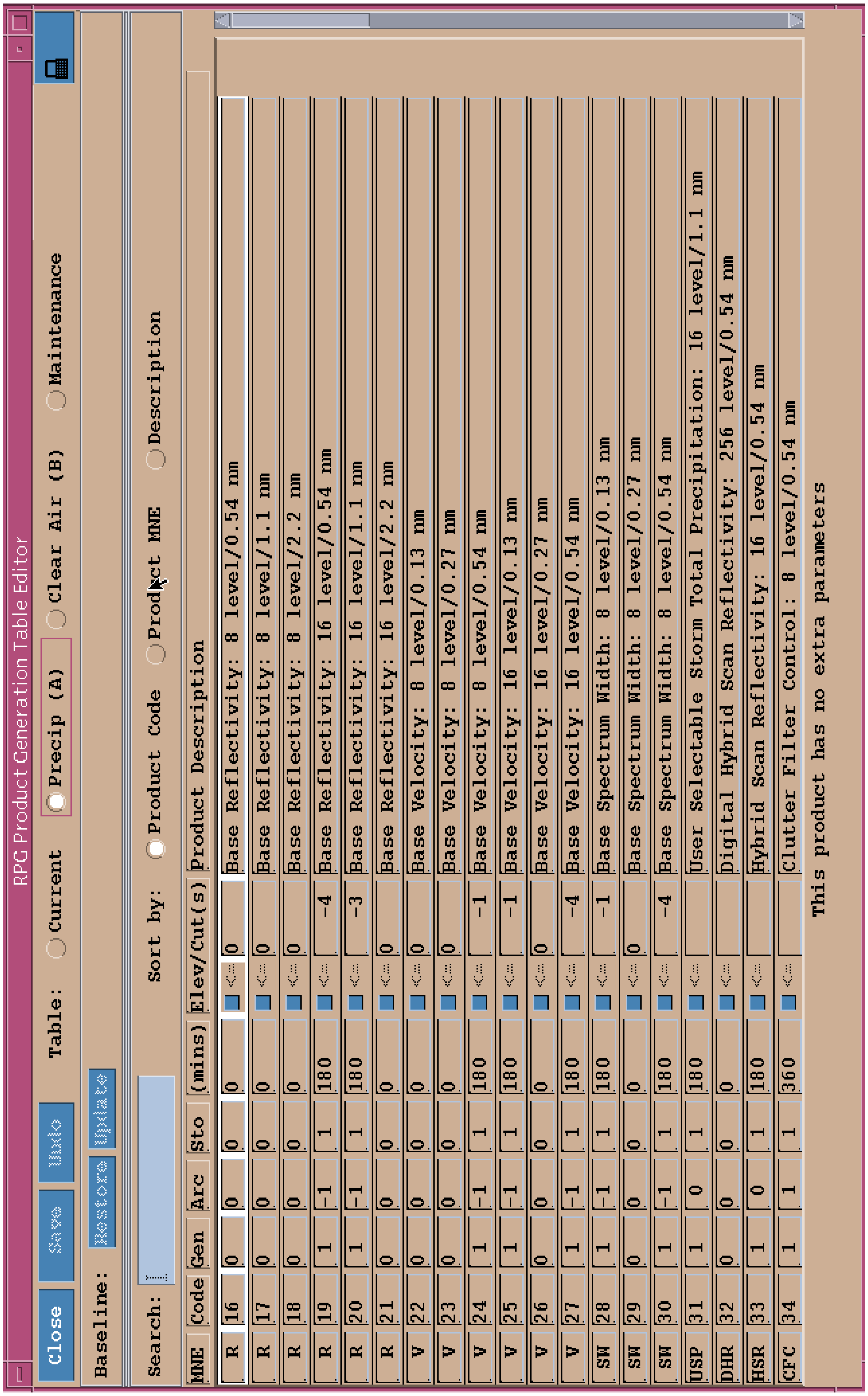
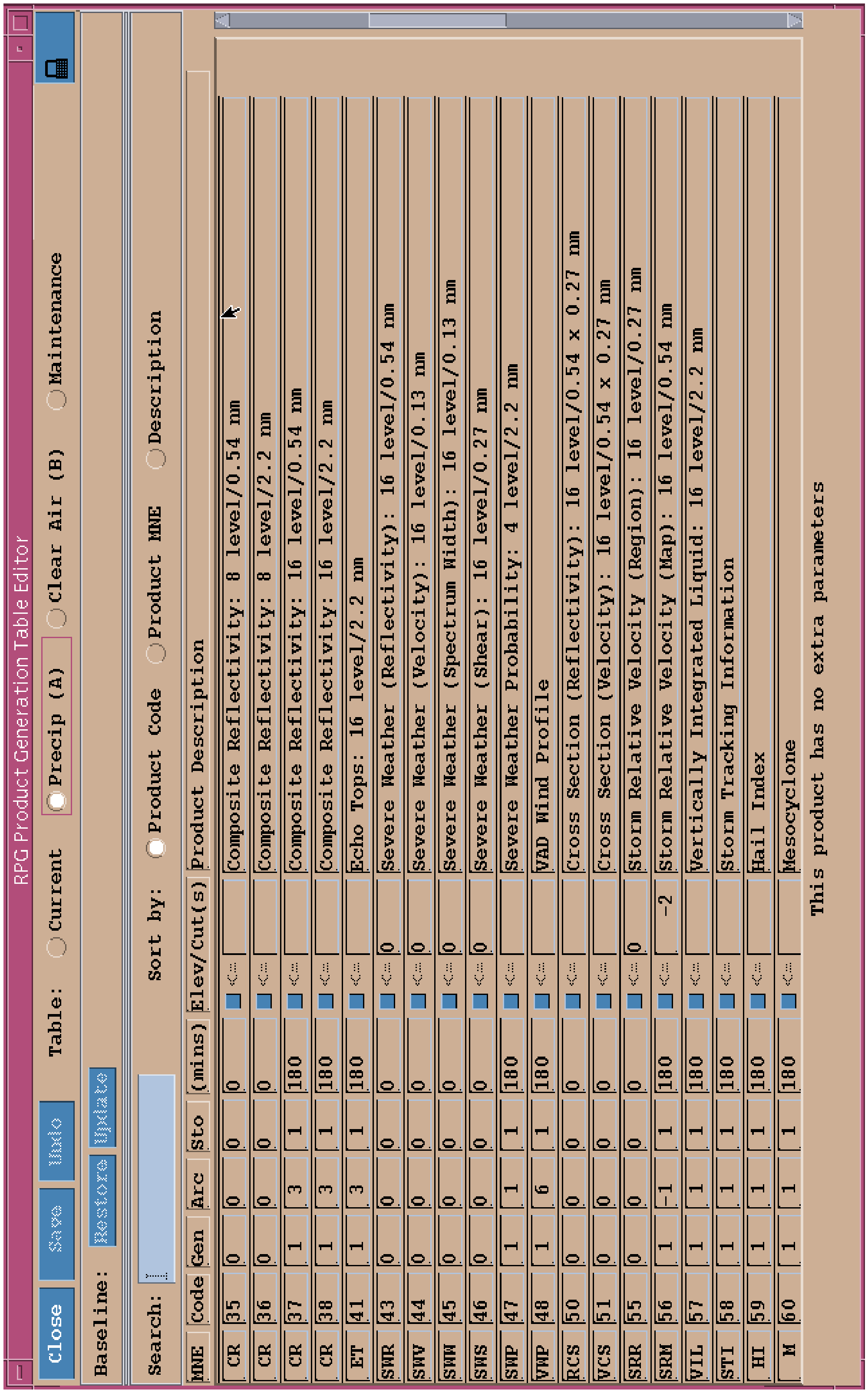



Figure 5-2. RPG Product Generation Table Editor - Precip (A) (Products 16-34)




| MNE | Code | Gen | Arc | Sto | (mins) | Elev/Cut(s) | Product Description |
|---|---|---|---|---|---|---|---|
| CR | 35 | 0 | 0 | 0 | 0 | <= | Composite Reflectivity: 8 level/0.54 nm |
| CR | 36 | 0 | 0 | 0 | 0 | <= | Composite Reflectivity: 8 level/2.2 nm |
| CR | 37 | 1 | 3 | 1 | 180 | <= | Composite Reflectivity: 16 level/0.54 nm |
| CR | 38 | 1 | 3 | 1 | 180 | <= | Composite Reflectivity: 16 level/2.2 nm |
| ET | 41 | 1 | 3 | 1 | 180 | <= | Echo Tops: 16 level/2.2 nm |
| SWR | 43 | 0 | 0 | 0 | 0 | <= 0 | Severe Weather (Reflectivity): 16 level/0.54 nm |
| SWV | 44 | 0 | 0 | 0 | 0 | <= 0 | Severe Weather (Velocity): 16 level/0.13 nm |
| SWW | 45 | 0 | 0 | 0 | 0 | <= 0 | Severe Weather (Spectrum Width): 16 level/0.13 nm |
| SWS | 46 | 0 | 0 | 0 | 0 | <= 0 | Severe Weather (Shear): 16 level/0.27 nm |
| SWP | 47 | 1 | 1 | 1 | 180 | <= | Severe Weather Probability: 4 level/2.2 nm |
| VWP | 48 | 1 | 6 | 1 | 180 | <= | VAD Wind Profile |
| RCS | 50 | 0 | 0 | 0 | 0 | <= | Cross Section (Reflectivity): 16 level/0.54 x 0.27 nm |
| VCS | 51 | 0 | 0 | 0 | 0 | <= | Cross Section (Velocity): 16 level/0.54 x 0.27 nm |
| SRR | 55 | 0 | 0 | 0 | 0 | <= 0 | Storm Relative Velocity (Region): 16 level/0.27 nm |
| SRM | 56 | 1 | -1 | 1 | 180 | <= -2 | Storm Relative Velocity (Map): 16 level/0.54 nm |
| VIL | 57 | 1 | 1 | 1 | 180 | <= | Vertically Integrated Liquid: 16 level/2.2 nm |
| STI | 58 | 1 | 1 | 1 | 180 | <= | Storm Tracking Information |
| HI | 59 | 1 | 1 | 1 | 180 | <= | Hail Index |
| M | 60 | 1 | 1 | 1 | 180 | <= | Mesocyclone |

Figure 5-3. RPG Product Generation Table Editor - Precip (A) (Products 35-60)

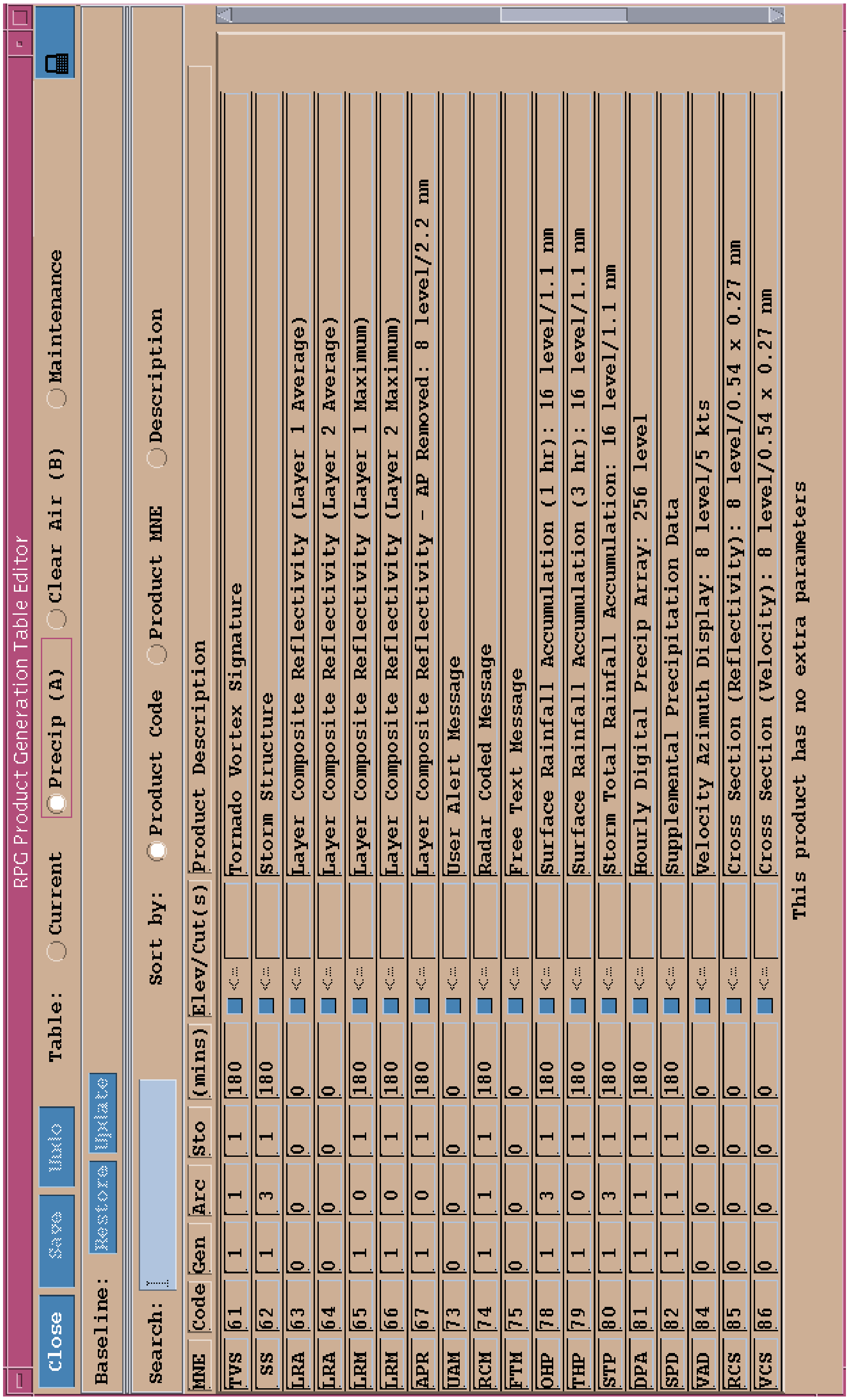



Figure 5-4. RPG Product Generation Table Editor - Precip (A) (Products 61-86)

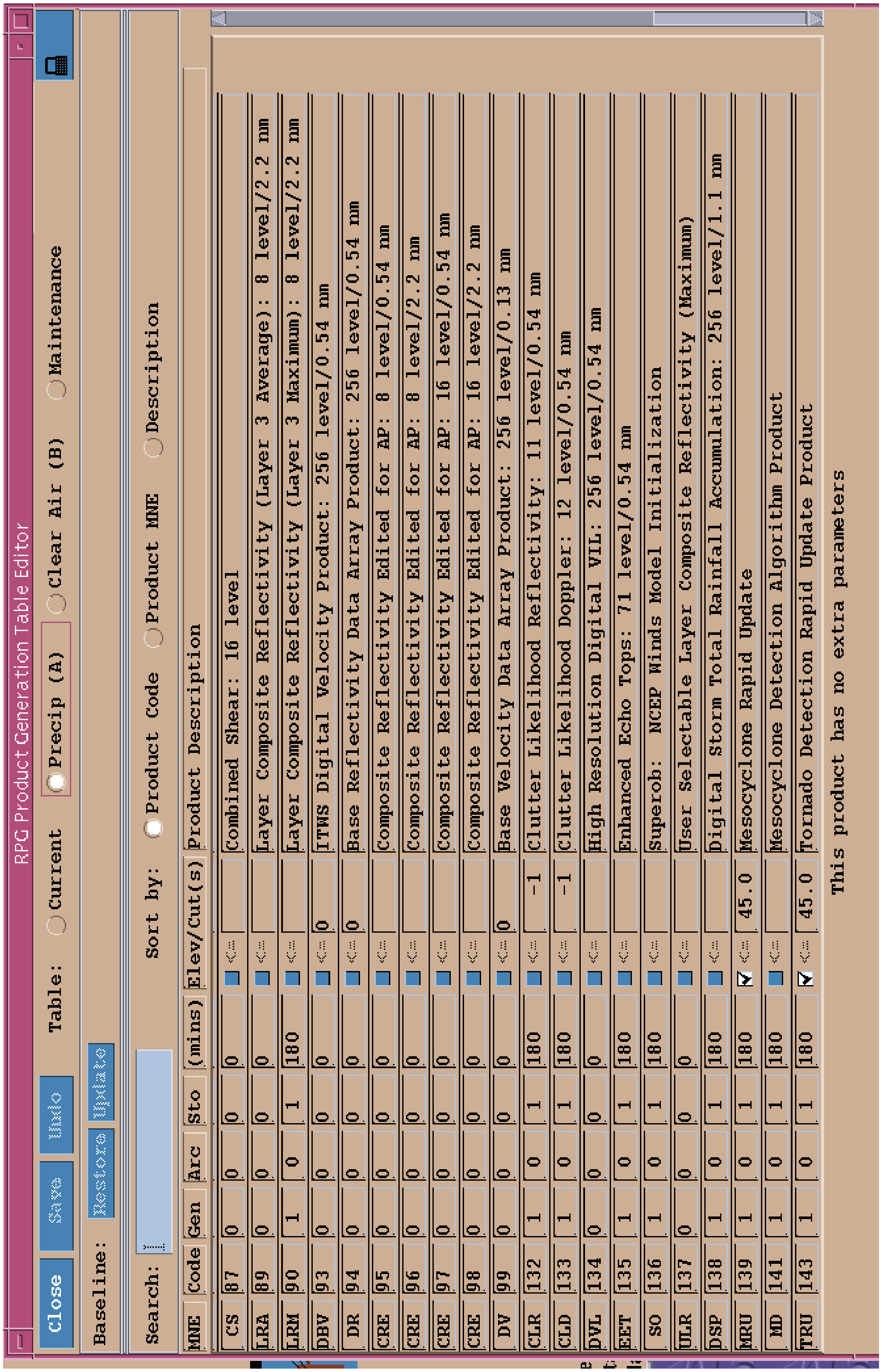



Figure 5-5. RPG Product Generation Table Editor - Precip (A) (Products 87-143)

#### 5.1.2.1 Extra Parameters for Selected Products - Precip Mode.

The extra parameters as shown in each figure (Figure 5-6 through 5-18) are associated with their respective products. They automatically appear in the bottom of the RPG Product Generation Table Editor when the product is selected and the generation value is set to 1.

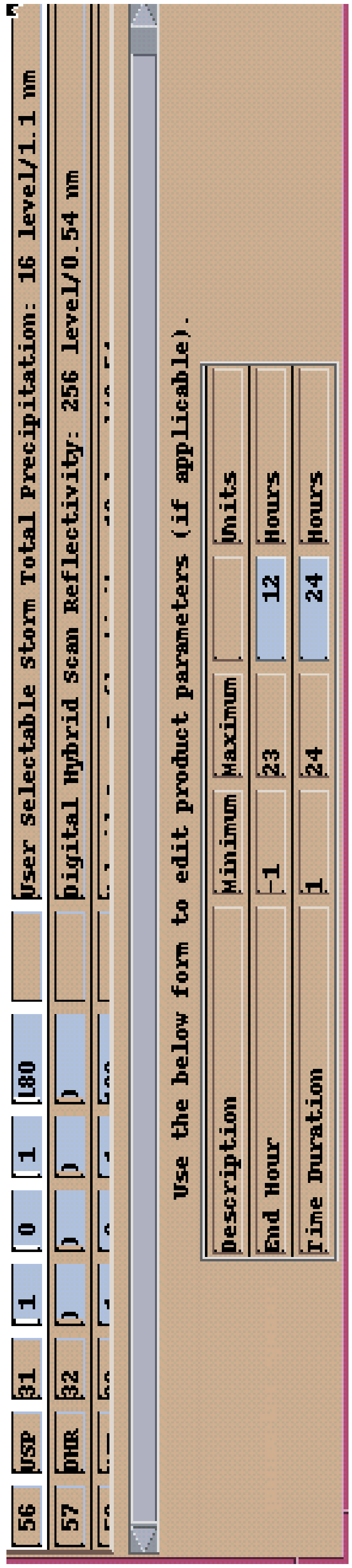



Figure 5-6. User Selectable Storm Total Precip - USP 31

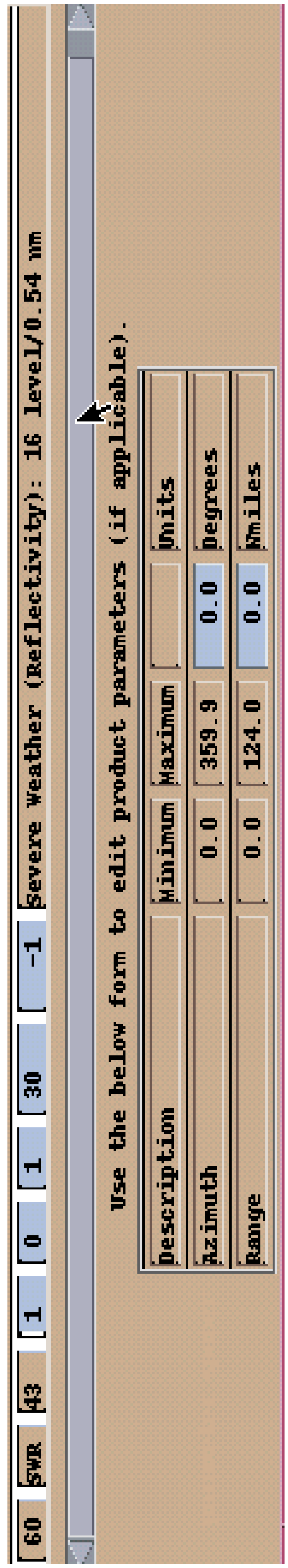



Figure 5-7. Severe Weather (Reflectivity) - SWR 43

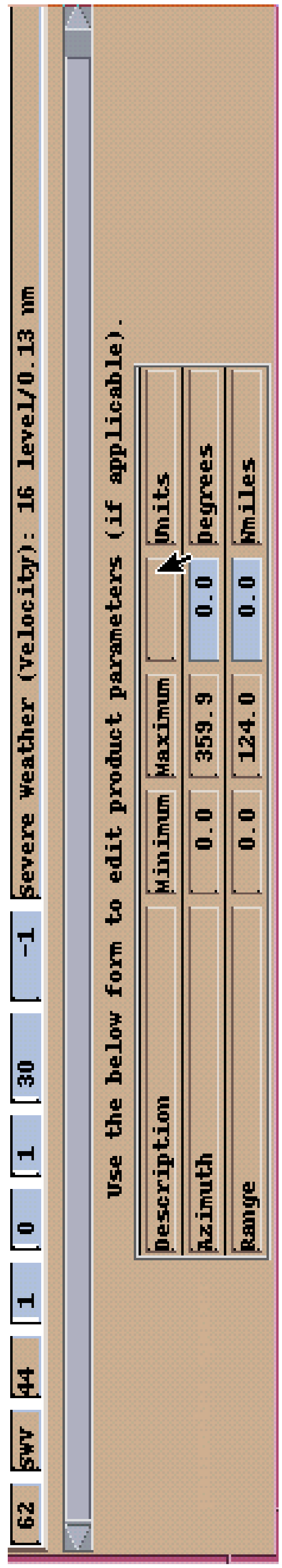



Figure 5-8. Severe Weather (Velocity) - SWV 44

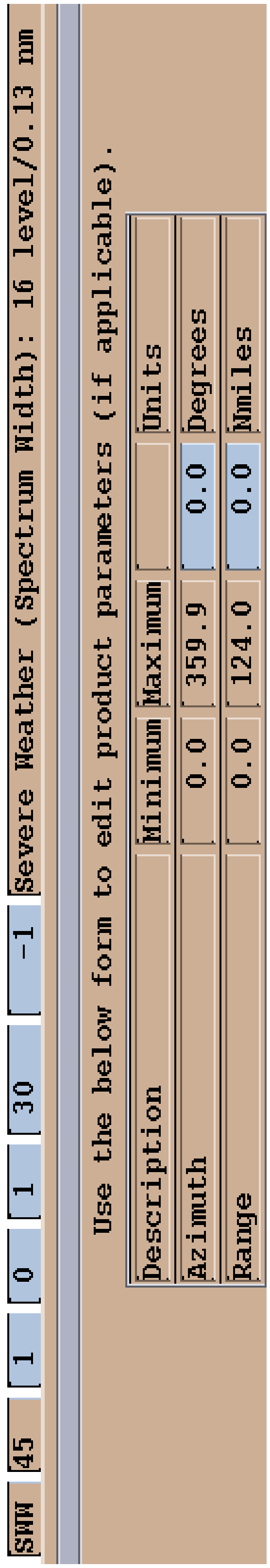



Figure 5-9. Severe Weather (Spectrum Width) - SWW 45


Figure 5-10. Severe Weather (Shear) - SWS 46

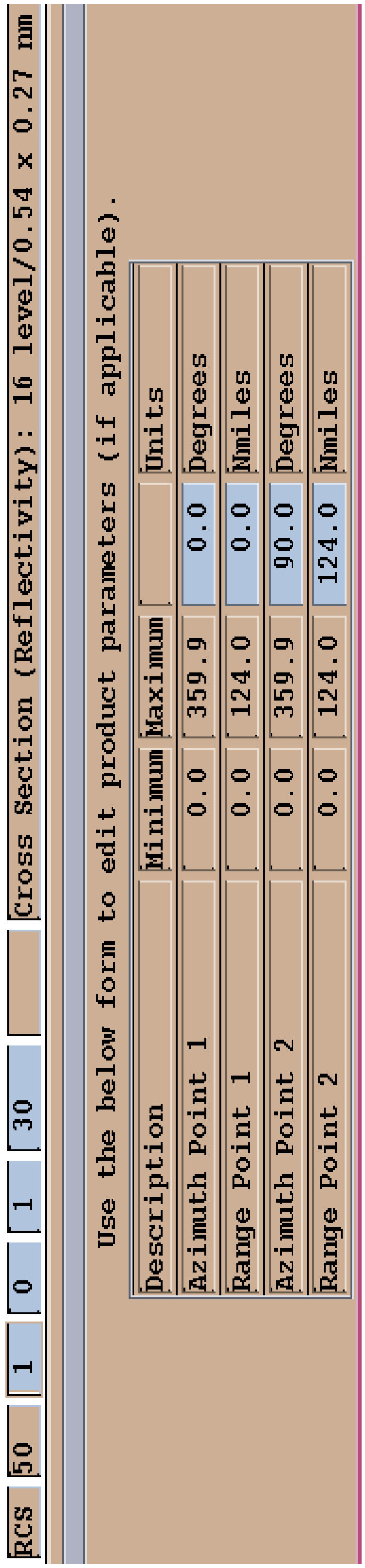



Figure 5-11.  Cross Section (Reflectivity) - RCS 50

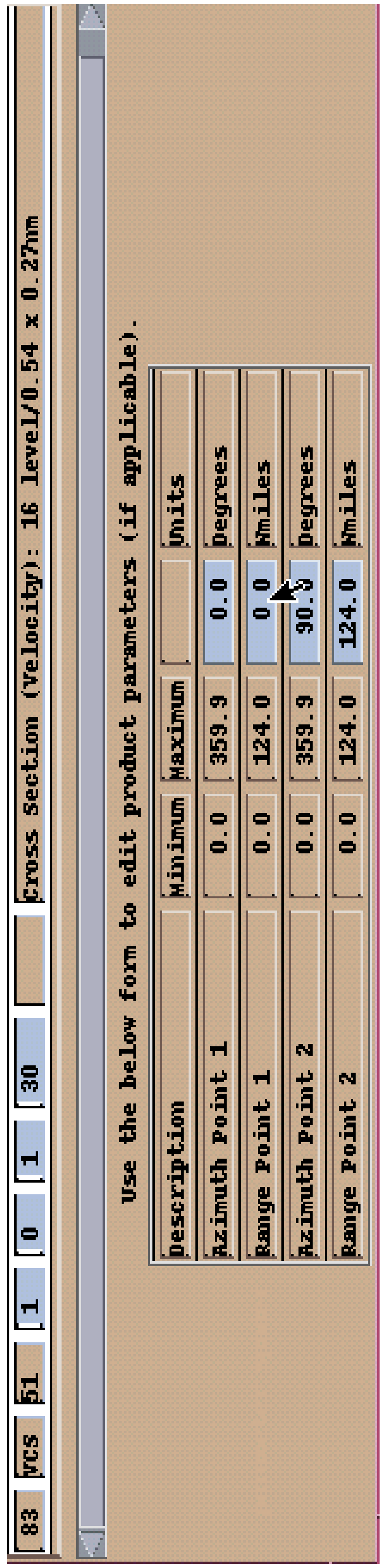



Figure 5-12. Cross Section (Velocity) - VCS 51

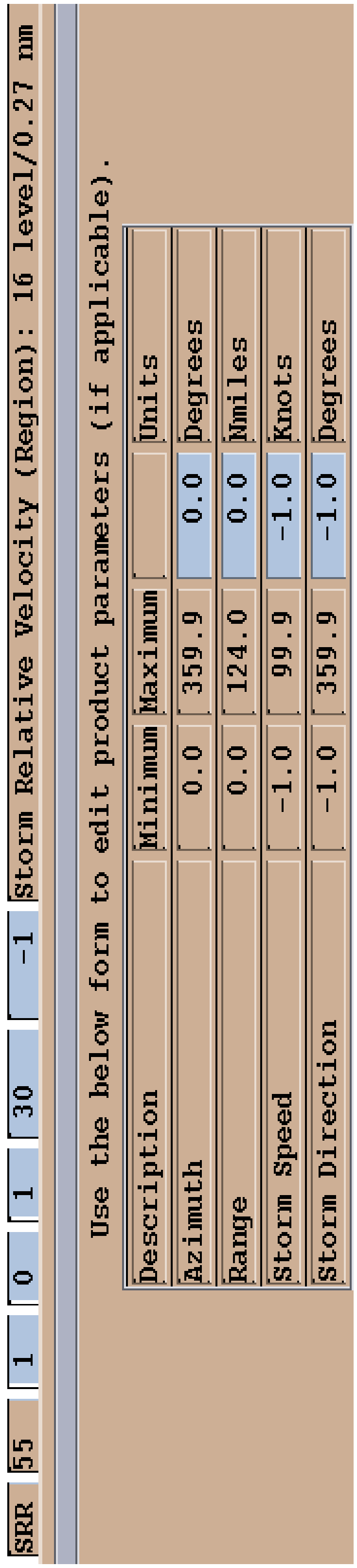



Figure 5-13. Storm Relative Velocity (Region) - SRR 55

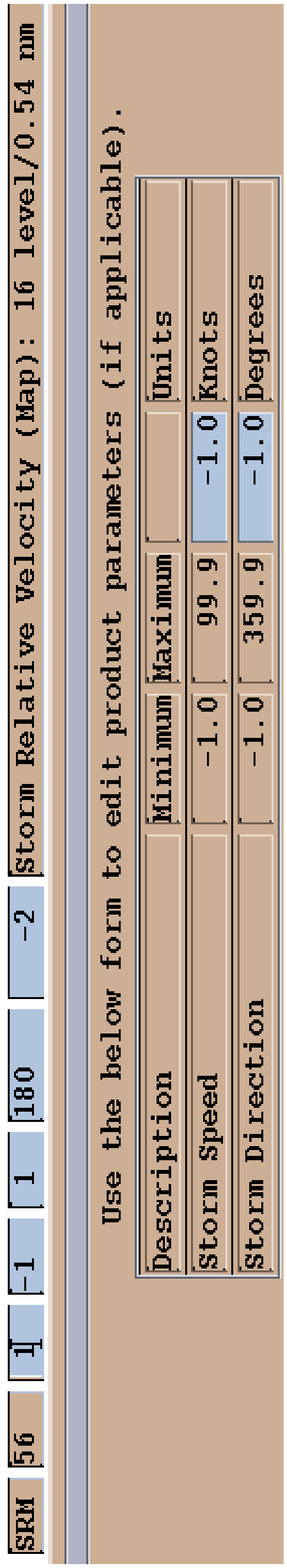



Figure 5-14. Storm Relative Velocity (Map) - SRM 56

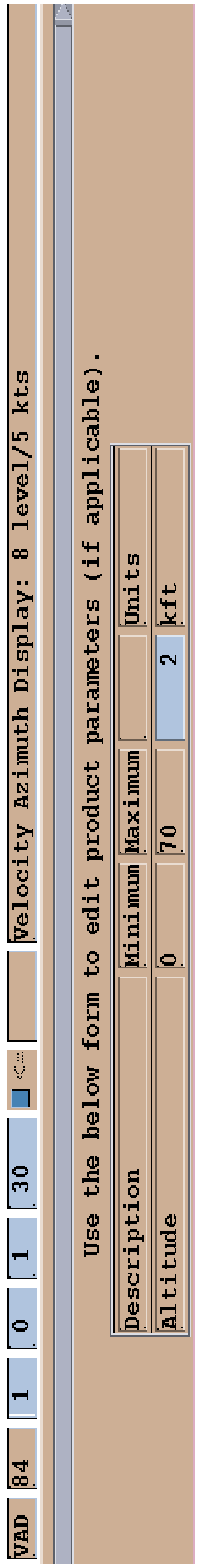



Figure 5-15.  Velocity Azimuth Display - VAD 84

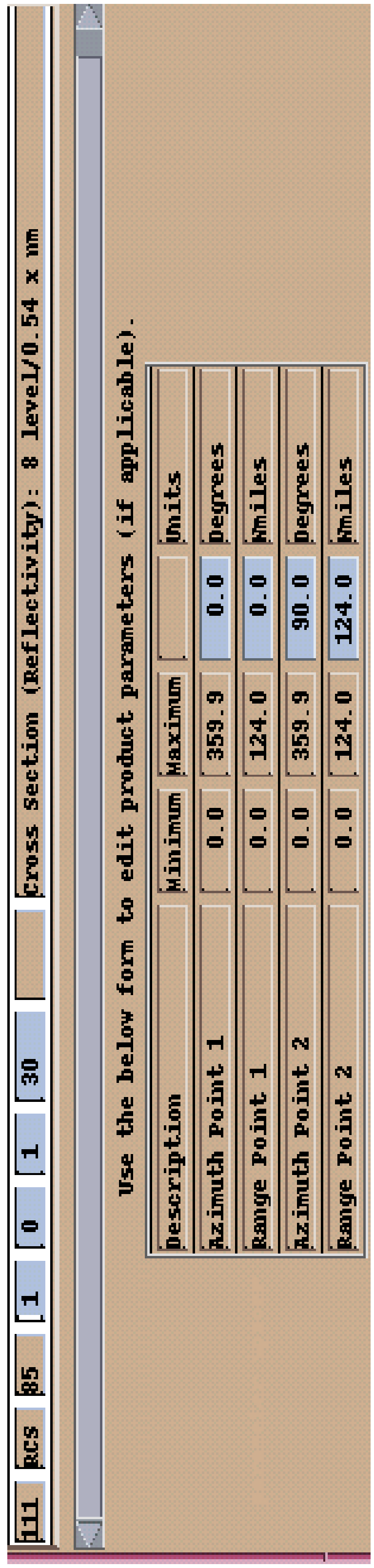



Figure 5-16. Cross Section (Reflectivity) - RCS 85

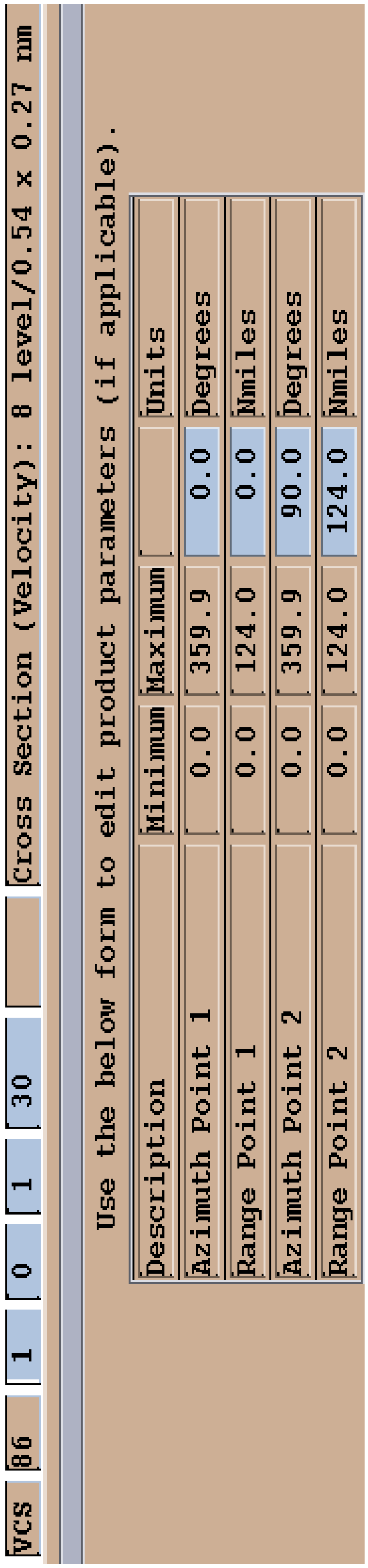



Figure 5-17. Cross Section (Velocity) - VCS 86

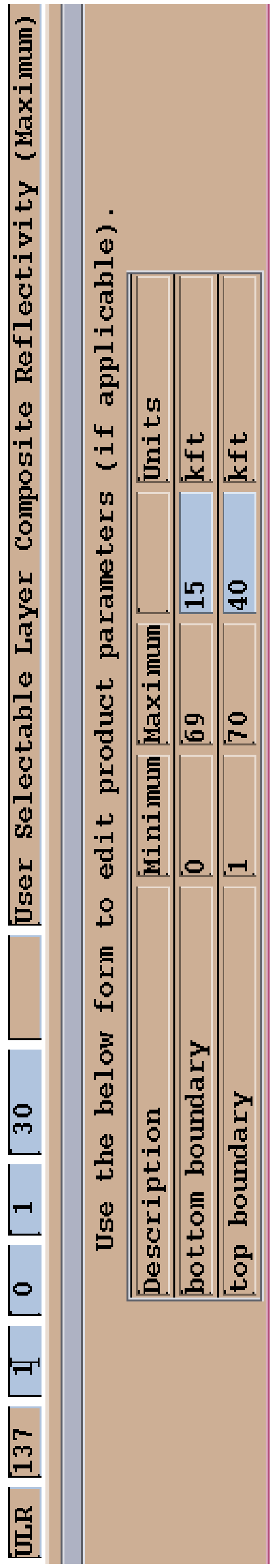



Figure 5-18. User Selectable Layer Composite Reflectivity Maximum - ULR 137

### 5.1.3 Clear Air Mode B Generation List

Click on the Clear Air (B) Table option and the window changes to the RPG Product Generation Table Editor (Clear Air Mode) and is password protected at the ROC level. See Figure 5-19, Figure 5-20, Figure 5-21, and Figure 5-22.

This list specifies, as a minimum, the product generation, archive, and availability requirements defined in FMH-11, Part A, Table 7-2. This list is password protected at the ROC level and cannot be modified at the user site. This list will automatically be invoked upon RPG restart or weather mode change from Precipitation Mode (A) to Clear Air Mode (B). Additional products may be added for generation and non-associated user distribution by the site adding to the Current generation list as a temporary addition, but the baseline listing remains under the ROC jurisdiction and control.

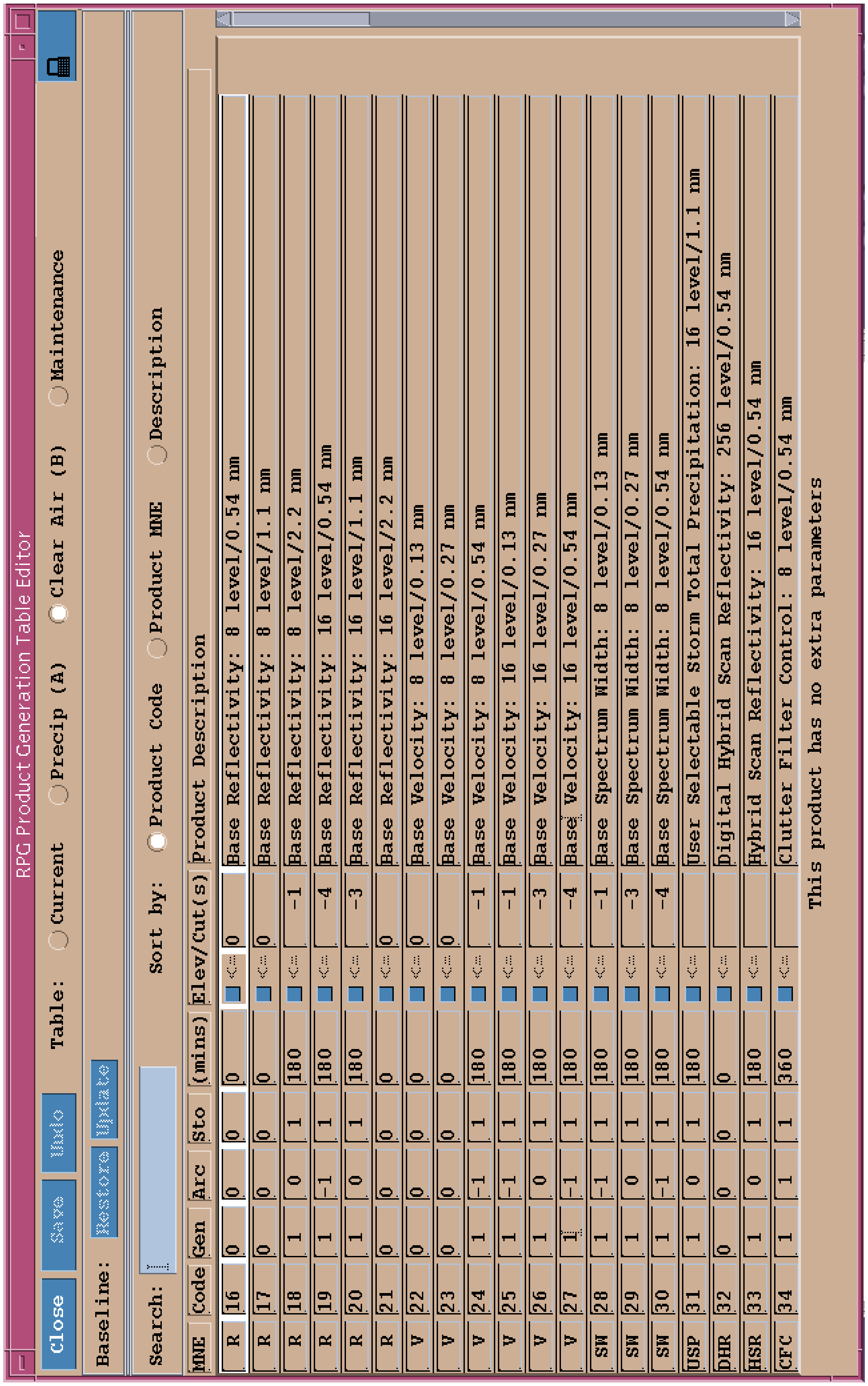
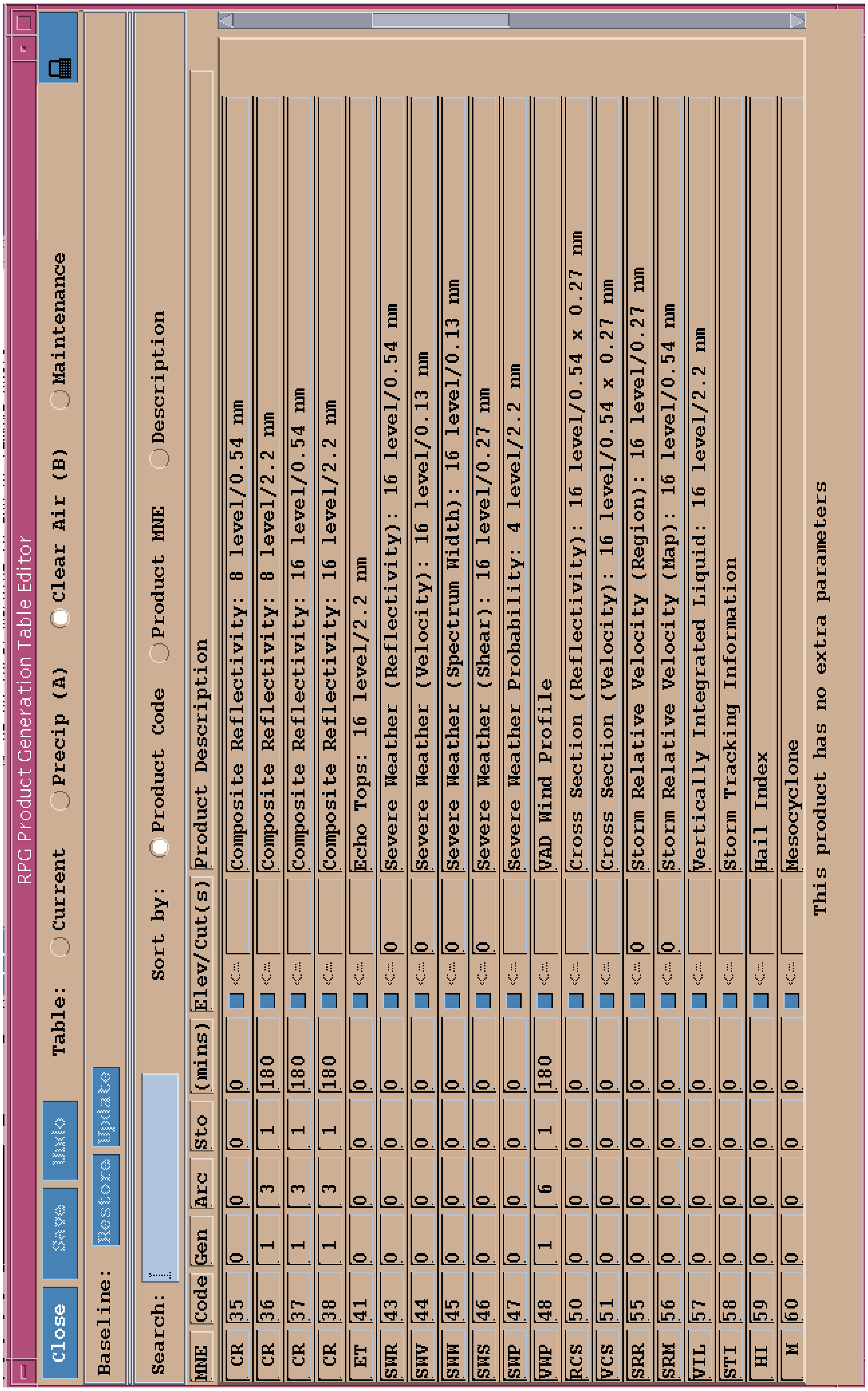



Figure 5-19. RPG Product Generation Table Editor - Clear Air (B) (Products 16-34)




| MNE | Code | Gen | Arc | Sto | (mins) | Elev/Cut(s) | | Product Description |
|---|---|---|---|---|---|---|---|---|
| CR | 35 | 0 | 0 | 0 | 0 | <= | | Composite Reflectivity: 8 level/0.54 nm |
| CR | 36 | 1 | 3 | 1 | 180 | <= | | Composite Reflectivity: 8 level/2.2 nm |
| CR | 37 | 1 | 3 | 1 | 180 | <= | | Composite Reflectivity: 16 level/0.54 nm |
| CR | 38 | 1 | 3 | 1 | 180 | <= | | Composite Reflectivity: 16 level/2.2 nm |
| ET | 41 | 0 | 0 | 0 | 0 | <= | | Echo Tops: 16 level/2.2 nm |
| SWR | 43 | 0 | 0 | 0 | 0 | <= | 0 | Severe Weather (Reflectivity): 16 level/0.54 nm |
| SWV | 44 | 0 | 0 | 0 | 0 | <= | 0 | Severe Weather (Velocity): 16 level/0.13 nm |
| SWW | 45 | 0 | 0 | 0 | 0 | <= | 0 | Severe Weather (Spectrum Width): 16 level/0.13 nm |
| SWS | 46 | 0 | 0 | 0 | 0 | <= | 0 | Severe Weather (Shear): 16 level/0.27 nm |
| SWP | 47 | 0 | 0 | 0 | 0 | <= | | Severe Weather Probability: 4 level/2.2 nm |
| VWP | 48 | 1 | 6 | 1 | 180 | <= | | VAD Wind Profile |
| RCS | 50 | 0 | 0 | 0 | 0 | <= | | Cross Section (Reflectivity): 16 level/0.54 x 0.27 nm |
| VCS | 51 | 0 | 0 | 0 | 0 | <= | | Cross Section (Velocity): 16 level/0.54 x 0.27 nm |
| SRR | 55 | 0 | 0 | 0 | 0 | <= | 0 | Storm Relative Velocity (Region): 16 level/0.27 nm |
| SRM | 56 | 0 | 0 | 0 | 0 | <= | 0 | Storm Relative Velocity (Map): 16 level/0.54 nm |
| VIL | 57 | 0 | 0 | 0 | 0 | <= | | Vertically Integrated Liquid: 16 level/2.2 nm |
| STI | 58 | 0 | 0 | 0 | 0 | <= | | Storm Tracking Information |
| HI | 59 | 0 | 0 | 0 | 0 | <= | | Hail Index |
| M | 60 | 0 | 0 | 0 | 0 | <= | | Mesocyclone |

Figure 5-20. RPG Product Generation Table Editor - Clear Air (B) (Products 35-60)

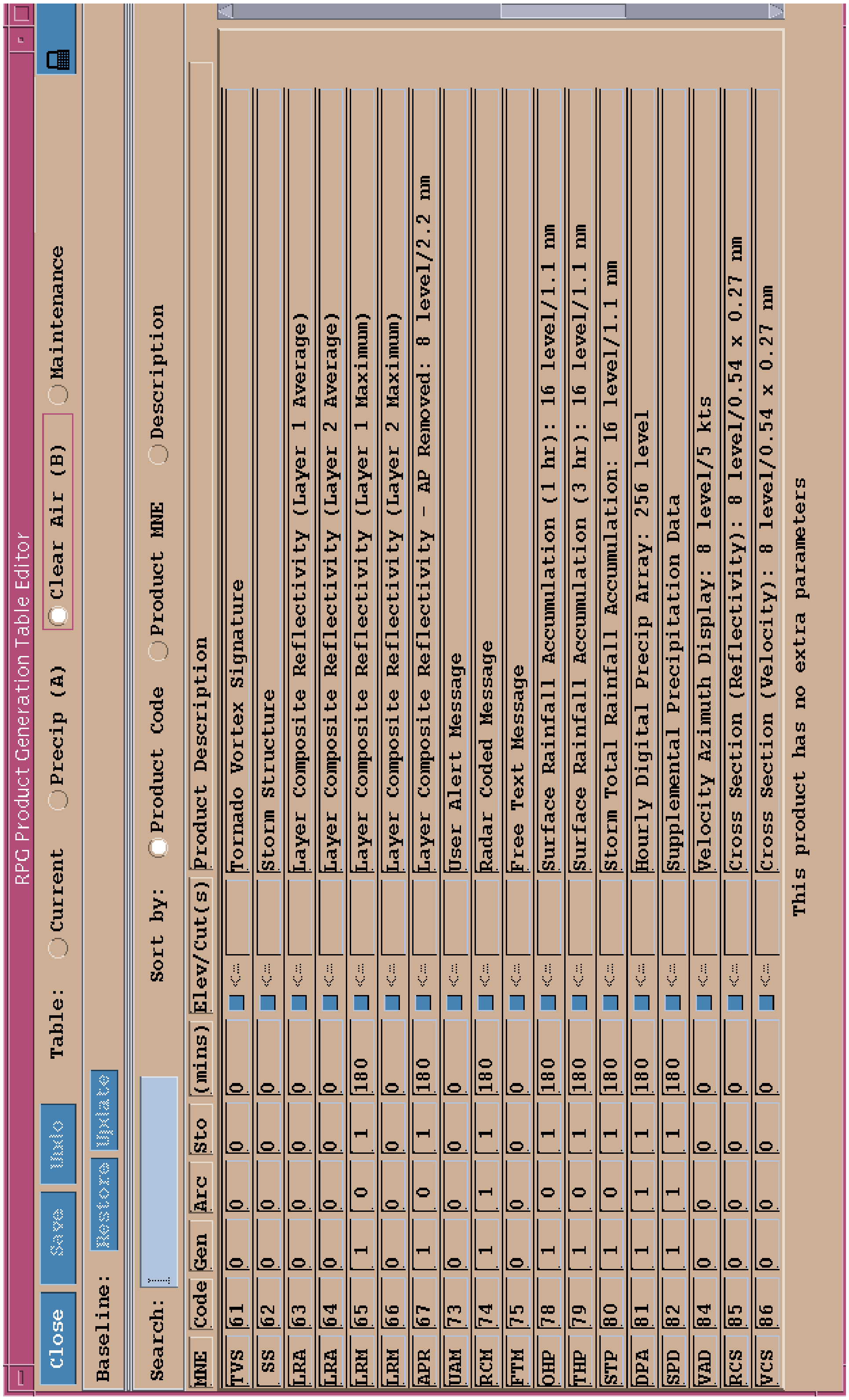



Figure 5-21. RPG Product Generation Table Editor - Clear Air (B) (Products 61-86)

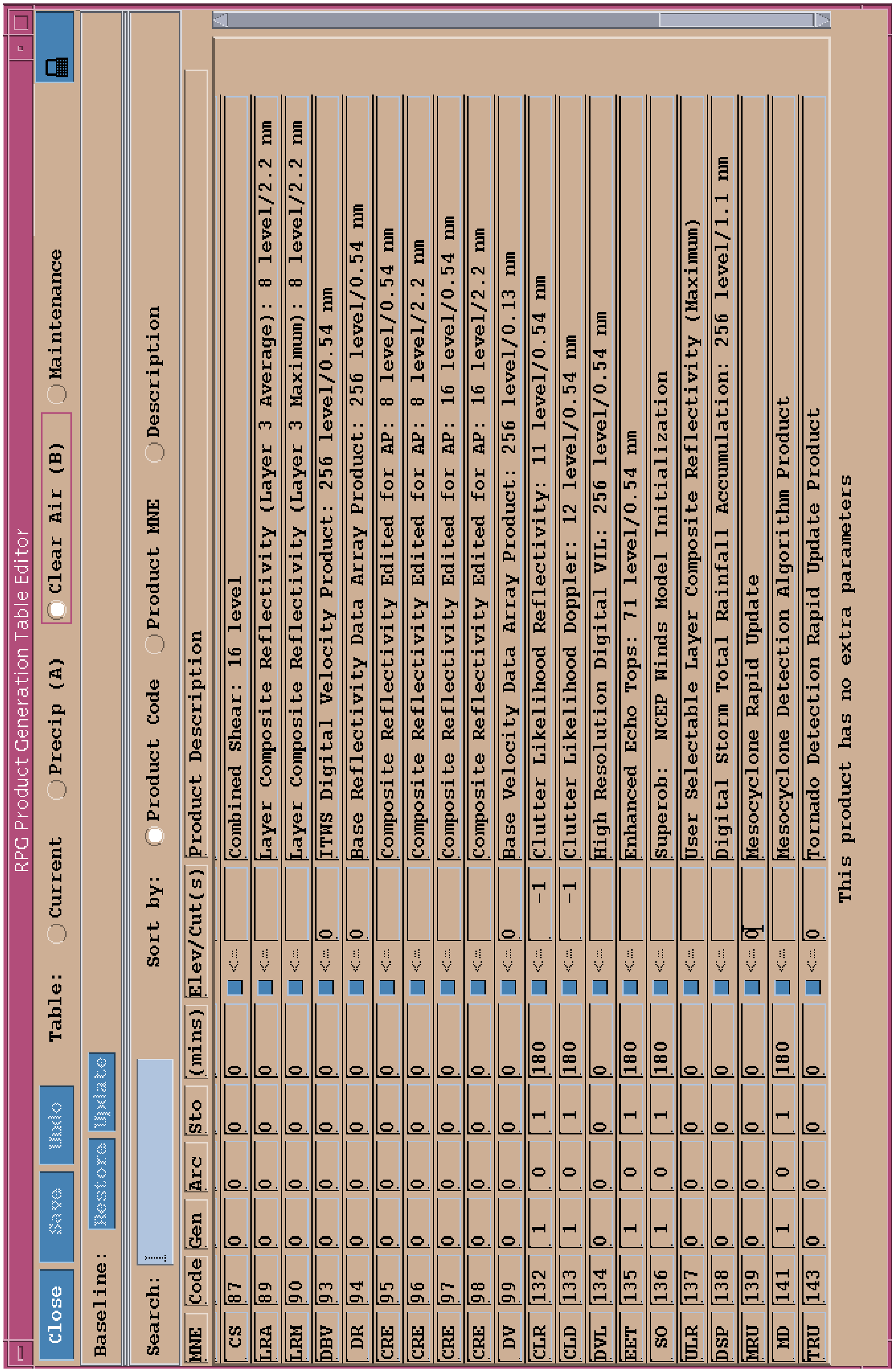



Figure 5-22. RPG Product Generation Table Editor - Clear Air (B) (Products 87-143)

#### 5.1.3.1 Extra Parameters for Selected Products - Clear Air Mode.

The extra parameters as shown in each figure (Figure 5-23 through Figure 5-39) are associated with their respective products. They automatically appear in the bottom of the RPG Product Generation Table Editor when the product is selected and the generation value set to 1.

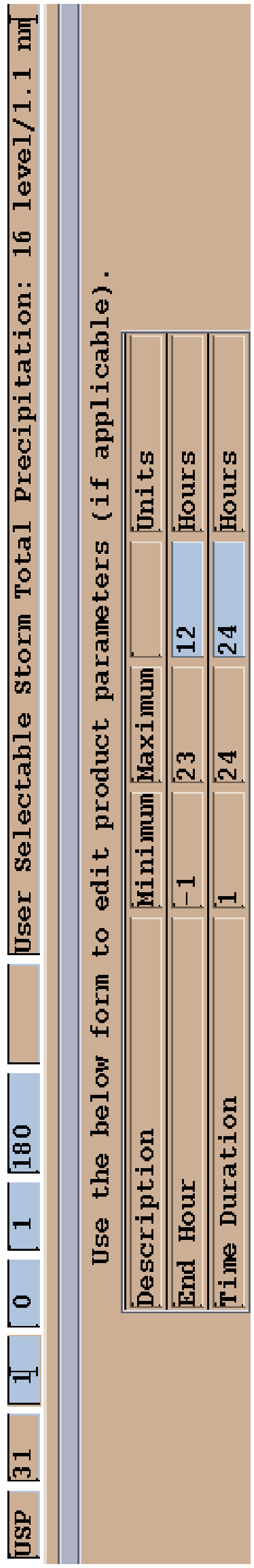



Figure 5-23.  User Selectable Storm Total Precip - USP 31

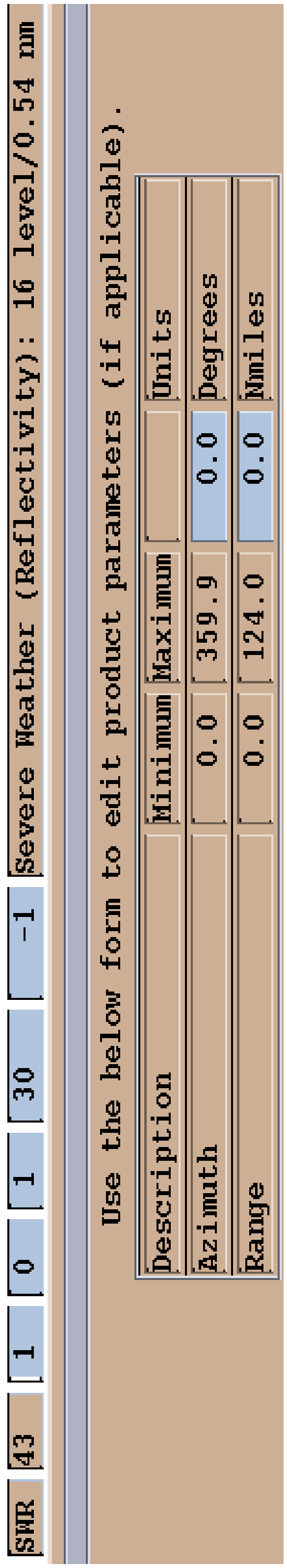



Figure 5-24.  Severe Weather (Reflectivity) - SWR 43


Figure 5-25. Severe Weather (Velocity) - SWV 44

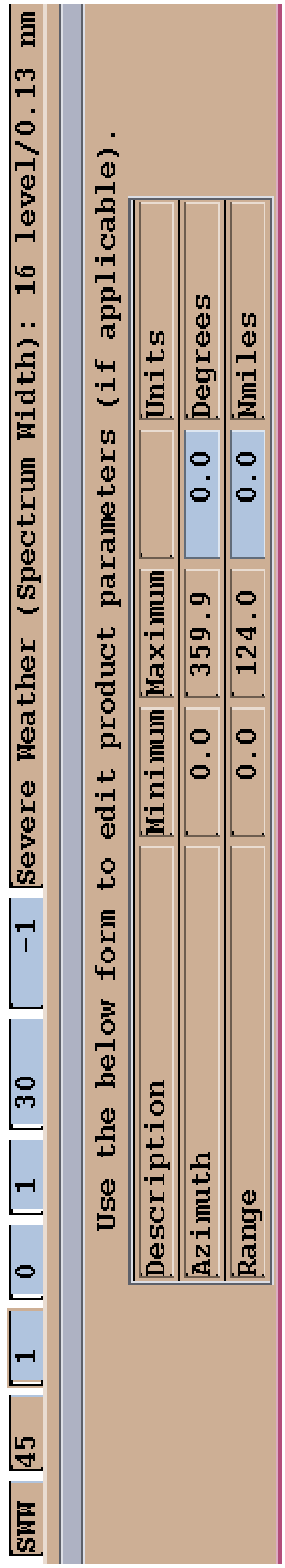



Figure 5-26.  Severe Weather (Spectrum Width) - SWW 45

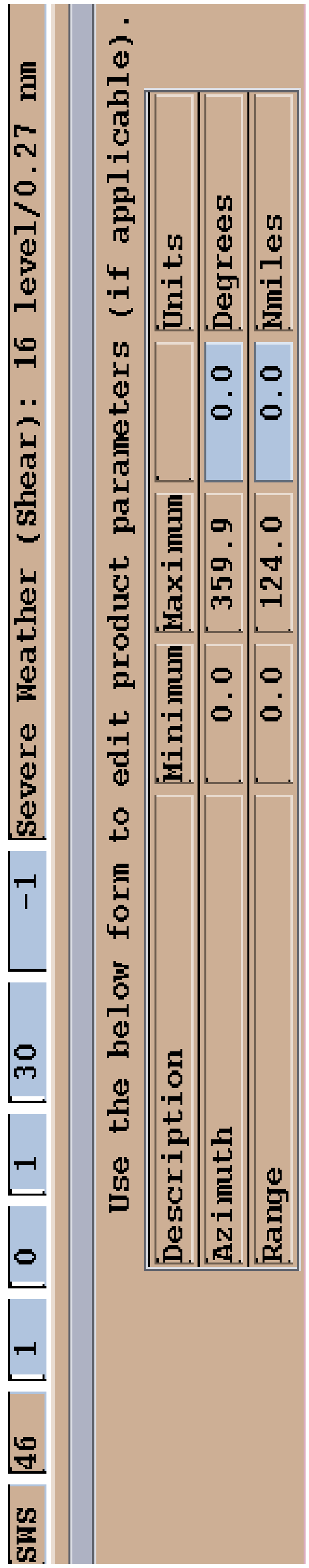



Figure 5-27. Severe Weather (Shear) - SWS 46

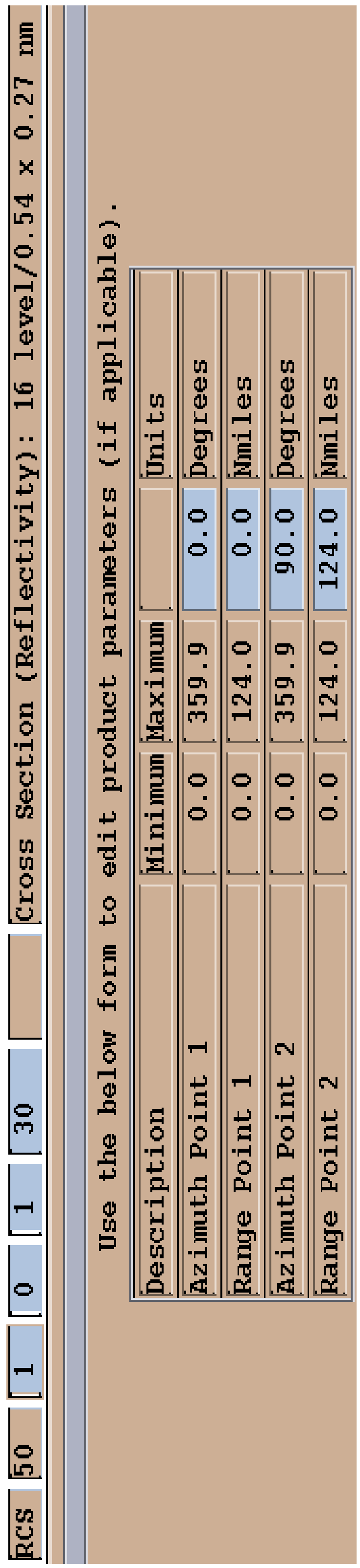



Figure 5-28. Cross Section (Reflectivity) - RCS 50

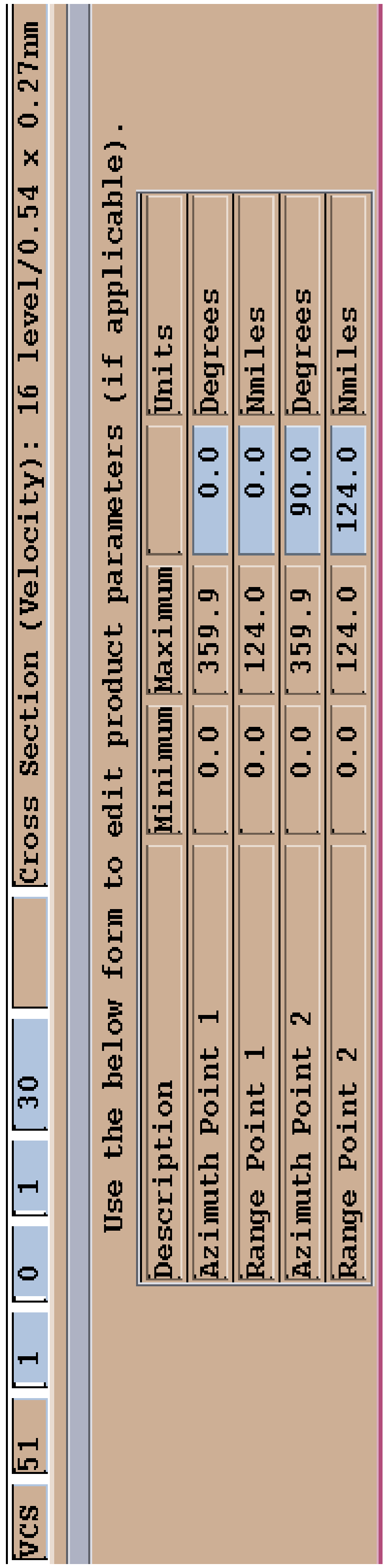



Figure 5-29.  Cross Section (Velocity) - VCS 51

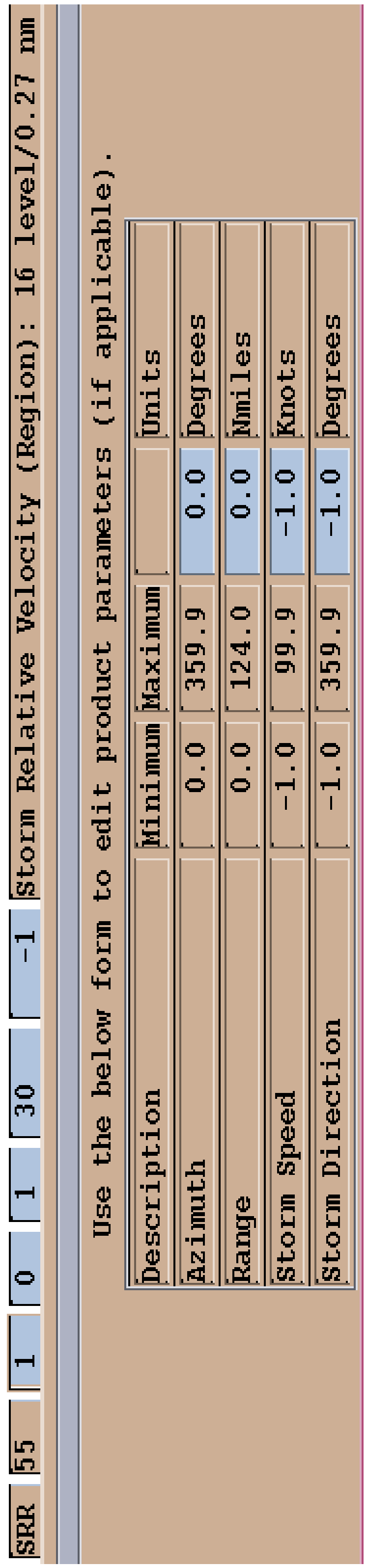



Figure 5-30.  Storm Relative Velocity (Region) - SRR 55

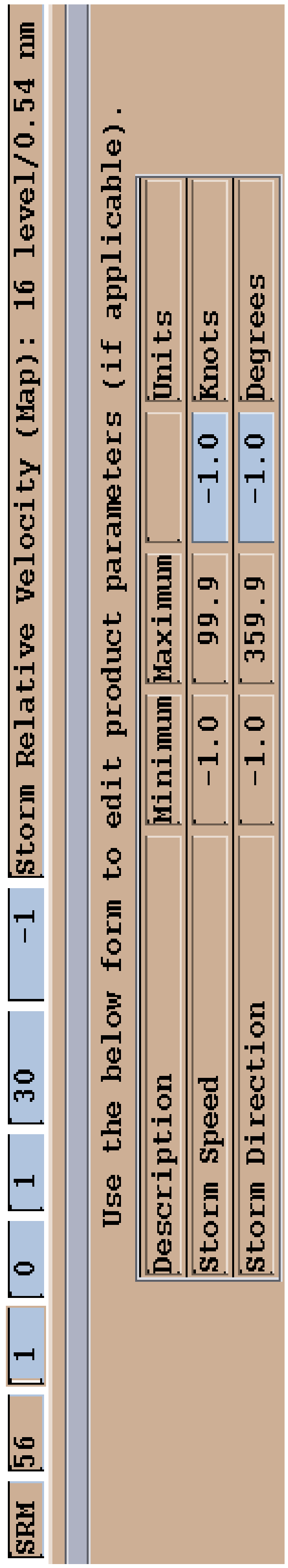



Figure 5-31. Storm Relative Velocity (Map) - SRM 56

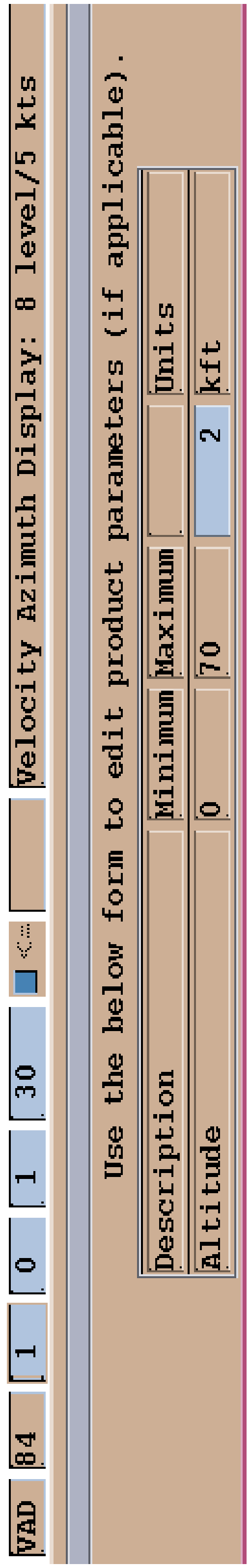



Figure 5-32.  Velocity Azimuth Display - VAD 84

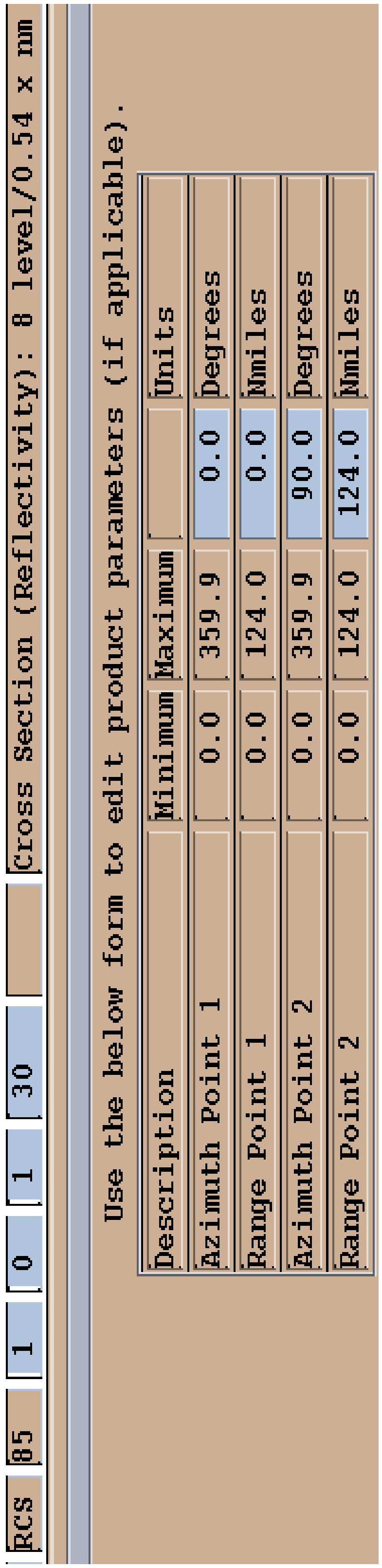



Figure 5-33. Cross Section (Reflectivity) - RCS 85

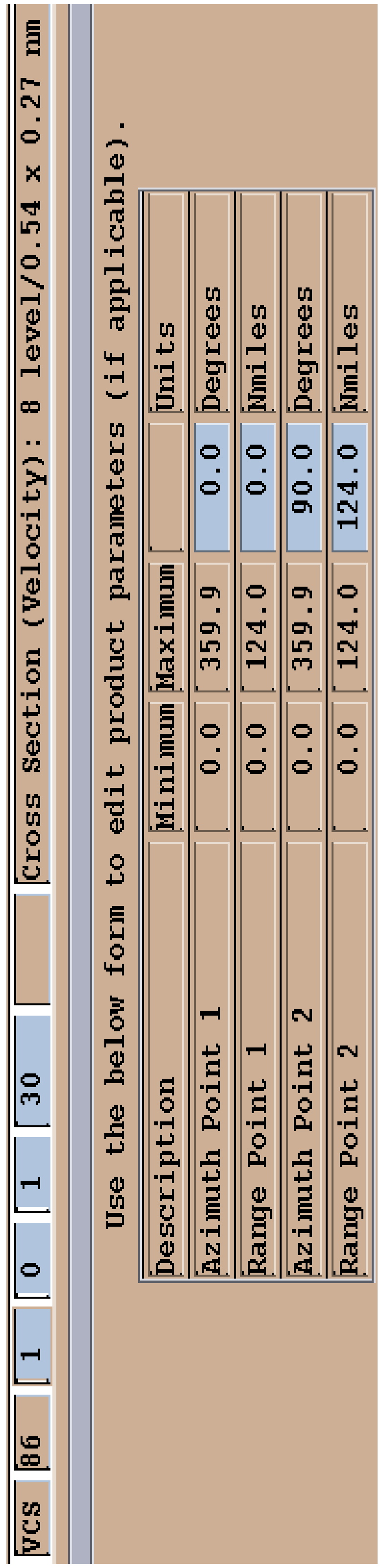



Figure 5-34. Cross Section (Velocity) - VCS 86

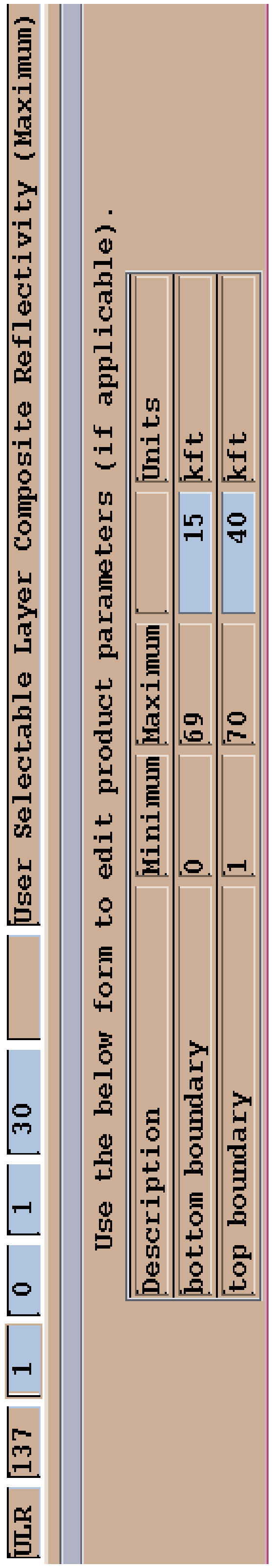



Figure 5-35. User Selectable Layer Composite Reflectivity Maximum - ULR 137

### 5.1.4 Maintenance Mode Generation List

Click on the Maintenance Table option and the window changes to the RPG Product Generation Table Editor Maintenance Mode and is password protected at the ROC level. See Figures 5-36 through 5-39. This mode is normally only used by the site technician when performing maintenance operations.

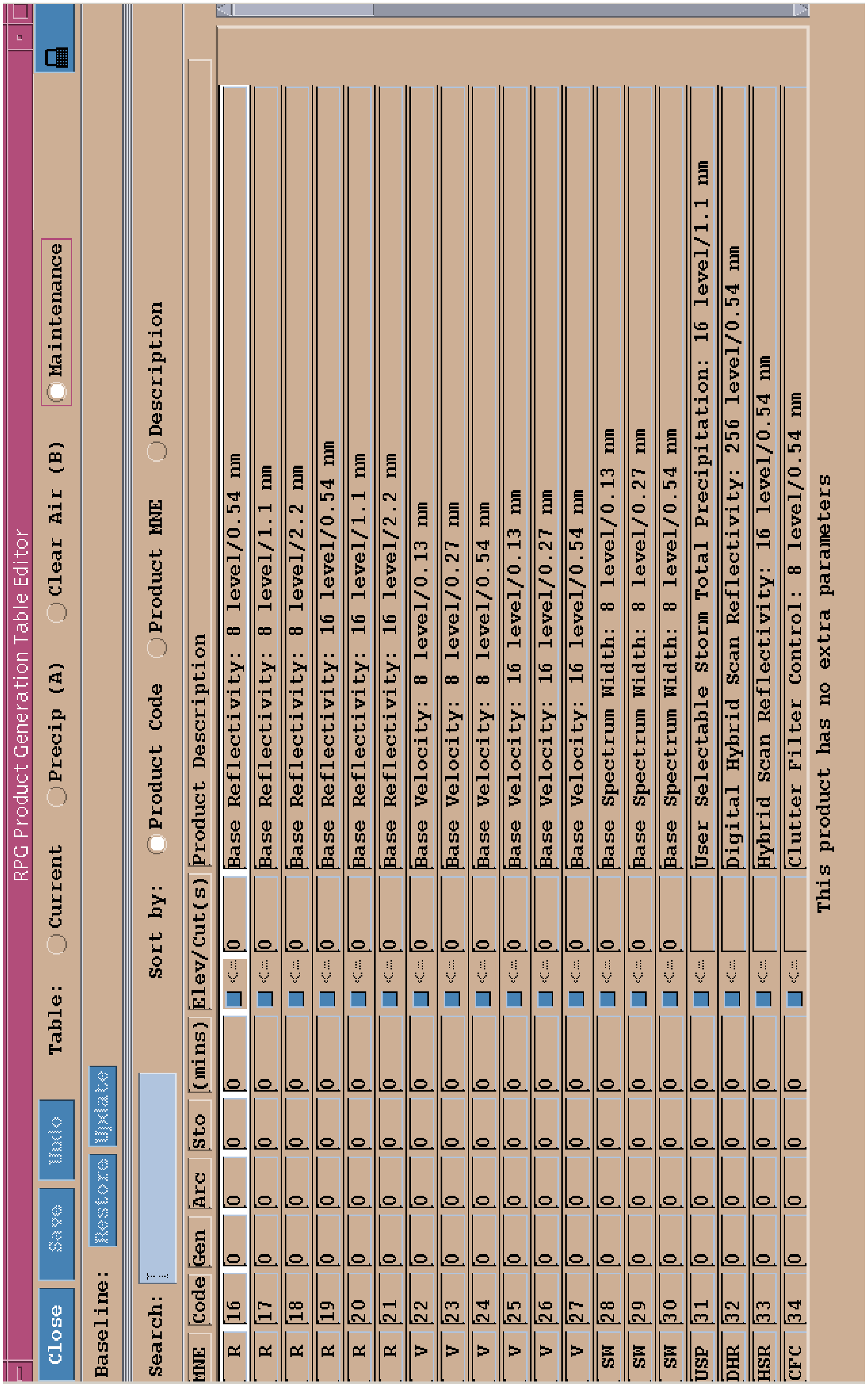



Figure 5-36.  RPG Product Generation Table Editor - Maintenance (Products 16-34)

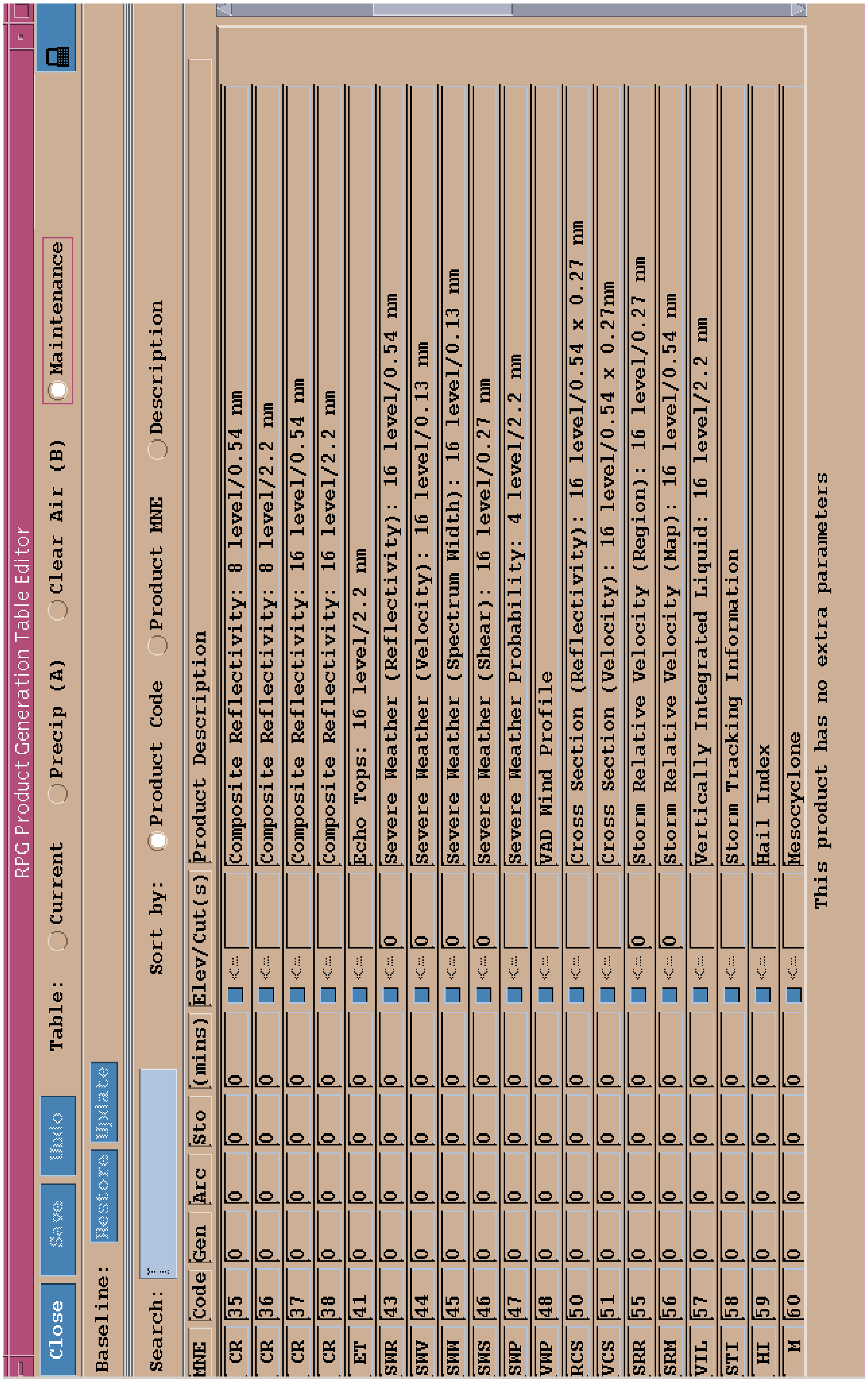



Figure 5-37. RPG Product Generation Table Editor - Maintenance (Products 35-60)

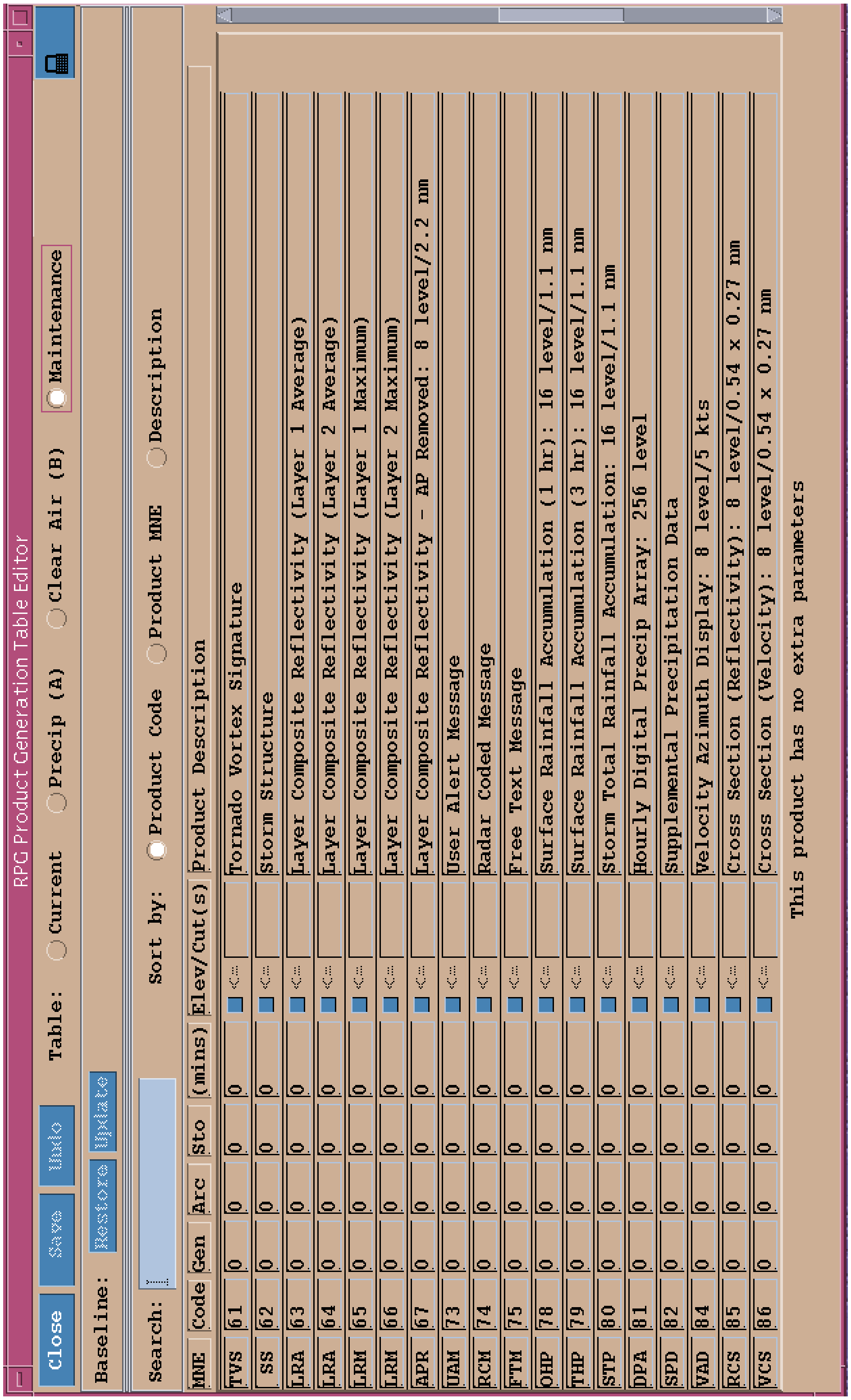



Figure 5-38. RPG Product Generation Table Editor - Maintenance (Products 61-86)

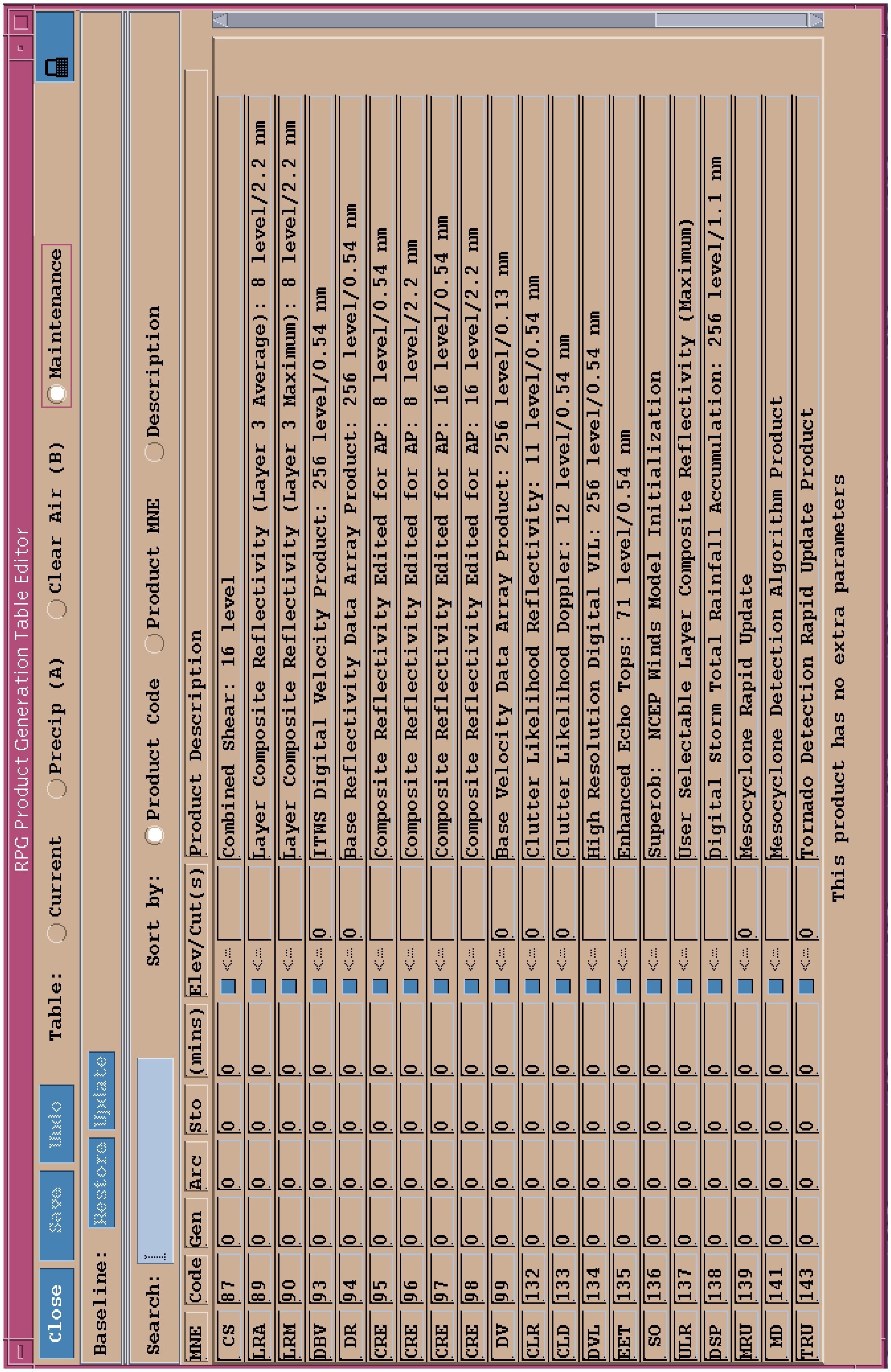
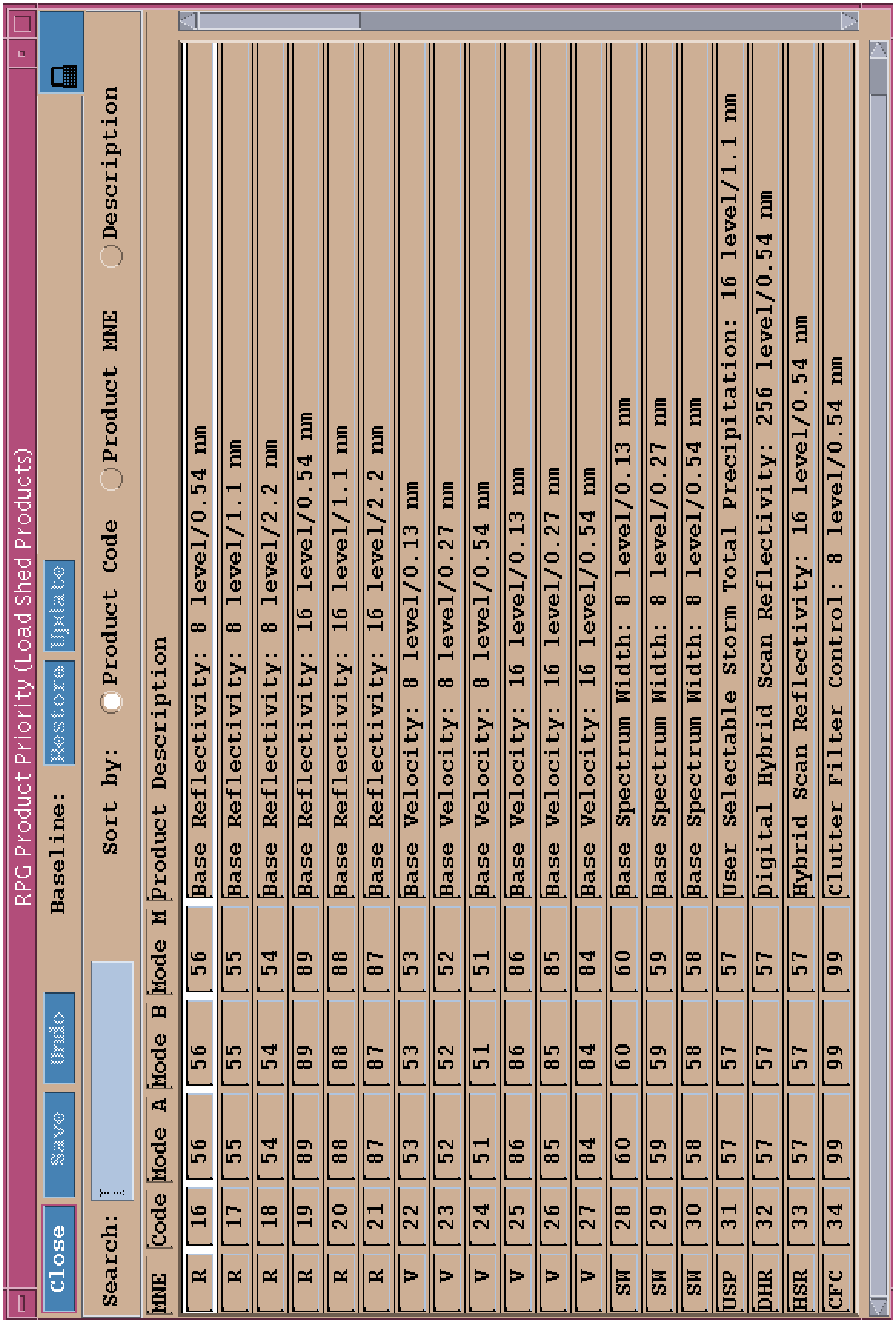



Figure 5-39. RPG Product Generation Table Editor - Maintenance (Products 87-143)

# Chapter 6
# RPG Products - Load Shed Products

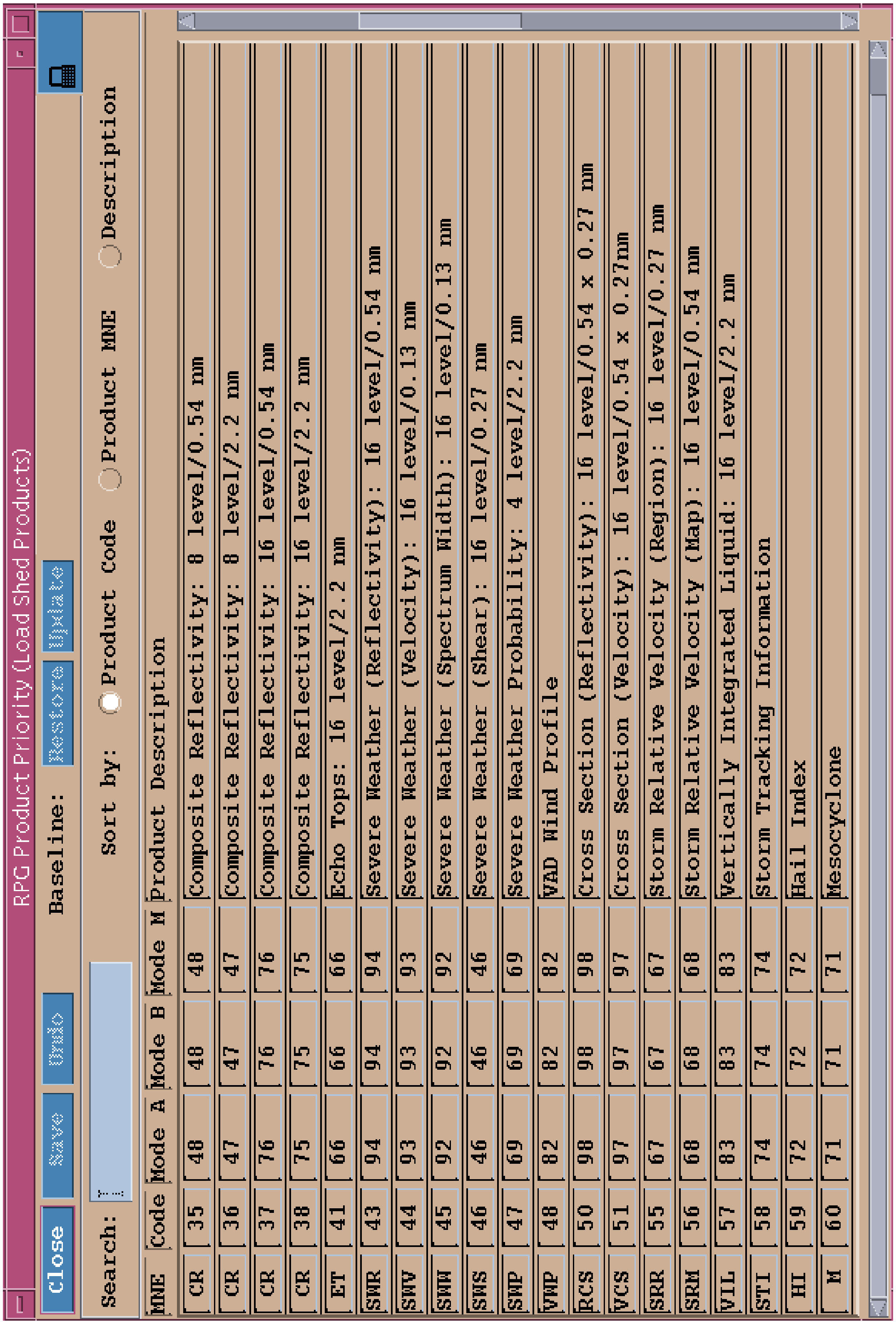
## 6.1 Load Shed Products

When product load shedding occurs, the goal is to ensure that products critical to the decision making process continue to be available at the expense of lower priority products. This RPG Product Priority (Load Shed Products) window (Figures 6-1 through 6-4) sets the relative product priorities (the higher the number, the higher the priority). This is password protected at the ROC LOCA, but is viewable at each site.



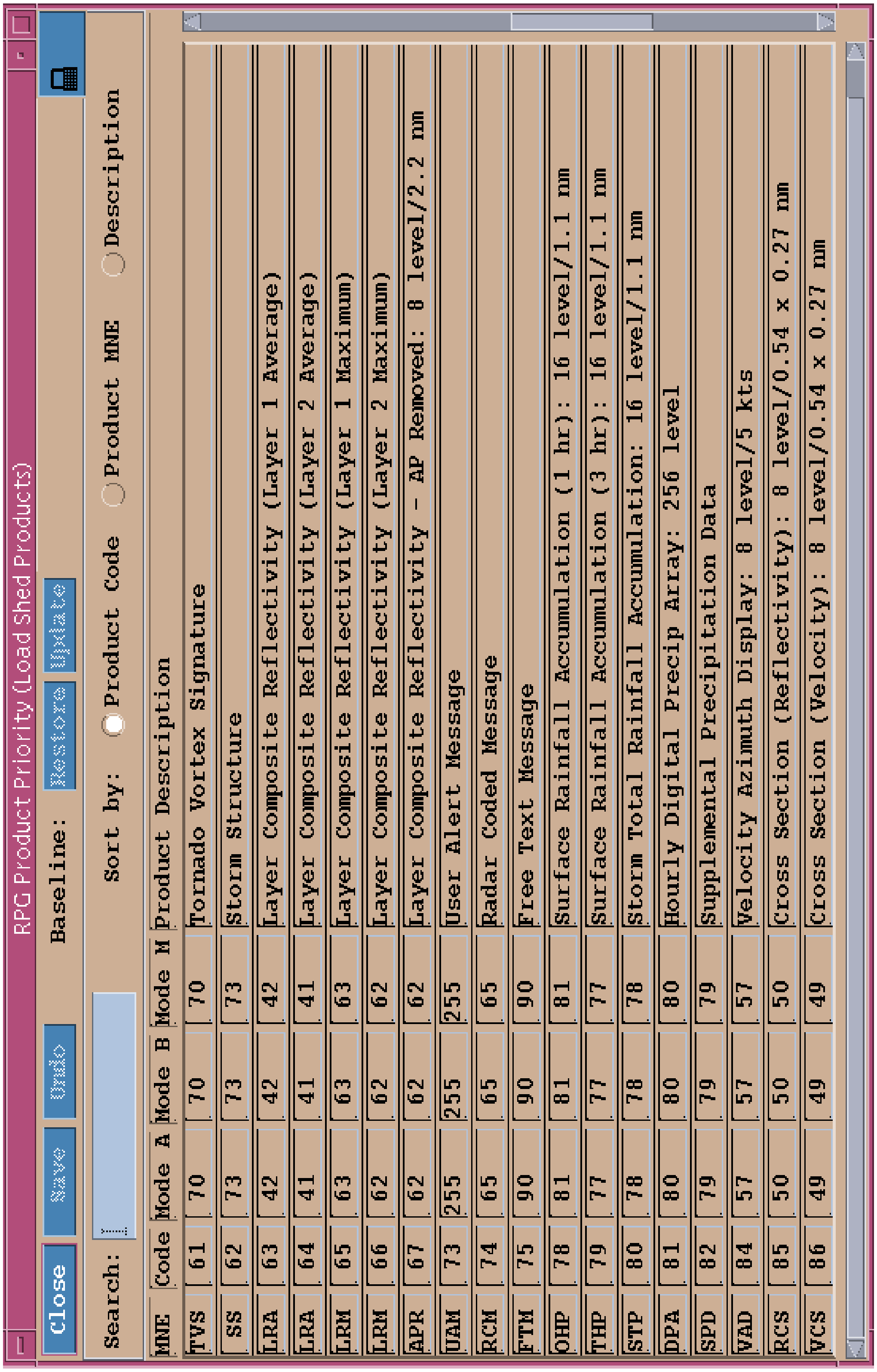

| MNE | Code | Mode A | Mode B | Mode M | Product Description |
|---|---|---|---|---|---|
| R | 16 | 56 | 56 | 56 | Base Reflectivity: 8 level/0.54 nm |
| R | 17 | 55 | 55 | 55 | Base Reflectivity: 8 level/1.1 nm |
| R | 18 | 54 | 54 | 54 | Base Reflectivity: 8 level/2.2 nm |
| R | 19 | 89 | 89 | 89 | Base Reflectivity: 16 level/0.54 nm |
| R | 20 | 88 | 88 | 88 | Base Reflectivity: 16 level/1.1 nm |
| R | 21 | 87 | 87 | 87 | Base Reflectivity: 16 level/2.2 nm |
| V | 22 | 53 | 53 | 53 | Base Velocity: 8 level/0.13 nm |
| V | 23 | 52 | 52 | 52 | Base Velocity: 8 level/0.27 nm |
| V | 24 | 51 | 51 | 51 | Base Velocity: 8 level/0.54 nm |
| V | 25 | 86 | 86 | 86 | Base Velocity: 16 level/0.13 nm |
| V | 26 | 85 | 85 | 85 | Base Velocity: 16 level/0.27 nm |
| V | 27 | 84 | 84 | 84 | Base Velocity: 16 level/0.54 nm |
| SW | 28 | 60 | 60 | 60 | Base Spectrum Width: 8 level/0.13 nm |
| SW | 29 | 59 | 59 | 59 | Base Spectrum Width: 8 level/0.27 nm |
| SW | 30 | 58 | 58 | 58 | Base Spectrum Width: 8 level/0.54 nm |
| USP | 31 | 57 | 57 | 57 | User Selectable Storm Total Precipitation: 16 level/1.1 nm |
| DHR | 32 | 57 | 57 | 57 | Digital Hybrid Scan Reflectivity: 256 level/0.54 nm |
| HSR | 33 | 57 | 57 | 57 | Hybrid Scan Reflectivity: 16 level/0.54 nm |
| CFC | 34 | 99 | 99 | 99 | Clutter Filter Control: 8 level/0.54 nm |

Figure 6-1. RPG Product Priority (Load Shed Products) (Products 16-34)




| MNE | Code | Mode A | Mode B | Mode M | Product Description |
|---|---|---|---|---|---|
| CR | 35 | 48 | 48 | 48 | Composite Reflectivity: 8 level/0.54 nm |
| CR | 36 | 47 | 47 | 47 | Composite Reflectivity: 8 level/2.2 nm |
| CR | 37 | 76 | 76 | 76 | Composite Reflectivity: 16 level/0.54 nm |
| CR | 38 | 75 | 75 | 75 | Composite Reflectivity: 16 level/2.2 nm |
| ET | 41 | 66 | 66 | 66 | Echo Tops: 16 level/2.2 nm |
| SWR | 43 | 94 | 94 | 94 | Severe Weather (Reflectivity): 16 level/0.54 nm |
| SWV | 44 | 93 | 93 | 93 | Severe Weather (Velocity): 16 level/0.13 nm |
| SWW | 45 | 92 | 92 | 92 | Severe Weather (Spectrum Width): 16 level/0.13 nm |
| SWS | 46 | 46 | 46 | 46 | Severe Weather (Shear): 16 level/0.27 nm |
| SWP | 47 | 69 | 69 | 69 | Severe Weather Probability: 4 level/2.2 nm |
| VWP | 48 | 82 | 82 | 82 | VAD Wind Profile |
| RCS | 50 | 98 | 98 | 98 | Cross Section (Reflectivity): 16 level/0.54 x 0.27 nm |
| VCS | 51 | 97 | 97 | 97 | Cross Section (Velocity): 16 level/0.54 x 0.27nm |
| SRR | 55 | 67 | 67 | 67 | Storm Relative Velocity (Region): 16 level/0.27 nm |
| SRM | 56 | 68 | 68 | 68 | Storm Relative Velocity (Map): 16 level/0.54 nm |
| VIL | 57 | 83 | 83 | 83 | Vertically Integrated Liquid: 16 level/2.2 nm |
| STI | 58 | 74 | 74 | 74 | Storm Tracking Information |
| HI | 59 | 72 | 72 | 72 | Hail Index |
| M | 60 | 71 | 71 | 71 | Mesocyclone |

Figure 6-2. RPG Product Priority (Load Shed Products) (Products 35-60)




| MNE | Code | Mode A | Mode B | Mode M | Product Description |
|---|---|---|---|---|---|
| TVS | 61 | 70 | 70 | 70 | Tornado Vortex Signature |
| SS | 62 | 73 | 73 | 73 | Storm Structure |
| LRA | 63 | 42 | 42 | 42 | Layer Composite Reflectivity (Layer 1 Average) |
| LRA | 64 | 41 | 41 | 41 | Layer Composite Reflectivity (Layer 2 Average) |
| LRM | 65 | 63 | 63 | 63 | Layer Composite Reflectivity (Layer 1 Maximum) |
| LRM | 66 | 62 | 62 | 62 | Layer Composite Reflectivity (Layer 2 Maximum) |
| APR | 67 | 62 | 62 | 62 | Layer Composite Reflectivity - AP Removed: 8 level/2.2 nm |
| UAM | 73 | 255 | 255 | 255 | User Alert Message |
| RCM | 74 | 65 | 65 | 65 | Radar Coded Message |
| FTM | 75 | 90 | 90 | 90 | Free Text Message |
| OHP | 78 | 81 | 81 | 81 | Surface Rainfall Accumulation (1 hr): 16 level/1.1 nm |
| THP | 79 | 77 | 77 | 77 | Surface Rainfall Accumulation (3 hr): 16 level/1.1 nm |
| STP | 80 | 78 | 78 | 78 | Storm Total Rainfall Accumulation: 16 level/1.1 nm |
| DPA | 81 | 80 | 80 | 80 | Hourly Digital Precip Array: 256 level |
| SPD | 82 | 79 | 79 | 79 | Supplemental Precipitation Data |
| VAD | 84 | 57 | 57 | 57 | Velocity Azimuth Display: 8 level/5 kts |
| RCS | 85 | 50 | 50 | 50 | Cross Section (Reflectivity): 8 level/0.54 x 0.27 nm |
| VCS | 86 | 49 | 49 | 49 | Cross Section (Velocity): 8 level/0.54 x 0.27 nm |

Figure 6-3. RPG Product Priority (Load Shed Products) (Products 61-86)

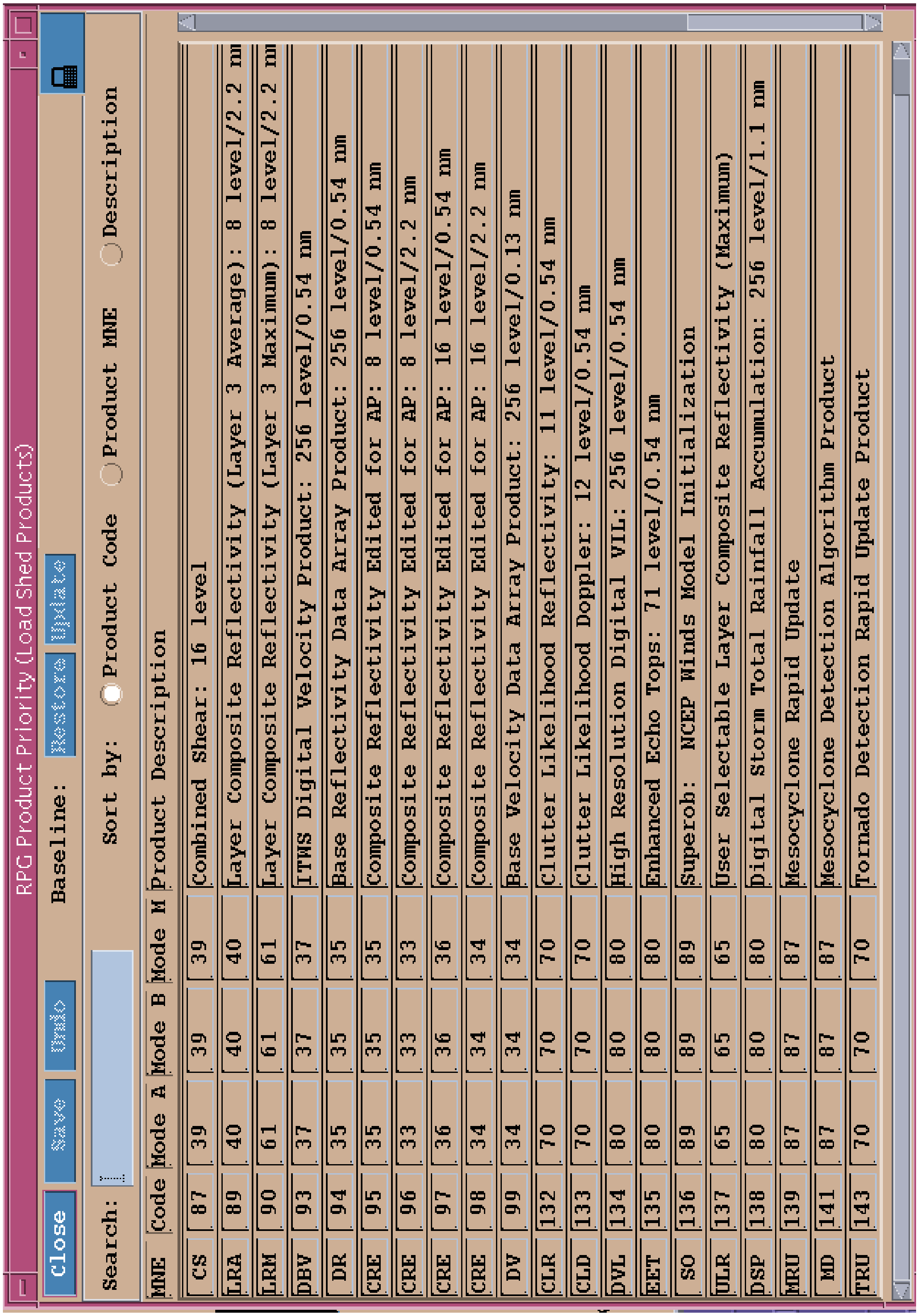



Figure 6-4. RPG Product Priority (Load Shed Products) (Products 87-143)

## 6.2 Load Shed Categories

When any utilization level reaches its predetermined threshold, the RPG initiates automatic load control measures to ensure continued RPG operation.  Click on the Load Shed: text line in the lower right hand corner of the RPG Control/Status window and the Load Shed Categories window appears.  See Figure 6-5. This is password protected at the ROC LOCA, but is viewable at each site.

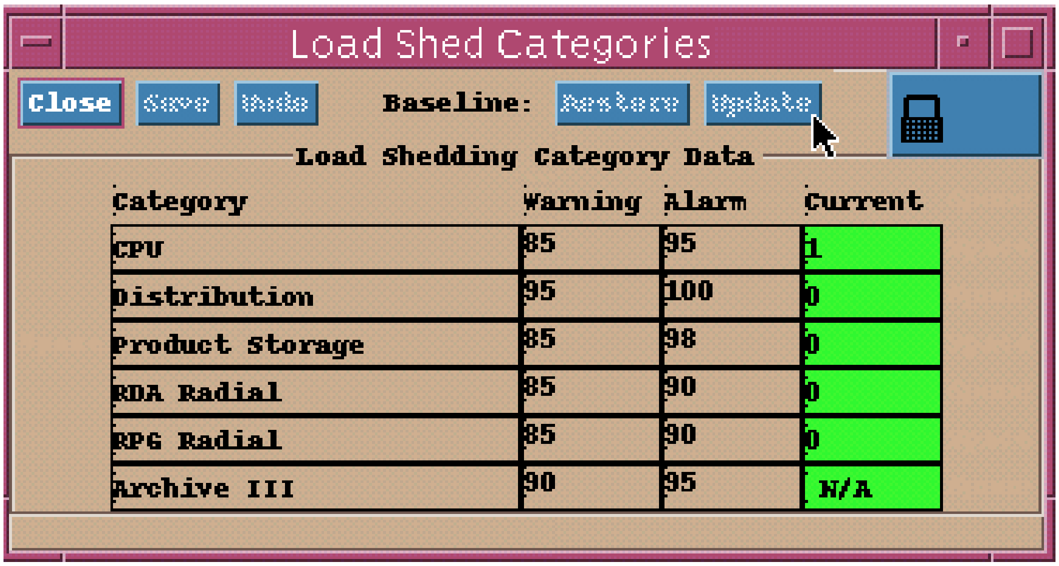



Figure 6-5.  Load Shed Categories

# Chapter 7

# RPG Products - Selectable Parameters

## 7.1 Cell Product

By altering the maximum number of cells in a product, users have control over both the visual appearance and the size of several products. Decreasing the number of cells required for transmission can decrease the product transmission time and therefore reduce potential narrowband loadshedding. In addition, by simplifying the display, it may also enhance the operator's ability to interpret products. However, caution should be exercised when limiting the number of cells included in the product. Decreasing the number of cells displayed may hide information on potentially significant storms. See Figure 7-1.

This window is used to adjust the maximum number of storm cells in the Storm Track Information (STI), Storm Structure (SS), Hail Alphanumeric Products, and the STI and Hail Attribute Tables disseminated to users. The primary reason for limiting the number of storm cells in products is to reduce the product sizes and, hence, reduce the chances of narrowband loadshedding. The parameters in this window do NOT affect the number of storm cells identified and tracked or the number of storms cells in the STI and Hail graphic products or overlays. When changing these parameters, one must consider that all users of the product will be affected. A compromise between the number of 'useful' storm cells (in the part of the product) and narrowband loadshedding should be the goal. If narrowband loadshedding is a problem for users requesting some or all of the SS, STI, Hail Index (HI), and Composite Reflectivity (CR) products, lower the values for all products in this window by the number of cells on one page of the product and observe the results. It is NOT recommended that the number of cells for any product (window row) be reduced to less than 20 cells. If appropriate changes are made to this window and narrowband loadshedding is still a problem, consider reducing the number of product requests (from the associated users).

In the range of values, the upper limit is 100, which is the same as the upper limit on the maximum number of storm cells per volume scan. The lower limit for each parameter is the number of storm cells which fit on the first page of that part of the product. For example, there can be up to ten storm cells on the first page of the Hail Alphanumeric Product.

To most efficiently reduce the product sizes, increase or decrease the maximum number of storm cells by the number of storm cells which fit on whole pages of (or part of) a product. The number of storm cells which fit on each page is equal to the lower limit in the range of acceptable values, except for the STI Alphanumeric Product. For example, the number of storm cells per page of the Hail Attribute Table is six. For the STI Alphanumeric Product, the first page lists up to seven storm cells, but each additional page can list up to nine storm cells.

The storm cells for each (part of a product) are sorted by a 'severity' attribute. For example, in the STI product, the storm cells are sorted by cell-based VIL, and secondly, maximum reflectivity. When the number of storm cells identified exceeds the maximum number of storm cells in a particular (part of a) product, the storm cells nearest the top of the sorted list (i.e. 'the most severe' storm cells) are included.

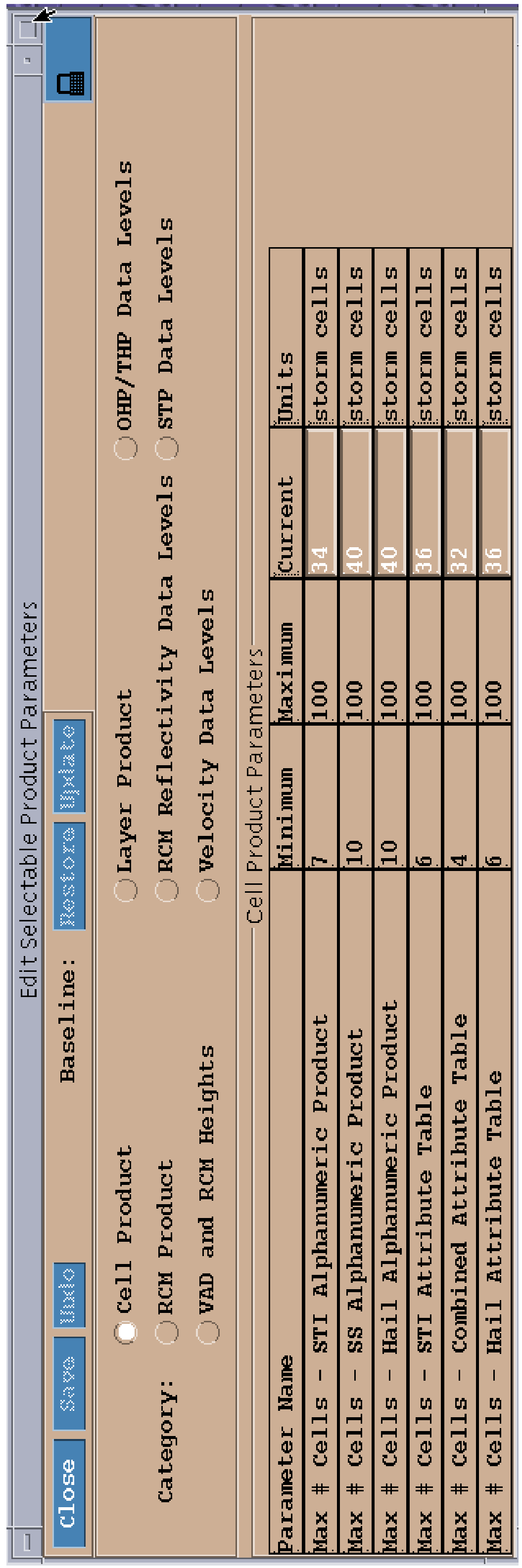



Figure 7-1. Cell Product

## 7.2 Layer Product

This window allows the specification of the layer definitions for the Layer Composite Reflectivity products. The design allows for four entries to define the three layers. Consequently, the first specified height (Layer 0) defines the bottom of the first layer. The second specified height (Layer 1) defines the top of the first layer and the bottom of the second layer. The third specified height (Layer 2) delineates the top of the second layer and the bottom of the third layer. The fourth specified height (Layer 3) defines the top of the third layer. See Figure 7-2.

The lowest height definition (Layer 0) on this window DOES NOT affect the Layer Composite Reflectivity - AP Removed (APR) product. However, changing the second height definition (Layer 1) will change the top of the lowest layer for the LRA and all other layer products.

Designed to support national layer composite maps, the height and depth definitions of the second and third layers are standardized as 24-33 kft and 33-60 kft, respectively. Because of this requirement, the second, third and fourth (Layer 1, Layer 2, and Layer 3) height definitions fall under the ROC LOCA to ensure these layer definitions support the national FAA aerospace monitoring program. However, since this program no longer uses the lowest layer Layer Composite Reflectivity product to build national radar mosaic products, the base of the lowest layer height specification is now under the URC LOCA. The first or lowest layer height (layer 0 height) must be defined above the RDA elevation and 6 kft below the next layer.

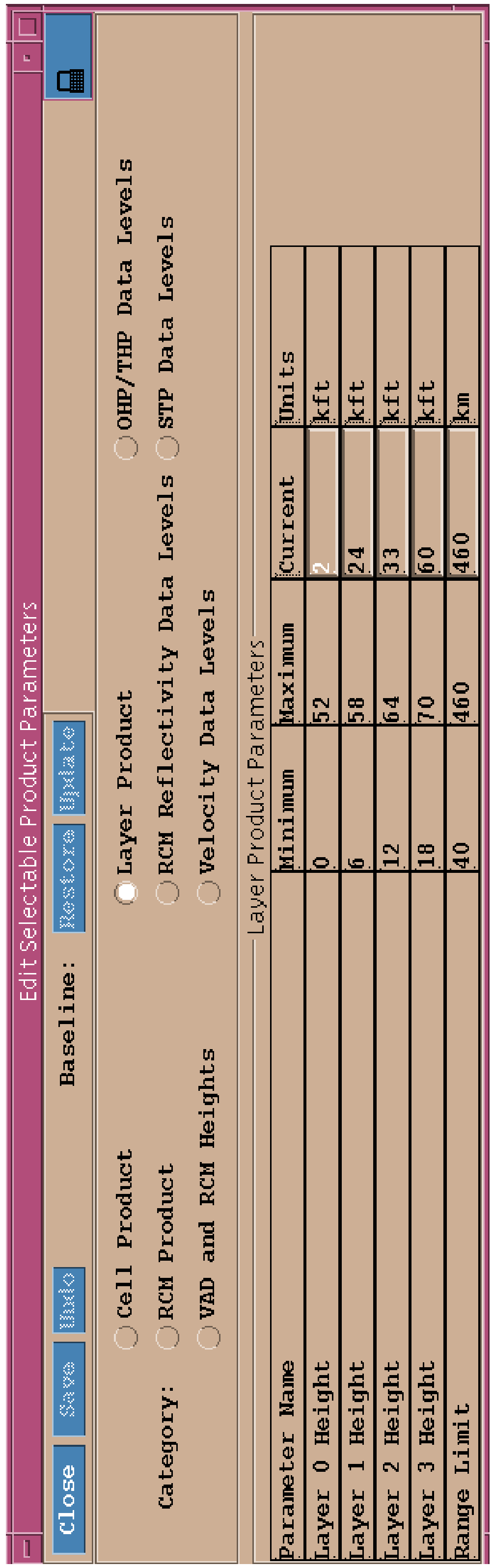



Figure 7-2. Layer Product

## 7.3 One/Three Hour Precipitation (OHP/THP Data Levels

The displayable range of precipitation accumulation and quantization of accumulations into each color level can be changed by modifying the current displayable precipitation accumulation values. This functionality enables WSR-88D sites to modify the precipitation accumulation values and quantizations to meet local data requirements.

The One-hour Precipitation Accumulation (OHP) and Three-hour Precipitation Accumulation (THP) product data levels are controlled via the same menu, and therefore have the same accumulation and quantization values. In addition, the User Selectable Precipitation (USP) product data levels are controlled by this menu if the USP maximum rainfall is less than the Code 16 value (default = 8.00 inches). If the USP maximum rainfall exceeds the Code 16 value, the USP product data levels are controlled by the Storm Total Precipitation Accumulation (STP) data level menu (see section 7.6). The displayable data levels range from 0.05 to 12.70 inches with a quantization resolution of 0.05 inches.

Modifications to these displayable product data levels will affect all associated users and non associated users of precipitation accumulation data. Coordination with affected RFCs is recommended.

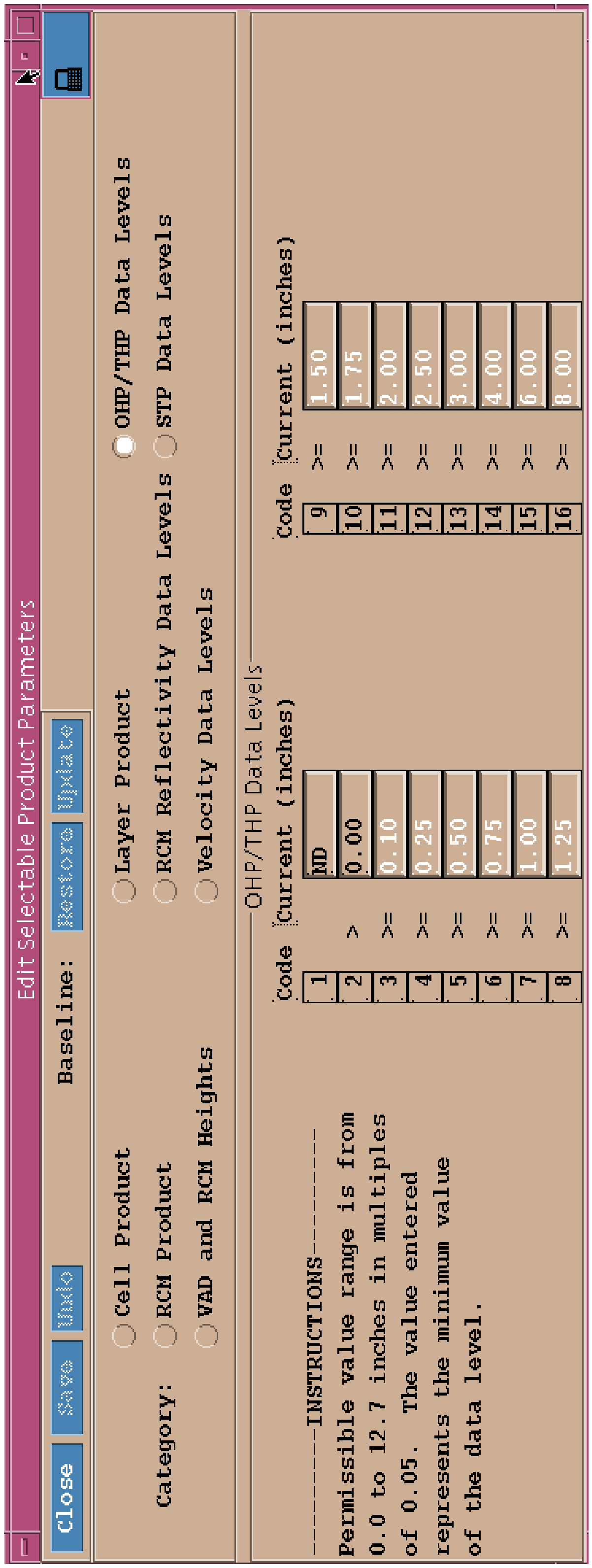



Figure 7-3. OHP/THP Data Levels

## 7.4 RCM Product

This window defines the parameters for the RCM. See Figure 7-4.

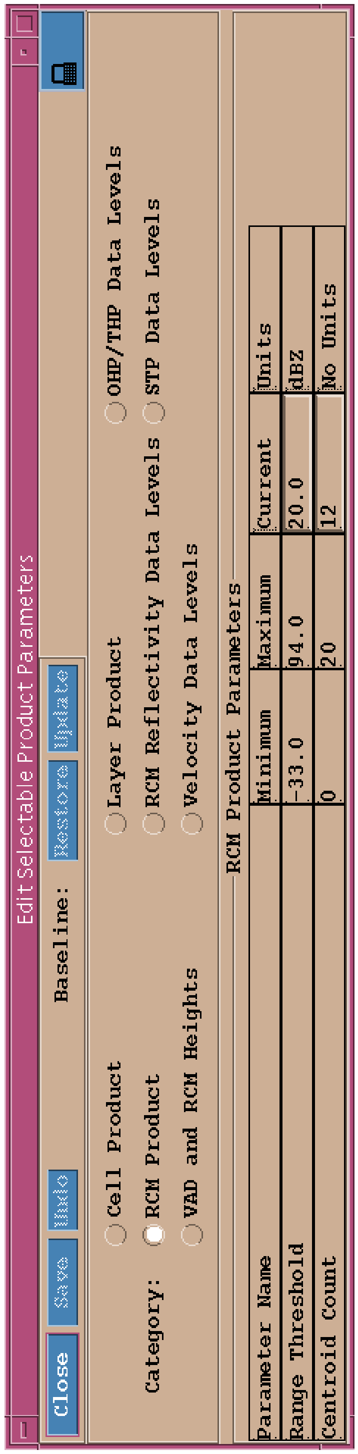



Figure 7-4. RCM Product

## 7.5 RCM Reflectivity Data Levels

This window defines the reflectivity data values for the RCM product only. See Figure 7-5.

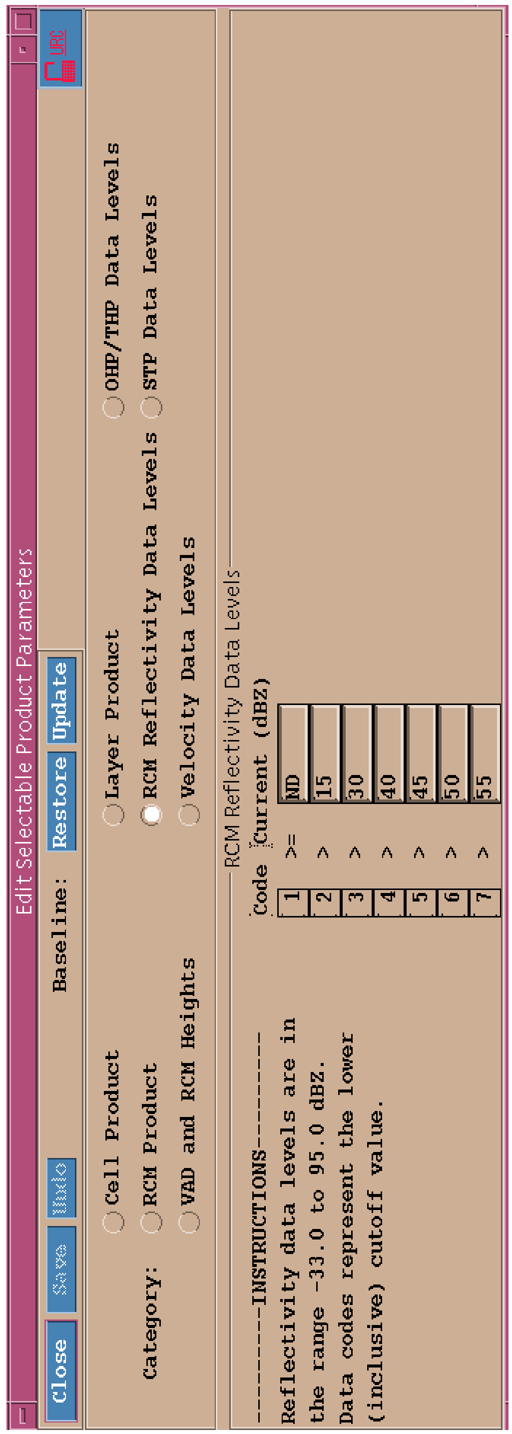



Figure 7-5. RCM Reflectivity Data Levels

## 7.6 STP Data Levels

The STP product data levels are controlled by this window. In addition, the USP product data levels are controlled by this window if the USP maximum value exceeds the Code 16 value (default = 8.00 inches) for the OHP/ THP data levels. If the USP maximum rainfall is less than the OHP/THP Code 16 value, the USP product data levels are controlled by the OHP/THP Data Levels window. The displayable range of precipitation accumulation and quantization of accumulations into each color level can be changed by modifying the current displayable precipitation accumulation values. This functionality enables modification of the precipitation accumulation values and quantizations to meet local data requirements. The displayable data levels range from 0.0 to 25.4 inches, with a quantization resolution of 0.1 inches. See Figure 7-6.

Modifications to these displayable product data levels will affect all associated users and non-associated users of precipitation accumulation data. Coordination with affected RFCs is recommended.

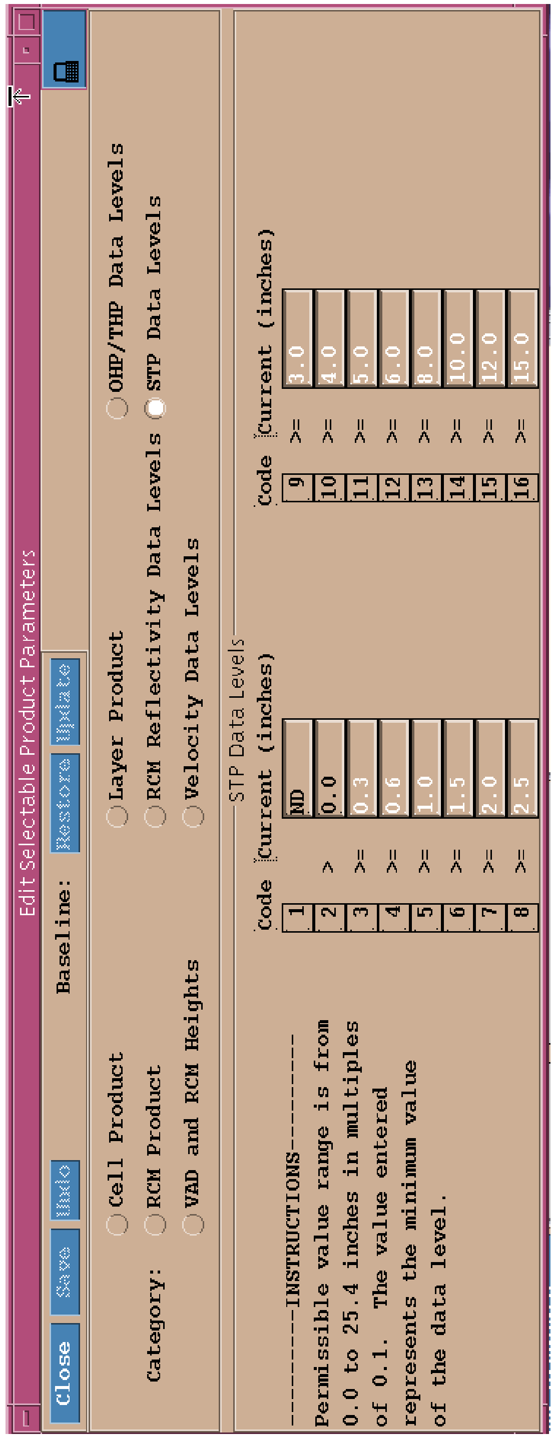



Figure 7-6. STP Data Levels

## 7.7 VAD and RCM Heights

This window is used to define the heights (MSL) of the VAD-derived wind estimates for the RCM and the VAD Wind Profile (VWP) products. See Figure 7-7.

### 7.7.1 Delegated Authority Restrictions

RCM wind direction and speed, as output from the VAD algorithm, shall be reported at 1,000 foot increments from the nearest 1,000 ft MSL above the radar level (surface) to 10,000 feet MSL; then at 2,000 foot increments from 12,000 to 20,000 feet MSL; and at the additional levels of 25,000; 30,000; 35,000 and 50,000 feet MSL. The VAD/RCM heights (up to 19 height values) must be specified as described herein to maintain national RCM wind height consistency. For radars with an elevation above 1000 ft MSL, the change authority is granted to the URC (or Agency field office where no URC exists) for the reassignment of the unused VAD/RCM heights to VAD only heights.

### 7.7.2 VAD Wind Profile (VWP) Display Heights

The VAD Wind Profile (VWP) Product has the capability to display up to 30 heights. The heights are specified as up to 19 combination VAD and RCM heights (designated by a check mark in both the VAD and RCM columns on the edit window) and the remaining, up to a total of 30 heights, as VAD only (designated by a check in the VAD column only).

In the example window shown in Figure Figure 7-7, the radar elevation is 1200 ft MSL. Therefore, the lowest VAD/RCM height defined on the edit window is the 2 kft height MSL (800 ft above the surface for this location). The "unused" VAD/RCM height (1 kft) was reassigned as VAD only (V) height selections at 45 kft.

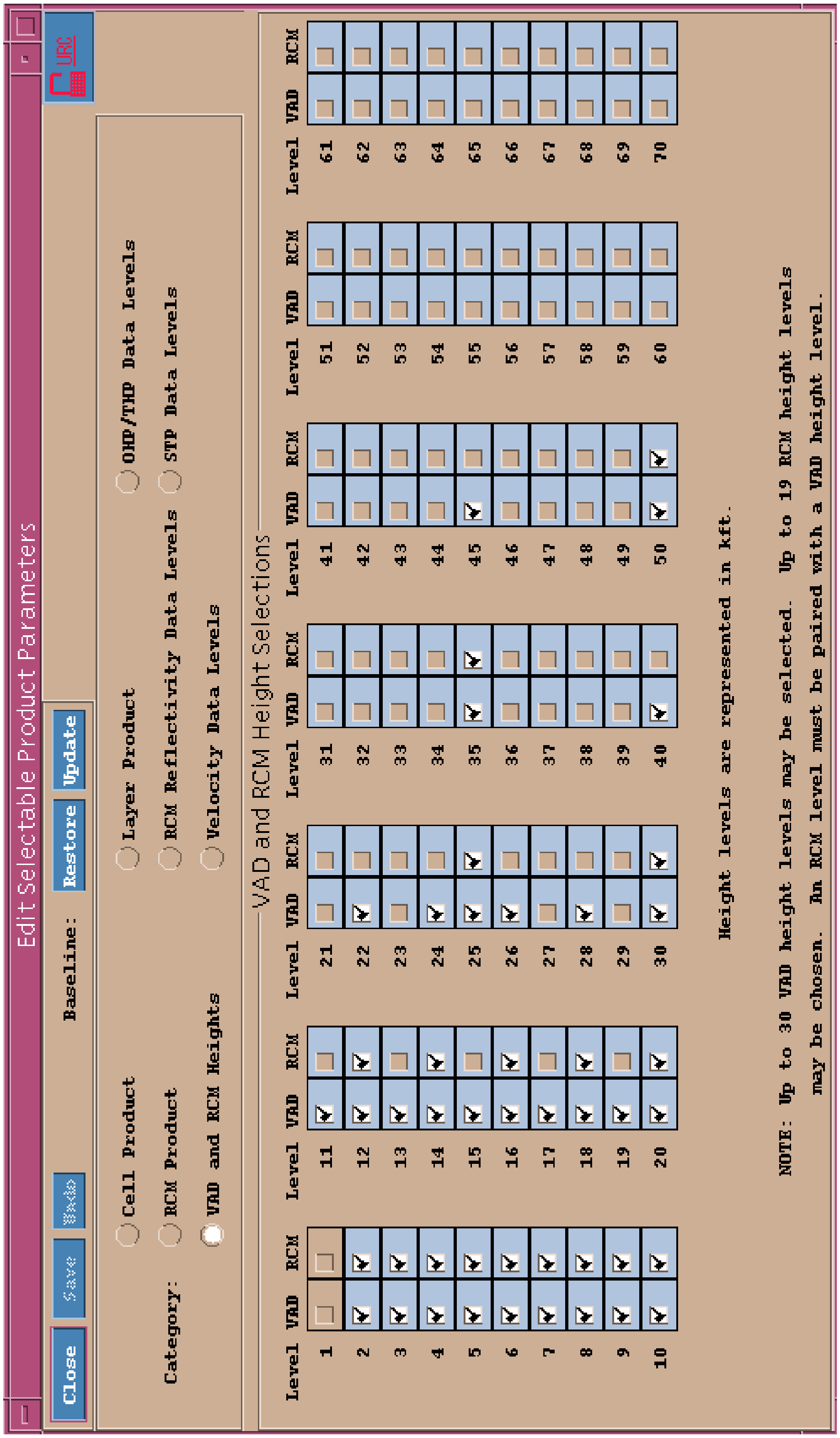



Figure 7-7. VAD and RCM Heights

## 7.8 Velocity Data Levels

The displayable range of velocities (maximum inbound to maximum outbound) and the quantification of velocities into each color level can be changed by modifying the velocity data levels in the velocity tables. The WSR-88D provides for eight velocity tables to define the base velocity product's display values. The eight different tables are needed to account for the velocity measurement increment being used and the weather mode. This enables sites to modify the velocity data maximum display values and quantifications to meet local velocity data requirements. For example, sites that are expecting very high sustained winds (e.g., a hurricane is approaching) may elect to modify the 16-level velocity table to display wind speeds from -80 to +80 kts. This modification of the quantification levels may de-emphasize weak velocity values, and help to better differentiate tropical cyclone and hurricane force wind speeds. See Figure 7-8.

### 7.8.1 Select Velocity Table

There are eight velocity tables stored at the RPG. Each table defines the velocity quantifications for a particular weather mode and velocity measurement increment. The velocity data levels windows shown below define the Velocity Tables as well as allowing for the selection of velocity data levels for each table.

Modifications to the velocity product data levels will affect all associated users and non associated users of velocity data.

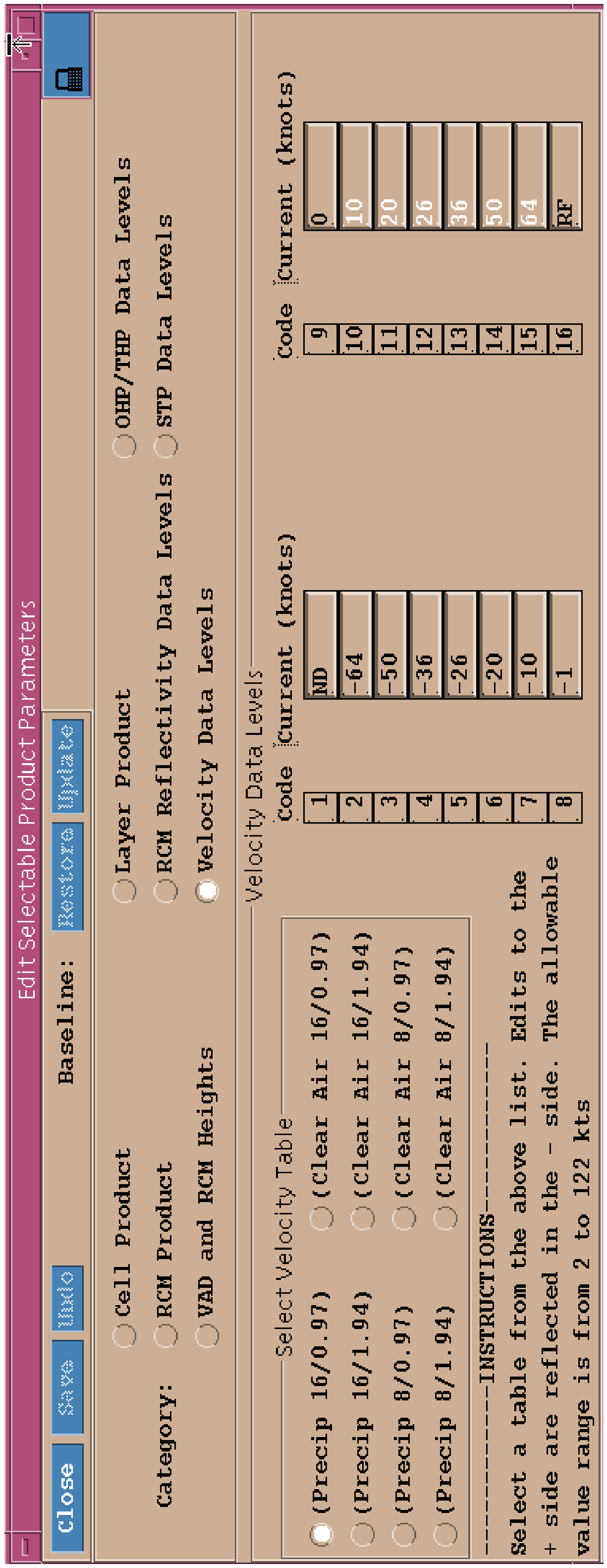



Figure 7-8. Velocity Data Levels - Precip 16/0.97

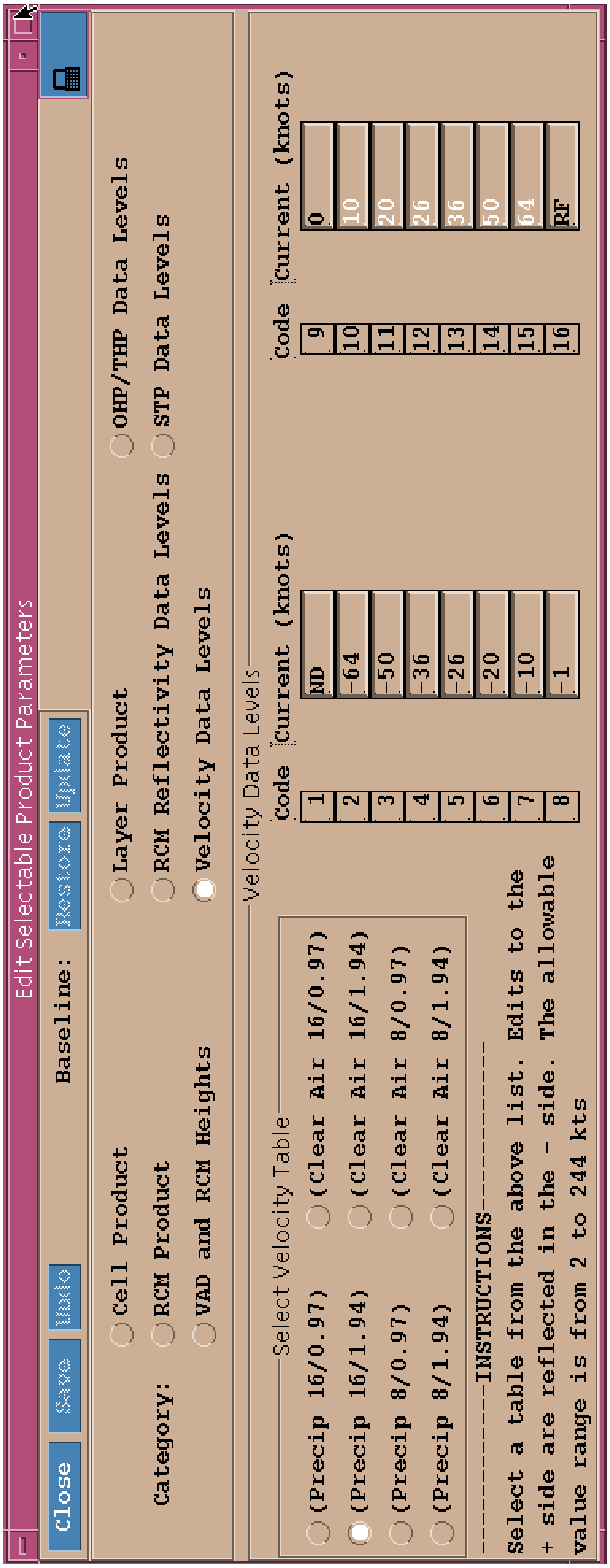



Figure 7-9. Velocity Data Levels - Precip 16/1.94

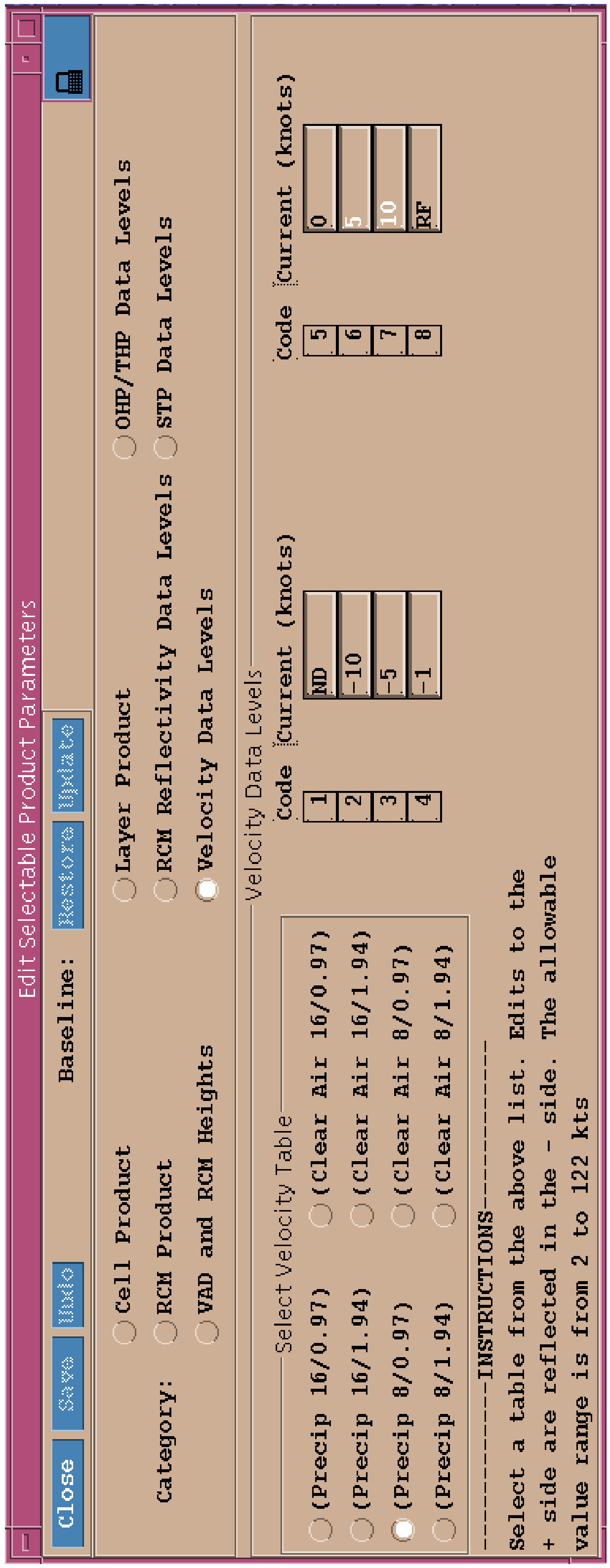



Figure 7-10. Velocity Data Levels - Precip 8/0.97

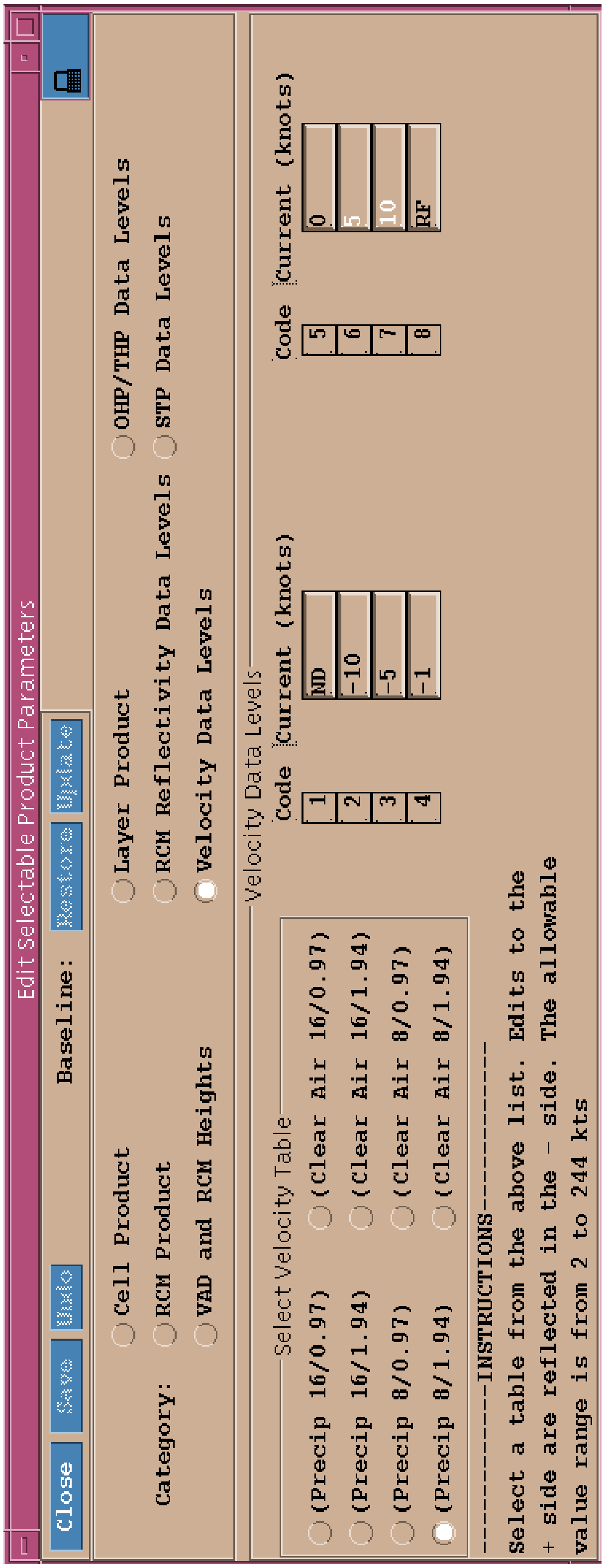



Figure 7-11. Velocity Data Levels - Precip 8/1.94

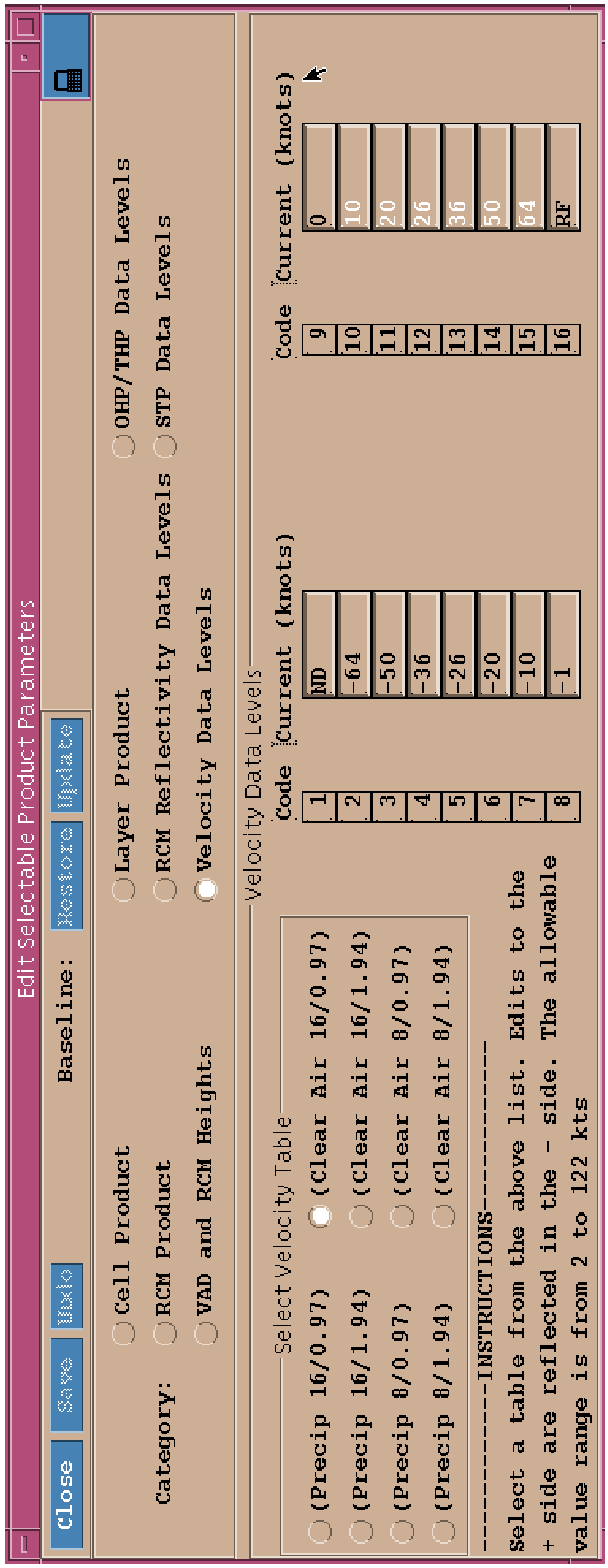



Figure 7-12. Velocity Data Levels - Clear Air 16/0.97

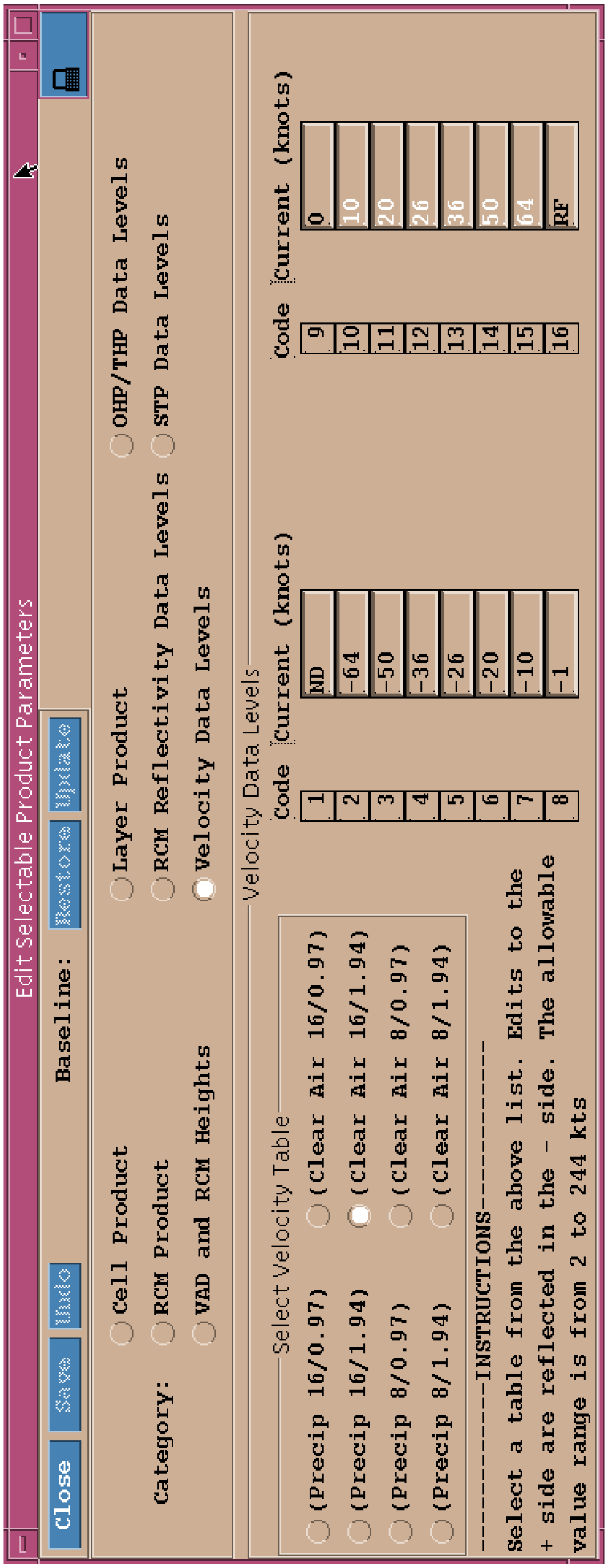



Figure 7-13. Velocity Data Levels - Clear Air 16/1.94

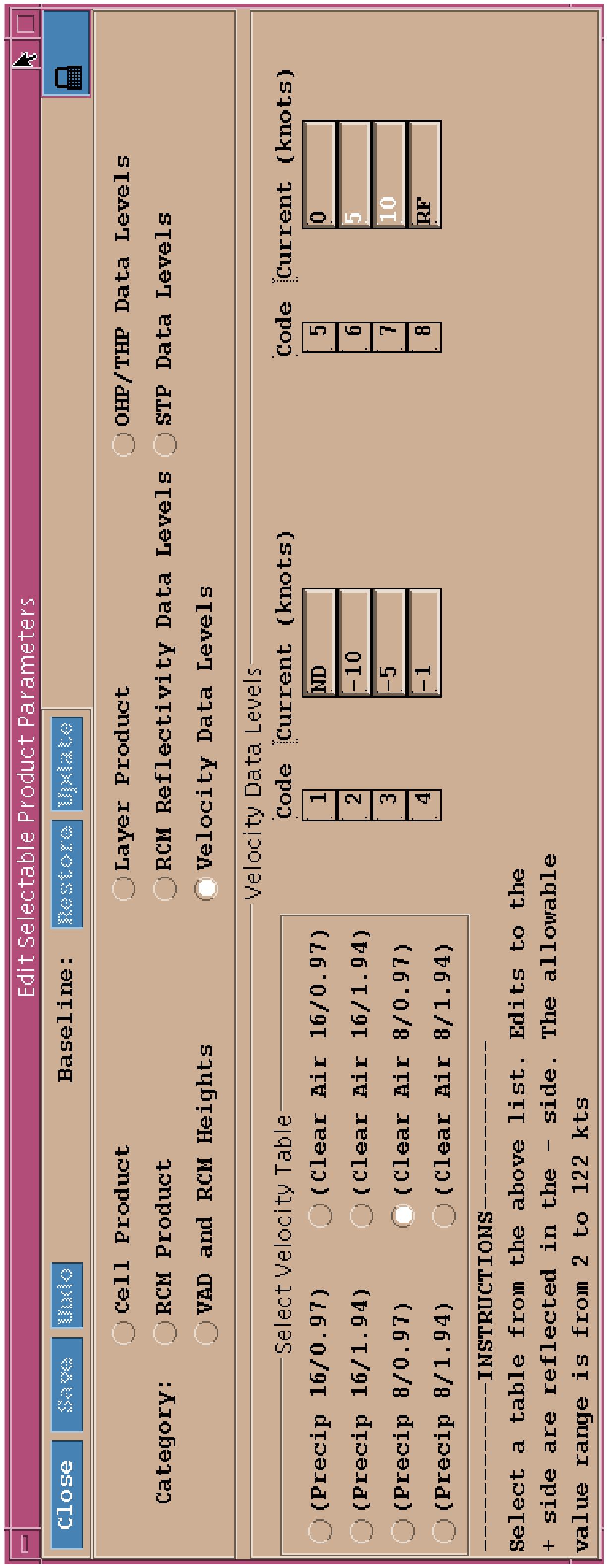



Figure 7-14. Velocity Data Levels - Clear Air 8/0.97

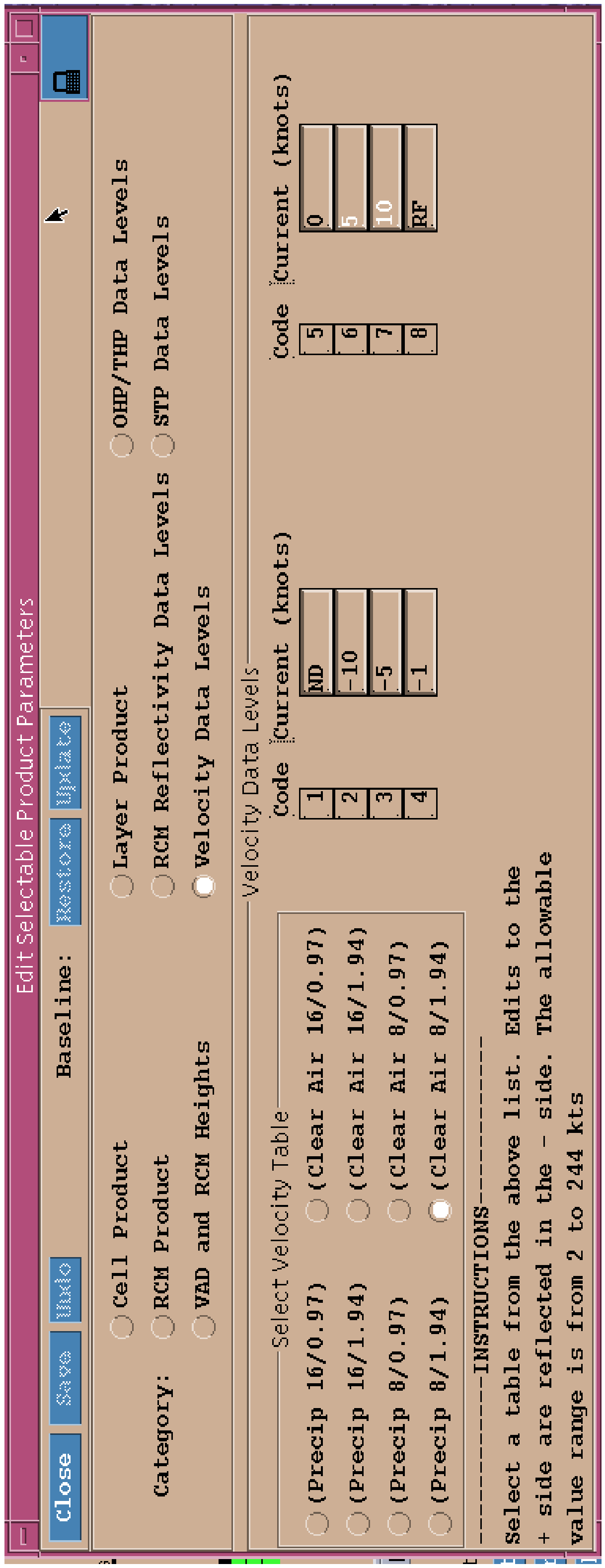



Figure 7-15. Velocity Data Levels - Clear Air 8/1.94

# Chapter 8
# RPG Products - Algorithms

## 8.1 URC Algorithm Parameters

This chapter presents the default settings for each of the adaptable parameters in the nineteen (21) WSR-88D meteorological algorithms. They are displayed with the URC LOCA clicked on. All values that are white are editable at the URC level. Some algorithms have more parameters than can be shown on the initial window. Use the scroll bars on the right hand side to view the remaining parameters.

The algorithms are presented in alphabetical order as seen in the pull down menu of the Algorithm window.

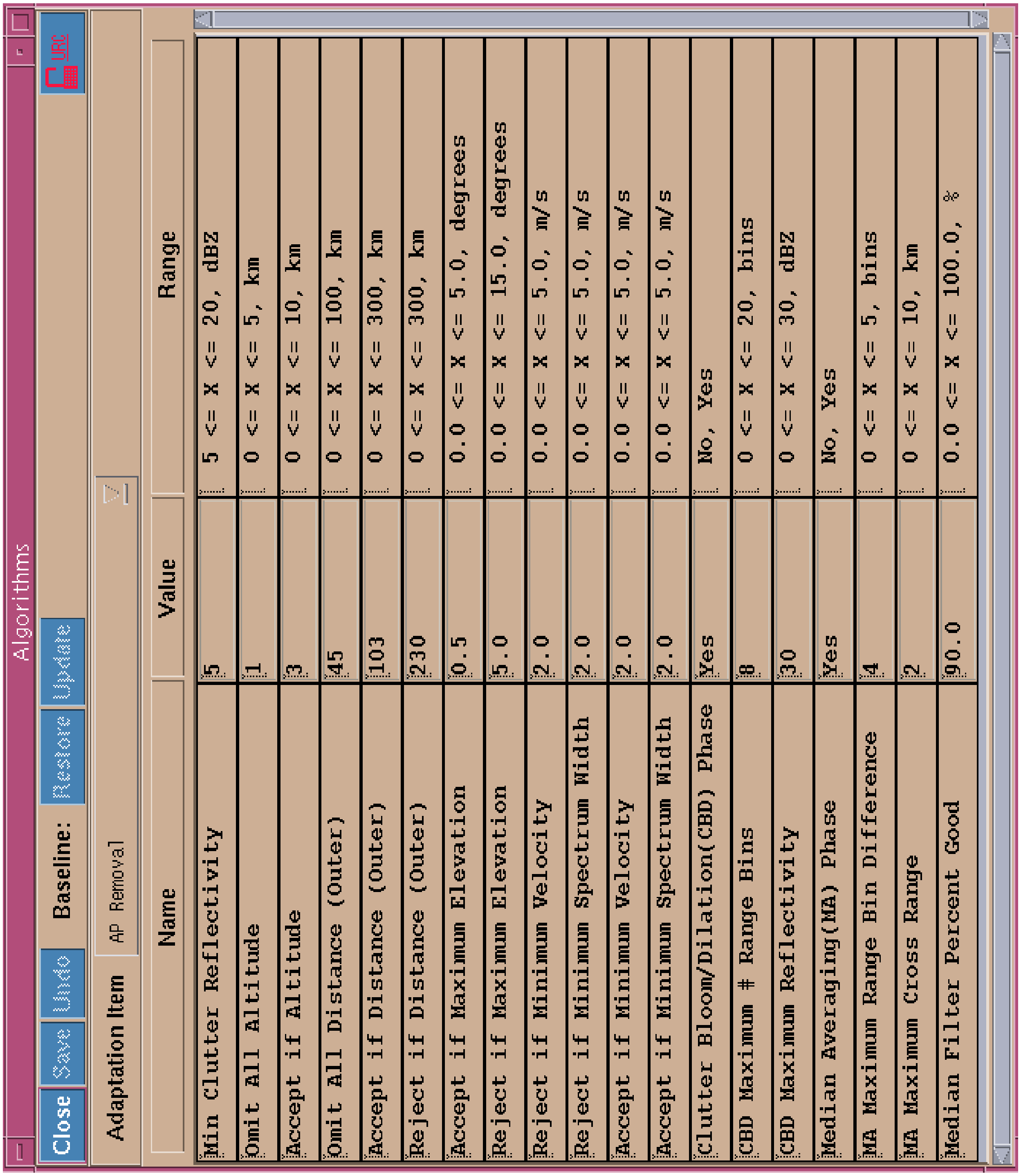
Environmental-condition sensitive algorithm parameters (examples: 0 and -20 degree Celsius heights, nominal clutter area, default storm motion, etc) should be routinely modified to improve algorithm performance.

CAUTION is warranted, however. Modifications to some algorithm parameters may have a significant detrimental impact on the performance, accuracy, and reliability of the target algorithm and related products, as well as on the RPG system performance. Algorithm research activity MUST NOT be done on the operational WSR-88D system. It can be accomplished using Archive II data and the SOO/SAC workstations running the WATADS software package.

## 8.2 AP Removal

Without the proper application of clutter suppression, areas of AP-induced ground clutter return can appear as areas of significant precipitation. See Figure 8-1. The AP Removal algorithm attempts to recognize areas of high reflectivity data caused by ground return due to anomalous propagation of the radar beam. The algorithm then removes the high reflectivity gates from consideration prior to building a low-layer (surface to 24 kft) layer composite reflectivity (APR) product. This product is used to support the FAA national aerospace weather monitoring program.

The following window defines the adaptable parameters for the AP Removal algorithm only and does not affect the other layer composite reflectivity products.




| Name | Value | Range |
|---|---|---|
| Min Clutter Reflectivity | 5 | 5 <= X <= 20, dBZ |
| Omit All Altitude | 1 | 0 <= X <= 5, km |
| Accept if Altitude | 3 | 0 <= X <= 10, km |
| Omit All Distance (Outer) | 45 | 0 <= X <= 100, km |
| Accept if Distance (Outer) | 103 | 0 <= X <= 300, km |
| Reject if Distance (Outer) | 230 | 0 <= X <= 300, km |
| Accept if Maximum Elevation | 0.5 | 0.0 <= X <= 5.0, degrees |
| Reject if Maximum Elevation | 5.0 | 0.0 <= X <= 15.0, degrees |
| Reject if Minimum Velocity | 2.0 | 0.0 <= X <= 5.0, m/s |
| Reject if Minimum Spectrum Width | 2.0 | 0.0 <= X <= 5.0, m/s |
| Accept if Minimum Velocity | 2.0 | 0.0 <= X <= 5.0, m/s |
| Accept if Minimum Spectrum Width | 2.0 | 0.0 <= X <= 5.0, m/s |
| Clutter Bloom/Dilation(CBD) Phase | Yes | No, Yes |
| CBD Maximum # Range Bins | 8 | 0 <= X <= 20, bins |
| CBD Maximum Reflectivity | 30 | 0 <= X <= 30, dBZ |
| Median Averaging(MA) Phase | Yes | No, Yes |
| MA Maximum Range Bin Difference | 4 | 0 <= X <= 5, bins |
| MA Maximum Cross Range | 2 | 0 <= X <= 10, km |
| Median Filter Percent Good | 90.0 | 0.0 <= X <= 100.0, % |

Figure 8-1. Algorithms - AP Removal

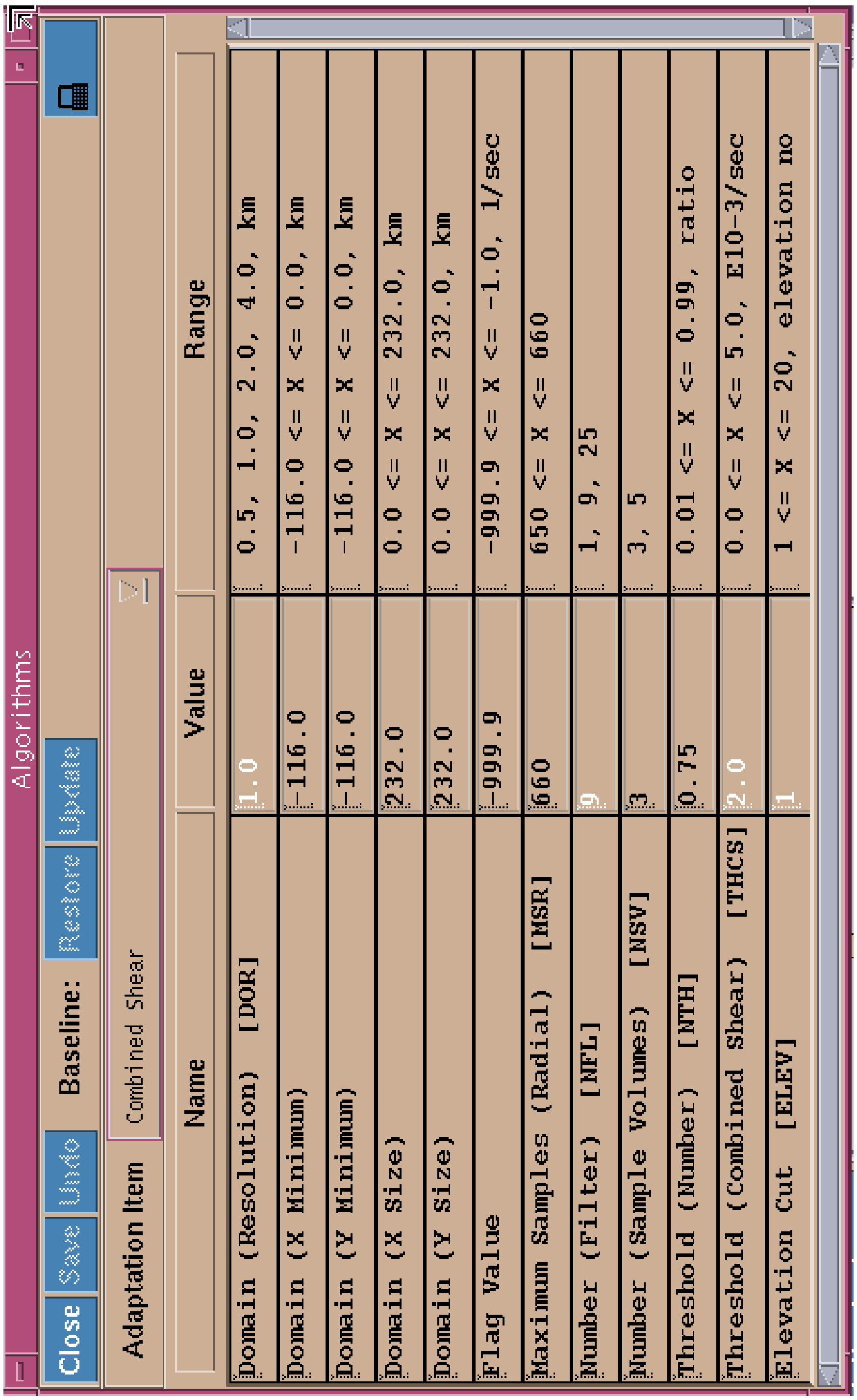
## 8.3 Combined Shear

The Combined Shear algorithm is intended to assist the user in identifying shear regions such as along gust fronts and in mesocyclones. See Figure 8-2. It is especially useful in that, unlike the human operator, it isn't keying off color contrasts. The combined shear algorithm computes estimates of shear along a radial and also gate-to-gate tangentially between two radials. These two measures are mapped onto separate Cartesian grids whose resolutions are controlled by the domain resolution (DOR) adaptable parameter. These two measures are combined by taking the square root of the sum of the squares of each estimate. The combined shear may be smoothed by applying an equally weighted two-dimensional filter to the gridded field. The filter is always centered on a grid point. Thus, it is required to have odd-numbered integer dimensions. The adaptable parameter number filter (NFL) adjusts the size of the filter and is specified as the total number of points in the filter. For example, a value of 25 for NFL indicates that a 5 x 5 point filter is being used. Because this algorithm is CPU-intensive, the user is restricted to applying it to only one elevation at a time. The default elevation scan is the 0.5 degree elevation scan. Each unique elevation angle is numbered sequentially from 1 to the highest number in the VCP. For VCP 21 the highest valid number is 9 and for VCP 11 the highest valid number is 14. The adaptable parameter elevation cut (ELEV) being set to 1 points to the 0.5 degree elevation. Once a combined shear field is generated, the Combined Shear Contour product may be generated. The adaptable parameter CI controls the contour interval and is expressed as an integer multiple of 0.001 $s^{-1}$. Note that the Combined Shear Product's legend displays the shear categories as 10 times the integer times $10^{-4}$ $s^{-1}$.

Changing the adaptable parameters DOR and NFL affects the magnitude of the shear displayed, the granularity and resolution of the data, and processing load on the RPG. The algorithm computes the average of all radial and tangential shears in their respective Cartesian grids. Increasing the value of DOR increases the number of shear values that are averaged together, which effectively lowers the maximum value of shears that will be displayed. Conversely, decreasing DOR will cause fewer shear values to be mapped to any particular grid location. With fewer values averaged together, greater extremes will be displayed. At 0.5 km resolution there is not enough resolution in the radial data to map a shear value to each Cartesian grid point. This results in a grainy appearance in the product. However, increasing DOR to 4 km may coarsen the product sufficiently to mask significant shear-producing features. The adaptable parameter NFL, by filtering the data further, reduces peak shear values. It will also "smear" data into empty grid points that are neighboring grid points with shear.

Note: A value of 1 for NFL does no filtering and a value of 25 does the most smoothing.

Because the overall domain remains fixed at 232 x 232 km, increasing the resolution from 4 km to 0.5 km increases the number of bins in the Cartesian grid by a factor of 64, and thus increases the amount of processing that must be performed by the RPG. Changing the NFL from 1 to 25 further significantly increases the processing load.




| Name | Value | Range |
|---|---|---|
| Domain (Resolution) [DOR] | 1.0 | 0.5, 1.0, 2.0, 4.0, km |
| Domain (X Minimum) | -116.0 | -116.0 <= X <= 0.0, km |
| Domain (Y Minimum) | -116.0 | -116.0 <= X <= 0.0, km |
| Domain (X Size) | 232.0 | 0.0 <= X <= 232.0, km |
| Domain (Y Size) | 232.0 | 0.0 <= X <= 232.0, km |
| Flag Value | -999.9 | -999.9 <= X <= -1.0, 1/sec |
| Maximum Samples (Radial) [MSR] | 660 | 650 <= X <= 660 |
| Number (Filter) [NFL] | 9 | 1, 9, 25 |
| Number (Sample Volumes) [NSV] | 3 | 3, 5 |
| Threshold (Number) [NTH] | 0.75 | 0.01 <= X <= 0.99, ratio |
| Threshold (Combined Shear) [THCS] | 2.0 | 0.0 <= X <= 5.0, E10-3/sec |
| Elevation Cut [ELEV] | 1 | 1 <= X <= 20, elevation no |

Figure 8-2. Algorithms - Combined Shear

## 8.4 Hail Detection

The Hail Detection algorithm (see Figure 8-3) provides for each storm cell the following three estimates:

- Probability of Hail (POH) of any size,
- Probability of Severe Hail (POSH) (or hail > 3/4" in diameter), and
- Maximum Expected Hail Size (MEHS).

Based on drop-size/hailstone distribution and empirical studies, the algorithm assumes that large reflectivity values observed aloft (above the freezing level ($0^oC$)) are most likely hail. The algorithm's inputs are environmental data and storm cells components' maximum reflectivity and height above ground level (AGL). The environmental data is the height (MSL) of the $0^oC$ and $-20^oC$ environmental temperatures. Hail estimates are only provided for storm cells identified within the Maximum Hail Processing Range; beyond that range hail estimates are labeled ‘UNKNOWN'.

To determine the POH of any size for each storm cell, the height of the highest component with a maximum reflectivity value of at least Thresh Min Reflectivity POH, which is above the freezing level, is used in an empirical relationship. The higher the component is above the freezing level, the greater the POH. The increasing heights correlate to probabilities through the POH Height Difference parameters.

To determine the POSH and MEHS for each storm cell, the algorithm uses a relationship between reflectivity and the Hailfall Kinetic Energy (HKE), the flux of kinetic energy of hailstones. HKE is calculated from components with maximum reflectivity values (of at least Thr HKE Ref Wgt Lower Lim) above the freezing level using an equation with the HKE Coefficients. The computation is weighted toward those components with a maximum reflectivity of at least Thr HKE Ref Wgt Upper Lim. A vertical integration of the HKE is done for all components within a storm cell (which meet the relative height and reflectivity criteria), resulting in a parameter called the Severe Hail Index (SHI). The integration is weighted toward those components above the height of the $-20^oC$ environmental temperature. The greater the collective depth of components in a storm cell with large HKE values and the higher those components are above the freezing level, the larger a storm cell's SHI value. The MEHS for each storm cell is computed using SHI in an empirical formula with the SHI Hail Size Coefficient and SHI Hail Size Exponent. The POSH is calculated from SHI, the POSH Coefficient, the POSH Offset, and a warning threshold which is a function of the height of the freezing level, the Warn Thresh Select Model (WTSM) Coefficient, and the Warn Thresh Select Model Offset*.

**NOTE**

The Warn Thresh Select Model Offset is a site specific parameter based on the RDA height msl.

For the RCM product, the POSH is converted to a Hail Index using the Threshold (RCM Probable Hail) and Threshold (RCM Positive Hail) parameters.

### 8.4.1 Delegated URC Authority

The ROC authorizes the URC to modify the Probability of Severe Hail (POSH) setting for the Hail Detection algorithm within the restrictions defined below.

The default value for POSH Offset is 50%. The URC may lower this value to 30% when summertime atmospheric conditions are present. Summertime atmospheric conditions are characterized by a relatively high melting level (> 13 kft) and low vertical shear (< 30 kts at 500 mb). When the summertime environment is no longer present the POSH Offset should be reset to 50%.

### 8.4.2 Supplemental Information - Hail Detection

The last six entries in the Hail algorithm represent the Date/Time that the 0 degrees and/or the -20 degree isotherm levels are updated. This is not a URC LOCA parameter nor it is merged forward from software build to software build. However, it is automatically updated once the heights are changed for either the 0 degrees or the -20 degrees isotherms.

For additional information refer to the following paper:

Evaluation of the Hail Detection Algorithm for High-Elevation WSR-88D Sites, A. Witt, 1998 (http://www.osf.noaa.gov/ops/9032.asp)

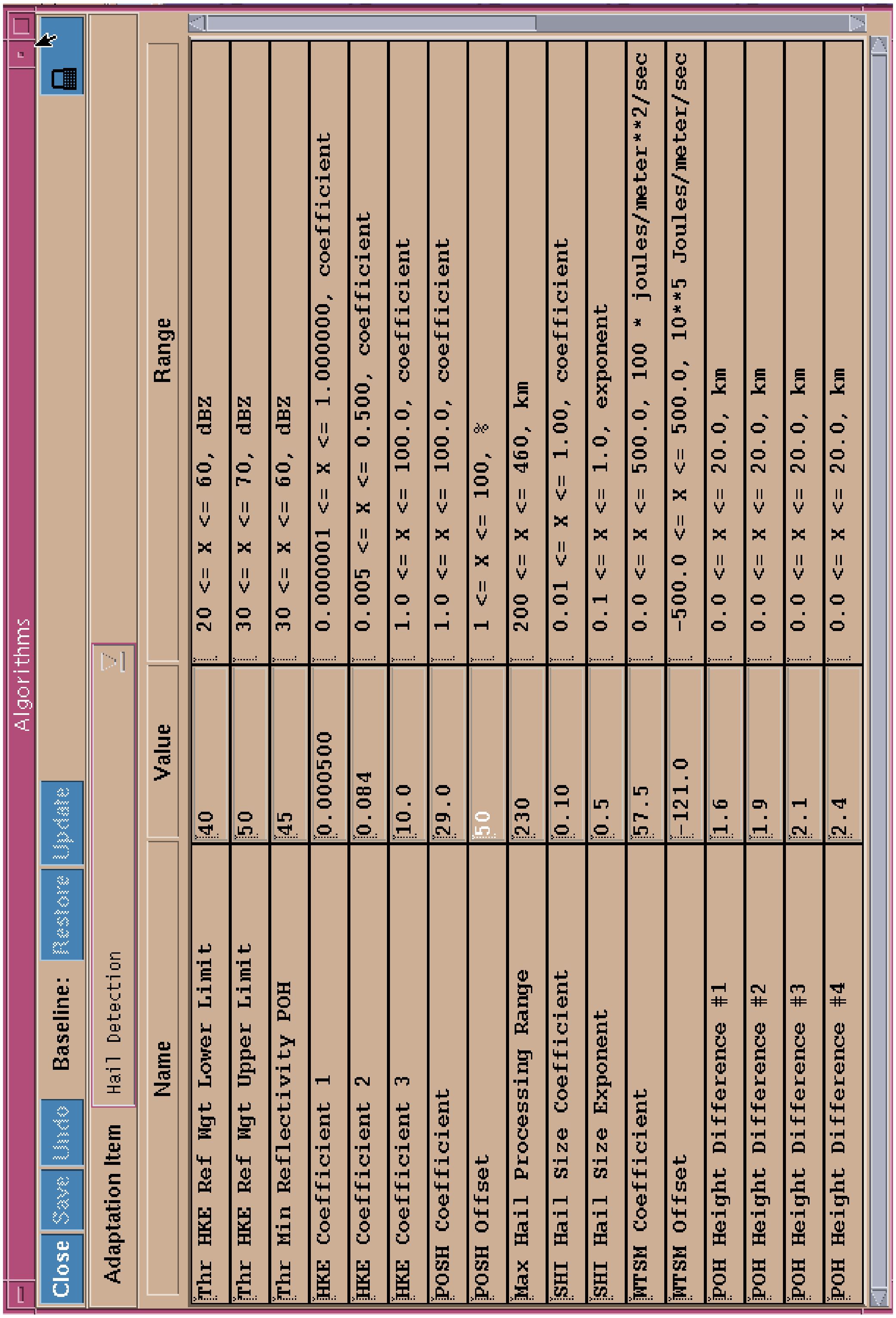
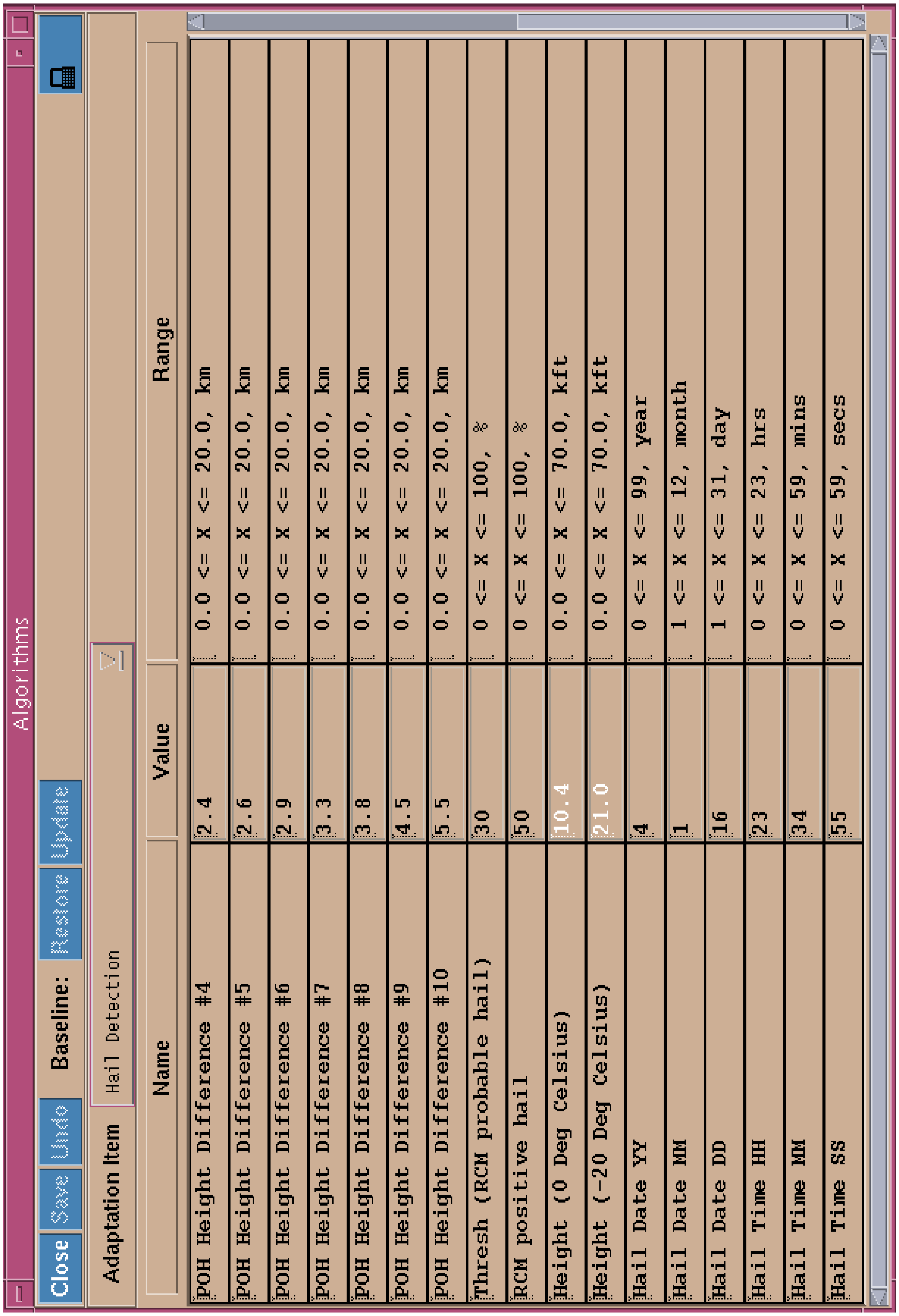



Figure 8-3. Algorithms - Hail Detection (1 of 2)




| Name | Value | Range |
|---|---|---|
| POH Height Difference #4 | 2.4 | 0.0 <= X <= 20.0, km |
| POH Height Difference #5 | 2.6 | 0.0 <= X <= 20.0, km |
| POH Height Difference #6 | 2.9 | 0.0 <= X <= 20.0, km |
| POH Height Difference #7 | 3.3 | 0.0 <= X <= 20.0, km |
| POH Height Difference #8 | 3.8 | 0.0 <= X <= 20.0, km |
| POH Height Difference #9 | 4.5 | 0.0 <= X <= 20.0, km |
| POH Height Difference #10 | 5.5 | 0.0 <= X <= 20.0, km |
| Thresh (RCM probable hail) | 30 | 0 <= X <= 100, % |
| RCM positive hail | 50 | 0 <= X <= 100, % |
| Height (0 Deg Celsius) | 10.4 | 0.0 <= X <= 70.0, kft |
| Height (-20 Deg Celsius) | 21.0 | 0.0 <= X <= 70.0, kft |
| Hail Date YY | 4 | 0 <= X <= 99, year |
| Hail Date MM | 1 | 1 <= X <= 12, month |
| Hail Date DD | 16 | 1 <= X <= 31, day |
| Hail Time HH | 23 | 0 <= X <= 23, hrs |
| Hail Time MM | 34 | 0 <= X <= 59, mins |
| Hail Time SS | 55 | 0 <= X <= 59, secs |

Figure 8-4. Algorithms - Hail Detection (2 of 2)

## 8.5 Hydromet Accumulation

The following window lists the adaptable parameters for the Hydromet Accumulation algorithm. See Figure 8-5. This algorithm uses rainfall rates for the current and previous volume scans to compute an accumulation over the time between the scans. Additionally, hourly accumulations are computed and a check for any missing periods is made.

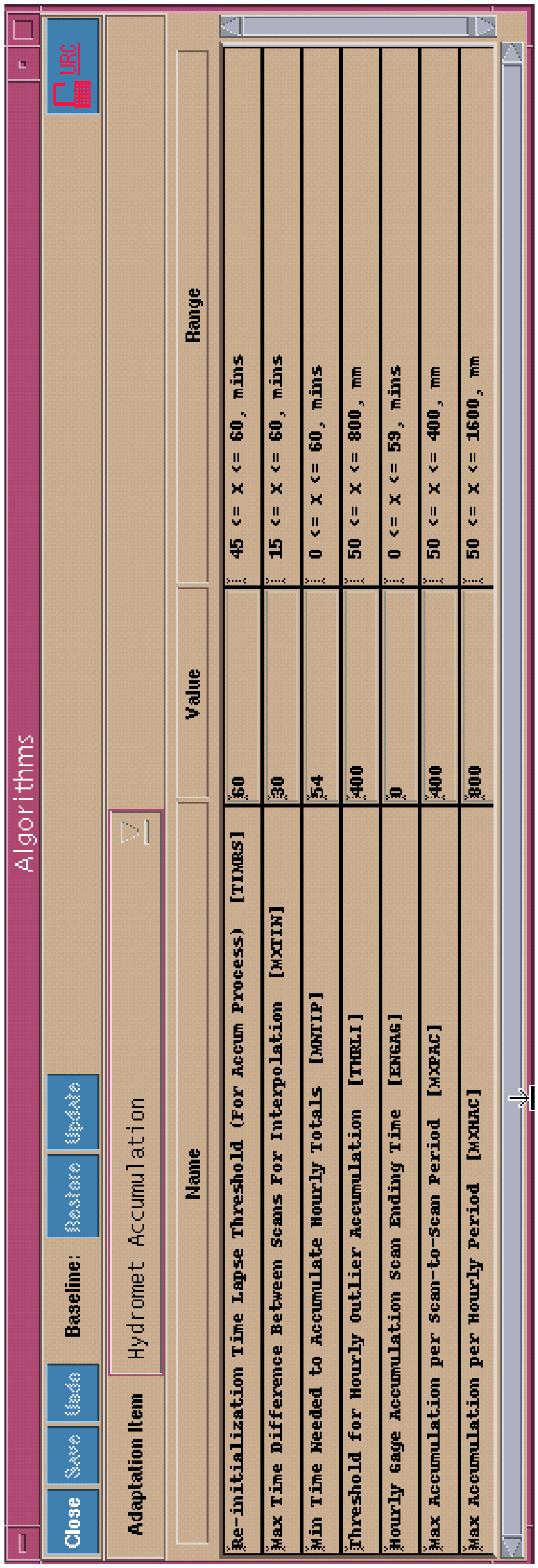



Figure 8-5.  Algorithms - Hydromet Accumulation

## 8.6 Hydromet Adjustment

The Hydromet Adjustment algorithm determines a mean-field, multiplicative Bias correction factor that may be applied to selected PPS rainfall accumulation products. A table of rain gage/radar biases (i.e., G/R Biases) for varying time durations ranging from short term to climatological is determined, hourly, in the Multisensor Precipitation Estimator function of AWIPS and sent to the RPG. There, it is ingested by the Adjustment algorithm and a single, "best" G/R Bias is extracted from the table, based upon the first row (evaluating from short to long term memory span) whose analysis was based upon an effective number of Gage-Radar Pairs exceeding the Gage/Radar Pairs Threshold (NGRPS). See Figure 8-6. The default setting of this parameter is 10 with a range of 6-30; if the user wishes the selected bias to trend more towards the short term - i.e., based on the present precip event - NGRPS may be lowered; whereas if the user wishes it to trend more towards the long term - i.e., seasonal or climatological - NGRPS may be raised. Note that this parameter will also be dependent on the density of reporting rain gages under the radar umbrella, and the default may be raised in the presence of a dense network.

If Bias Tables are not received from AWIPS on a regular, hourly basis, a self adjusting procedure kicks in to modify the biases in the most recent Bias Table on hand in the RPG toward more climatological values and the selection process continues as above, but if the Longest Time Lag (LGLAG) is exceeded, the default Bias is reset to the Reset Value of the G/R Estimate (RESBI). The Reset Value is also that used upon startup.

Once the G/R Bias value is determined, it is not automatically applied to all the PPS accumulation products. Whether or not it is applied to any is determined by the setting of the (URC LOCA) Bias Flag. Note that the default setting of this flag is FALSE, so that user action is required to turn it on.

### 8.6.1 Effects of Bias Flag on RPG PPS Products

Since the Bias Flag may be turned on and off by the operator during a precipitation event, the long duration PPS accumulation products may contain a mixture of periods when G/R Bias adjustments were Applied and were Not applied. The effects on the individual RPG PPS accumulation products are as follows:

- OHP (Hourly accumulation ending at the current volume scan or, when the "top of the hour" is passed, covering the most recent Clock Hour): The value of the G/R Bias at the end of the hour is applied to the entire hour's accumulation if the Bias Flag is ON; the accumulation field is entirely uncorrected if the flag is OFF.
- THP, USP (Multi-hourly accumulations ending at the top of the hour): Each component clock-hour's accumulation is entirely corrected or non-

corrected dependent upon whether the Bias Flag was ON or OFF at the end of that hour.

- STP, DSP (Storm Total accumulations ending presently or at the end of a defined precipitation event): The contributions from each scan-to-scan accumulation period (i.e., at the end of each volume scan) are either corrected or non-corrected before being added to the existing totals, dependent upon the momentary setting of the Bias Flag.
- DPA (Hourly digital accumulation): The G/R Bias is never applied in the PPS, but the value at the end of the hour is appended to the product for potential, external application.

Note: once a determination (True/False) is made for the Bias Flag, it is recommended that the setting remain in effect for the duration of the present precipitation event.

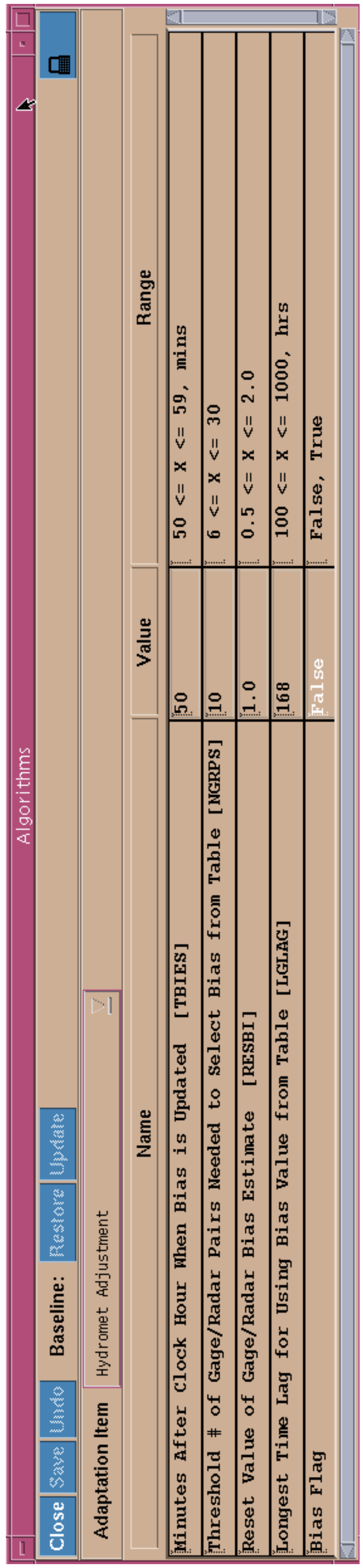



Figure 8-6. Algorithms - Hydromet Adjustment

## 8.7 Hydromet Preprocessing

The RPG Build 5.0 Hydromet Preprocessing uses the internal Enhanced Preprocessing Algorithm (EPRE) to prepare the precipitation detection and hybrid scan data for further processing by the precipitation algorithms.

EPRE takes Base Reflectivity data, Clutter/AP Percent Likelihood data, and terrain-based Blockage data to produce the Hybrid Scan intermediate product, which is used by the downstream Precipitation Processing System (PPS) algorithms and products as the basis for the determination of all rainfall rates and accumulations. It is a replacement for the original Precipitation Preprocessing Algorithm, assembling the Hybrid Scan in a somewhat different manner.

The algorithm works on the fundamental premise that the lowest unblocked, uncontaminated sample bin will be used at any location. Starting at the lowest elevation, a given sample bin is tested first against a Blockage Threshold, then to see whether it is contained within an Exclusion Zone, then to see whether its clutter likelihood is less than a Clutter Threshold. (Exclusion Zones are user-defined regions to account for residual clutter due to man-made objects such as buildings or wind farms, large tree growth, etc.) If all tests are passed, then that bin's contribution to the adjacent slots on the fixed, 1 degree-wide Hybrid Scan grid are weighted to those slots. If the combined weight of contributions in a given, fixed-grid sample bin location exceeds a Weight Threshold, then that sample bin's reflectivity is used in the Hybrid Scan. Otherwise, processing continues at the next higher elevation until all tests are passed at that location. At the end of each elevation scan, the percentage of fixed-grid bin locations filled in the Hybrid Scan is tested against a Full Hybrid Scan Threshold and, if exceeded (or if the next-to-highest elevation scan has been processed), the Hybrid Scan is considered "full" and is released into the output linear buffer for use by the downstream, PPS tasks. (Note that all thresholds referred to above are algorithm adaptation data.)

Compared to the previous version of this algorithm (commonly known as "PREPROC"), this version uses higher-resolution terrain blockage information in determination of beam blockage; uses AP/Clutter likelihood information to identify and remove clutter contamination; allows the definition of Exclusion Zones (via adaptation data) to enable identification and removal of areas of persistent, residual clutter; spatially averages incoming radials into the fixed, 1 degree wide slots of the Hybrid Scan, (rather than laterally moving them to the nearest slot); and can build the Hybrid Scan "dynamically" by accommodating the elevation strategy of any, operational NEXRAD Volume Coverage Pattern (VCP), rather than being confined to the fixed set of low-elevation angles shared by all the operational VCPs in effect to date.

EPRE also differs from PREPROC in that it performs its own Rainfall Identification function off of the fully-assembled Hybrid Scan, analogous to that performed by the Precipitation Detection Function (PDF) off of base reflectivity data. The downstream PPS tasks now respond to this Rainfall Identification from EPRE in determination of the start/stop times of precipitation "events" (such as in the Storm Total Precip (STP) product), rather than the determinations from PDF. (Note that the PDF has not been removed and may still be used in the determination of the official Precipitation Category, the Weather Mode, and the Pulse Repetition Frequency.)

Within the algorithm, there are several parameters that can be modified at the URC Level. See Figure 8-7, Algorithms - Hydromet Preprocessing, Screen 1. These parameters are described below.

### 8.7.1 Max Allowable Percent Likelihood of Clutter (CLUTTHRESH)

The (URC LOCA) Clutter Threshold (CLUTTHRESH) should be tuned to best discern AP/Clutter from actual precipitation. If set too high, it will be too difficult to reject sample bins that may predominantly represent clutter, resulting in their incorporation into the Hybrid Scan and, ultimately, their erroneous integration into rainfall totals. If set too low, sample bins that may predominantly represent rainfall may be rejected, usually resulting in sample bins from higher elevations being used instead. In this circumstance, rainfall at these az/ran locations will usually be underestimated, due to the typical fall off of reflectivity with height in the vertical reflectivity profile (especially during stratiform precipitation events), although in some situations, the opposite will be true, e.g., if the sample bin at the higher elevation is within a bright band (i.e., melting) layer. In either case, the reflectivity sample bin from above is less likely to yield an accurate estimate of precipitation at the surface, below.

The current, default setting of CLUTTHRESH is 75%. This seemingly high value has been enacted because, in "range folded" or range-ambiguous regions (indicated by the appearance of "purple haze" in low-level, base velocity fields), the REC algorithm tends to generate abnormally high readings of AP/Clutter %, which may result in a rather high likelihood of "real" rainfall echoes being rejected. The user should carefully monitor the presence and extent of "purple haze" in products such as low-level Base Velocity and Clutter Likelihood - Doppler. In situations where the "purple haze" in these products is extensive and where readings at the corresponding locations in the Clutter Likelihood - Reflectivity product are visibly high compared to the remainder of the field, the user should retain the default of 75% (see Figure 8-7). However, in situations where it is observed that range folding is not prevalent, the Clutter Threshold should be set to a lower value, with 50% recommended (see Figure 8-6B).

New Volume Coverage Patterns (VCPs) that employ Multi-PRF Velocity Dealiasing, which tends to minimize the extent of range unambiguous regions, such as VCP

121, are planned to be incorporated into NEXRAD operations increasingly in the upcoming years. When these VC Ps are in use, a setting in the vicinity of 50% for the Clutter Threshold would typically be more appropriate.

### 8.7.2 Number of Exclusion Zones (NEXZONE)

This is the number of zones to be excluded from the HYBRID SCAN (Reflectivity) Array. The values may range from 0 to 20, defaults is 0, and the precision is 1. These Exclusion Zones that the site creates can prevent known areas of persistent clutter residue (for instance, wind generator farms) from contaminating the HYBRID SCAN. This number controls how many zones are included in the processing.

EXAMPLES:

If 5 is entered as this value, the algorithm will incorporate the first five exclusion zones (#1 through #5).

If 0 is entered as this value, yet exclusion zones are created in the following blocks, they will not be used in the processing of the algorithm

The site MUST enter in the correct value of the number of exclusion zones they create.

### 8.7.3 Exclusion Zones

The site can create up to 20 Exclusion Zones (see Figures 8-7 and 8-8, Algorithms - Hydromet Preprocessing - Screens 1 and 2). This second screen is a continuation of the 20 Exclusion Zones and illustrates how Zones 3 through 6 appear in the window. Use the scroll bar down the right hand side of the window to display the remainder of the zones. Each zone has five parameters to enter:

- Begin Azimuth
- End Azimuth
- Begin Range
- End Range
- Elevation Angle

Enter the Azimuth angles to the tenth of a degree. Start at 0 degrees and enter the azimuth angles with clockwise values (i.e. 60 to 75 degrees). Do not make an azimuth range pass through 360 degrees. Enter the Range to the whole nautical mile, from the closest point in to the furthest distance away (i.e. 16 to 21 nm). Enter the Elevation Angle to the tenth of a degree. The elevation angle entered represents the top of the zone, with the bottom being a default of 0.0 degrees. Up to 20 zones can be defined. In order for each zone to be evaluated in the algorithm, it must be counted as one of the zones in the Number of Exclusion Zones parameter. They also must be in numerical sequence in order to be utilized.

### 8.7.4 Precipitation Detection Functionality within EPRE

A precipitation detection-like function has been incorporated into the new, "Enhanced" version of the Precipitation Preprocessing algorithm, EPRE, which replaced the Legacy version of the algorithm (commonly referred to as PREPROC) in Open RPG Build 5. In this functional component, the reflectivity at each sample bin on the assembled Hybrid Scan is compared against the Rain dBZ Threshold (RAINZ). The areas of those sample bins that exceed the threshold are summed over the entire scan and then compared against the Rain Area Threshold (RAINA). If that is exceeded, precipitation is said to have been "Detected" and flags are set which affect the operations of the downstream, PPS tasks, including (if this is the first time rain has been detected in quite a while) resetting the starting time of the Storm Total Product (STP) and Digital Storm Total product (DSP). When the rain stops, the time since precipitation was last detected is tested against the Rain Time Threshold (RAINT); once exceeded, the rainfall event is considered to be over and the Storm Total accumulation fields are reset to zero.

**NOTE**

The preliminary Precipitation Detection Function, itself, is still executed and its results still used in determining the official Rainfall Category and Precipitation Mode. It is no longer used in the PPS to determine the start/stop times of precipitation events, however.

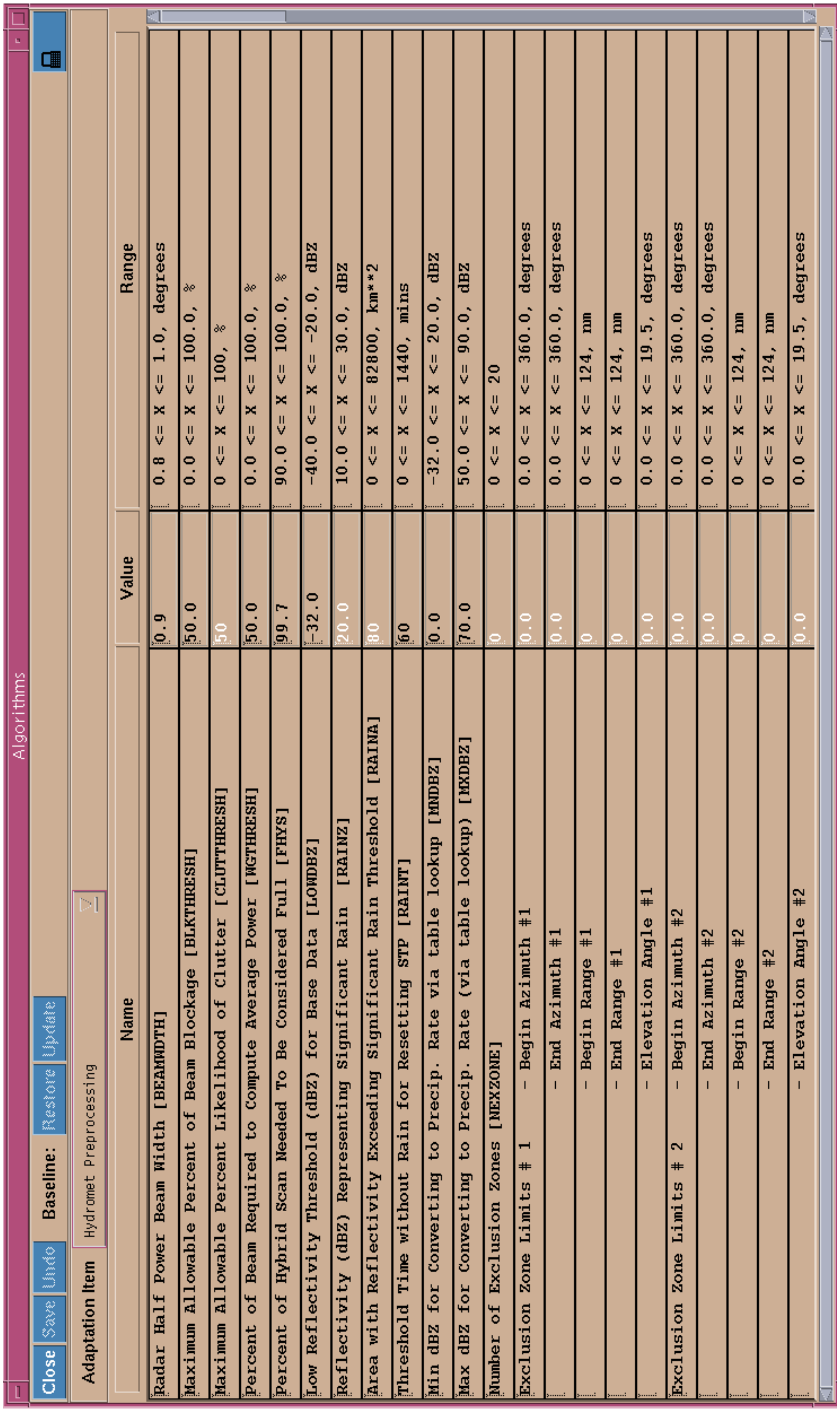
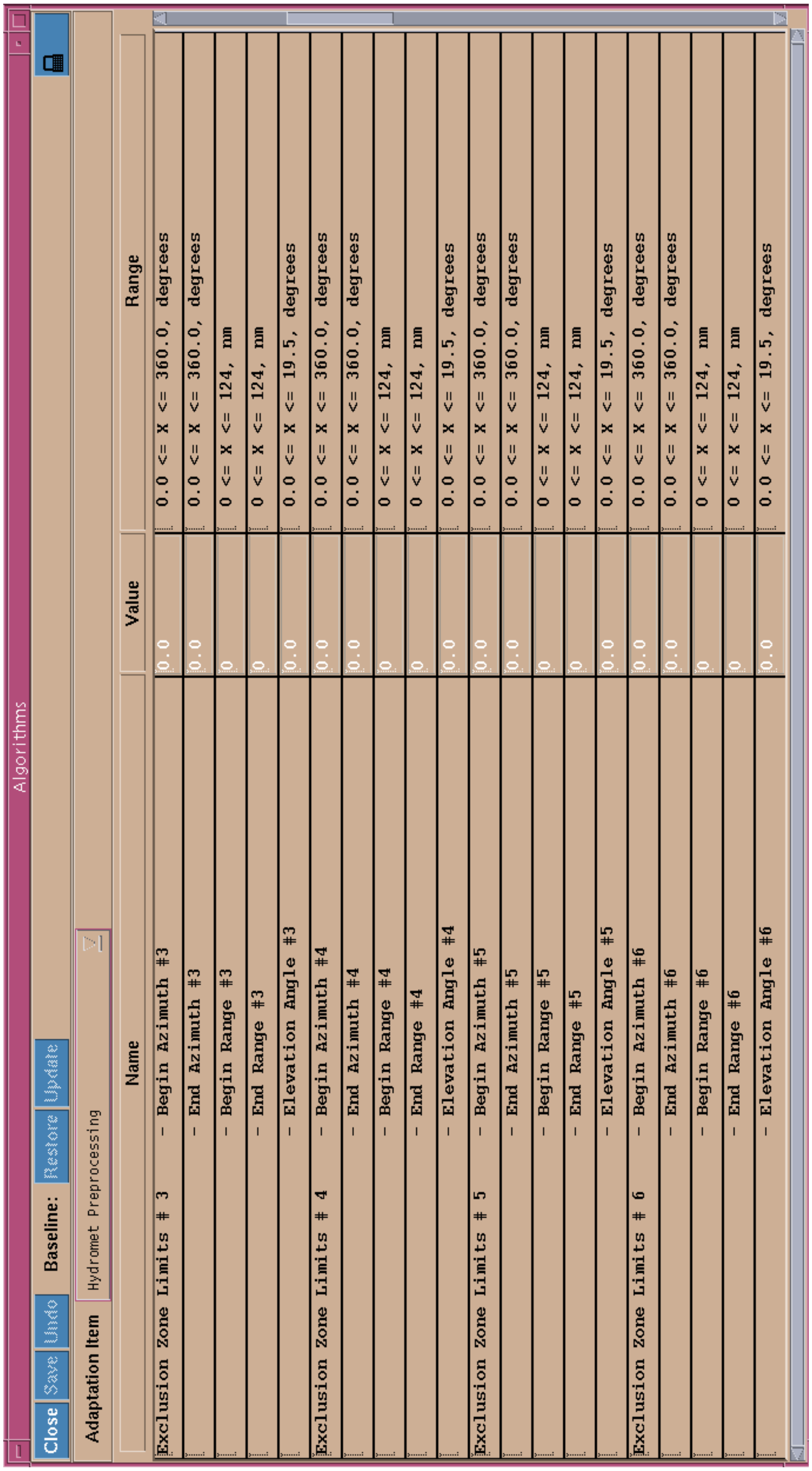



Figure 8-7. Algorithms - Hydromet Preprocessing - Screen 1 of 2





| Name | | Value | Range |
|---|---|---|---|
| Exclusion Zone Limits # 3 | - Begin Azimuth #3 | 0.0 | 0.0 <= X <= 360.0, degrees |
| | - End Azimuth #3 | 0.0 | 0.0 <= X <= 360.0, degrees |
| | - Begin Range #3 | 0 | 0 <= X <= 124, nm |
| | - End Range #3 | 0 | 0 <= X <= 124, nm |
| | - Elevation Angle #3 | 0.0 | 0.0 <= X <= 19.5, degrees |
| Exclusion Zone Limits # 4 | - Begin Azimuth #4 | 0.0 | 0.0 <= X <= 360.0, degrees |
| | - End Azimuth #4 | 0.0 | 0.0 <= X <= 360.0, degrees |
| | - Begin Range #4 | 0 | 0 <= X <= 124, nm |
| | - End Range #4 | 0 | 0 <= X <= 124, nm |
| | - Elevation Angle #4 | 0.0 | 0.0 <= X <= 19.5, degrees |
| Exclusion Zone Limits # 5 | - Begin Azimuth #5 | 0.0 | 0.0 <= X <= 360.0, degrees |
| | - End Azimuth #5 | 0.0 | 0.0 <= X <= 360.0, degrees |
| | - Begin Range #5 | 0 | 0 <= X <= 124, nm |
| | - End Range #5 | 0 | 0 <= X <= 124, nm |
| | - Elevation Angle #5 | 0.0 | 0.0 <= X <= 19.5, degrees |
| Exclusion Zone Limits # 6 | - Begin Azimuth #6 | 0.0 | 0.0 <= X <= 360.0, degrees |
| | - End Azimuth #6 | 0.0 | 0.0 <= X <= 360.0, degrees |
| | - Begin Range #6 | 0 | 0 <= X <= 124, nm |
| | - End Range #6 | 0 | 0 <= X <= 124, nm |
| | - Elevation Angle #6 | 0.0 | 0.0 <= X <= 19.5, degrees |

Figure 8-8. Algorithms - Hydromet Preprocessing - Screen 2 of 2

## 8.8 Hydromet Rate

The following information describes the Maximum Precipitation Rate and the Z-R Coefficients, plus provides additional references.

### 8.8.1 Max Precipitation Rate (MXPRA)

The adaptable parameter MXPRA defines the maximum instantaneous rainfall rate (in mm/hr) that the Precipitation Processing Subsystem (PPS) uses to estimate rainfall. MXPRA should be used to mitigate contamination of radar rainfall estimates caused by the high reflectivity values associated with hail. The value of MXPRA can be changed using a URC password. Operators should set the value depending on atmospheric conditions and on their experienced observation of WSR-88D data and products.

There is no fixed optimum value for MXPRA, instead it is a function of the atmospheric conditions which determine climatological maximum rainfall rates. A limited study by the Forecast Systems Laboratory (Kelsch, 1992) showed that the range of maximum radar-based rainfall rates extends from about 63 mm/hr (2.5 in/hr) in semiarid and arid climates to 328 mm/hr (~13 in/hr) in record tropical convective rainfalls. Considering the rarity and small areal extent of very heavy rain events and the significant overestimation that can be caused by hail contamination, the ROC recommends that MXPRA never be set higher than 200 mm/hr (~8 in/hr). Table 8-1 can be used as guidance to help establish the proper value for MXPRA.

Table 8-1. Rain Fall Rate vs: Equivalent Reflectivity

| **Climate/regime** | **MXPRA Value** |
|---|---|
| Arid - High Plains Spring | 75 mm/hr (~3 in/hr) |
| Central Plains Spring, High Plains Summer | 100 mm/hr (~4 in/hr) |
| Central Plains Summer, Gulf Coast Spring | 125 mm/hr (~5 in/hr) |
| Tropical - Gulf Coast Summer | 150 mm/hr (~6 in/hr) |

The determination of an operational value for MXPRA is complicated because climatological maximum rainfall rates can be highly variable, there is no clearly defined value that separates rain from hail, and rain and hail frequently occur in the same radar bin. Generally, the value of MXPRA should be higher in a deep moist airmass that in a dry shallow airmass. Changing the value of MXPRA within the limits in Table 8-1 will affect only small areas of rainfall in the cores of thunderstorms. However, improperly setting the value of MXPRA can significantly degrade rainfall estimates in those areas. If the value is set too low, areas of intense rainfall could be underestimated, causing forecasters to miss flash flood events. If the value is set too high, the contamination from hail or wet ice can generate small regions of seriously overestimated rainfall, degrading River Forecast Center models and potentially leading to false flash flood warnings.

References:

Kelsch, M., 1992, Estimating Maximum Convective Rainfall Rates for Radar-derived

Accumulations, Preprints, Fourth Workshop on Operational Meteorology, Whistler, B.C., Canada, American Meteorological Society, Boston, MA.

### 8.8.2 Z-R Coefficients (CZM and CZP)

The Z-R Multiplier Coefficient (CZM) and Z-R Exponent Coefficient (CZP) define the relationship that the PPS uses to convert from reflectivity (Z) to rainfall rate (R) using the following equation:

$Z=CZM \times R^{CZP}$

The selection of a valid Z-R relationship may be the single most important factor contributing to the accuracy of radar-based rainfall estimates. Sites can modify CZM and CZP using the URC password.

The optimum Z-R relationship is a function of numerous variables, including the season, the geographic location, and expected weather type. The ROC recommends that sites use the five relationships in Table 8-2 as guidance in selecting the best Z-R relationship for a rain event.

Table 8-2. Recommended Z-R Relationship

| **Relationship** | **Optimum for:** | **Also recommended for:** |
|---|---|---|
| WSR-88D Convective ($Z=300R^{1.4}$) | Summer deep convection | Other non-tropical convection |
| Rosenfeld Tropical ($Z=250R^{1.2}$) | Tropical convective systems | |
| Marshall-Palmer ($Z=200R^{1.6}$) | General stratiform precipitation | |
| East-Cool Stratiform ($Z=130R^{2.0}$) | Winter stratiform precipitation - east of continental divide | Orographic rain - East |
| West-Cool Stratiform ($Z=75R^{2.0}$) | Winter stratiform precipitation - west of continental divide | Orographic rain - West |

When mixed precipitation types are present, select a Z-R relationship based on the most significant and/or most widespread type of precipitation.

The guidance in Table 8-2 is based on several years of operational WSR-88D experience and a number of studies.

- The WSR-88D Convective relationship was used as the early default NEXRAD relationship and is most applicable in deep summertime convection.
- The Rosenfeld-Tropical relationship (Rosenfeld, et al., 1993) was developed to improve PPS rainfall estimate in tropical convective systems, particularly during land falling hurricanes and tropical storms.
- The Marshall-Palmer relationship (Marshall, et al., 1955), should provide the best PPS estimates during general stratiform rainfall events.
- Studies of cool season stratiform rain events (Super and Holroyd, 1998; Cairns, et al., 1998; Huggins and Kingsmill, 1998; and Quinlan and Sinsabaugh, 1999) have shown that the best Z-R relationship depends significantly on geographic location. The ROC is recommending separate Z-R relationships for Eastern and Western U.S. locations.

Selecting the appropriate Z-R relationship should improve radar rainfall estimates. However, several other factors can limit or degrade the performance of the PPS. Sites should be aware of these factors:

- The radar must be well calibrated to provide consistent accurate rainfall estimates.
- Stratiform and orographic precipitation are generally shallow with a fairly steep vertical reflectivity gradient. This will cause the radar beam to sample rain more poorly with increasing range in stratiform events when compared with convective rainfall, and will significantly shorten the effective range for reliable rainfall estimates.
- A "bright band" will cause areas of overestimation in PPS products.
- Cool season stratiform Z-R relationships enhance rainfall estimates from lower reflectivity values (see Table 8-3), so clutter contamination may appear more prominent in cool season stratiform events than in other stratiform or convective events.

| Table 8-3. Recommended Z-R Relationship | | | | | |
|---|---|---|---|---|---|
| **Reflectivity** | **WSR-88D Convective ($Z=300R^{1.4}$)** | **Rosenfeld Tropical ($Z=250R^{1.2}$)** | **Marshall-Palmer ($Z=200R^{1.6}$)** | **East-Cool Stratiform ($Z=130R^{2.0}$)** | **West-Cool Stratiform ($Z=75^{2.0}$)** |
| **15 dBZ** | <0.01 in/hr | <0.01 in/hr | 0.01 in/hr | 0.02 in/hr | 0.03 in/hr |
| **20 dBZ** | 0.02 in/hr | 0.02 in/hr | 0.03 in/hr | 0.04 in/hr | 0.05 in/hr |
| **25 dBz** | 0.04 in/hr | 0.05 in/hr | 0.05 in/hr | 0.06 in/hr | 0.08 in/hr |
| **30 dBz** | 0.09 in/hr | 0.13 in/hr | 0.11 in/hr | 0.11 in/hr | 0.14 in/hr |
| **35 dBZ** | 0.21 in/hr | 0.33 in/hr | 0.22 in/hr | 0.19 in/hr | 0.26 in/hr |
| **40 dBZ** | 0.48 in/hr | 0.85 in/hr | 0.45 in/hr | 0.35 in/hr | 0.46 in/hr |
| **45 dBZ** | 1.10 in/hr | 2.22 in/hr | 0.93 in/hr | 0.61 in/hr | 0.81 in/hr |
| **50 dBZ** | 2.50 in/hr | 5.80 in/hr | 1.91 in/hr | 1.09 in/hr | 1.44 in/hr |
| **55 dBZ** | 5.68 in/hr | 15.14 in/hr | 3.93 in/hr | 1.94 in/hr | 2.56 in/hr |
| **60 dBZ** | 12.93 in/hr | 39.53 in/hr | 8.07 in/hr | 3.45 in/hr | 4.55 in/hr |

Sites should be aware that changes to the PPS Z-R relationship can directly and significantly impact NWS River Forecast Center (RFC) operations and products. Please coordinate with and/or notify any RFCs that use your PPS products whenever your site changes these parameters.

References:

Cairns, M., A. Huggins, and S. Vasiloff, 1998: Precipitation Algorithm improvements in the Eastern Sierra. *NWS Western Region Technical Attachment No. 98-08*, Salt Lake City, UT, 5 pp.

Huggins, A., and D. Kingsmill, 1998: Improvements of WSR-88D Algorithms in the Intermountain West with Applications to Flash Flood Forecasts and Wintertime QPFs. *CIASTA Annual Report on Progress under Task II: Weather Research.* Desert Research Institute, Dandini Research Park, Reno, NV, 26 pp.

Marshall, J. S., W. Hitschfeld, and K. L. S. Gunn, 1955: Advances in radar weather. *Adv. Geophys*. 2, 1-56.

Quinlan, J. S. and E. J. Sinsabaugh, 1999: An evaluation of the performance of the Snow Algorithm at NWFO Albany, NY during the 1997-98 Winter Season. *29th Conf. on Radar Meteor.*, Montreal, Quebec, Canada, Amer. Meteor. Soc., 794-797.

Rosenfeld, D., D. B. Wolff, and D. Atlas, 1993: General probability-matched relations between radar reflectivity and rain rate, *J. Appl. Meteor.*, 32, 50-72.

Super, A. and E. Holroyd III, 1998: Snow accumulation algorithm for the WSR-88D radar, Final Report. *Bureau of Reclamation Report R-98-05*, Denver, CO, 75 pp.


Figure 8-9. Algorithms - Hydromet Rate

## 8.9 MDA

The Mesocyclone Detection Algorithm (MDA) has been designed as a warning decision tool for operational forecasters. The MDA uses radial velocity and reflectivity data to detect storm-scale (1-10 km) cyclonic vortex signatures and diagnose attributes of the detected signatures to determine if they are associated with tornadoes and/or damaging wind. There are three parameters that are URC LOCA adaptable. The MDA does not replace the Mesocyclone Algorithm and that alerts are not based on MDA output.

### 8.9.1 Minimum Reflectivity

The minimum reflectivity threshold removes velocity data from MDA analysis when the velocity data comes from a bin in which the reflectivity is too small. The goal is to make sure that MDA evaluates velocity values from storms, not clear air. The default minimum reflectivity value is 10 dBZ with an allowable range of -25 dBZ to 35 dBZ.

This parameter affects all MDA output. The algorithm uses this reflectivity value as a minimum threshold that must be met in order for the corresponding radial velocity data to be processed in its search for cyclonic circulations. A setting of -25 dBZ will process all velocity data bins while a setting of 30 dBZ will process only those bins producing precipitation.

Field personnel need not change this parameter unless clear air false alarms cause problems.

### 8.9.2 Overlap Display Filter

The Overlap Display Filter is the Boolean value that allows a user to turn on the algorithm based overlap display filter. The overlap display filter eliminates the display of 3D features that overlap lower elevation features; default TRUE, range TRUE to FALSE. This display filter reduces clutter and allows more important, lower elevation features to be displayed.

This parameter affects only the MD product. When set to YES, elevated circulations that overlap a circulation at a lower elevation will not be included in the product. When set to NO, all features meeting the MINIMUM DISPLAY FILTER RANK parameter will be included in the MD product.

Field personnel need not change this parameter because AWIPS plans on implementing this filter on the display device.

### 8.9.3 Minimum Display Filter Rank

The Minimum Display Filter Rank is the minimum strength rank below which the 3D features are marked not to be displayed; default 5, range 1 to 5, precision: 1. This display filter reduces clutter and eliminates less important, weaker features from being displayed.

This parameter affects only the MD product. The algorithm uses this strength rank as a minimum threshold that must be met in order for a circulation to be included in the MD product. Research has shown that a value of 5 for this parameter results in circulations included in the MD product closely matching the circulations in the legacy M product. A value lower than 5 will increase the number of lower strength rank features in the MD product.

Field personnel need not change this parameter because AWIPS plans on implementing this filter on the display device. This display filter serves only as a backup filter in the event the AWIPS filter does not get implemented.

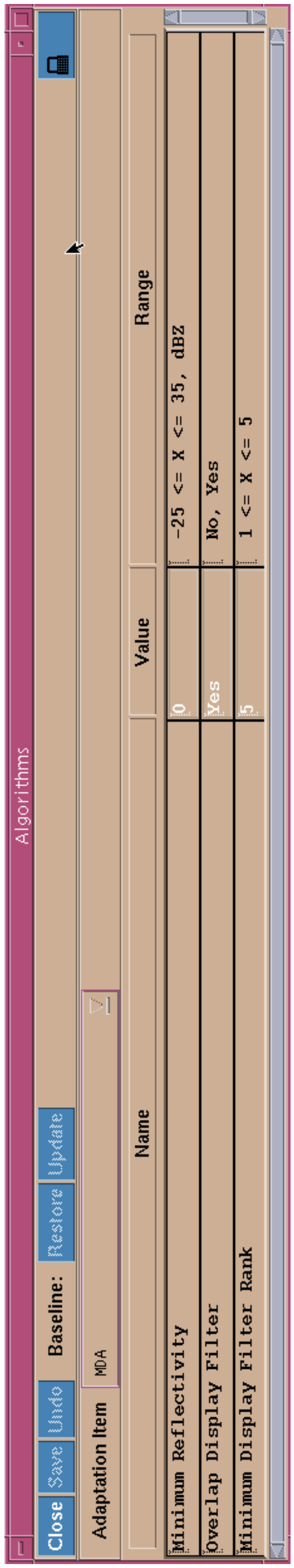



Figure 8-10.  Algorithms - MDA

## 8.10 Mesocyclone

When non-traditional supercell mesocyclones are forecast or observed, operators should consider reducing the Mesocyclone algorithm adaptable parameter TPV. (TPV defines the minimum number of pattern vectors contained in a 2D Feature.) At smaller values of TPV, the Mesocyclone algorithm should produce more detections on smaller features. However, this change may also generate more false alarms. If the change has a detrimental effect on the Mesocyclone algorithm's performance, return the adaptable parameter setting to its original value of 10.

### 8.10.1 Delegated URC Authority

The ROC has authorized field personnel to change the TPV adaptable parameter in the Mesocyclone algorithm. See Figure 8-11.

The default value of TPV is set at 10. Sites may change the value of TPV from 10 to lower values, but not lower than 6.

### 8.10.2 Supplemental Information - Mesocyclone

For additional information, refer to the following papers:

Burgess, D. W., R. J. Donaldson, T. Sieland, and J. Hinkelman, 1979: Final Report on the Joint Doppler Operational Project (JDOP 1976 - 1978). Part 1: Meteorological Applications. NOAA Tech. Memo. ERL NSSL-86, NOAA, Boulder CO, 84 pp. [NTIS PB80-107/88/AS.]

Burgess, D. W., R. J. Donaldson, and P.R. Desrochers, 1993: Tornado detection and warning by radar. The Tornado: Its Structure, Dynamics, Prediction, and Hazards, Geophys. Monogr., No. 79, Amer. Geophys. Union, 203-221.

Desrochers, P. R. and R. J. Donaldson Jr., 1992: Automatic tornado prediction with an improved mesocyclone-detection algorithm. Wea. Forecasting, 7, 373-388.

Doswell, C. A., III, R. Jones, and D. L. Keller, 1990: On summary measures of skill in rare event forecasting based on contingency tables. Wea. Forecasting, 5, 576-585.

Lee, R. R., and A. White, 1998: Improvement of the WSR-88D Mesocyclone Algorithm. Wea. Forecasting, 13, 341-351.

Zrnic, Dusan S, D.W. Burgess, T. Gal-Chen, 1984: Automatic Detection of Mesocyclonic Shear: Test Results, 22nd Conference on Radar Meteorology, 10-13 September, 1984, Zurich Switzerland, Amer. Meteor. Soc., 160 - 165.

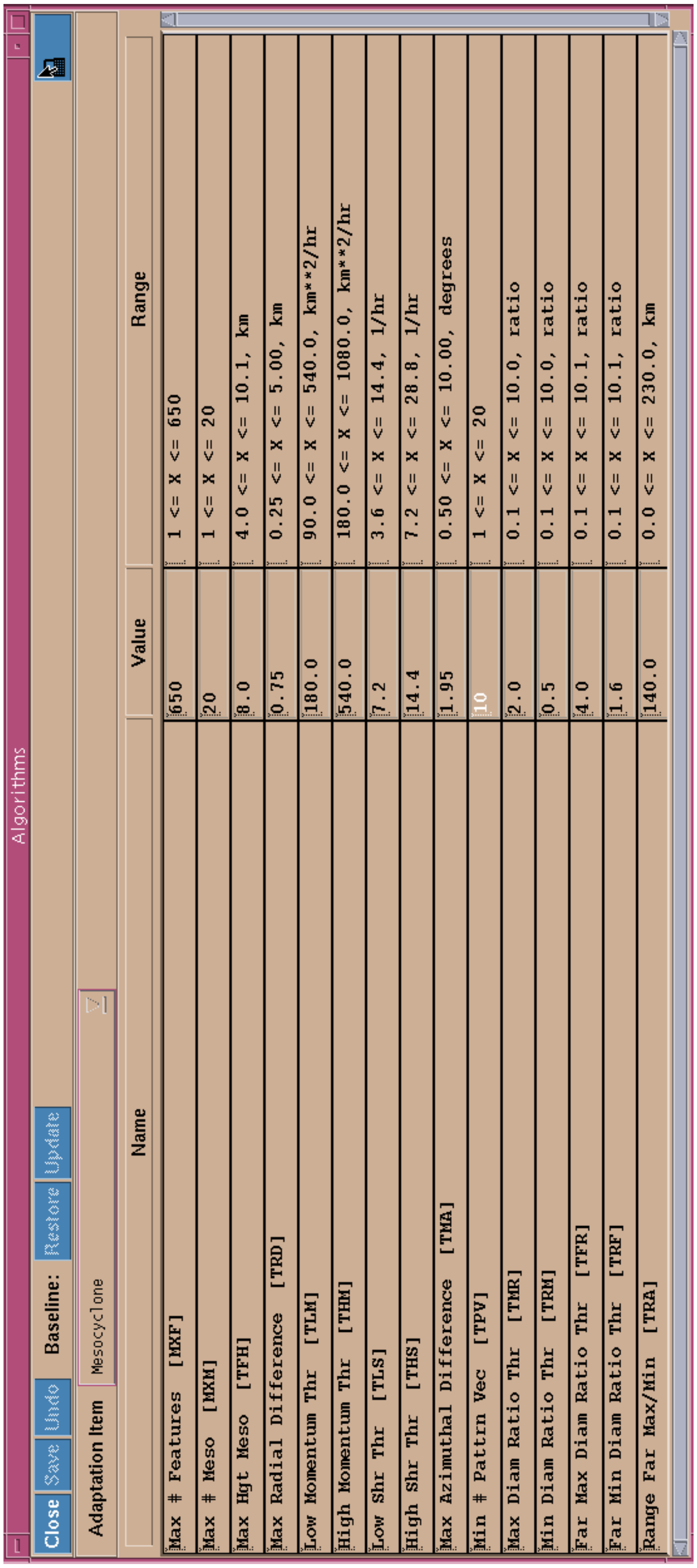



Figure 8-11. Algorithms - Mesocyclone

## 8.11 REC AP/Clutter Target

The Radar Echo Classifier (REC) algorithm determines the likelihood that the radar is detecting a specific Target Category. Initially, the REC has been designed to determine the likelihood that the radar is detecting Anomalous Propagation (AP) ground clutter. Work is underway to refine the REC logic to identify additional target categories, including precipitation, clutter residue, large hail, and biological targets.

The REC output includes graphic products that depict the bin by bin likelihood (in percent) of AP/Clutter. These products are intended to assist in operational clutter filtering and system maintenance decisions and to increase operator confidence in REC identifications. The REC output also includes digital products that can be provided to other real-time algorithms that can make use of precise and accurate AP/Clutter information.

The REC identification is based on a comparison of the pattern of the base radar data with the expected patterns of specific targets over a small bounded area. The Pattern Characteristics have been selected based on their ability to discriminate the specific Target Category (i.e., AP/Clutter). The Pattern Characteristics that are used to identify AP/Clutter are described in the following paragraphs. The REC algorithm computes Pattern Characteristic values for each base data radar bin and then scales the Pattern Characteristic values using the Target Category Scaling Functions. The REC then weights the scaled Pattern Characteristic values using the Target Probability weights and sums the weighted Characteristic values to define the Target Likelihood. For each radar bin, the Target Likelihood expresses the likelihood that the radar information from that bin is a member of the Target Category.

All REC adaptable parameters are currently defined as ROC level of change authority.

### 8.11.1 Reflectivity Pattern Characteristics

For all reflectivity Pattern Characteristics, the bounded area surrounding the target bin is defined by the Azimuthal Extent and the Reflectivity Range Extent.

#### 8.11.1.1 Texture of Reflectivity

The mean of the squared differences in reflectivity (in dBZ) between range adjacent bins over a bounded area. The squared differences are computed between successive range bins. Because of the spatial variability of reflectivity in AP/Clutter, the Texture of Reflectivity will generally be larger than it would be in precipitation. However, the strong reflectivity gradients in convective precipitation can also generate large Texture values.

#### 8.11.1.2 Mean Sign of Reflectivity Change

The average of the signs of the change in reflectivity over the bounded area used to compute the Texture. The sign of reflectivity change for each bin is considered to be 1, 0, or -1 if the difference in reflectivity between that bin and the bin immediately nearer the radar is positive, zero, or negative respectively. A small absolute value of the Mean Sign (near zero) is expected in regions of AP/Clutter, while large absolute values (near one) may indicate the strong reflectivity gradients in convective precipitation.

#### 8.11.1.3 Reflectivity Spin Change

For bins where the reflectivity exceeds the Spin Reflectivity Threshold, the percent of the reflectivity changes within the bounded area exceeding the Spin Change Threshold. A value near 50% indicates a high likelihood of AP/clutter, values near 0% or 100% are more likely to be caused by non-clutter targets.

### 8.11.2 Doppler Pattern Characteristics

The Doppler Pattern Characteristics are comprised of the following areas.

#### 8.11.2.1 Velocity

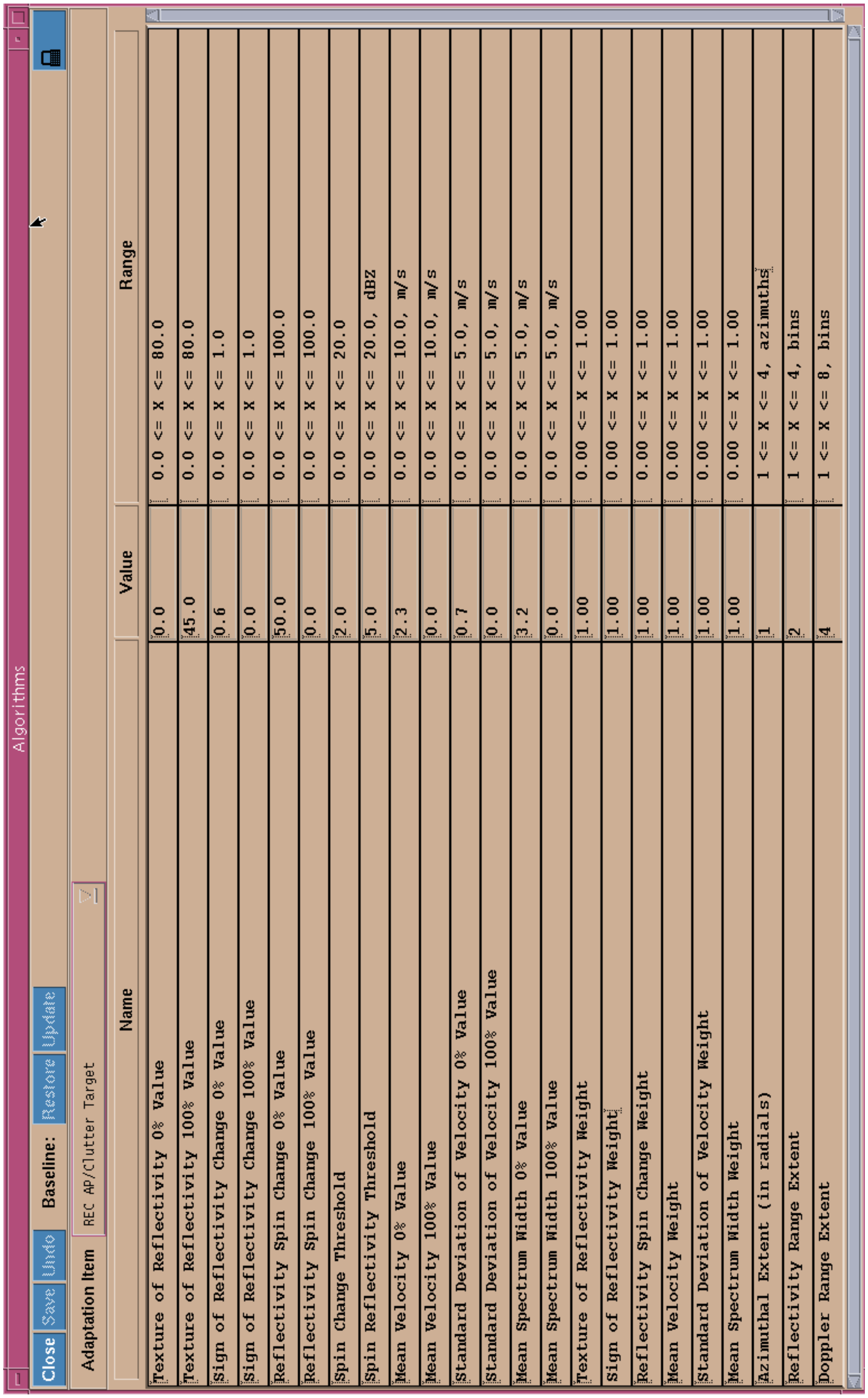
The point Doppler velocity value. The absolute value is generally very small (near zero) in AP/clutter, but shows a wide range in precipitation echoes.

#### 8.11.2.2 Standard Deviation of Velocity

The statistical distribution of Doppler velocity values in the bounded area (defined by the Azimuthal Extent and the Doppler Range Extent) surrounding the Doppler bin. Very low values are more likely to represent AP/clutter than higher values.

#### 8.11.2.3 Spectrum Width

The point spectrum width value. Lower values are more likely to indicate AP/clutter, higher values are more likely to indicate meteorological targets or system noise.




| Name | Value | Range |
|---|---|---|
| Texture of Reflectivity 0% Value | 0.0 | 0.0 <= X <= 80.0 |
| Texture of Reflectivity 100% Value | 45.0 | 0.0 <= X <= 80.0 |
| Sign of Reflectivity Change 0% Value | 0.6 | 0.0 <= X <= 1.0 |
| Sign of Reflectivity Change 100% Value | 0.0 | 0.0 <= X <= 1.0 |
| Reflectivity Spin Change 0% Value | 50.0 | 0.0 <= X <= 100.0 |
| Reflectivity Spin Change 100% Value | 0.0 | 0.0 <= X <= 100.0 |
| Spin Change Threshold | 2.0 | 0.0 <= X <= 20.0 |
| Spin Reflectivity Threshold | 5.0 | 0.0 <= X <= 20.0, dBZ |
| Mean Velocity 0% Value | 2.3 | 0.0 <= X <= 10.0, m/s |
| Mean Velocity 100% Value | 0.0 | 0.0 <= X <= 10.0, m/s |
| Standard Deviation of Velocity 0% Value | 0.7 | 0.0 <= X <= 5.0, m/s |
| Standard Deviation of Velocity 100% Value | 0.0 | 0.0 <= X <= 5.0, m/s |
| Mean Spectrum Width 0% Value | 3.2 | 0.0 <= X <= 5.0, m/s |
| Mean Spectrum Width 100% Value | 0.0 | 0.0 <= X <= 5.0, m/s |
| Texture of Reflectivity Weight | 1.00 | 0.00 <= X <= 1.00 |
| Sign of Reflectivity Weight | 1.00 | 0.00 <= X <= 1.00 |
| Reflectivity Spin Change Weight | 1.00 | 0.00 <= X <= 1.00 |
| Mean Velocity Weight | 1.00 | 0.00 <= X <= 1.00 |
| Standard Deviation of Velocity Weight | 1.00 | 0.00 <= X <= 1.00 |
| Mean Spectrum Width Weight | 1.00 | 0.00 <= X <= 1.00 |
| Azimuthal Extent (in radials) | 1 | 1 <= X <= 4, azimuths |
| Reflectivity Range Extent | 2 | 1 <= X <= 4, bins |
| Doppler Range Extent | 4 | 1 <= X <= 8, bins |

Figure 8-12. Algorithms - REC AP/Clutter Target

## 8.12 Severe Weather Probability

This window allows changing the Severe Weather Probability (SWP) coefficient parameters and the box size for which SWP values are calculated. See Figure 8-13.

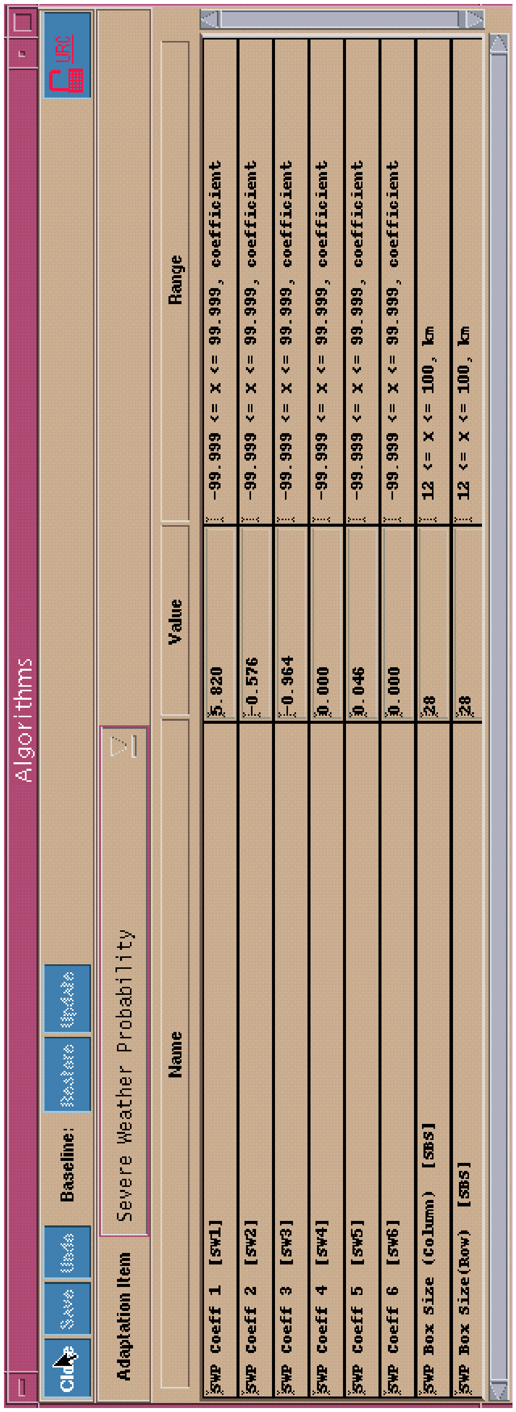



Figure 8-13. Algorithms - Severe Weather Probability

## 8.13 Storm Cell Components

The Storm Cell Components algorithm is the part of the Storm Cell Identification and Tracking (SCIT) algorithm which identifies storm cells and their components. The largest difference between the SCIT algorithm and the Storm Series algorithms is that instead of defining the volume of convective storms, this algorithm identifies the individual high reflectivity cores or cells within convective storms. The SCIT algorithm's ability to identify and track cells within a larger area of significant reflectivity (e.g. squall line) is significantly improved over the Storm Series legacy algorithm package. However, SCIT will still have difficulty identifying (and tracking) cells if a large area of significant reflectivity is nearly constant with no substantial reflectivity maximum, as in a uniform squall line or a stratiform area of moderate to heavy rain. See Figure 8-14.

### 8.13.1 Overview of SCIT

First, to identify cells, the algorithm combines segments (from the Storm Cell Components algorithm) into two-dimensional potential components. The segment must overlap radially by at least the Threshold (Segment Overlap) and be on adjacent radials which are less than the Threshold (Az Separation) apart. Since there are multiple reflectivity thresholds used to find segments, only segments found on the same elevation scan with the same reflectivity threshold are combined. The Threshold (Max Pot Comps/Elv) is the maximum number of potential components which can be saved per reflectivity threshold per elevation scan. The potential component is labeled a component if it has a minimum of at least the Threshold (# Segments/ Comp) number of segments and has a minimum area of Threshold (Component Area #1 and #6) for its reflectivity threshold. Next, a search is done for overlapping components of different reflectivity thresholds on the same elevation scan to identify centroids. A centroid is the mass-weighted center of a component or cell. If the centroid of a component found with a higher reflectivity threshold falls within the boundaries of another component, the component found with the higher reflectivity threshold is saved, and the other is discarded. After this process, the Threshold (Max Comps/Elev) value is the final number of components per elevation scan which can be saved.

Then the components are vertically correlated, i.e. assigned to the same cell. The centroids of the components at adjacent elevation scans are compared for horizontal proximity. For each component, the distance from the center of every component in the next highest elevation scan is compared until a component is found within a specified search radius, Threshold (Search Radius #1). If no match is found for a component, then the search radius is increased to Threshold (Search Radius #2), and the comparison is done again. This process is repeated if necessary with

Threshold (Search Radius #3). At this point, Threshold (Max Detected Cells) is the maximum number of cells saved (in a volume scan).

If two cells' centroids are within spacial proximity, the cells are merged. To merge two cells, their centroids must be within a specified horizontal distance, Threshold (Horizontal Merge), and their bases and tops must be within a specified vertical and angular separation, Threshold (Height Merge) and Threshold (Elevation Merge), respectively. When merging two cells, one cell's components are added to the other cell, and a new centroid is calculated. Next, to reduce the crowding, when two cells are still within spacial proximity, the cell with the lesser Cell based VIL is deleted. To delete one of the cells, either of their centroids must be no more than Threshold (Horizontal Delete) apart. Or, the difference in their cell depths must be greater than the Threshold (Depth Delete) and their centroids must be no more than twice the Threshold (Horizontal Delete) apart. The final maximum number of cells (after the merging and deletion processes) in a volume scan is Threshold (Max Cells/Volume).

### 8.13.2 Threshold Maximum Cell Based VIL

The Threshold (Maximum Cell Based VIL) value is the maximum Cell based VIL which will be computed or displayed. The Cell based VIL is an estimate of the liquid water through a storm cell, based on the cell's component's maximum reflectivities. The purpose of the Threshold (Maximum Cell Based VIL) is to mitigate hail contamination of the Cell based VIL. However, since the Cell based VIL can be used as a hail predictor, the default value is set at its maximum value. The value can be lowered to prevent extremely high Cell based VILs due to hail contamination. For example, the threshold can be set equal to 80 kg/m2, the same as the MVT - Max VIL Threshold in the VIL algorithm. This adaptable parameter only affects the Cell-based VIL.

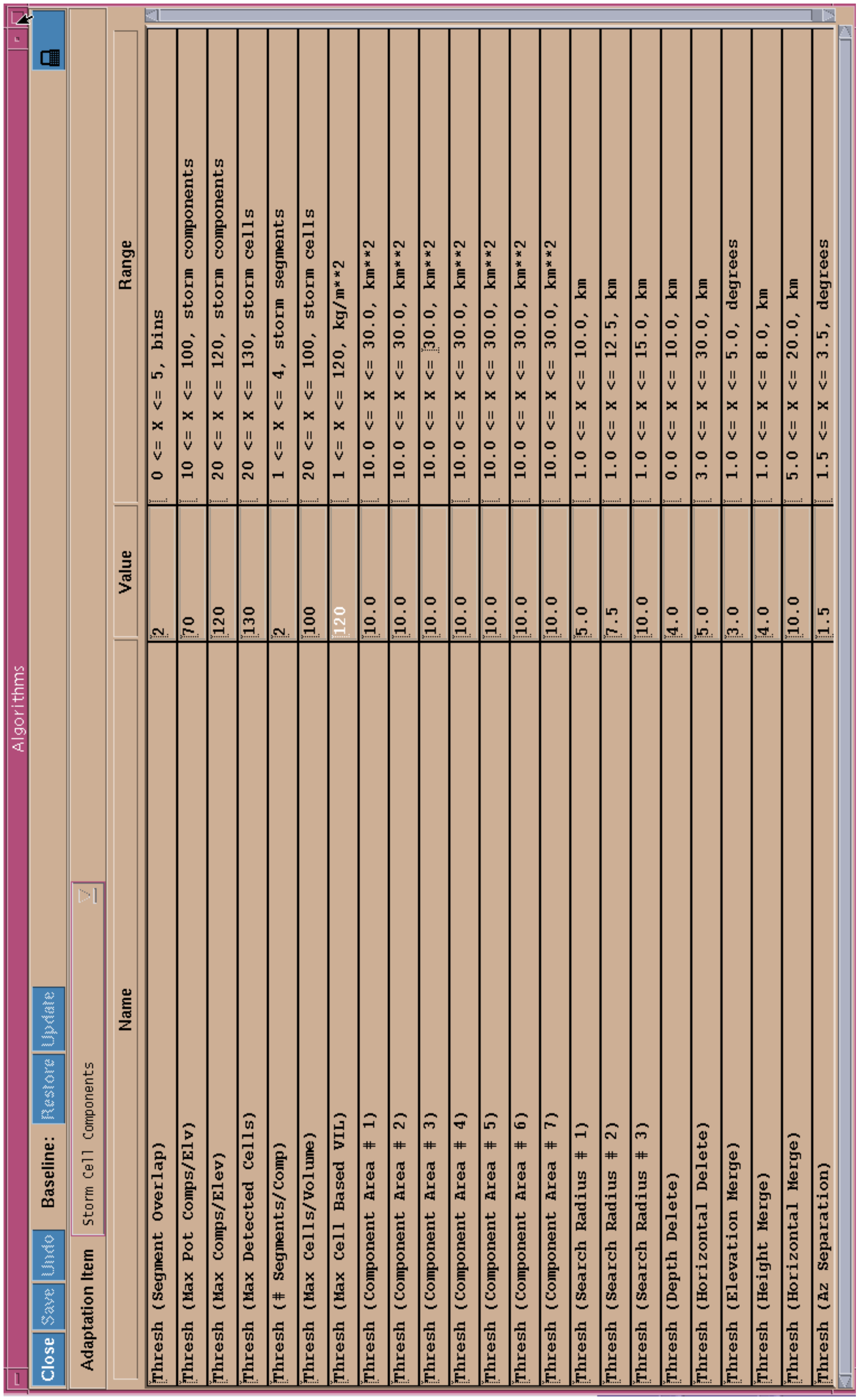



Figure 8-14. Algorithms - Storm Cell Components

## 8.14 Storm Cell Segments

This algorithm identifies radial sequences of reflectivity, or segments, as part of the processing to identify storm cells. See Figure 8-15. These segments are runs of contiguous range bins with reflectivity values greater than or equal to a specified Threshold (Reflectivity #1 - #7) and have a combined length greater than a specified Threshold (Segment Length #1 - #7). Also, a segment may contain up to a Threshold (Dropout Count) number of contiguous range bins which are within Threshold (Dropout Ref Diff) below the reflectivity threshold. The range of allowable values for these adaptable parameters are such that the parameters can be set low enough to identify and track snow showers.

The algorithm has seven Reflectivity Thresholds (and a minimum segment length threshold for each reflectivity threshold). The algorithm searches for segments within the Threshold (Max Segment Range). As a processing limitation, there is a maximum number of segments per radial (for each reflectivity threshold) and per elevation scan, Max # of Segments/Radial and Max # of Segments/Elevation, respectively.

For each segment, the following attributes are calculated and saved: maximum reflectivity, mass- weighted length, and mass-weighted length squared. The maximum reflectivity is a running average of the reflectivity values in Reflectivity Avg Factor bins. To calculate the mass-weighted length and the mass-weighted length squared, the Mass Weighted Factor, Mass Multiplicative Factor, and Mass Coefficient Factor are used.

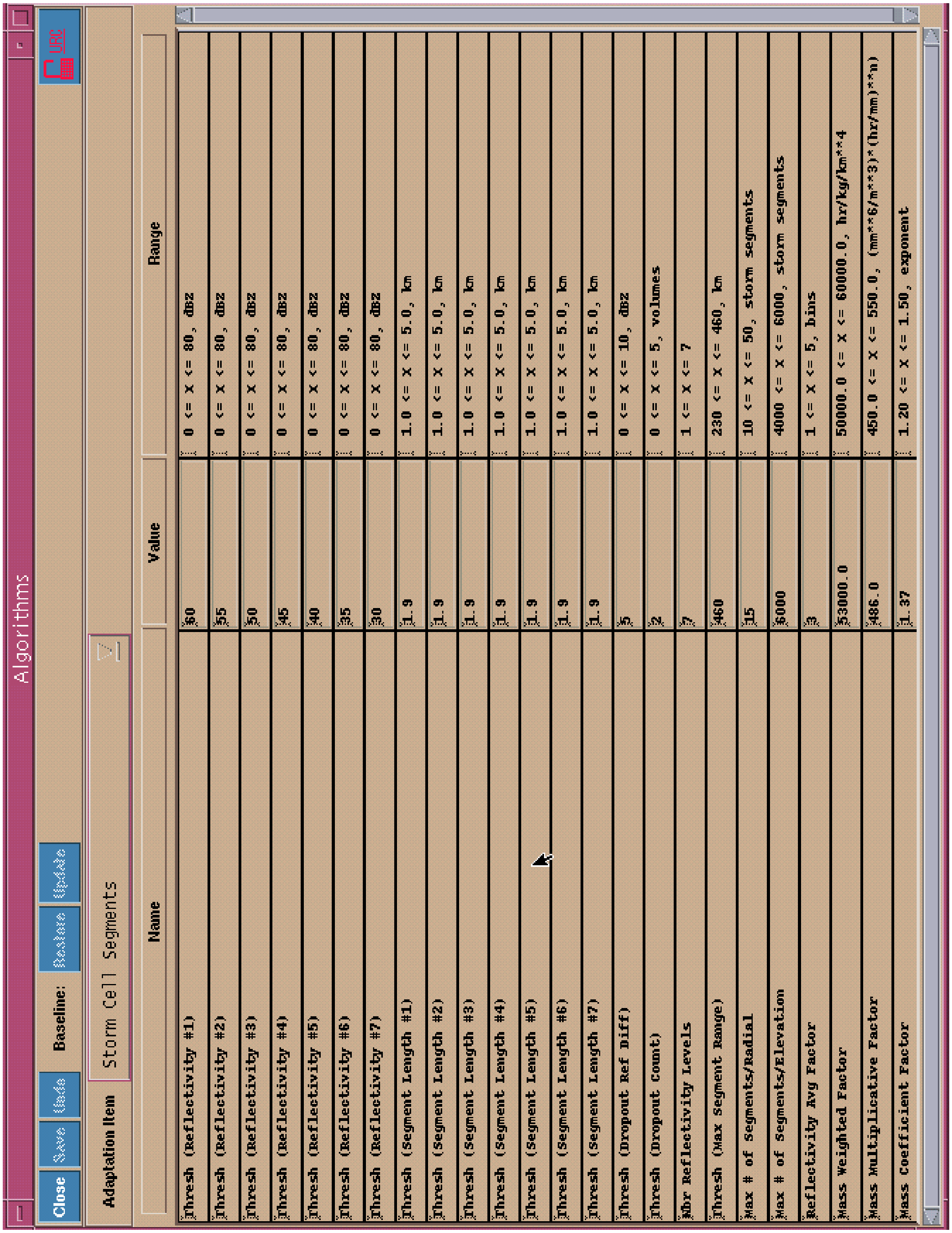



Figure 8-15. Algorithms - Storm Cell Segments

## 8.15 Storm Cell Tracking

The Storm Cell Tracking algorithm monitors the movement of storm cells as part of the SCIT algorithm suite. Although the SCIT algorithm suite exhibits significant tracking and forecast skill, cell mergers/splits and rapid cell decay/growth may not be handled well.

The first step is matching storms found in the current volume scan to the storm cells from the previous volume scan in time and space. The second step is to forecast their movement. Figure 8-16 displays the Storm Cell Tracking window.

The storm cells are matched as follows. Starting with the most intense cell (i.e. largest Cell based VIL value) in the current volume scan, the centroid position is compared to the projected centroid positions of cells from the previous volume scan. A cell's projected centroid position is its forecasted position for the current volume scan. The cell from the previous volume scan with a projected centroid located within a distance computed from the Correlation Speed which is closest to the current cell is correlated. When a cell is correlated, it is considered the same cell and assigned the same storm cell ID. Then, the next most intense cell in the current volume scan is compared to all uncorrelated cells in the previous volume scan, and so on, until all cells in the current volume scan are processed. Once a cell from the previous volume scan is correlated, it is not compared to any more cells in the current volume scan. If no projected centroid positions are within the adaptable range of a cell's centroid position, the cell remains uncorrelated and is assigned a new storm cell ID. If a time period of more than Time (Maximum) has passed between the current and past volume scans, then no matching is done, and all storms in the current volume scan are considered new. The centroid positions used are in a Cartesian coordinate system with the radar at the origin, and where the X-axis denotes east-west directions and the Y-axis denotes north-south directions.

The forecast of a storm cell's movement is based on the cell's movement over its lifetime, for up to the Number of Past Volumes, including the current volume scan. The first time a storm cell is detected it is labeled new. In this case, no prediction of movement is made, and the cell is assigned a vector average storm motion of all cells in the previous volume scan (or the default storm motion if no storm cells previously existed. After the first volume scan a storm cell is detected, a forecast movement is computed based on a linear least squares extrapolation of its previous movement. Forecast positions are computed in time steps equal to the Forecast Interval. The number of forecast positions, or Number of Intervals, computed for a cell depends upon the scaled forecast error and the permissible error. The scaled forecast error is the accuracy of the previous volume scan's forecast (or forecast error) scaled by the ratio of the Error Interval over the time between volume scans. The permissible error is the Allowable Error scaled by the Error Interval over the length (in time) of the forecast (for this Forecast Interval). Basically, the poorer a forecast was for a cell for the past volume scan, the fewer the number of forecast positions. For display purposes only, if a storm cell's forecasted movement is less than the Thresh (Minimum Speed), then no past and forecast positions are graphically displayed. In this case, the cell's movement is displayed as a centroid symbol with a concentric circle (at the current position).

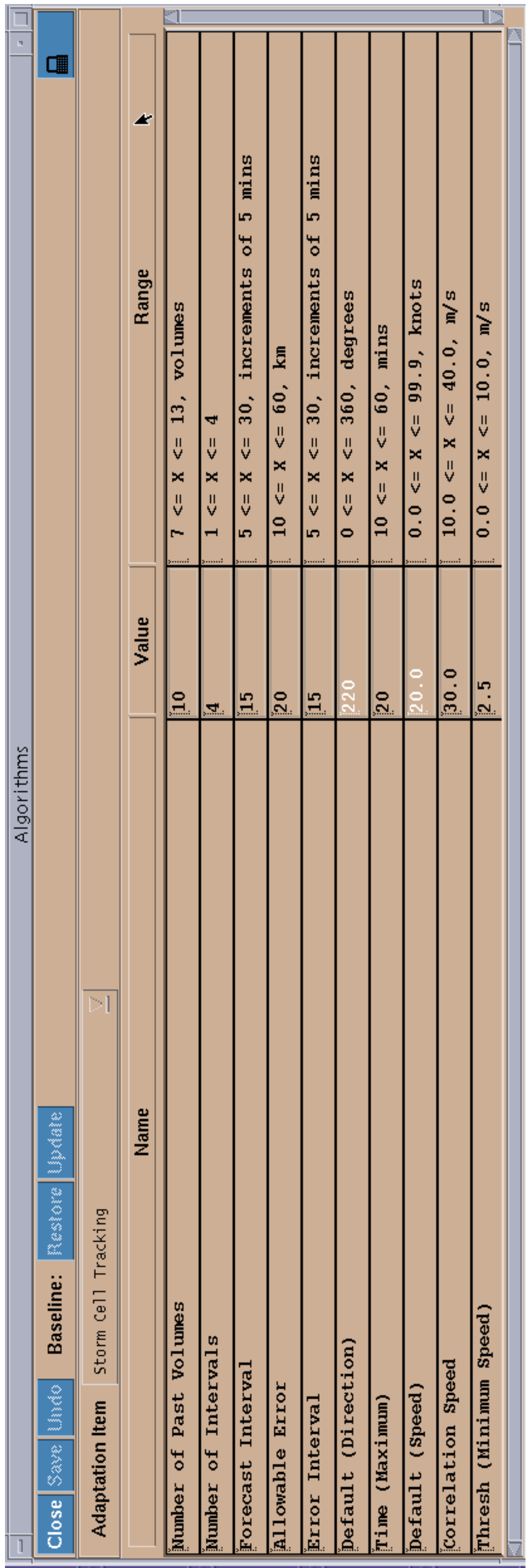



Figure 8-16. Algorithms - Storm Cell Tracking

## 8.16 Superob Adaptation

The product code is 136 and the mnemonic is SO. It contains an average of radial velocities within small azimuth-range sectors (called SuperOb cells) for each elevation angle. It is generated periodically (adaptable at the RPG by ROC only), however, the default is not expected to change. The initial default will cause generation once an hour at 30 minutes past the hour. The product size will be proportional to the amount of weather.

The Superob product is compressed using BZIP2. The RPG leaves the message header Block and Product Description Block unaltered. Flags are set in the Product Description Block to denote that the product was compressed, the compression type, and the uncompressed product length. All product data following the Product Description Block will be compressed. This compression is set in the product tables, and the user can not change it.


Figure 8-17. Algorithms - Superob Adaptation

## 8.17 Tornado Detection

The Tornado Detection Algorithm (TDA) is the replacement for the Tornadic Vortex Signature (TVS) algorithm. The TDA is designed to search base velocity data to identify intense circulations which are producing or about to produce tornadoes. The output from this algorithm is used to build the TVS product. The circulations identified by the TDA are called TVSs (and ETVSs) as in the old TVS Algorithm. See Figure 8-18.

The TDA adaptable parameters were determined from studies on a large, geographically diverse data set of tornadic events. These studies were conducted by persons from NWS forecast offices, the NSSL, and the ROC. During TDA's development, the algorithm's performance and the default parameters were considered optimized when the Critical Success Index (CSI) was highest. Using default adaptable parameter values and an independent data set, Mitchell et al. (1998, Weather and Forecasting) showed the TDA to have a POD = 0.43, an FAR = 0.48, and a CSI = 0.31. Comparison studies by Mitchell (28th Conference on Radar Meteorology, A Performance Evaluation in Comparison of the NSSL Tornado Detection Algorithm and the WSR-88D Tornadic Vortex Signature algorithm, 1997) showed that the old TVS Algorithm with optimized adaptable parameters had a POD = 7, an FAR = 8, and a CSI = 7.

Until further field experience is gained, all the TDA adaptable parameters will remain under the ROC LOCA. However, since the operational approach differs from site to site and TDA algorithm performance characteristic vary in different weather regimes, the ROC authorizes the URCs to change selected TDA adaptable parameters in accordance with the guidance and restrictions presented in the following paragraphs.

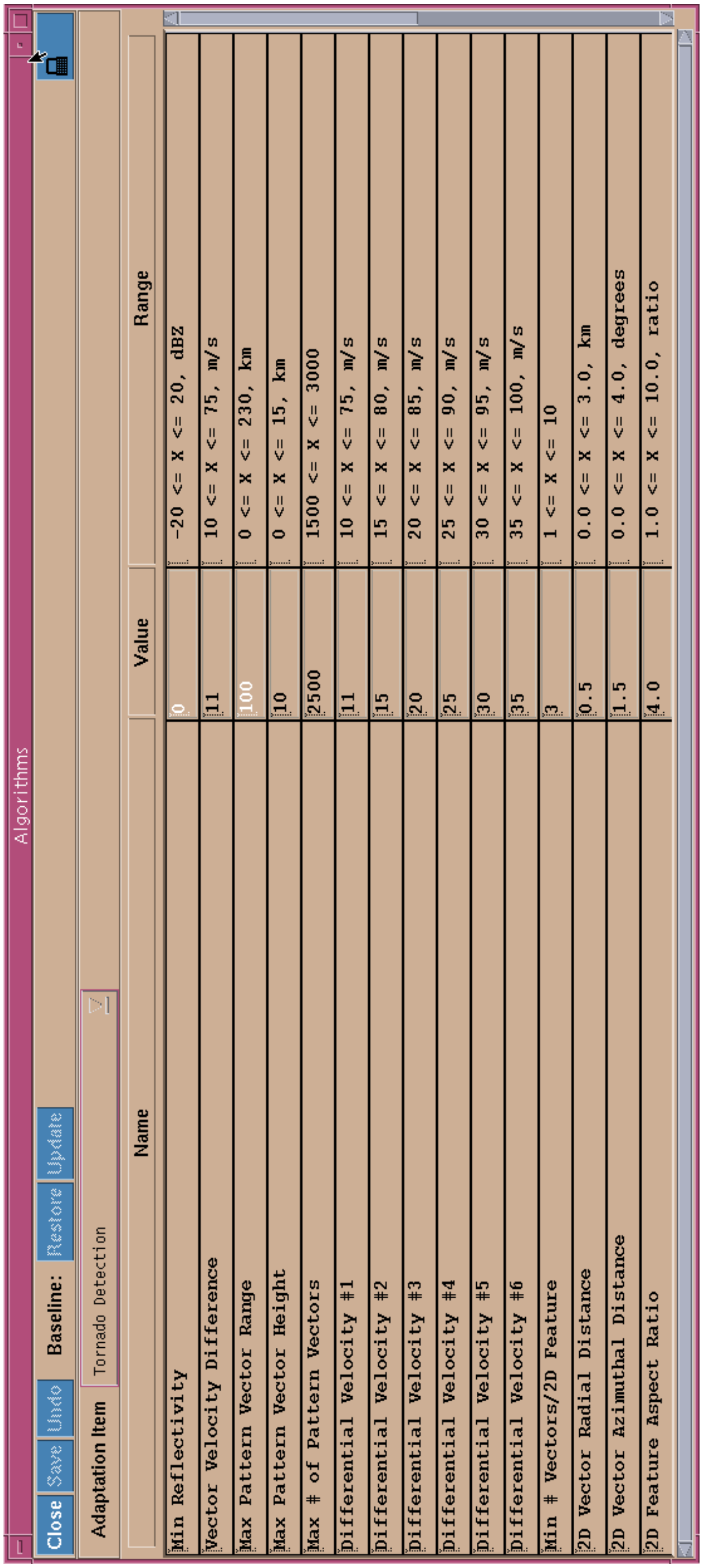



Figure 8-18. Algorithms - Tornado Detection (1 of 2)

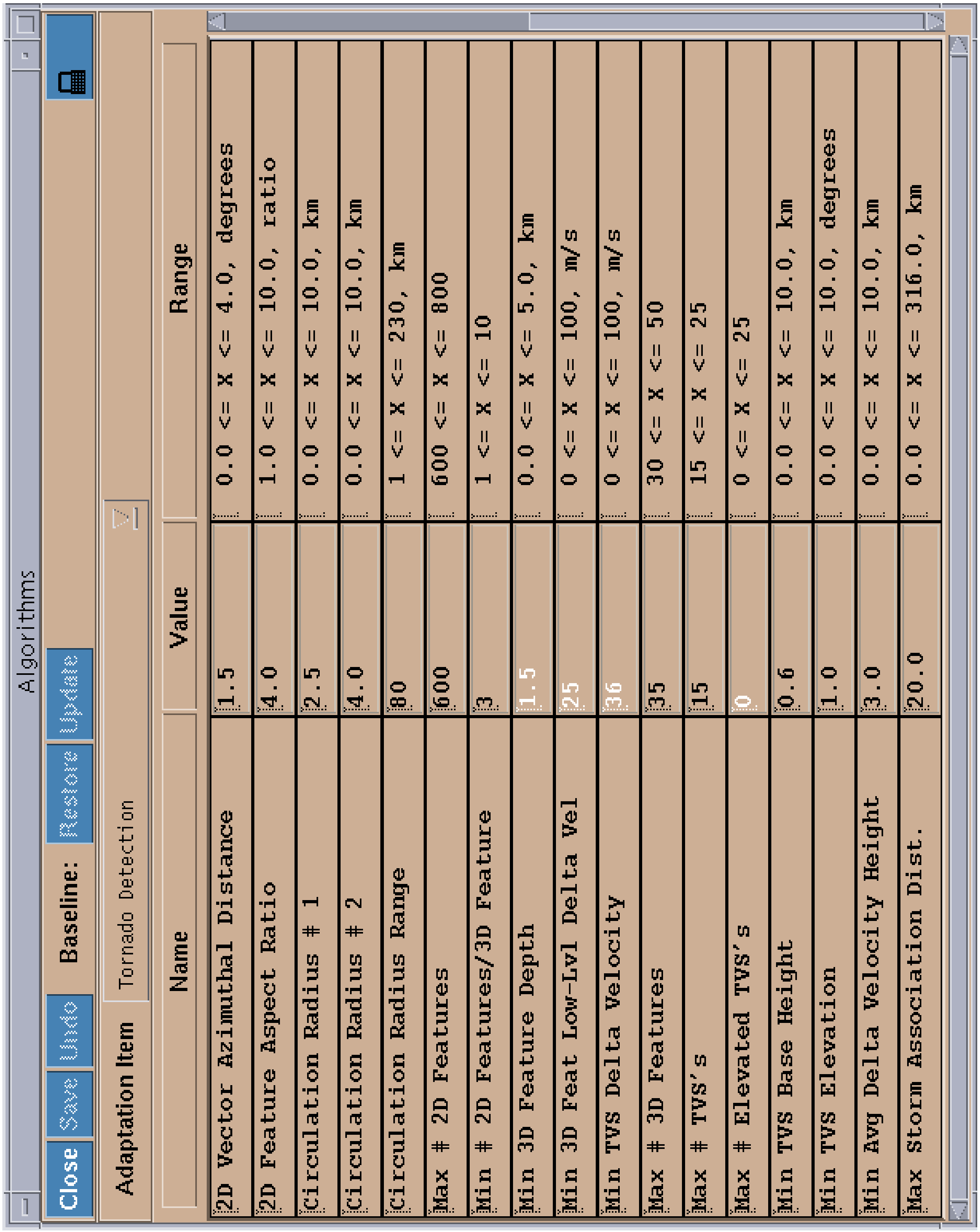



Figure 8-19. Algorithms - Tornado Detection (2 of 2)

## 8.17.1 Delegated URC Authority

Most adaptable parameters for the Tornado Detection Algorithm (TDA) are ROC-Level of Change Authority. The URC may change the Minimum Reflectivity Threshold (Min Reflectivity), the Maximum Pattern Vector Range (Max Pattern Vector Range), and Maximum Number of Elevated TVSs (Max # Elevated TVSs) within the limits discussed below. In addition, there are four different TDA adaptable parameter sets which each URC may select from to best meet the needs of its members. They are:

1) a Default Set which optimizes overall algorithm performance

2) a Minimized Set which makes the TDA mimic the performance of the old TVS algorithm

3) Isolated Supercell Set that optimizes TDA for isolated supercells

4) Squall line and Other Set that optimizes TDA for squall lines, mini-supercells, and typical cyclones.

These sets of adaptable parameters are described below. The ROC plans to add and possibly modify parameter sets as needed.

### 8.17.1.1 Minimum Reflectivity Threshold

The URC is authorized to change the Minimum Reflectivity Threshold parameter to any value between 0 and 20 dBZ (0 dBZ = default). Values below 0 dBZ are possible, but not recommended at this time. This adaptable parameter prevents identification of one-dimensional pattern vectors and, hence, any TVSs (or ETVSs) from any velocity sample volumes that do not also have a corresponding reflectivity of at least the threshold value. Increasing the value will eliminate TVS identifications in low reflectivity regions and, at the same time, decrease the amount of processing for the algorithm possibly helping to alleviate CPU loadshedding. Therefore, a URC may increase the value (above 0 dBZ) if there are false alarm TVSs (or ETVSs) being identified in areas of low reflectivity which are clearly not tornadic storms. These false alarms may be found in shear regions such as sea breezes, gust fronts, and velocity dealiasing errors primarily close to the radar. Studies have shown that increasing the value (above 0 dBZ) will slightly decrease the TDA's overall performance. The Minimum Reflectivity Threshold value should not be set below 0 dBZ. Parameter studies have shown that the number of false alarms increases as the reflectivity threshold is lowered below 0 dBZ.

#### 8.17.1.2 Maximum Pattern Vector Range

The URC may change the Maximum Pattern Vector Range parameter only to a value between 100 and 150 km (100 km = default), even though the window shows a range of Maximum Pattern Vector Range to be 0 - 230 km. One-dimensional pattern vectors and, hence, any TVSs (or ETVSs) can only be identified within this range. Decreasing this parameter to values less than 100 km limits the radar umbrella coverage for TVS detections. Increasing the parameter will extend the algorithm's processing range and processing load (or CPU at the RPG). The default value (of 100 km) was determined from a diverse set of cases. And, overall, when the range is extended, algorithm performance decreases due to beam broadening and increasing beam height. Also, at longer distances, there is a greater likelihood of range folding and dealiasing errors which decrease algorithm performance. However, in cases with very strong, tall tornadic storms, performance does not decrease when the range is extended. Therefore, a URC may increase the value up to 150 km to extend the TDA processing range.

#### 8.17.1.3 Maximum # of Elevated TVSs

The maximum number of elevated TVSs represents the maximum number of ETVSs that the algorithm can process per volume scan. This parameter permits the detection of more or fewer elevated TVSs. Since statistical studies on ETVS were not complete at the time of Build 10 release, the default value of Maximum # of Elevated TVSs was set to zero. With a default value of 0, this parameter stops TDA from identifying ETVSs; and the ETVS detections are not placed on the Combined Attribute Table. If users decide to generate ETVSs, with a value greater than 0, ETVSs will be placed in the Combined Attribute Table and users will receive ETVS information. If ETVSs are generated at the RPG, users will have to change an adaptable parameter (Display ETVSs Yes or No?) from a default value of No to a value of Yes to display the ETVS detections on associated users' windows.

### 8.17.2 Adaptable Parameter Sets

The Build 10 TDA uses 30 adaptable parameters to specify program memory limits, modify data processing thresholds, and establish criteria for detecting 2D (2-dimensional) and 3D vortex features. Three of these 30 adaptable parameters filter 3D vortices by depth and gate-to-gate velocity difference.

The LLDV (Low Level Delta Velocity) parameter value specifies the minimum gate-to-gate velocity difference allowed at the lowest elevation angle in a 3D vortex. The MDV (Minimum TVS Delta Velocity) parameter value specifies the minimum gate-to-gate velocity difference anywhere within a 3D vortex. (The TDA requires the LLDV value or the MDV value to be greater than a specified threshold to identify a TVS signature.) The Depth parameter value specifies the minimum depth allowed for a 3D vortex to be identified as a TVS. By systematically adjusting the values of these three adaptable parameters, TDA performance was optimized for several convective data sets.

Scientists from the NSSL and the ROC analyzed 45 cases containing approximately 2500 volume scans (approximately 210 hours of radar data) representing 194 tornadoes from many different areas of the United States. The 45 cases were categorized by storm type (15 isolated supercell cases, 13 squall line cases, 11 mini-supercell, and 6 tropical storm cases). A composite data set was created by combining all the squall line and isolated supercell cases.

#### 8.17.2.1 Default Adaptable Parameter Set

The default set of adaptable parameters (LLDV, MDV, and Depth) is recommended for general use. This parameter set is based on 28 cases (15 isolated supercell, 13 squall line) containing 131 tornadoes, a small sample. If the convective mode cannot be forecast or a mix of convective modes exist at the same time in the county warning area, this default parameter set is recommended for use. The URC is authorized to make the following changes:

DEFAULT ADAPTABLE PARAMETER SET
Depth = 1.5 km.
Minimum 3D Feature Low Level Delta Velocity (LLDV) = 25 m/s
Minimum TVS Delta Velocity (MDV) = 36 m/s.
These values of LLDV, MDV, and Depth are to be used only in this combination.
Algorithm performance:
POD = 0.32
FAR = 0.61
CSI = 0.21

Algorithm performance will vary, depending on the convective mode. Best performance will be observed with isolated supercells. Expect poorer performance when using this parameter set in squall lines, tropical storms, and minisupercells.

#### 8.17.2.2 Minimized Adaptable Parameter Set

Using default adaptable parameter values, the TDA will identify more TVS circulations than the pre-Build 10 TVS algorithm. Obviously, this will require a change of operational approach when using the TDA. The TVS algorithm rarely identified a TVS (i.e., low POD), but if a TVS was identified, then the circulation was likely tornadic or about to be (i.e., low FAR). When using default values, the Build 10 TDA may identify multiple TVSs in one storm cell. This should not be taken to mean that the storm cell in question is more likely tornadic than had a single detection been made. Forecasters should always use other information (e.g., knowledge of environment, reflectivity structure, spotter reports, etc.) to identify detections which are most likely associated with tornadoes. Forecasters, using the NSSL WDSS test platform for the last two years, have become accustomed to TDA and find its performance acceptable and much better than the pre-Build 10 TVS algorithm, in spite of the increased number of detections. See Figure 8-18.

The default parameter set and/or the new operational approach, may not be best for all users. Therefore, in addition to the default set, authority is given to URC's to use a Minimized Adaptable Parameter Set. URCs may use the Minimized Adaptable Parameter Set to make TDA perform similar to the pre-Build 10 TVS algorithm. When the Minimized Set is used, the TDA will identify TVSs only rarely (i.e. low POD, FAR, and CSI). The Minimized Adaptable Parameter Set is provided in case some sites want to make the TDA emulate performance of the pre-Build 10 TVS algorithm. This parameter set is based on 45 cases containing 194 tornadoes (all storm types). When selecting a minimized mode of operation, the URC is authorized to make the following changes:

MINIMIZED ADAPTABLE PARAMETER SET
Depth = 5.0 km.
Minimum 3D Feature Low Level Delta Velocity (LLDV) = 56 m/s
Minimum TVS Delta Velocity (MDV) = 74 m/s
These values of LLDV, MDV, and Depth are to be used only in this combination.
Algorithm performance:
POD = 0.02
FAR = 0.08
CSI = 0.02

### 8.17.2.3 Isolated Supercell Adaptable Parameter Set

The set of adaptable parameters (LLDV, MDV, and Depth) which optimized algorithm performance on the isolated supercell data set are recommended for use with isolated supercells. This parameter set is based on 15 cases containing 68 tornadoes, a small sample. The URC is authorized to make the following changes:

ISOLATED SUPERCELL ADAPTABLE PARAMETER SET
Depth = 3.1 km.
Minimum 3D Feature Low Level Delta Velocity (LLDV) = 27 m/s
Minimum TVS Delta Velocity (MDV) = 30 m/s

These values of LLDV, MDV, and Depth are to be used only in this combination.
Algorithm performance of the isolated supercell parameter set on isolated supercells:
POD = 0.43
FAR = 0.44
CSI = 0.32

#### 8.17.2.4 Squall Line and Other Adaptable Parameter Set

The set of adaptable parameters (LLDV, MDV, and Depth) which optimized algorithm performance on the squall line data set are recommended for use in squall lines. This same parameter set is also recommended for use with tropical cyclones and mini-supercells. This parameter set is based on 30 cases (13 squall line, 11 mini- supercell, 6 tropical cyclone) containing 126 tornadoes, a small sample. The URC is authorized to make the following changes:

SQUALL LINE and OTHER ADAPTABLE PARAMETER SET
Depth = 1.6 km.
Minimum 3D Feature Low Level Delta Velocity (LLDV) = 27 m/s
Minimum TVS Delta Velocity (MDV) = 27 m/s
These values of LLDV, MDV, and Depth are to be used only in this combination.
Algorithm performance of the Squall Line parameter set on squall lines:
POD = 0.18
FAR = 0.77
CSI = 0.11

Expect poorer performance on tropical cyclones and mini-supercells. The shallow nature of these storm types preclude easy identification by a radar beam that broadens and bends upwards with range.

### 8.17.3 TDA Adaptable Parameters

To support local TDA performance studies using Archive II playback via WATADS, a brief description of each TDA adaptable parameter is provided below.

- MIN REFLECTIVITY

  The TDA only identifies Pattern Vectors from velocity data from radar bins that have corresponding reflectivity values which meet or exceed this threshold. Therefore, this parameter allows the operator to increase or decrease the number of algorithm detections within weak reflectivity regions. Changing this parameter will also greatly affect the amount of work (or CPU) that the algorithm does.

  Increasing the threshold from 0 to +20 dBZ reduces the number of circulations detected, both real and false alarms; but also, increases the number of misses. At the same time, this change would decrease the amount of work the algorithm does. Decreasing the threshold from 0 to -20 dBZ greatly increases the number of false alarms and the amount of work performed by the algorithm.

The Minimum Reflectivity parameter is modifiable by the URC.

- VECTOR VELOCITY DIFFERENCE

  This is the minimum required gate-to-gate velocity difference required for Pattern Vectors. Lower threshold values require additional memory and computing time but result in the detection of weaker circulations (e.g. tornadoes along gust fronts, derechos). However, lower values may result in more false alarms. Conversely, increasing VECTOR VELOCITY DIFFERENCE may constrain the algorithm to only identify the stronger circulations, reducing detections and false alarms.

  The Vector Velocity Difference parameter is not modifiable by the URC.

- MAX PATTERN VECTOR RANGE

  This is the maximum slant range at which Pattern Vectors are identified. It may be necessary to limit the detection of circulations beyond a certain range (100 km = default) from the radar due to lack in the algorithm's ability to identify long range, tornadic circulations. At long ranges, the algorithm may only detect mid-level rotation on a mesocyclone size scale. As a tornadic storm with an identified TVS moves beyond the Maximum Pattern Vector Range, the TVS detection will be lost. Using the default value of Maximum Pattern Vector Range, TDA will stop identifying storms that move beyond 100 km.

  CPU loadshedding may result for large values of this parameter as more detections and their components are identified and processed. Of course, events beyond MAXIMUM PATTERN VECTOR RANGE will not be identified.

  The Maximum Pattern Vector Range parameter is modifiable by the URC.

- MAX PATTERN VECTOR HEIGHT

  This is the maximum height at which Pattern Vectors are identified. If computing resources are limited then this value may be set lower. The range of detection decreases with a decrease in MAXIMUM PATTERN VECTOR HEIGHT (decrease probability of detection).

  The Maximum Pattern Vector Height parameter is not modifiable by the URC.

- MAX # OF PATTERN VECTORS

  This is the maximum number of Pattern Vectors the algorithm will process per elevation scan. Too few Pattern Vectors may cause the algorithm to miss important circulations. In large, intense squall lines, a large number of Pattern Vectors may contribute to CPU loadshedding at the RPG.

The Maximum Number of Pattern Vectors parameter is not modifiable by the URC.

- DIFFERENTIAL VELOCITY #1 - #6

There are six velocity difference thresholds used as criteria for building 2D Features. The threshold values should increase from smallest to largest. It is recommended that the difference between successive threshold values not exceed 5 m/s (e.g. 11, 15, 20, 25, 30, 35 m/s).

The use of multiple thresholds costs more in terms of computing and memory requirements. Increasing the value of the thresholds will make the algorithm less sensitive; i.e., it will not identify the weaker circulations. However, it is not known exactly how the algorithm would respond to changes in the thresholds.

The Differential Velocity #1-#6 parameters are not modifiable by the URC.

- MINIMUM # VECTORS / 2D FEATURE

This is the minimum number of Pattern Vectors required to declare a 2D Feature. The lower the threshold, the greater the chance for detecting smaller scale phenomena (e.g., tornadic vortices along a gust front, landspouts, etc.,). However, this also increases the chances of CPU loadshedding and can cause a greater number of false alarms.

Adjusting this parameter toward the upper limit (10 pattern vectors) will significantly reduce the likelihood of false alarms but will limit the algorithm to detecting only the larger scale circulations (e.g. supercell tornadoes).

The Minimum number of vectors per 2D Feature parameter is not modifiable by the URC.

- 2D VECTOR RADIAL DISTANCE

This is the maximum radial distance allowed between two Pattern Vectors to be associated into the same 2D Feature. This parameter constrains the construction of 2D features to only those pattern vectors which are in close radial proximity. Increasing this threshold may increase the number of false alarms.

The 2D Vector Radial Distance parameter is not modifiable by the URC.

- 2D VECTOR AZIMUTHAL DISTANCE

This is the maximum azimuthal distance allowed for two Pattern Vectors to be associated into the same 2D Feature. This parameter constrains the construction of 2D Features to only those pattern vectors which are in close proximity. Increasing this thresholds may also increase the number of false alarms and may contribute to CPU loadshedding.

The 2D Vector Aximuthal Distance parameter is not modifiable by the URC.

- 2D FEATURE ASPECT RATIO

  Maximum allowable aspect ratio (delta Range (Slant)/ delta Azimuth) for a 2D Feature. This parameter discards long thin regions of shear such as some velocity dealiasing errors oriented along an azimuth. More appropriate values (e.g. 2) may be deemed necessary for identifying bonafide circulations. Larger values (greater than 4) may result in a high false alarm rate due to gust fronts oriented along the beam being identified.

  The 2D Feature Aspect Ratio parameter is not modifiable by the URC.

- CIRCULATION RADIUS #1

  The maximum horizontal radius used for searching for 2D Features on adjacent or the same elevation scans in building a 3D Feature. This radius is used when the Range(Slant) of an assigned 2D Feature is less than or equal to Threshold Circulation Radius Range. (See description for CIRCULATION RADIUS RANGE).

  Increasing this parameter will allow highly tilted circulations to be identified. The distance between two consecutive 2D Features is a function of both vortex tilt and vortex translation between elevation angles. Also, the distance between two consecutive 2D circulations may become quite large at larger ranges due to spreading of the radar beam, and artificial shifting of azimuthal shear by improper velocity dealiasing.

  Small values may limit the algorithm's ability to fully construct 3D Features. Large values may result in a higher false alarm rate by associating unrelated and/or false circulation signatures.

  The Circulation Radius 1 parameter is not modifiable by the URC.

- CIRCULATION RADIUS #2

  The maximum horizontal radius used for searching for 2D Features on adjacent or the same elevation scans in building a 3D Feature. This radius is used when the Range(Slant) of an assigned 2D Feature is greater than Threshold Circulation Radius Range. (See description for CIRCULATION RADIUS RANGE.)

Increasing this parameter will allow highly tilted circulations to be identified. The distance between two consecutive 2D Features is a function of both vortex tilt and vortex translation between elevation angles. Also, the distance between two consecutive 2D Features may become quite large at larger ranges due to spreading of the radar beam, and artificial shifting of azimuthal shear by improper velocity dealiasing.

Small values may limit the algorithm's ability to fully construct 3D Features. Large values may result in a higher false alarm rate by associating unrelated and/or false circulation signatures.

The Circulation Radius 2 parameter is not modifiable by the URC.

- CIRCULATION RADIUS RANGE

  The Range (Slant) beyond which Threshold Circulation Radius 2 is invoked, otherwise Threshold Circulation Radius 1 is used. (See descriptions for CIRCULATION RADIUS 1 and CIRCULATION RADIUS 2.) A large circulation radius is used beyond this range to account for beam broadening

  It may be deemed necessary to increase or decrease the value to invoke Threshold Circulation Radius 2 or Threshold Circulation Radius 1. (See descriptions for CIRCULATION RADIUS 1 and CIRCULATION RADIUS 2.) Small / large values may limit the algorithm's ability to fully construct 3D Features or liberally construct 3D Features near to / far from the RDA.

  The Circulation Radius Range parameter is not modifiable by the URC.

- MAX # 2D FEATURES

  Maximum number of 2D Features the algorithm can process per volume scan. This parameter permits the detection of more or fewer 2D Features. Too few 2D Features may cause the algorithm to miss important circulations. Too many 2D Features may cause CPU loadshedding.

  The Maximum Number of 2D Features parameter is not modifiable by the URC.

- MIN # 2D FEATURES / 3D FEATURE

  Minimum number of 2D Feature needed to make a 3D Feature. Defines the fewest number of 2D Features required to correlate into a 3D Feature. A lower value may increase the probability of detection at greater ranges (especially shallow circulations at ranges greater than or equal to 80 km). However, a lower value may also result in a higher false alarm rate at near ranges, especially in shear regions clearly not associated with tornadic storms, e.g., sea breezes, gust fronts, ground clutter.

The Minimum Number of 2D Features/3D detection parameter is not modifiable by the URC.

- MIN 3D FEATURE DEPTH

  Minimum depth required to declare a TVS or an ETVS. Depths of 3D circulations may vary according to expected storm type. Also, studies show that the majority of tornadic circulations meet or exceed 1.5 km depth. However, the operator may want to lower this value in cases of very low topped tornadic convection. Large values may result in a lower probability of detection. Small values may result in an increased number of false detections.

  The Minimum 3D Feature Depth parameter is modifiable by the URC; however, the value used can only be used in specific combination with the other adaptable parameters (LLDV and MDV) that define the meteorologically classified adaptable parameter sets: Default Set, Minimized Set, Isolated Supercell Set, and Squall Line and Other Set).

- MIN 3D FEAT LOW-LVL DELTA VEL

  Minimum radial velocity difference in the lowest 2D Feature within a 3D Feature required to identify a TVS or ETVS. Allows freedom to consider weaker circulations or consider only the stronger circulations based upon expected type of events (e.g. supercells, squall line, bow-echo, etc.). Lower values allow the detection of tornadic circulations in their incipient stages. Additionally, lower values will allow weaker circulations to be processed, however, this could result in a higher false alarm rate.

  The Minimum 3D Low-Level Delta Velocity parameter is modifiable by the URC; however, the value used can only be used in specific combination with the other adaptable parameters (MDV and depth) that define the meteorologically classified adaptable parameter sets: Default Set, Minimized Set. Isolated Supercell Set, and Squall Line and Other Set).

- MIN TVS DELTA VELOCITY

  Minimum radial velocity difference of the maximum 3D Feature delta velocity required to declare a TVS. See MIN 3D FEAT LOW-LVL DELTA VEL.

  The Minimum TVS Delta Velocity parameter is modifiable by the URC; however, the value used can only be used in specific combination with the other adaptable parameters (LLDV and depth) that define the meteorologically classified adaptable parameter sets: Default Set, Minimized Set. Isolated Supercell Set, and Squall Line and Other Set).

- MAX #3D FEATURES

  Maximum number of 3D Features the algorithm can process per volume scan. Permits the detection of more or fewer 3D Features. Setting this number too low may cause the algorithm to miss important circulations.

  The Maximum Number of 3D Features parameter is not modifiable by the URC.

- MAX # TVS’s

  Maximum number of TVS's the algorithm can process per volume scan. Permits the detection of more or fewer TVSs. Setting this number too low may cause the algorithm to miss important circulations.

  The Maximum Number of TVSs parameter is not modifiable by the URC.

- MAX # ELEVATED TVS’s

  Maximum number of elevated TVS's the algorithm can process per volume scan. This parameter permits the detection of more or fewer elevated TVSs. With a default value of 0, this parameter stops TDA from identifying ETVSs and the placement of ETVS detections on the Combined Attribute Table. If users decide to generate ETVSs, with a value greater than 0, ETVSs will be placed in the Combined Attribute Table and Other users will receive ETVS information. If ETVSs are generated at the RPG, users will have to change an adaptable parameter on the Associated User, Display ETVSs Yes or No, from a default value of No to a value of Yes to display the ETVS detections on the Associated User window.

  The Maximum Number of ETVs parameter is modifiable by the URC.

- MIN TVS BASE HEIGHT

  Minimum height AGL to which the base of a 3D Feature must extend to be declared a TVS. Used in conjunction with Minimum TVS Base Elevation. (See description MINIMUM TVS BASE ELEVATION.)

  TVS detections at near ranges may not extend to the lowest elevation angle, yet are very close to the ground. This parameter allows these circulations to be identified as TVSs. Large values may limit the ability to detect of tornadic circulations. The false alarm rate may increase with an increase in MINIMUM TVS BASE HEIGHT.

  The Minimum TVS Base Height parameter is not modifiable by the URC.

- MIN TVS ELEVATION

  Lowest elevation angle to which the base of a 3D Feature must extend to declare a TVS unless the circulation extends to or below Minimum TVS Base Height (See description for MINIMUM TVS BASE HEIGHT). Three dimensional circulations which do not extend to the prescribed lowest elevation angle are declared ETVSs.

  At close ranges, circulations are often detected first at higher elevation angles. However, increasing the MINIMUM TVS BASE ELEVATION may also increase the false alarm rate.

  The Minimum TVS Base Elevation parameter is not modifiable by the URC.

- MIN AVG DELTA VELOCITY HEIGHT

  Minimum height below which all 2D Features comprising a 3D Feature are assigned an equal weighting of 1 in the calculation of average delta velocity of the entire 3D Feature.

  Thus, this parameter gives more weight to more lower tilts in the calculation of average delta velocity of the entire 3D Feature. Increasing MIN AVG DELTA VEL HEIGHT will increase the depth over which 2D Features contribute equally to the calculation of average delta velocity of the entire 3D Feature.

  The Minimum Average Delta Velocity Height is not modifiable by the URC.

- MAX STORM ASSOCIATION DIST.

  Maximum distance from a storm within which to associate TVS and ETVS detections with storm cell detections. Association is not required to declare a TVS or ETVS detection.

  The number and type of expected storms may change on a daily basis and from region to region. Smaller values may result in not associating an identified TVS/ETVS with a storm.

  The failure to associate a TVS/ETVS with a storm has NO impact on detection of tornadic circulations. However, a TVS/ETVS not associated with a storm cell will not be displayed in the Combined Attributes Table (of the Composite Reflectivity product).

  The Maximum Storm Association Distance parameter is not modifiable by the URC.

### 8.17.4 Supplemental Information - Tornado Detection

For additional information refer to the following material:

Build 10 Precursor Training Booklet.

Lee and Mitchell, 1999: Performance of the WSR-88D Build 10 tornado detection algorithm: Development of optimal adaptable parameter sets. Submitted to the 15th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology, In Press.

Mitchell E.D., M.A., Fresch, R,R, Lee, T.M. Smith, W.D. Zittel, 1998: The new NSSL tornado detection algorithm for the WSR-88D. Preprints, 14th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology, Phoenix AZ, Amer. Meteor. Soc., 271 - 274.

Mitchell E.D., S.V. Vasiloff, G.J. Stumpf, A. Witt, M.D. Eilts, J.T. Johnson, K.W. Thomas, 1988: The National Severe Storms Laboratory tornado detection algorithm. Weather and Forecasting, Vol. 13, No. 2, pp.352 - 366.

Mitchell E.D., 1997: A Performance Evaluation in Comparison of the NSSL Tornado Detection Algorithm and the WSR-88D Tornadic Vortex Signature Algorithm, Preprints, 28th Conf. on Radar Meteorology, Austin TX, Amer. Meteor. Soc., 351 - 352.

## 8.18 VAD

Three adaptable parameters under the URC LOCA allow local modification of the VAD algorithm. See Figure 8-20. The beginning azimuth angle (TBZ) and ending azimuth angle (TEZ) parameters enable the local site to define a partial circle from which to collect data. This allows the site to restrict data collection over areas where residual clutter may severely bias the velocity estimate (e.g., a ridge line, area of tall buildings, etc.,). The third parameter, VAD Analysis Slant Range (VAD), defines the optimal slant range to collect velocity samples. This parameter should be modified to ensure adequate velocity samples are available for analysis. For example, on a cold, clear, dry day, decrease the VAD (slant) range to enable the radar to collect enough samples to perform the VAD analysis. On the other hand, on a muggy summer day, increase the VAD (slant) range to negate the effects of residual ground clutter near the radar.

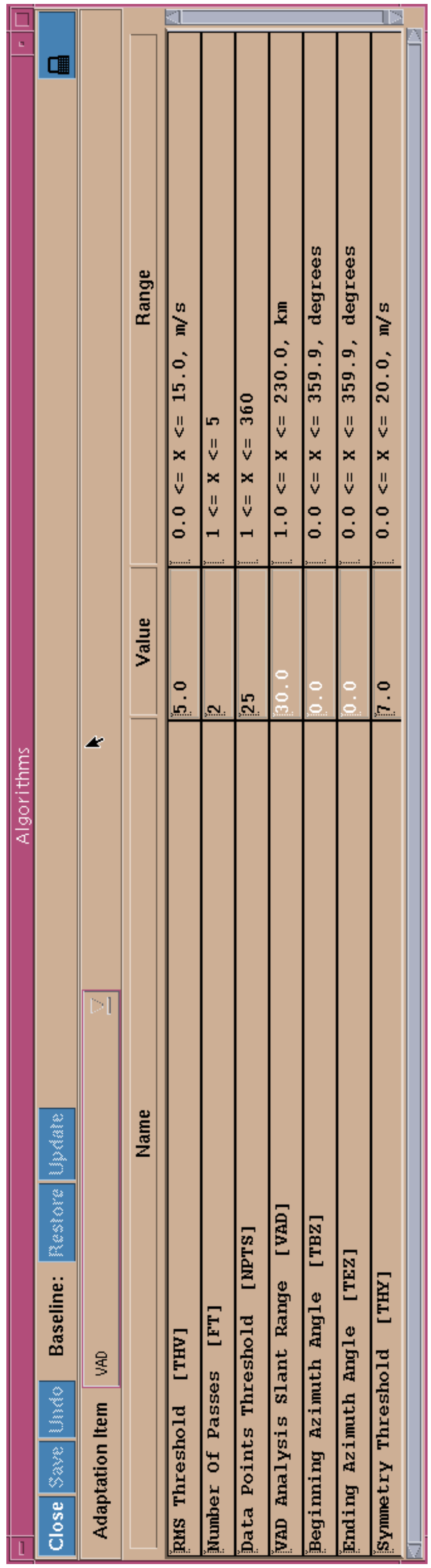



Figure 8-20. Algorithms - VAD

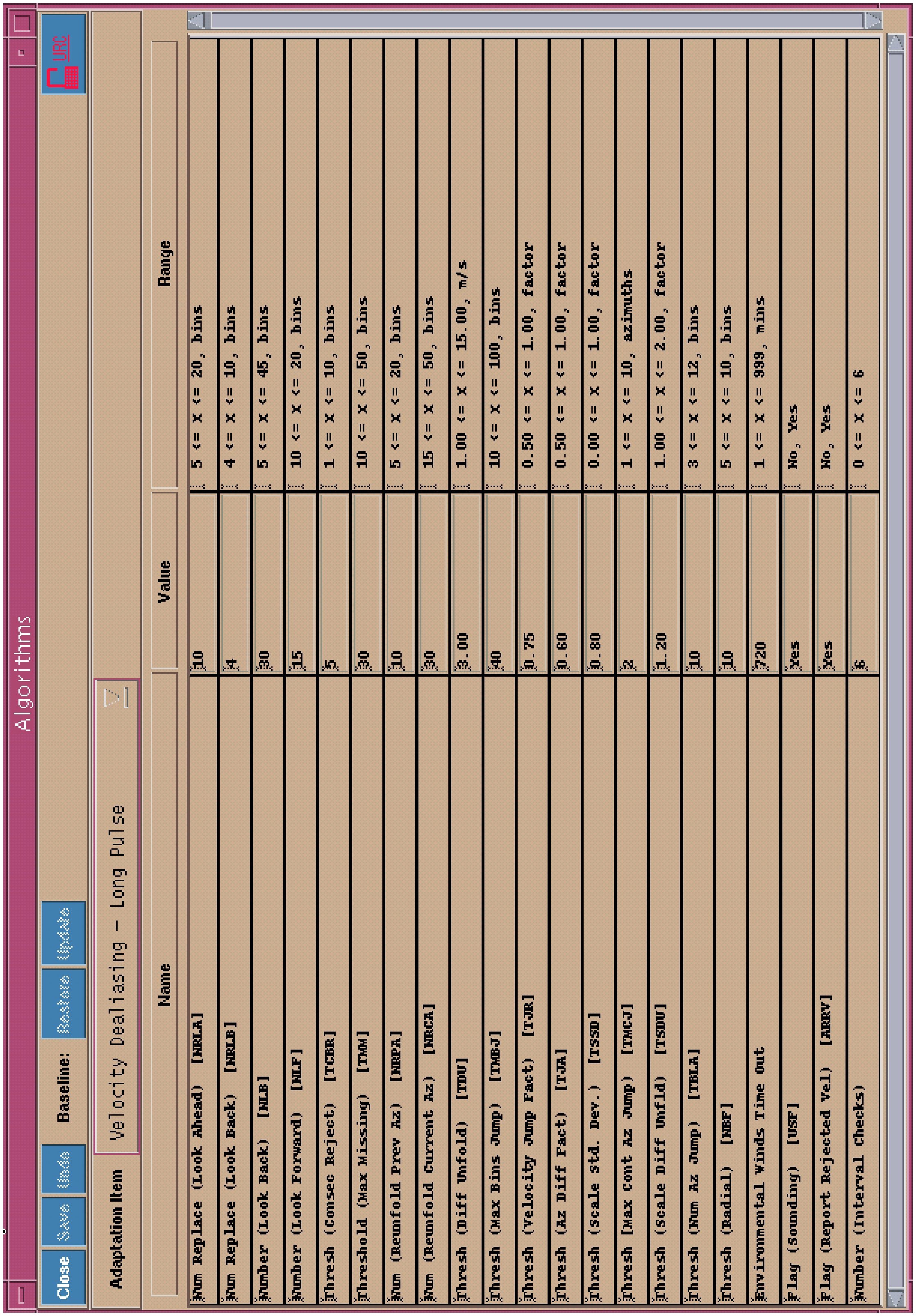
## 8.19 Velocity Dealiasing - Long Pulse

These parameters are used when operating in VCP 31. See Figure 8-21, Algorithms - Velocity Dealiasing - Long Pulse

### 8.19.1 Supplemental Information - Velocity Dealiasing

For additional information refer to the following paper:

Efficient Dealiasing of Doppler Velocities Using Local Environmental Constraints, Eilts and Smith, 1990.




| Name | Value | Range |
|---|---|---|
| Num Replace (Look Ahead) [NRLA] | 10 | 5 <= X <= 20, bins |
| Num Replace (Look Back) [NRLB] | 4 | 4 <= X <= 10, bins |
| Number (Look Back) [NLB] | 30 | 5 <= X <= 45, bins |
| Number (Look Forward) [NLF] | 15 | 10 <= X <= 20, bins |
| Thresh (Consec Reject) [TCBR] | 5 | 1 <= X <= 10, bins |
| Threshold (Max Missing) [TMM] | 30 | 10 <= X <= 50, bins |
| Num (Reunfold Prev Az) [NRPA] | 10 | 5 <= X <= 20, bins |
| Num (Reunfold Current Az) [NRCA] | 30 | 15 <= X <= 50, bins |
| Thresh (Diff Unfold) [TDU] | 3.00 | 1.00 <= X <= 15.00, m/s |
| Thresh (Max Bins Jump) [TMBJ] | 40 | 10 <= X <= 100, bins |
| Thresh (Velocity Jump Fact) [TJR] | 0.75 | 0.50 <= X <= 1.00, factor |
| Thresh (Az Diff Fact) [TJA] | 0.60 | 0.50 <= X <= 1.00, factor |
| Thresh (Scale Std. Dev.) [TSSD] | 0.80 | 0.00 <= X <= 1.00, factor |
| Thresh (Max Cont Az Jump) [TMCJ] | 2 | 1 <= X <= 10, azimuths |
| Thresh (Scale Diff Unfld) [TSDU] | 1.20 | 1.00 <= X <= 2.00, factor |
| Thresh (Num Az Jump) [TBLA] | 10 | 3 <= X <= 12, bins |
| Thresh (Radial) [NBF] | 10 | 5 <= X <= 10, bins |
| Environmental Winds Time Out | 720 | 1 <= X <= 999, mins |
| Flag (Sounding) [USF] | Yes | No, Yes |
| Flag (Report Rejected Vel) [ARRV] | Yes | No, Yes |
| Number (Interval Checks) | 6 | 0 <= X <= 6 |

Figure 8-21.  Algorithms - Velocity Dealiasing - Long Pulse

## 8.20 Velocity Dealiasing - Multi-PRF

The Multi-PRF Dealiasing Algorithm (MPDA) technique combines velocity data from multiple sweeps at the same elevation angle. This accomplishes two things: First, because each sweep has a different PRF with a corresponding different unambiguous range, Doppler data that may be range folded at one PRF may not be range folded at another PRF. Range folding reduction of 50% to 70% is expected. Second, where there are redundant velocity measurements, MPDA produces robustly dealiased velocity data. Overall accuracy is comparable to velocity dealiasing using a high PRF number. Spectrum width data are range unfolded at the same time as the velocity data.

### 8.20.1 MPDA Data Input/Output

Raw surveillance mode reflectivity data as they are acquired from the input buffer are immediately sent to the output buffer as RPG base data. A copy of the data are saved for range unfolding the 2nd and 3rd velocity scans later. Doppler velocity data, spectrum width data, and batch mode reflectivity data are not sent to the output buffer and not available for other algorithms to use until all required sweeps have been received and the MPDA has completed processing. Once processing is completed, the RPG base data are sent out in a burst. Above 4.3 degrees elevation, dealiasing reverts to the VDA. Raw base data are received, velocity data dealiased, and all moments sent to the output buffer as RPG base data on a radial basis.

### 8.20.2 MPDA Processing Steps

After azimuthally aligning data from the multiple velocity sweeps, the MPDA attempts to dealias velocities in all locations with three velocity estimates. The three original velocities or velocities adjusted by the Nyquist co-interval must not differ by more than an threshold value. The MPDA next attempts to dealias locations with only two velocity estimates or locations with three velocity estimates that could not be previously dealiased. Next it attempts to find a solution using individual velocity estimates. Finally, it fills in remaining locations with an un-dealiased velocity estimate that most closely matches its neighbors. At all processing steps, a candidate velocity solution must be within threshold difference of a "seed" velocity. The seed values may come from a previously accepted solution, nearby averages, or the Environmental Wind Table. After each key processing step, data quality modules correct for outliers, large velocity differences along a radial and runs of large azimuthal velocity differences.

### 8.20.3 MPDA NOTES

Auto PRF - Toggling the Auto PRF function on while MPDA is running is allowed. However, the Auto PRF function will not download VCP 121 to the RDA with a new PRF. The MPDA requires its own predefined PRFs to run correctly.

GUI PRF Selection Tool - The GUI PRF Selection Tool remains functional while in VCP 121 to help the user to decide if running in VCP 121 (MPDA) or using sectorized PRFs is more advantageous.

Algorithm Performance - Because of the time required to acquire two extra velocity scans (about 25 seconds at the lower elevation angles), it is postulated that algorithms that build three-dimensional features by vertically associating two-dimensional features may not work as expected. Tornadic signatures close to the radar may be lost due to weakened velocity gradients and feature translation. Fast-moving weather events would increase the likelihood of a failure. These problems have not been observed in the limited data sets on which the MPDA was developed and tested.

### 8.20.4 Range Unfold Power Difference

This parameter has the same function as TOVER at the RDA. It is the mimimum power difference in dB between echoes at different trips required to determine at which trip to place radar echo returns. The MPDA uses this parameter when range unfolding the second and third velocity scans. Its default value is +5 dB which is the same value that TOVER has. The source scientist for the MPDA originally set this value at +10 dB but during validation testing Applications Branch staff determined lowering the value to +5 dB did not add noise or errors to the MPDA output velocity and did increase the volume of range-unfolded velocities. Set the value higher if there appears to be noise around the echo perimeters. Setting the value below TOVER is not recommended. The parameter may be set anywhere between 0 and +20 dB.

### 8.20.5 Fix Trip Minimum Bin/Fix Trip Maximum Bin

These two parameters jointly define an annulus around the end of the first trip for each MPDA velocity scan where data are arbitrarily removed. The default values are 0 for the Fix Trip Minimum Bin and -1 for Fix Trip Maximum Bin which assures that no data are removed. Historically, some WSR-88Ds contained rings of noisy velocity data at the end of the first trip, especially with batch cuts. If rings of bad velocity data are observed around the end of first trip mark, the user may set the Fix Trip Minimum as low as -4 and the Fix Trip Maximum Bin +12. During validation testing, no such rings were observed.

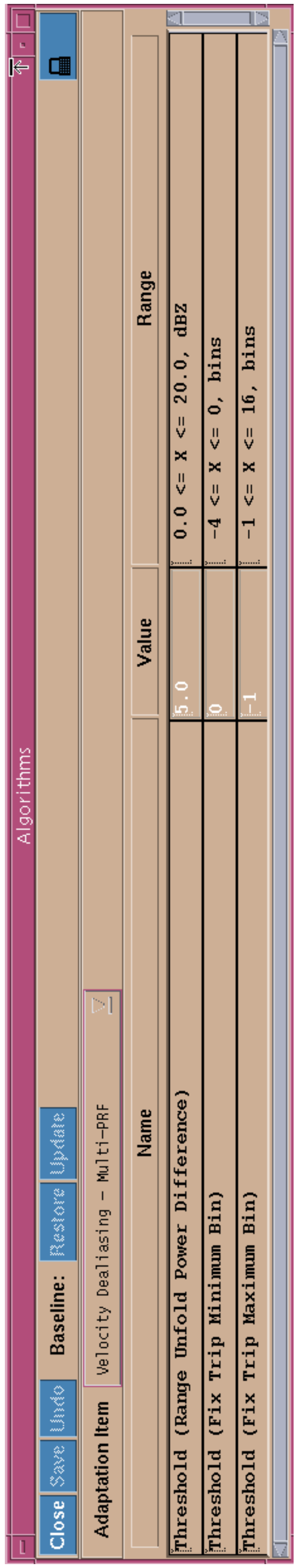



Figure 8-22. Algorithms - Velocity Dealiasing - Multi-PRF

## 8.21 Velocity Dealiasing - Short Pulse

These parameters are used when operating in VCPs 11, 21, and 32. See Figure 8-23.

### 8.21.1 Supplemental Information - Velocity Dealiasing

For additional information refer to the following paper:

Efficient Dealiasing of Doppler Velocities Using Local Environmental Constraints, Eilts and Smith, 1990.

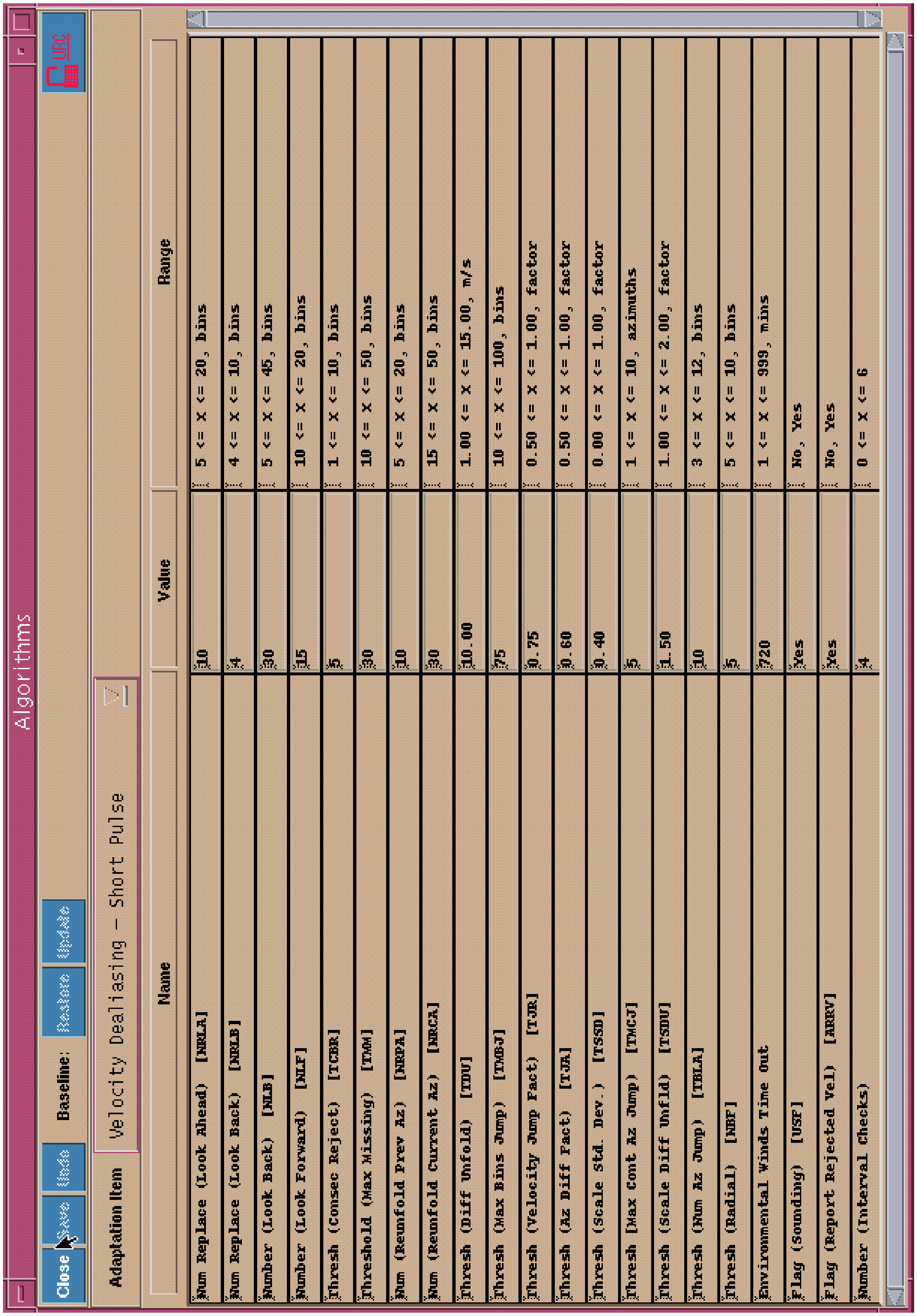



Figure 8-23. Algorithms - Velocity Dealiasing - Short Pulse

## 8.22 VIL/Echo Tops

This window allows the Vertically Integrated Liquid (VIL) and Echo Tops parameters to be modified. See Figure 8-24.

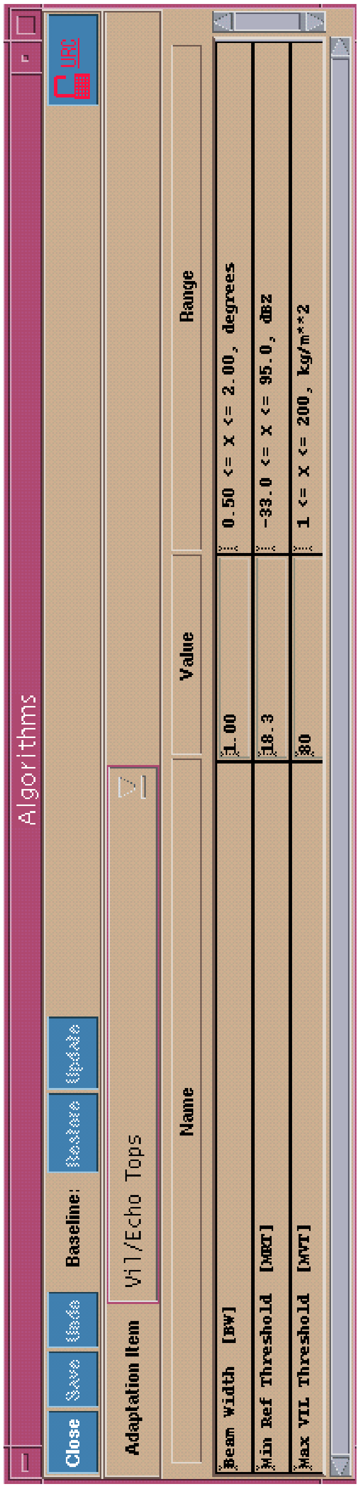



Figure 8-24. Algorithms - VIL/Echo Tops

# Chapter 9

# Product Distribution Comms Status & RDA/RPG Interface

## 9.1 Narrowband Communications

Narrowband communications control is exercised through the parameter settings defined in this chapter. Every site has different narrowband communications requirements; therefore, many of the specific parameter settings contained in this chapter will NOT be the same as the settings at any particular site.

Each site is required to maintain a Communications Documentation Notebook to provide a ready reference to facilitate communications problem identification and resolution. The information required for this notebook is provided by the WSR-88D Hotline and should be closely monitored by the local focal point.

**NOTE**

This chapter is provided for reference only, **DO NOT MODIFY YOUR NARROWBAND COMMUNICATIONS PARAMETERS** TO REFLECT THE ENTRIES PRESENTED HERE.

## 9.2 Product Distribution Comms Status

Upon initial setup and whenever communications ports are expanded, the narrowband configuration will require modification using this window. Additionally, communications security requirements may necessitate password changes for dial-in ports. The ROC will authorize site personnel to modify the narrowband configuration when these modifications are required. This window also identifies associated users with a dedicated line number and allows password and product availability control for individual dial-in ports. This window also defines timeout and retry time for the narrowband communications interfaces. See Figure 9-1 and Figure 9-2. This window is password protected at the ROC and Agency LOCA.

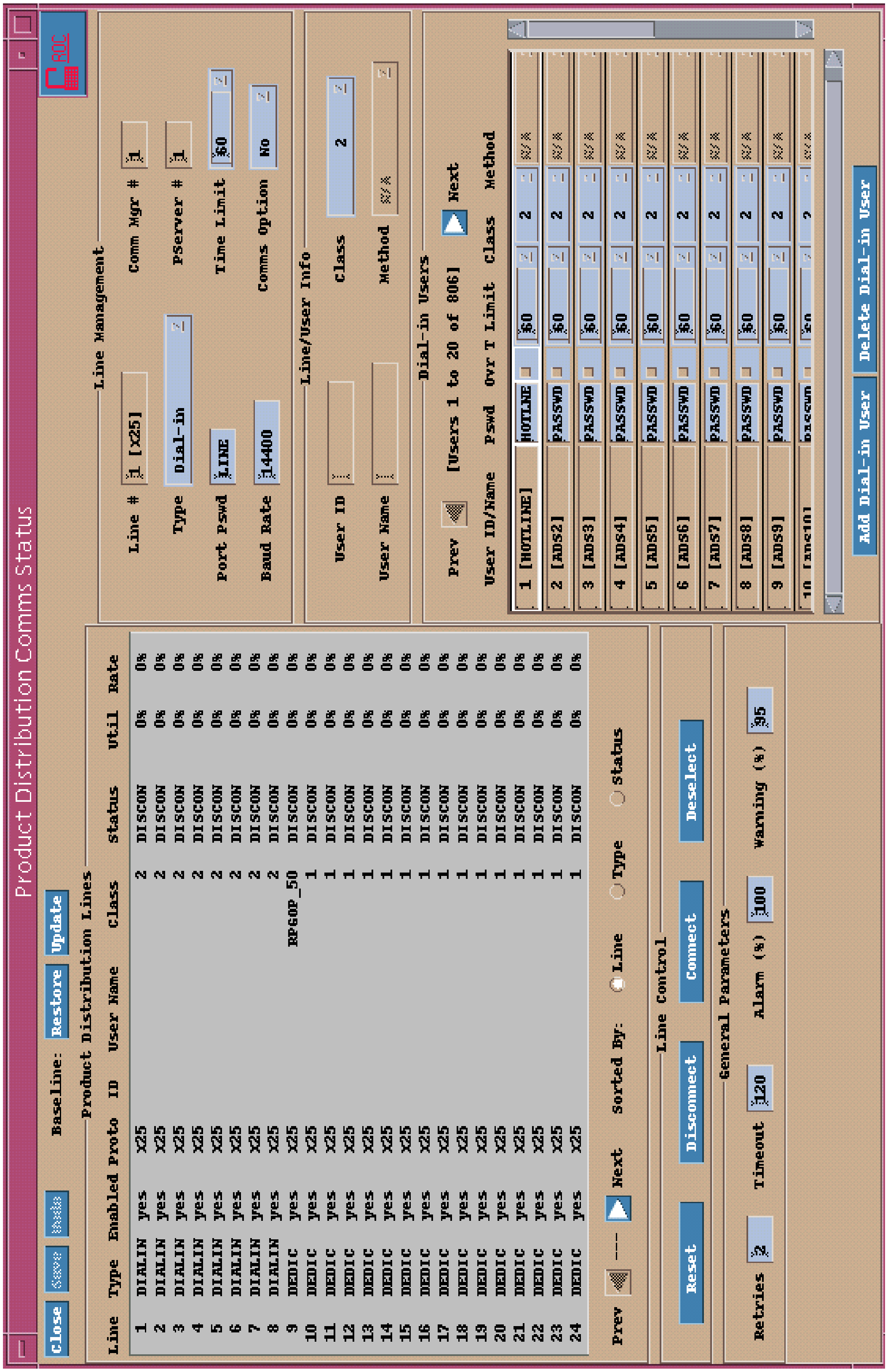



Figure 9-1. Product Distribution Comms Status (Lines 1-24)

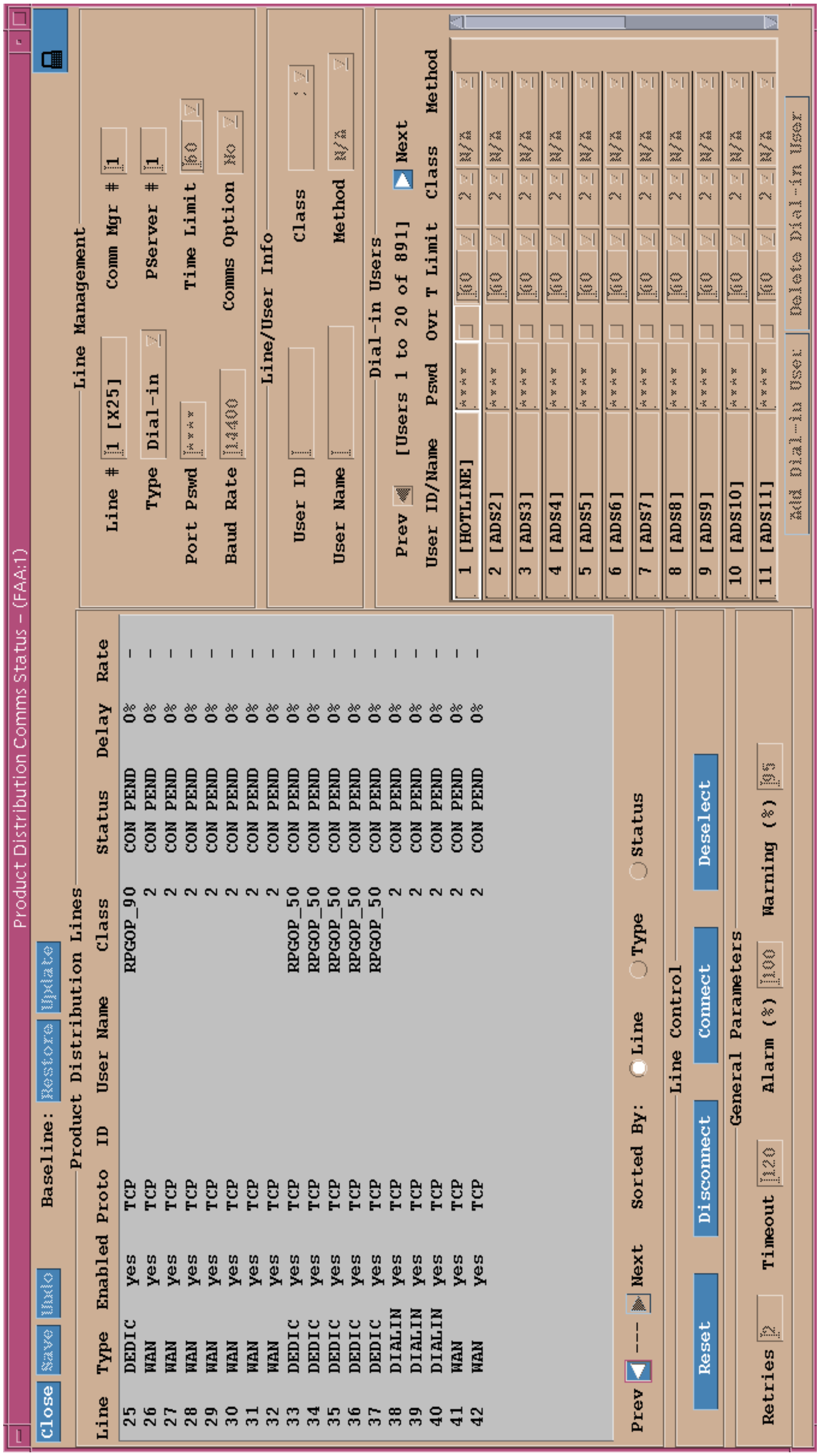



Figure 9-2. Product Distribution Comms Status (Lines 25-42)

### 9.2.1 Dial-In Users

In the lower right hand corner of the Product Distribution Comms Status window is the Dial-in Users section. This section is used to specify those dial-in users authorized access to the RPG and to assign site-specific dial-in user passwords. Changes to this section, including instructions to make the modifications, are provided by the WSR-88D Hotline. Dial-in users can be deleted from this section and there is also an additional window which can be selected for adding dial-in users. See Figure 9-3. This window is only available through the ROC and Agency LOCA authority.

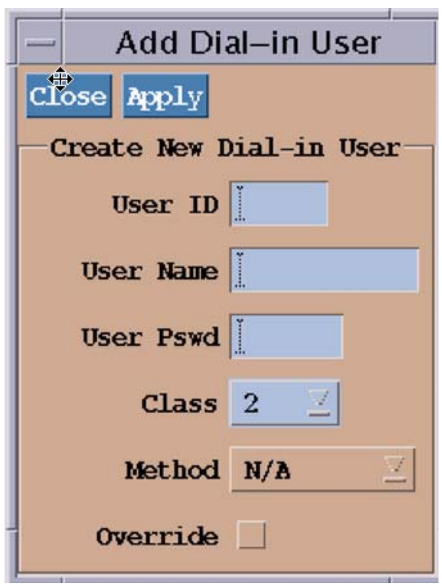



Figure 9-3. Add Dial-In User

## 9.3 RDA/RPG Interface Control/Status

This window is accessed by clicking on the wideband connection on the RPG Control/Status window. It defines the timeout and retry times for the wideband as well as connect and disconnect control and status. See Figure 9-4.

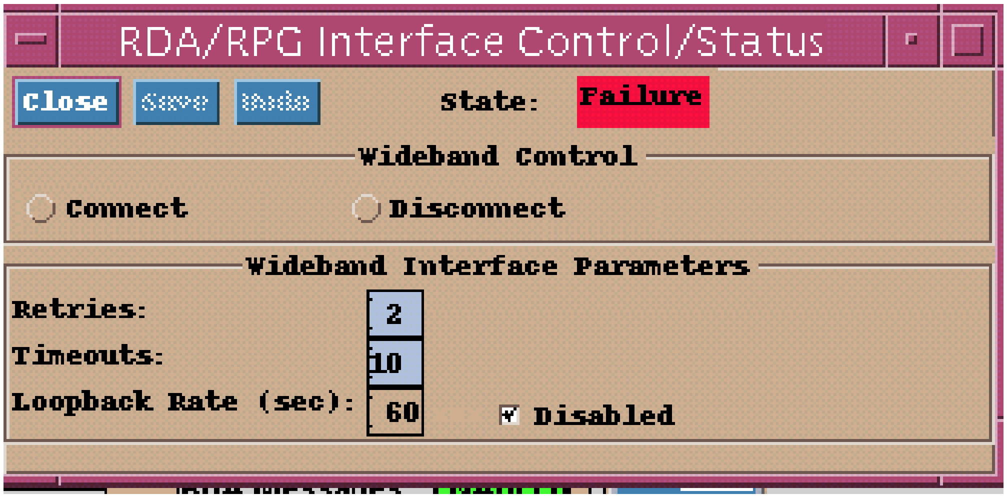



Figure 9-4. RDA/RPG Interface Control/Status

# Chapter 10

# USERS Products - RPG Product Distribution Control

## 10.1 Class 2 Users

Open the RPG Product Distribution Control window by clicking on the Products button in the USERS box. The default window appears as the RPG Product Distribution Control Class 2 Users. See Figures 10-1 through 10-5.

The window has a padlock with only a ROC LOCA permissions. However, the only locked area/control is the Baseline: Update button. Each site can edit any of the distribution fields at any time for either the Precipitation Mode (A) or Clear Air Mode (B) as the check boxes are sensitized with a light blue background.

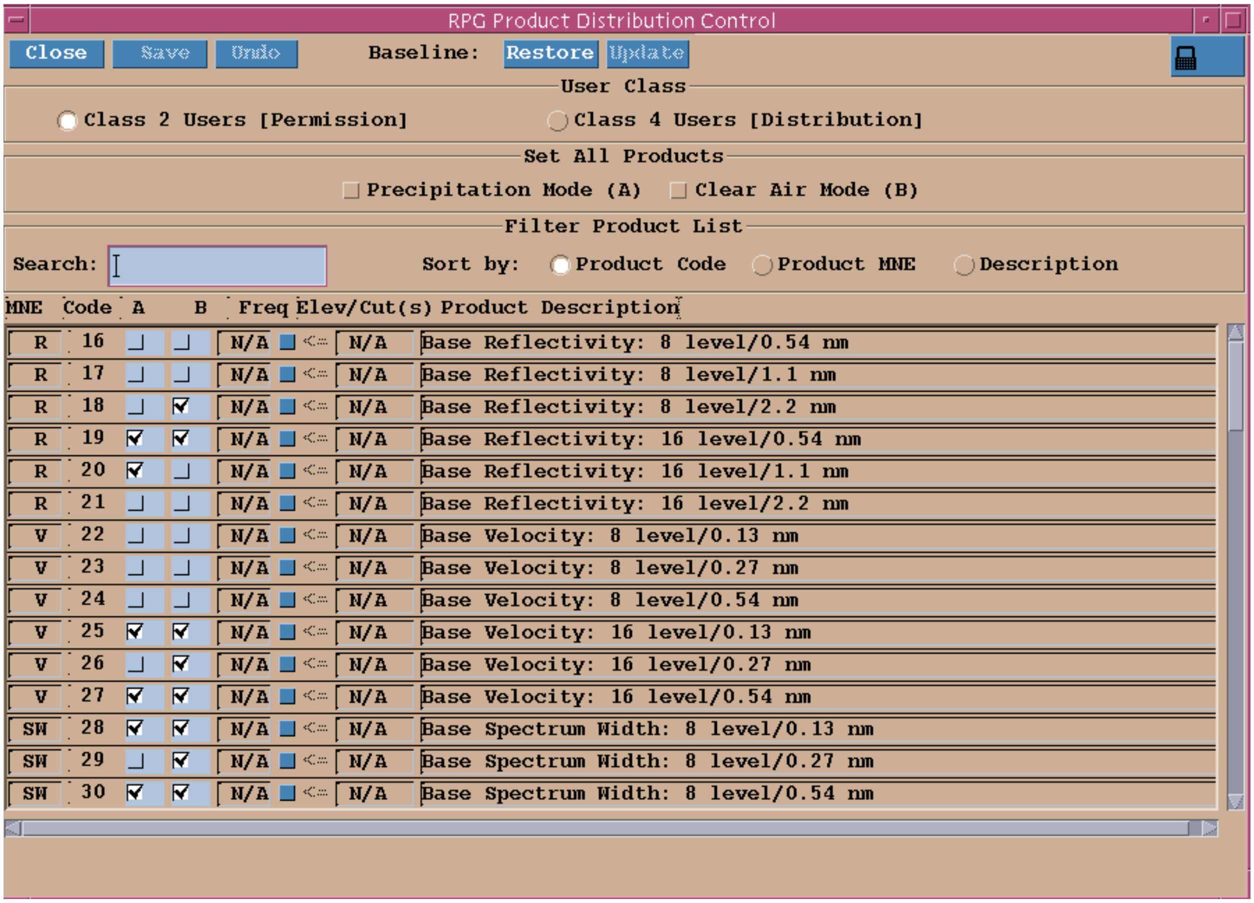



Figure 10-1. RPG Product Distribution Control - Class 2 Users (Products 16-30)

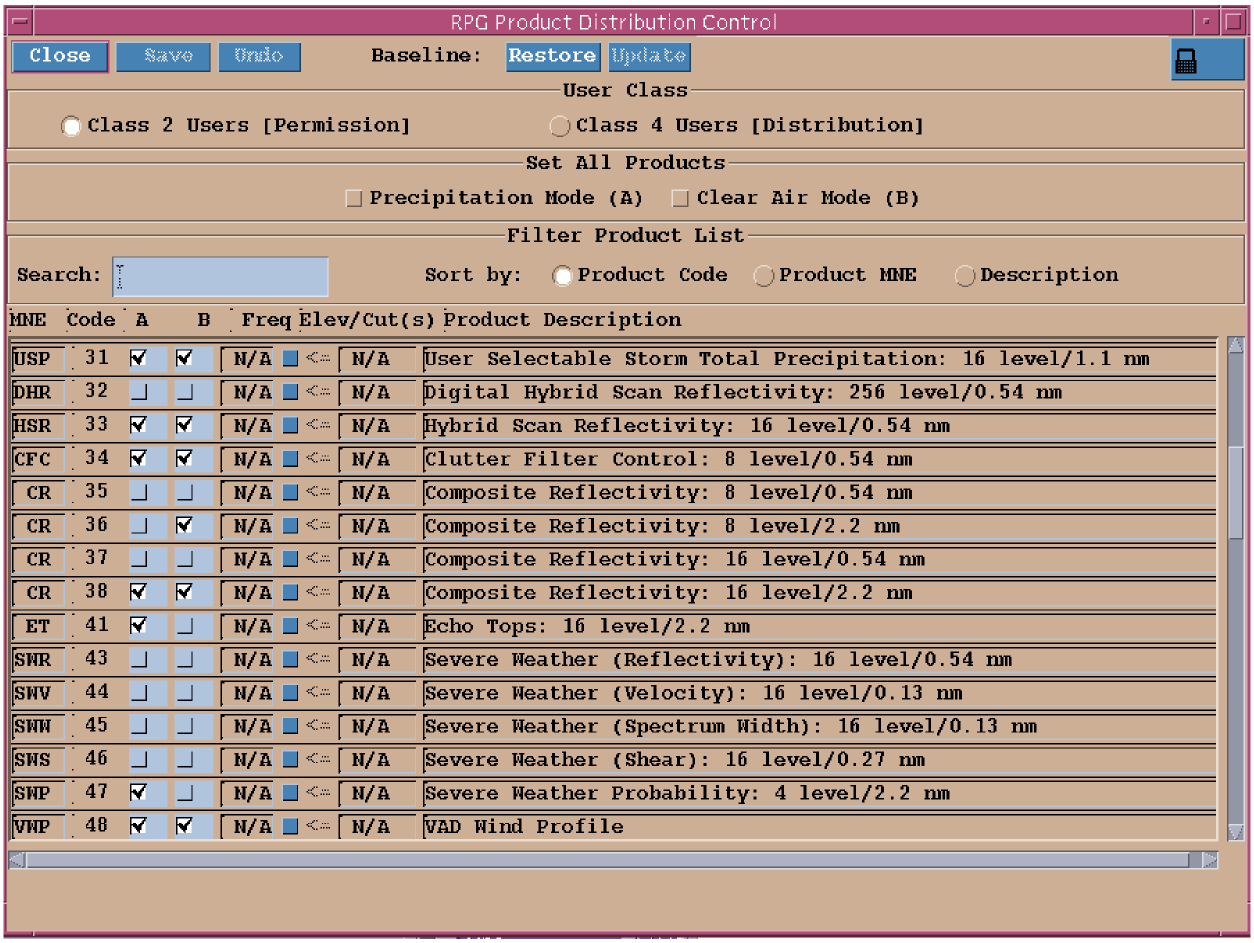



Figure 10-2. RPG Product Distribution Control - Class 2 Users (Products 31-48)

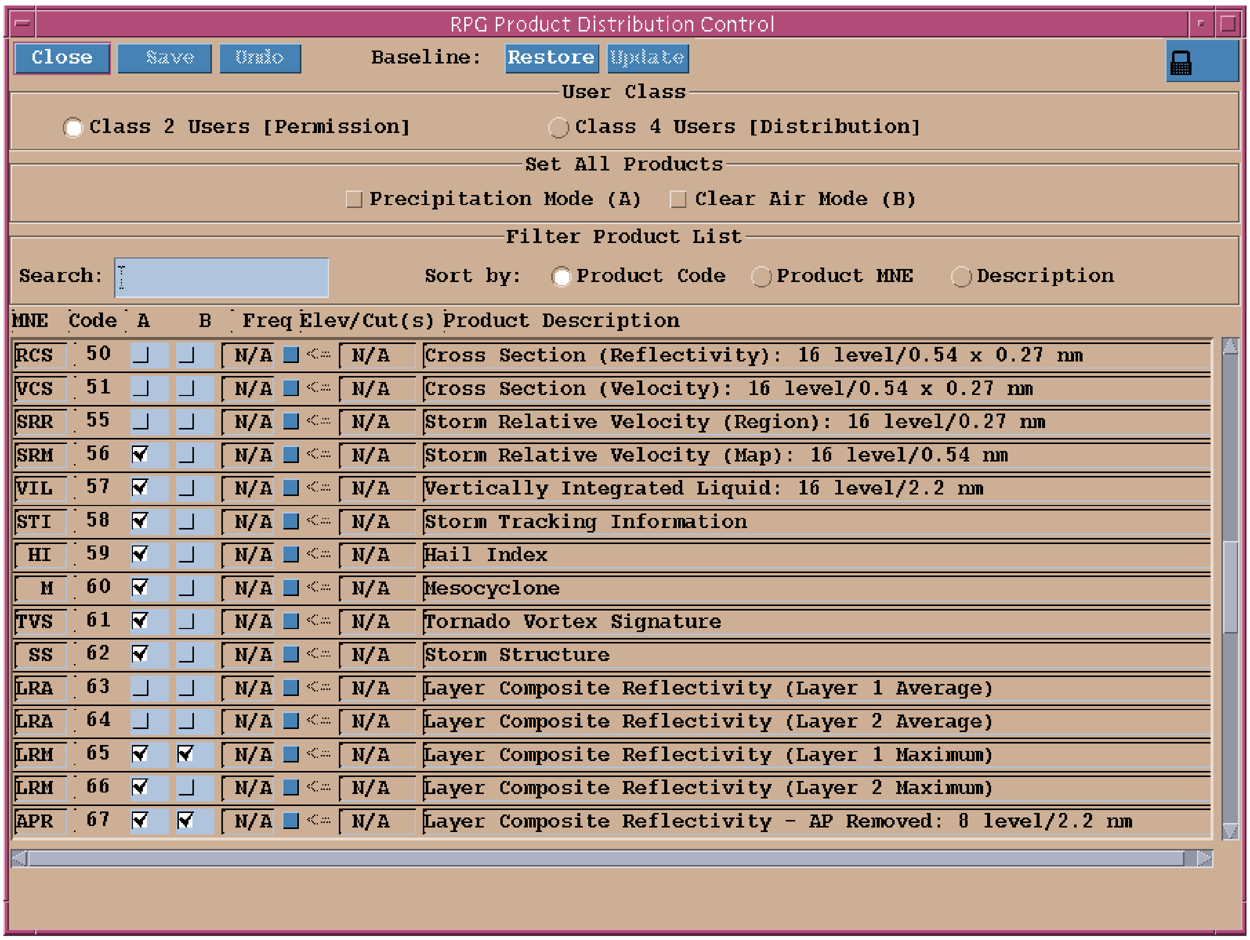



Figure 10-3. RPG Product Distribution Control - Class 2 Users (Products 50-67)

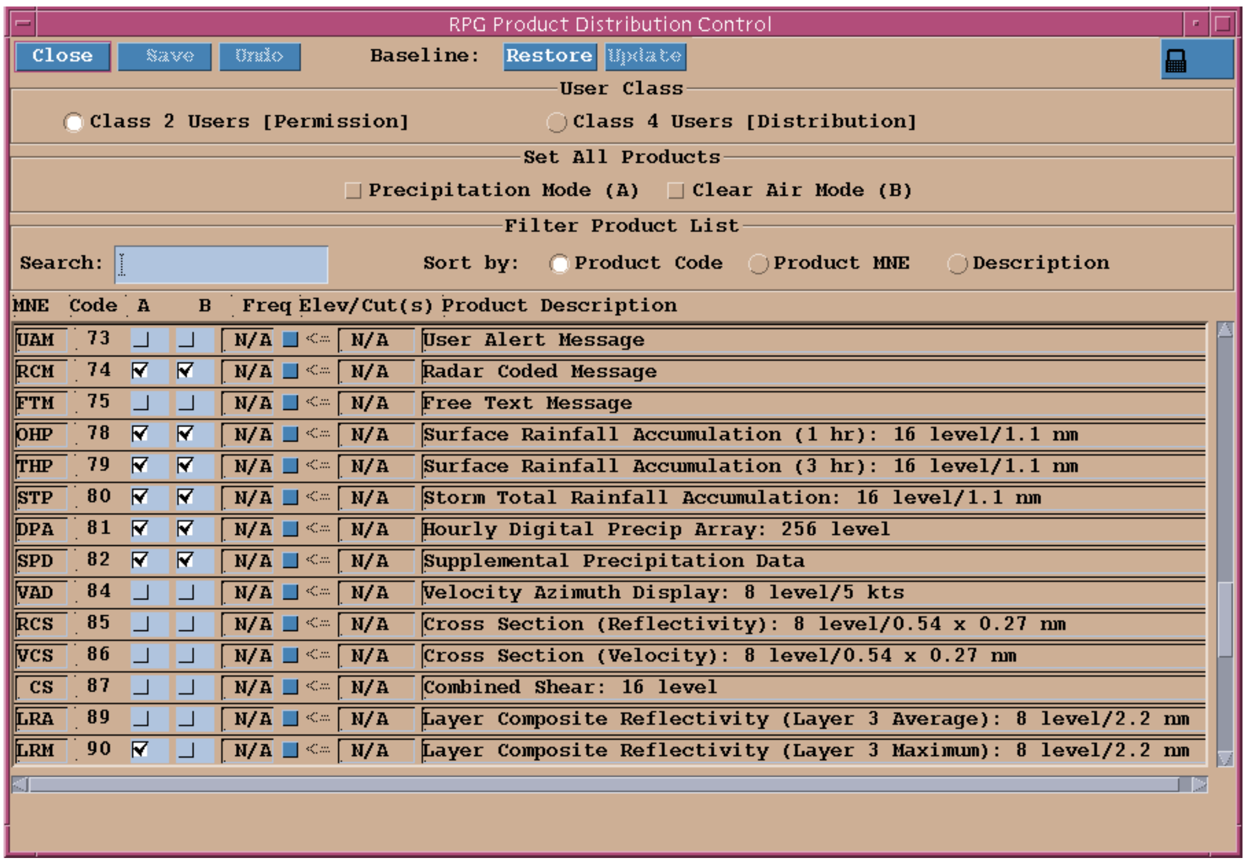



Figure 10-4. RPG Product Distribution Control - Class 2 Users (Products 73-90)

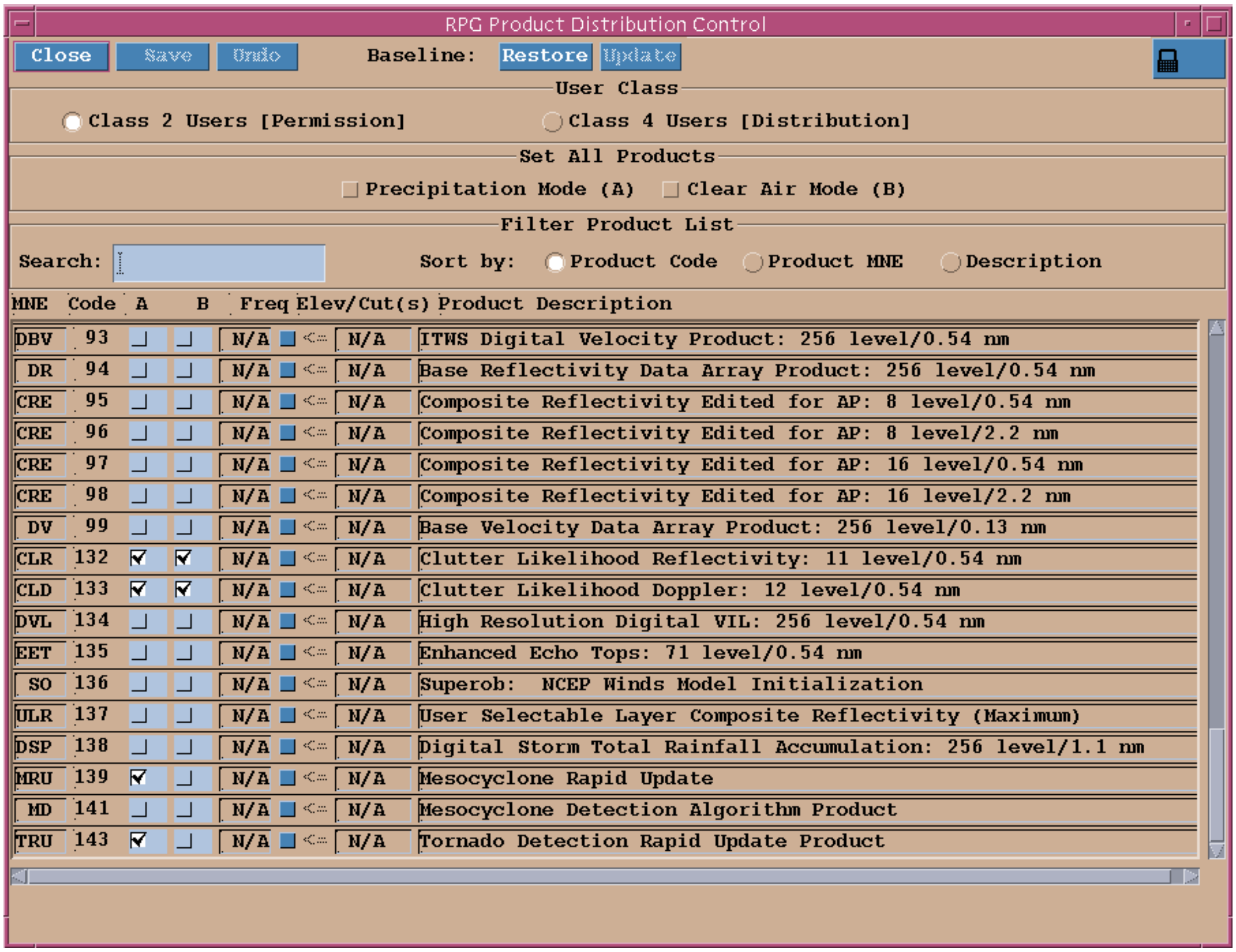



Figure 10-5. RPG Product Distribution Control - Class 2 Users (Products 93-143)

## 10.2 Class 4 Users

The user can switch to the Class 4 Users listing and modify the distribution options in a similar fashion. The padlock window is only for the ROC LOCA, and controls only the Baseline: update button. See Figures 10-6 through 10-10.

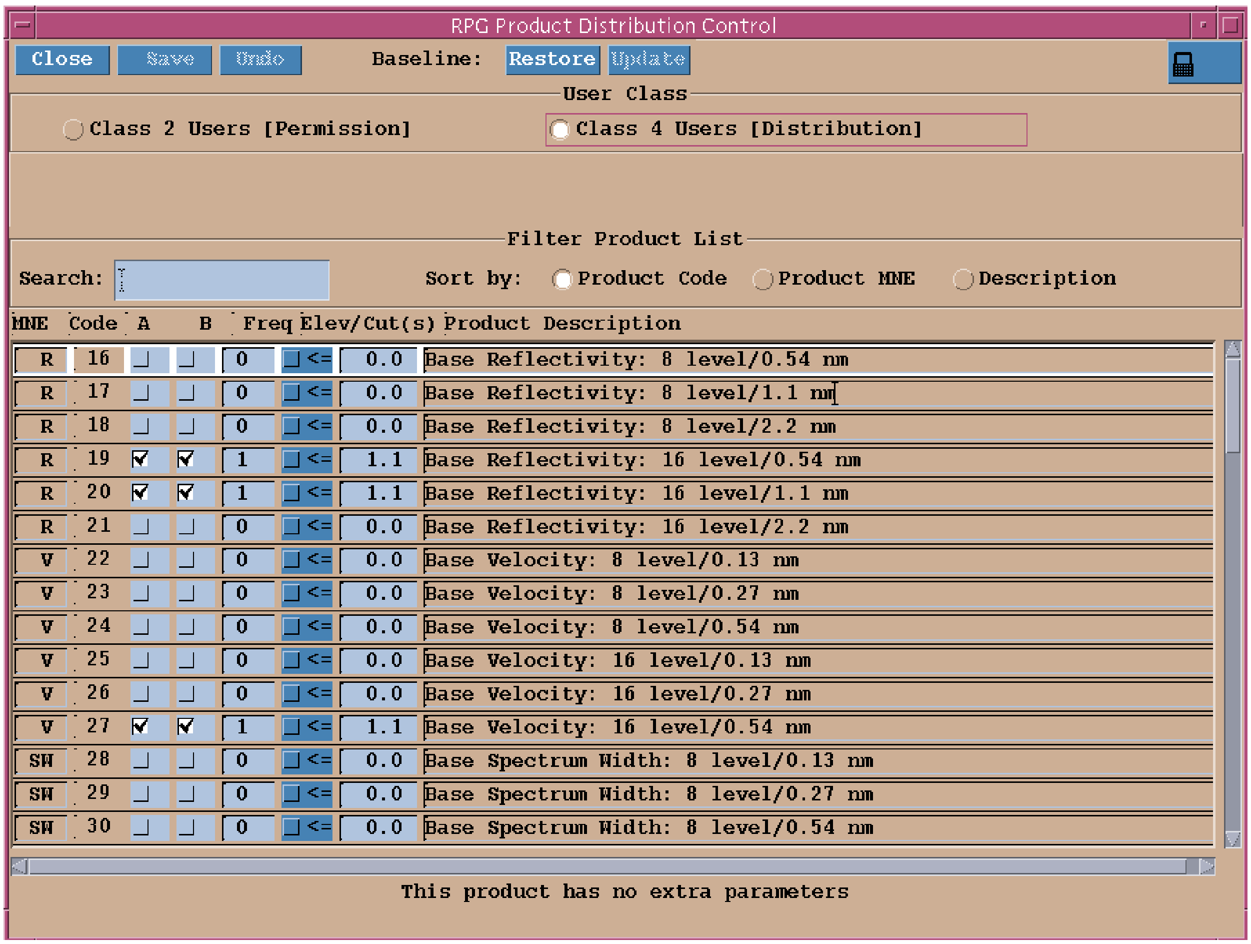



Figure 10-6. RPG Product Distribution Control - Class 4 Users (Products 16-30)

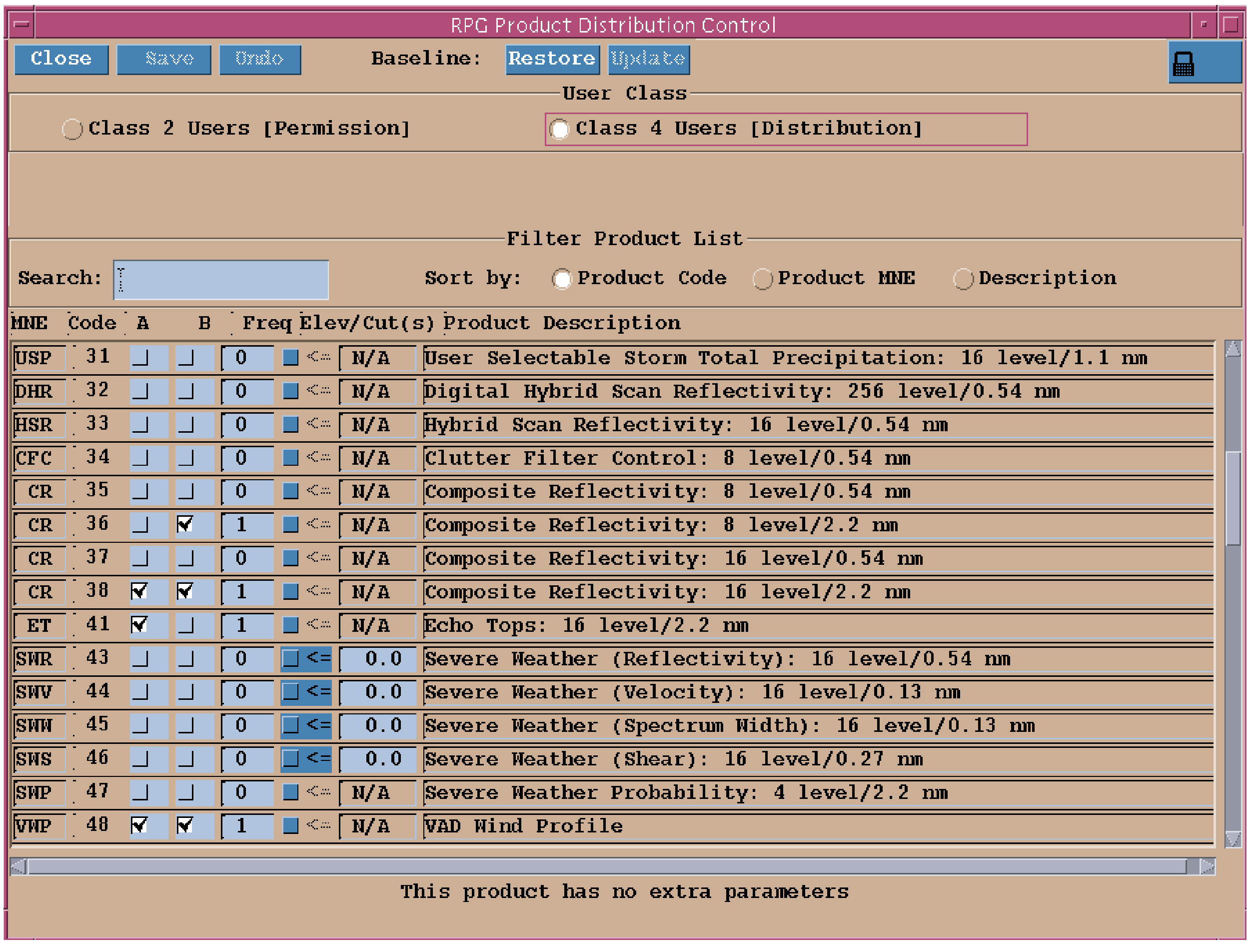



Figure 10-7. RPG Product Distribution Control - Class 4 Users (Products 31-48)

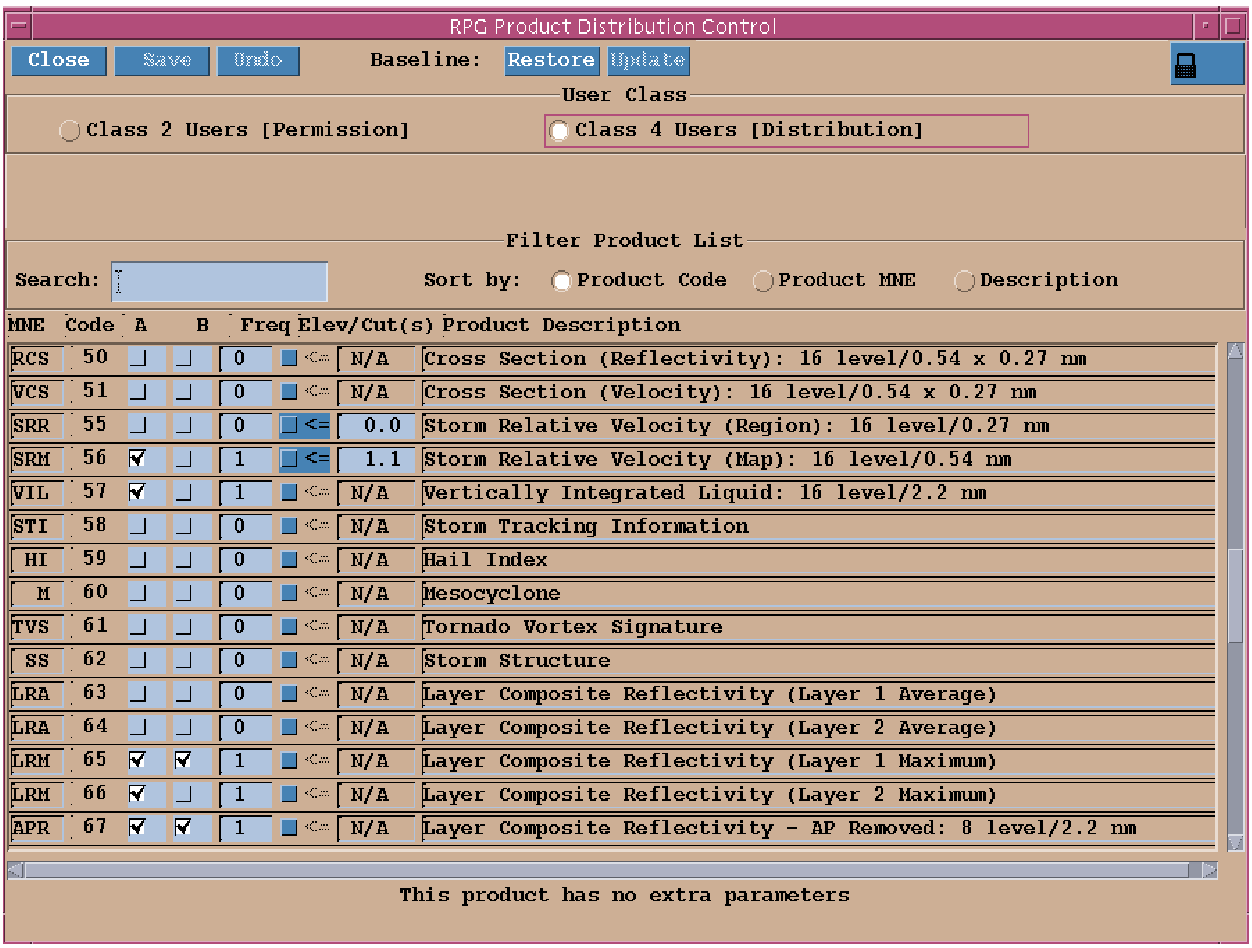



Figure 10-8. RPG Product Distribution Control - Class 4 Users (Products 50-67)

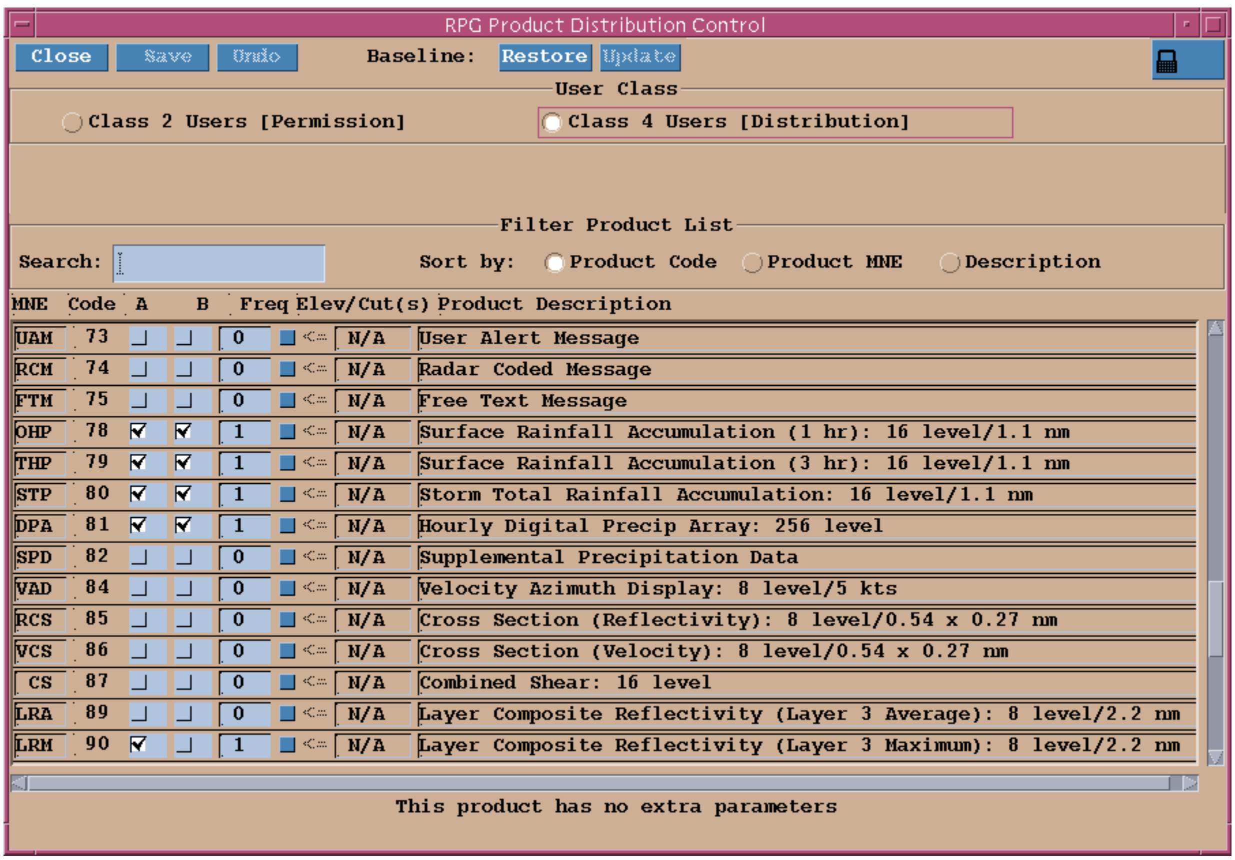



Figure 10-9. RPG Product Distribution Control - Class 4 Users (Products 73-90)

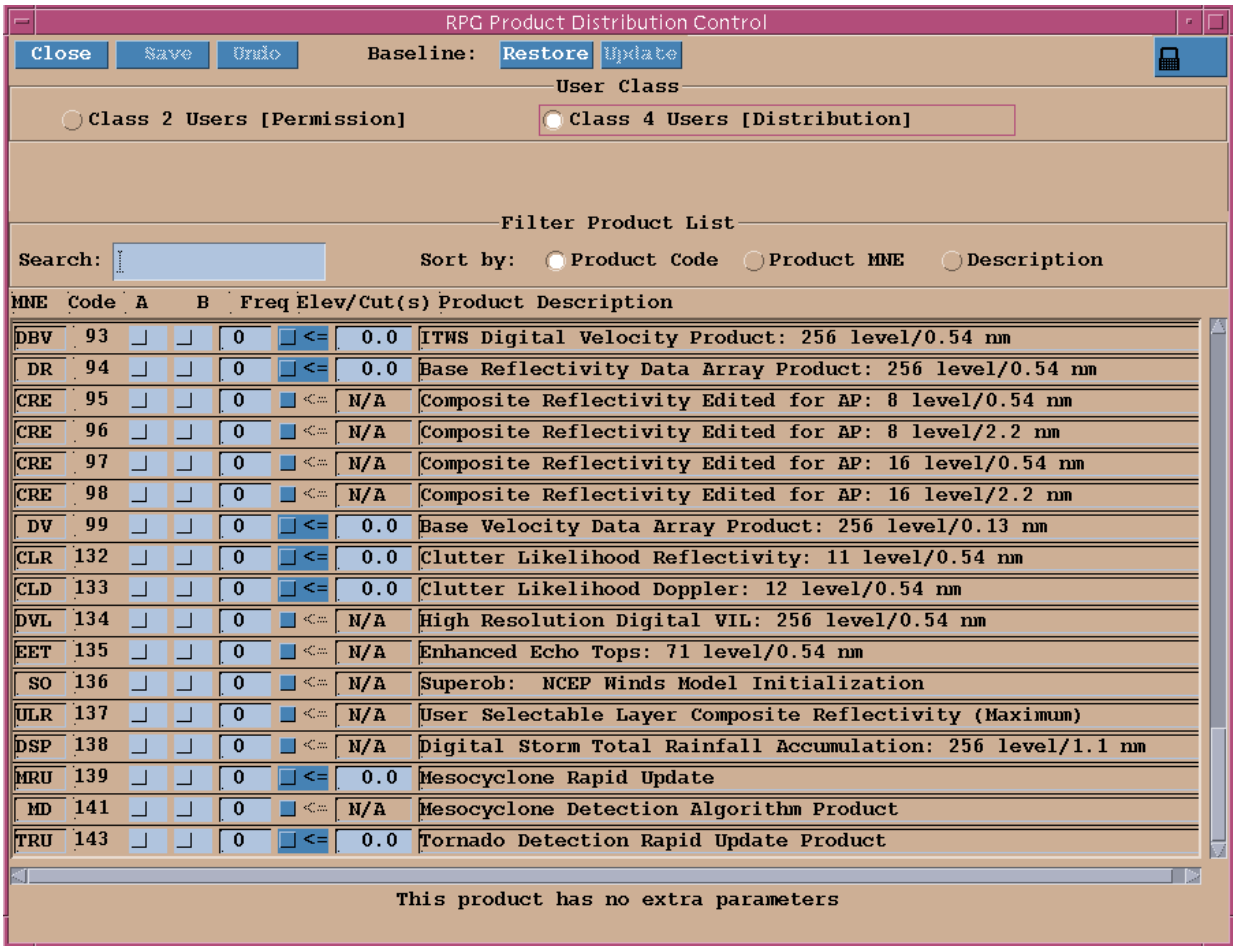



Figure 10-10. RPG Product Distribution Control - Class 4 Users (Products 93-143)

# Chapter 11

# Precipitation Categories

## 11.1 Precipitation Status

The Precipitation Detection Function (PDF) is designed to automatically determine if precipitation is occurring within 124 nm of the radar. See Figure 11-1. The PDF examines reflectivity returns from the four lowest elevation angles, and compares them to the Precipitation Rate Threshold and an Area Threshold, which is the sum of the Precipitation Area Threshold and the Nominal Clutter Area Threshold. One of the following three Precipitation Categories is assigned each volume scan depending on which combination of thresholds are met or exceeded:

- Category 0 - No precipitation detected.
- Category 1 - Significant precipitation detected.
- Category 2 - Light precipitation detected.

When Precipitation Category 1 has not been detected during the past hour, any VCP can be selected. When the assigned Precipitation Category is 1, the radar can only be operated in a Precipitation Mode (VCP 11, 12, 21, or 121).

When the assigned Precipitation Category is 1 or 2, the PPS computes rainfall accumulations and rain gage data is requested from the Gage Data Support System (GDSS). When the assigned Precipitation Category is 0, "null" (zero-valued) rainfall products are generated and no gage data is requested from the GDSS.

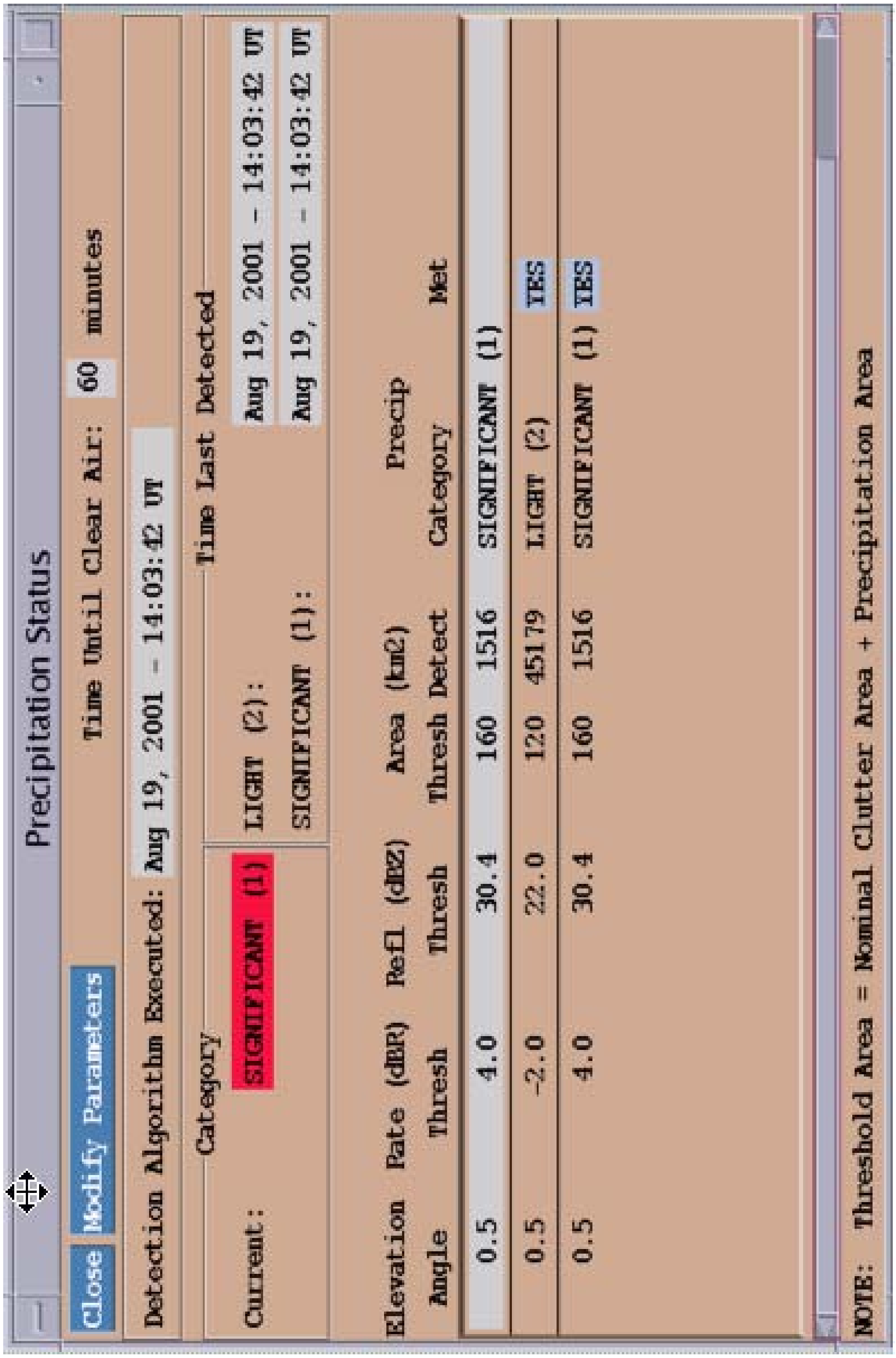



Figure 11-1. Precipitation Status

## 11.2 Modify Precipitation Detection Parameters

Click on the Modify Parameters button of the Precipitation Status window and the Modify Precipitation Detection Parameters window appears. See Figure 11-2. This window is password protected, but does allow the URC LOCA.

Each line of the Modify Precipitation Detection Parameters window is defined by a Tilt Domain (elevation angle range), a Precipitation Rate Threshold, the Nominal Clutter Area and Precipitation Area Thresholds, and the resulting Precipitation Category.

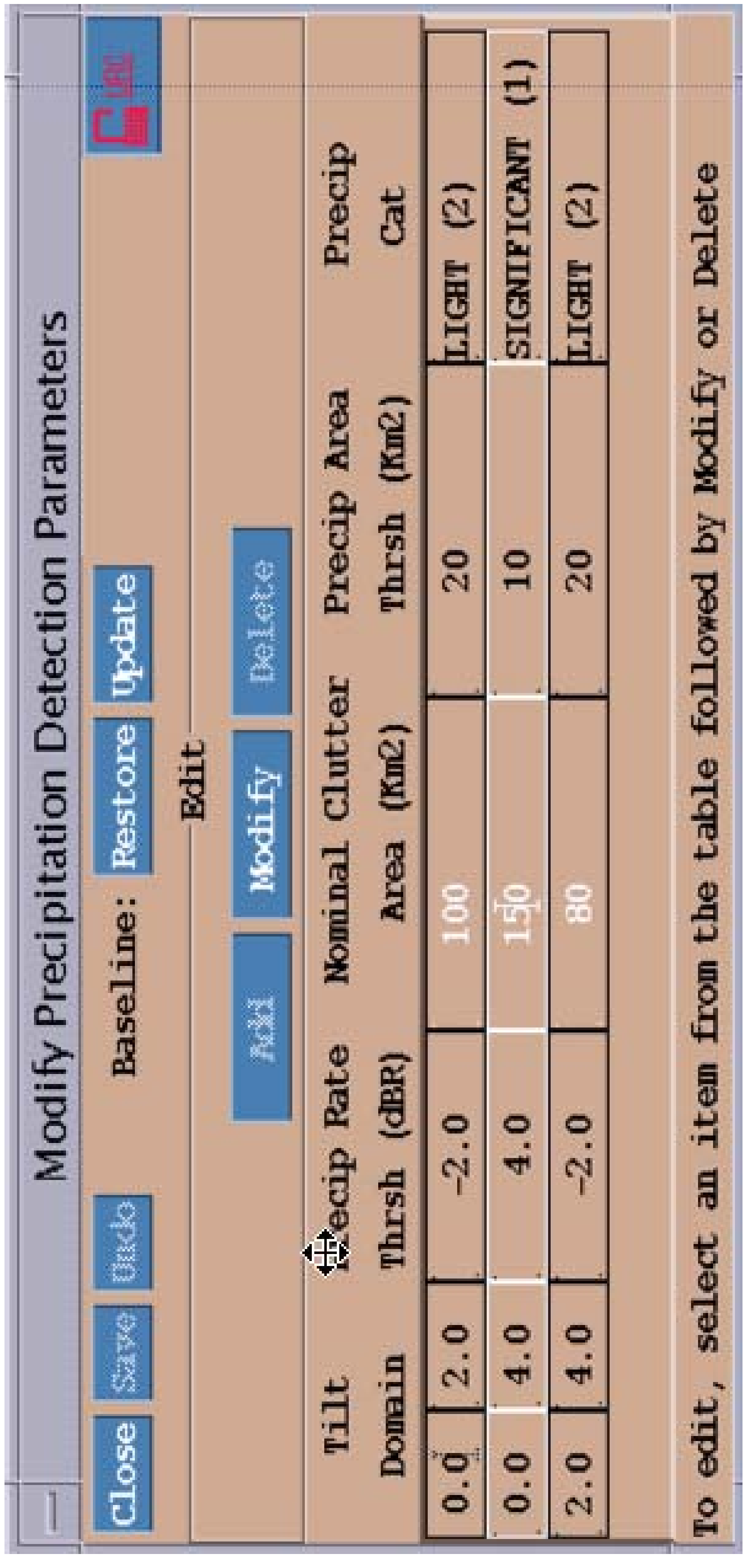



Figure 11-2.  Modify Precipitation Detection Parameters

## 11.3 Modify Precipitation Table Item

Click on the Modify button in the Edit section of the Modify Precipitation Detection Parameters window and the Modify Precipitation Table Item window appears for the line selected. See Figure 11-3.

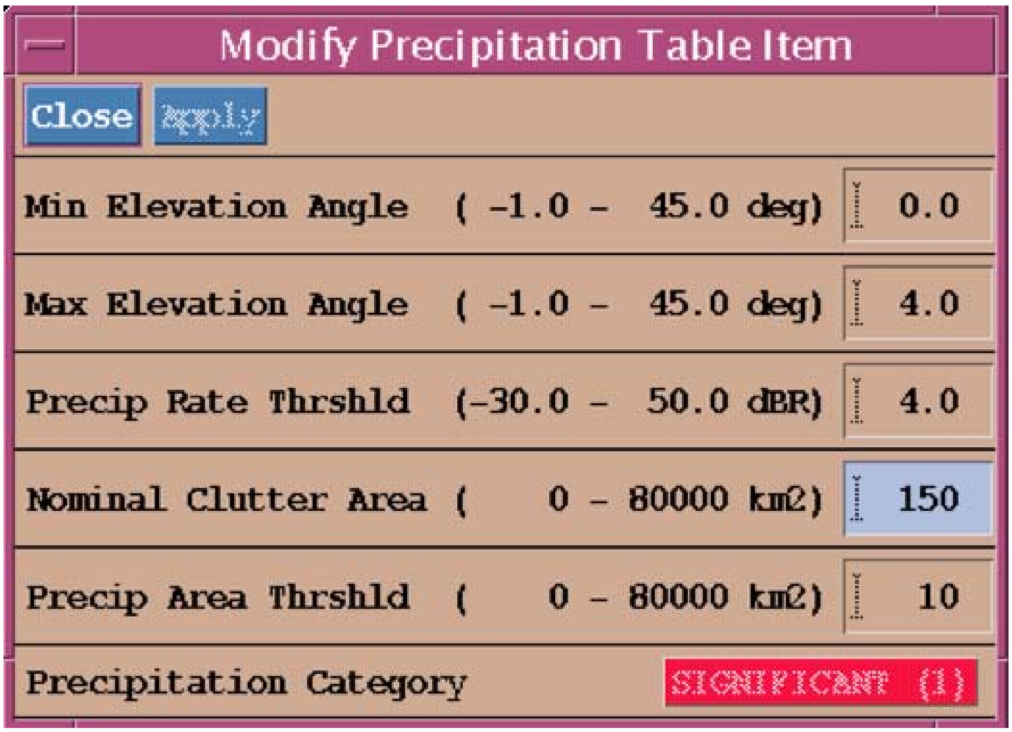



Figure 11-3. Modify Precipitation Table Item

The Nominal Clutter Area (NCA) is the only adaptable parameter on the Precipitation Detection window that may be changed under URC level of change authority. All others are under ROC level of change authority. The NCA allows the operator a way to account for residual clutter. By setting the NCA for both categories 1 and 2 equal to or slightly larger than the area of residual clutter, which is typically observed on days with no rainfall-producing echoes or anomalous propagation, it will prevent the radar from going into Precipitation Mode due to the presence of non-meteorological echoes. The NCA should be regularly monitored and set so that Precipitation Categories 1 and 2 are assigned by the PDF when real precipitation is occurring anywhere within range of the radar. In order to correctly set the NCA, the detected area of reflectivity returns can be checked on the Precipitation Status window.

The NCA value only affects the minimum areal threshold for assigning Precipitation Categories. If not correctly set, the NCA may allow for the accumulation of non-precipitation returns, but has no impact on the quality of other radar data. Thus, every effort should be made to filter normal and abnormal ground clutter at the RDA.

The PDF computes the areal coverage of return from all the reflectivities above the Rate Threshold values. The PDF does not discern between a ground return and a real precipitation target. In events where the PDF assigns a precipitation category incorrectly due to ground returns, the operator should first attempt to reduce the ground returns using clutter suppression, and then account for any residual clutter with the NCA Threshold. The NCA is only a threshold value, and has no effect on the base data.

The NCA should not generally be used to prevent the radar from switching into Precipitation Mode A due to the presence of anomalous propagation echoes. To prevent the radar from switching into Mode A when transient anomalous propagation echoes are the only echoes present, it is recommended to judiciously use operator-defined clutter suppression regions during the time when the anomalous propagation conditions are occurring. This will improve the quality of the base data products and consequently the derived products as well. Increasing the NCA in anomalous propagation situations will not improve the quality of the base data since the anomalous propagation echoes will still remain in the products.

It is especially important to note that if operator-defined clutter suppression regions cannot properly remove all of the anomalous propagation contamination and therefore the decision is made to increase the NCA to prevent the radar from switching into Precipitation Mode A, then you should only increase the value of NCA for Precipitation Category 1. It is Precipitation Category 1 in the Precipitation Detection Function which controls what mode the radar operates in. If and when the NCA is increased to prevent the radar from switching into Precipitation Mode A because of the existence of anomalous propagation, the NCA must be promptly returned to the proper smaller value characteristic of residual clutter to permit the radar to operate properly and switch into Precipitation Mode when real rainfall begins.

The operator should never increase the values of NCA for the "light precipitation" Category 2 since Precipitation Category 2 controls if and when the precipitation algorithms run. The values of NCA for Category 2 should always remain at values which are slightly larger than the area of residual clutter on days with no rain- producing echoes.

In the event of anomalous propagation with NCA for Category 2 set to proper low values, the precipitation algorithms will execute as expected and automatically remove the negative effects of anomalous propagation on the precipitation estimates through quality control logic internal to the algorithms. The danger with indiscriminately increasing the NCA for Precipitation Category 2 is that the precipitation algorithms may not execute when in fact it is raining. This may occur, for example, when a rain event is developing and the radar operator forgets that the Category 2 values had been increased. This will result in the unrecoverable loss of rainfall accumulation for that period. Note that this would be a more serious effect than had that person used operator-defined clutter suppression regions to remove anomalous propagation and forgotten to delete them after the AP conditions abated since only those areas with zero radial velocity would be improperly underestimated. It is important that the rainfall algorithms execute even when the lightest rain is occurring in order to preserve water volume data for the hydrologic models.

## 11.4 Supplemental Information - Mode B and Very Light Precipitation

At times, precipitation accumulations may be desired while the radar is operating in a Clear Air Mode VCP. This is appropriate for very light rain or snow events. In this case, it is permissible under URC guidelines to raise the NCA threshold value for Category 1 precipitation, but leave it set relatively low for Category 2 precipitation. If this is done, the Precipitation Rate and Area thresholds will be exceeded for Category 2, but will not be exceeded for Category 1. Any VCP can be invoked and precipitation products will accumulate rainfall estimates.

The Precipitation Status window provides the results from the Precipitation Detection Function for each volume scan. Types of data include the currently assigned precipitation category and the time left until the operator may select a Clear Air Mode VCP. Additionally, the detected area of reflectivity returns above the precipitation rate threshold can be used to correctly adjust the NCA.

# Chapter 12
# Clutter Regions

## 12.1 Clutter Suppression Control

Clutter suppression is used to remove the power returned by clutter targets from a range bin ***prior*** to the calculation of the base data.

Ground clutter and Anomalous Propagation (AP) contamination have a significant effect on the accuracy of the base data. The clutter induced bias in the base data not only brings into question the reliability of the data presented on the base products but also has a detrimental effect on ***all*** downstream algorithms.

Clutter suppression filters are designed to reduce the power of those signals that have a mean radial velocity at or near zero. To do this, clutter suppression filters reduce signal power for targets within a notch width centered about the zero mean radial velocity value. This reduction in signal power effectively decreases the clutter's power contribution in the given range bin. To maintain meteorological return integrity, only the signal power whose radial motion falls within the notch width is reduced. Therefore, with appropriate clutter suppression invoked, the bias in the base data (R, V, and SW) estimates due to clutter contamination within the range bin can be minimized.

The clutter suppression regions defined as Region 1 for both Low and High Segments ensure the normal ground clutter pattern, as defined by the Bypass Map, is addressed. Click on the Clutter Regions Applications icon to bring up the Clutter Regions window (Figure 12-1). This region should always be included in each clutter suppression region file definition. Additional regions (operator select code All Bins forcing clutter suppression) should be defined as subsequent regions as needed to address transient clutter (e. g., AP).

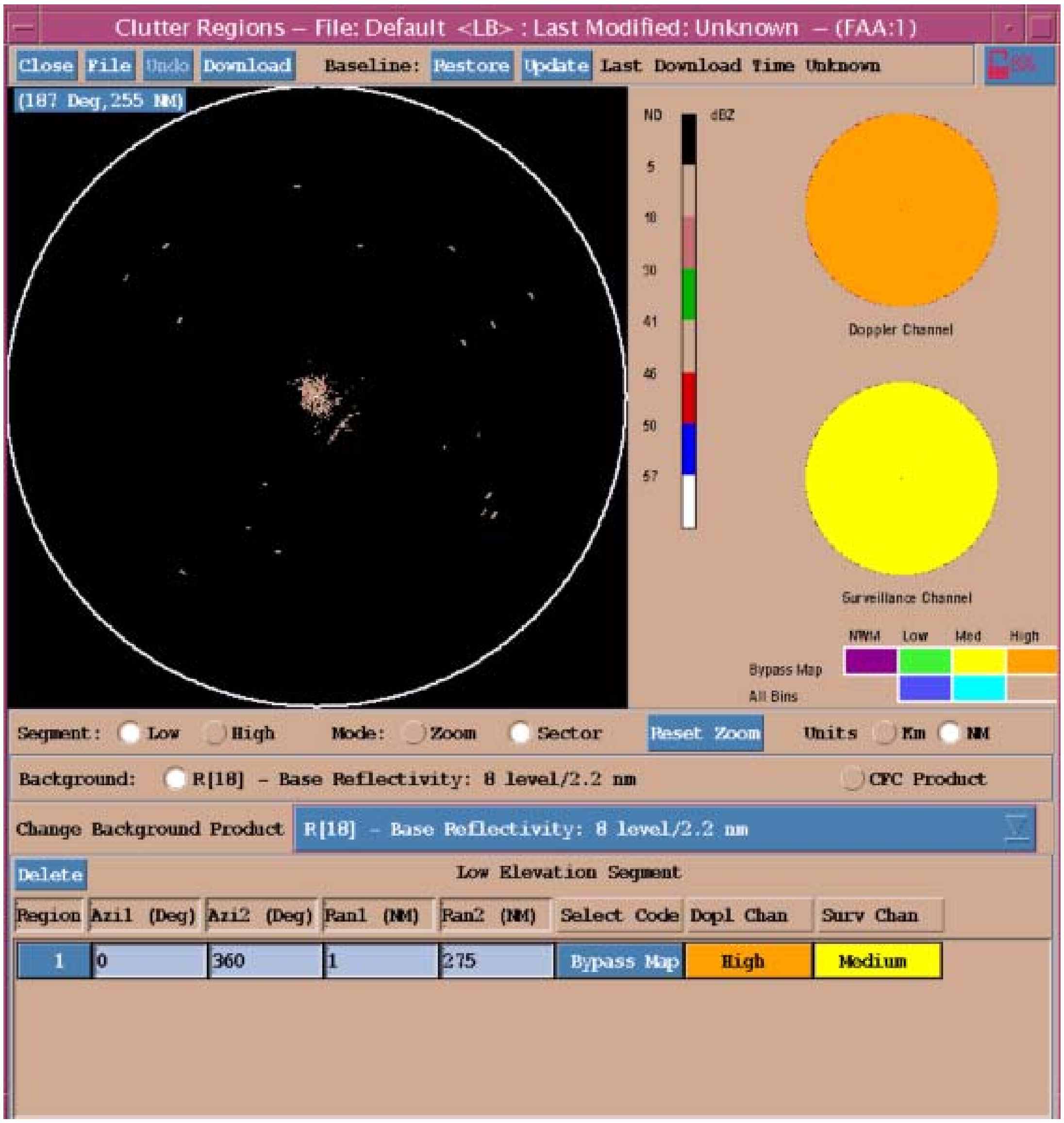



Figure 12-1. Clutter Regions

### 12.1.1 Operator-Defined Clutter Suppression Regions

The operator may define up to fifteen (15) individual regions per each of the twenty (20) allowed Clutter Region Files (See Figure 12-2). Clutter Suppression Region Files are not associated with any specific VCP. Each region is delineated by start and stop ranges, start and stop azimuths, and an elevation segment. The elevation segment (Low or High) specifies which set of predefined elevation slices to include within the region definition. The elevations included in the different segments are defined in the RDA adaptation data.

The Clutter Suppression Regions are used to control the application of clutter suppression within the defined area by selecting from the options listed below.

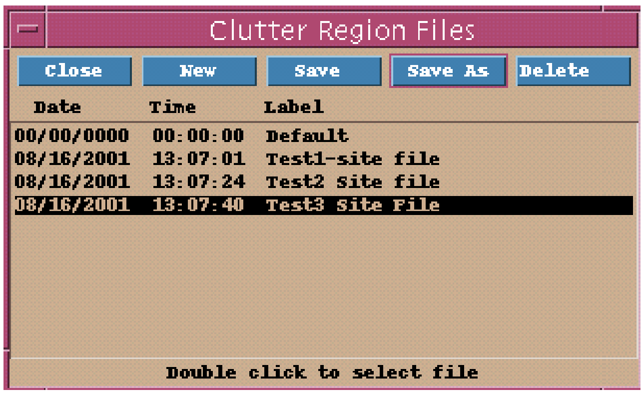



Figure 12-2. Clutter Region Files

#### 12.1.1.1 Options for Clutter Suppression Within Operator-Defined Regions

Within each operator-defined region, the operator has three choices to determine how filtering will be invoked.

a. **No Clutter Suppression:** Select Code None. This selection will turn off ***ALL*** filtering, including the Bypass Map identified areas, within the confines of the operator-defined region.

b. **Bypass Map in Control Using the Operator-Specified Notch Width**: Select Code Bypass Map. This selection will invoke the selected suppression level (notch width) for each area identified by the Bypass Map within the confines of the operator-defined region.

c. **Forced Clutter Suppression Using the Operator-Specified Notch Width**: Select Code All Bins. This option forces the specified suppression level (notch width) for every range bin within the confines of the operator-defined region.

### 12.1.1.2 Notch Width Selections

There are three notch width selections, or levels of suppression, available for inclusion in the Default Notch Width Map definitions and Clutter Suppression Region definitions (with Select Codes None or Bypass Map). The notch width determines the target motions, around zero radial velocity, that will be subjected to signal power reduction (suppression). The Surveillance channel and Doppler channel are suppressed using different notch width values (see Table 12-1) to reduce base data estimate bias in the different channels.

a. **Notch Width Selection Low (Green)**. Invokes a suppression level of approximately 30 dB (Low). See Table 12-1 for typical notch width values.

b. **Notch Width Selection Medium (Yellow)**. Invokes a suppression level of approximately 40 dB (Medium). See Table 12-1 for typical notch width values.

c. **Notch Width Selection High (Orange)**. Invokes a suppression level of approximately 50 dB (High). See Table 12-1 for typical notch width values.

Table 12-1. Notch Width Selections and Suppression Values

| **Notch Width Selection** | **Low** | | **Medium** | | **High** | |
|---|---|---|---|---|---|---|
| **Channel** | **kts** | **dB** | **kts** | **dB** | **kts** | **dB** |
| Surveillance | 3.38 (±1.69) | ≈30 | 4.85 (±2.43) | ≈40 | 6.79 (±3.40) | ≈50 |
| Doppler | 4.58 (±2.29) | ≈30 | 6.05 (±3.03) | ≈40 | 8.92 (±4.46) | ≈50 |

**NOTE**

By design, the notch widths vary based upon antenna rotation rate. Therefore, the value listed in Table 12-1 is an approximation and varies with elevation angle and antenna rotation rate.

With regard to forced clutter suppression (All Bins), the SMALLEST AREA and LOWEST LEVEL of suppression that will properly remove the ground clutter or Anomalous Propagation contamination of the base data should always be used. Use of the highest suppression level (Notch Width High) over all azimuths, ranges, and elevation angles has a strong detrimental effect on the integrity of all reflectivity and reflectivity-based products (such as precipitation and VIL) in those regions of real meteorological echoes that are located along the zero radial velocity isodop.

### 12.1.2 Supplemental Information - Clutter Regions

For additional information concerning the application of clutter filtering, refer to the following papers:

WSR-88D Clutter Suppression and Its Impact On Meteorological Data Interpretation, Chrisman, et al, Jan 1995, and available at http://www.wdtb.noaa.gov/resources/papers/clutter/clutter.pdf

# Chapter 13

# Bypass Map Editor

## 13.1 Clutter Bypass Map Editor - Segment 1

This window allows the operator to edit the RDASOT-generated Bypass Map. Click on the Bypass Map Editor icon and the Clutter Bypass Map Editor, Segment Number 1 opens. Segment 1 is the Low Elevation Bypass Map 1.5 degrees of elevation and below. See Figure 13-1.

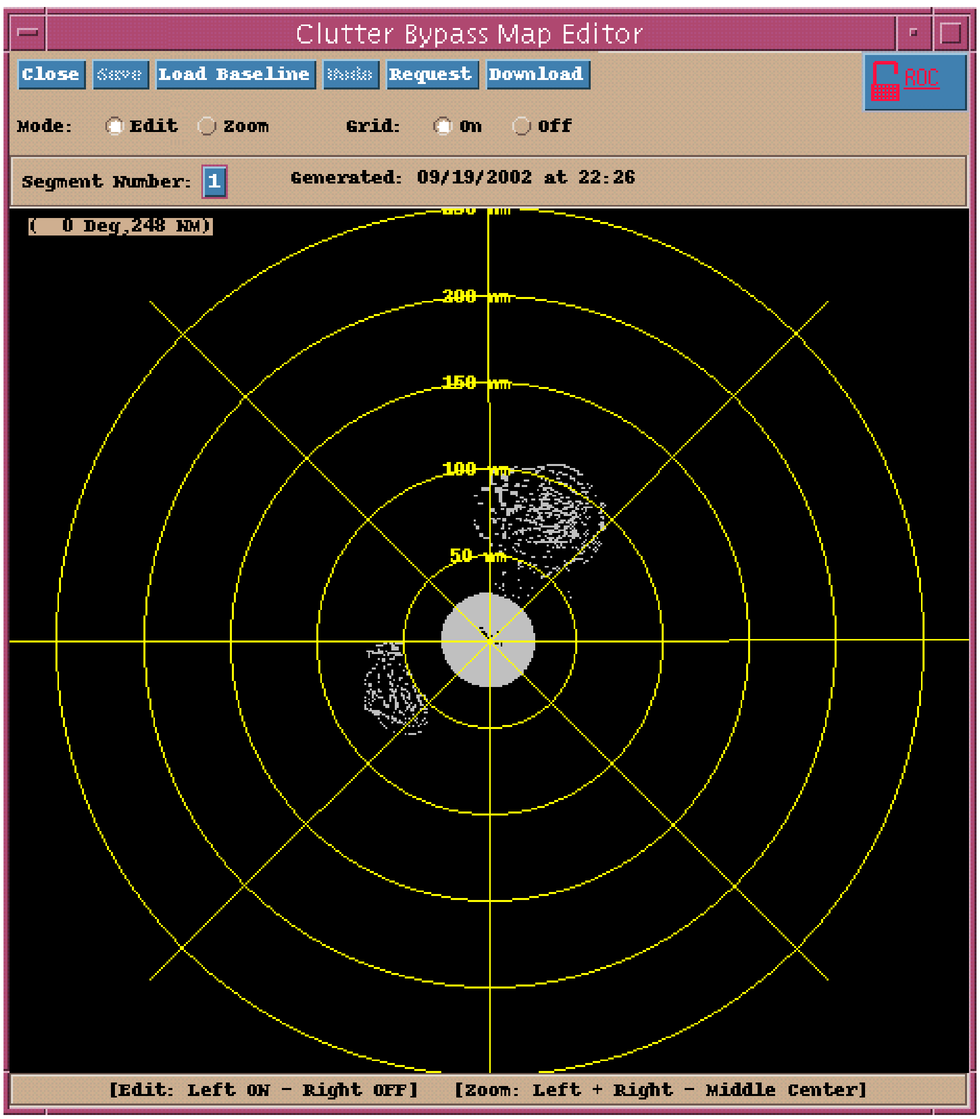



Figure 13-1. Clutter Bypass Map Editor, Segment 1

## 13.2 Clutter Bypass Map Editor - Segment 2

Once the Clutter Bypass Map Editor window is open, click on the Segment Number block, and the Number 1 toggles to Number 2. Segment Number 2 Map is the High Elevation Bypass Map, above 1.5 degrees in elevation. See Figure 13-2.

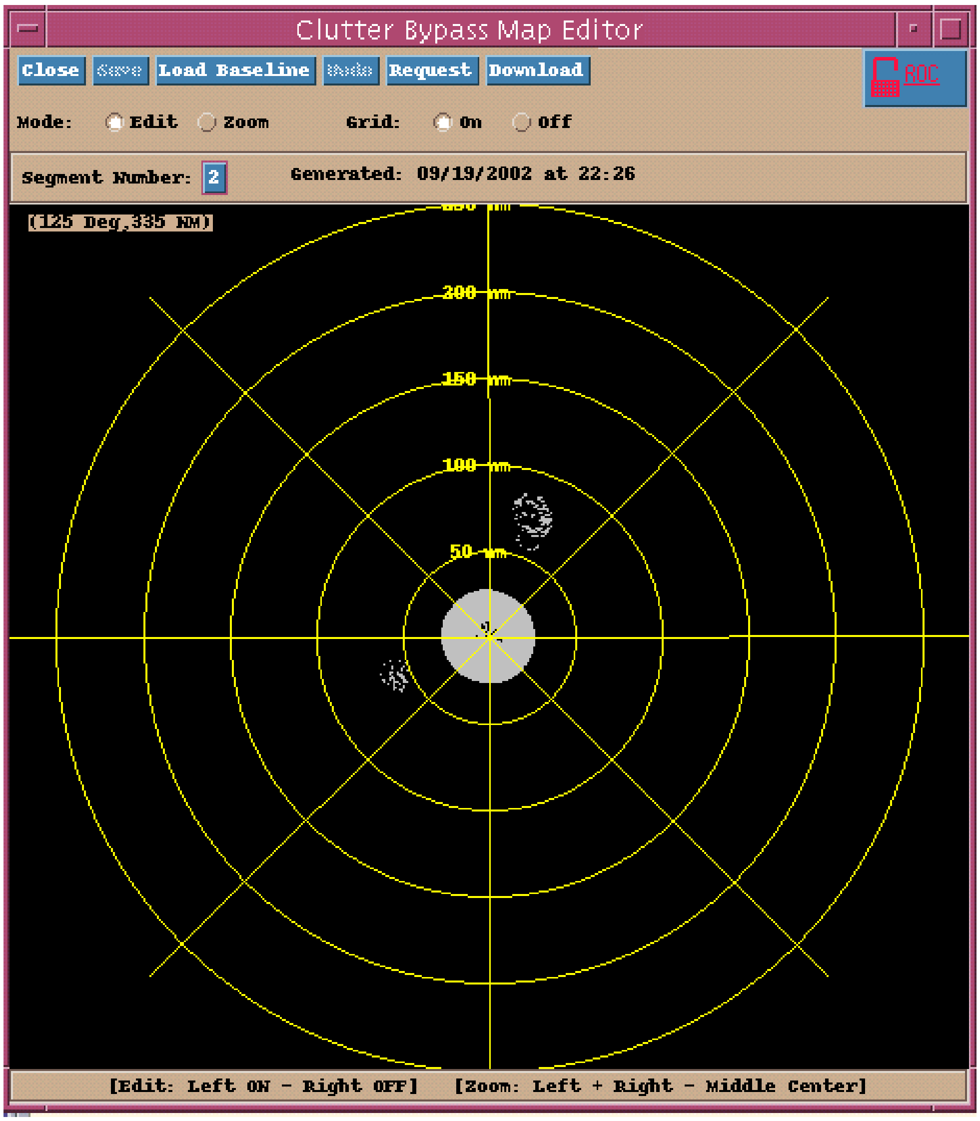



Figure 13-2. Clutter Bypass Map Editor, Segment 2

# Chapter 14
# Environmental Data

## 14.1 Environmental Data Editor

The Environmental Data Editor is a list of wind speeds and directions at 1000 ft intervals from the surface to 70,000 ft MSL. The Velocity Dealiasing algorithm uses information from the environmental data editor when there is no continuity available to dealias suspect velocity estimates. With the VAD Update Feature enabled, the wind speeds and directions are updated every volume scan by the Velocity Azimuth Display task. Additionally, manual modification of this table is possible. The Environmental Data Editor window is used to observe the current values being used by the algorithm, as well as to modify the values to ones that better reflect the ambient wind field. Use Figure 14-1, to enter the data graphically.

Occasionally aliased velocity data is not handled well by the Velocity Dealiasing Algorithm. One possible cause may be that the current Environmental Data Editor does not accurately reflect the ambient wind field. When this occurs, use other reliable sources for upper air data and manually update the Environmental Data Editor and ensure the Auto VAD Update function is on.

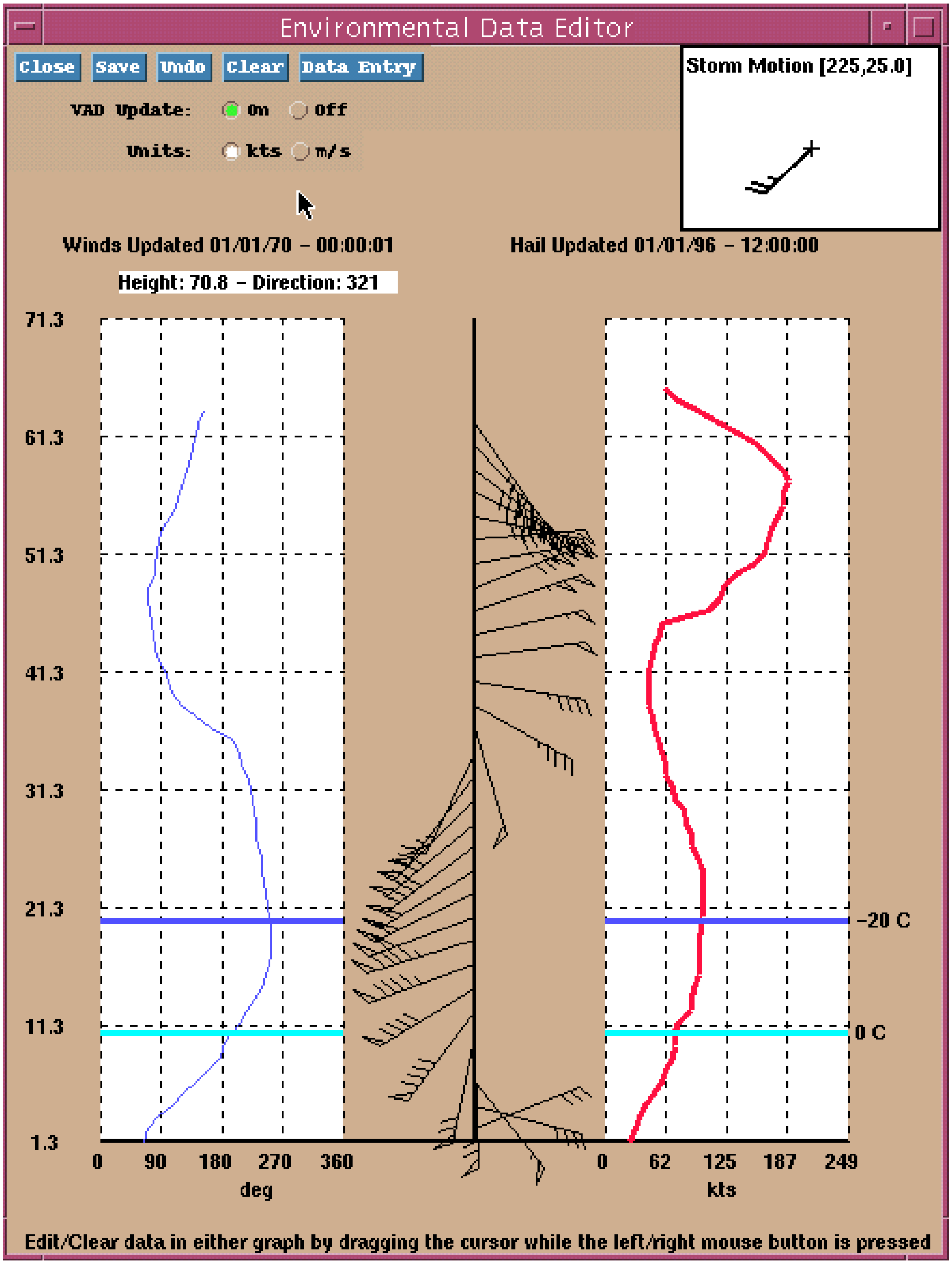



Figure 14-1. Environmental Data Editor

## 14.2 Environmental Data Entry

Click on the Data Entry button in the top line of the Environmental Data Editor and the Environmental Data Entry window appears. Use Figure 14-2, to enter the data in a tabular format.

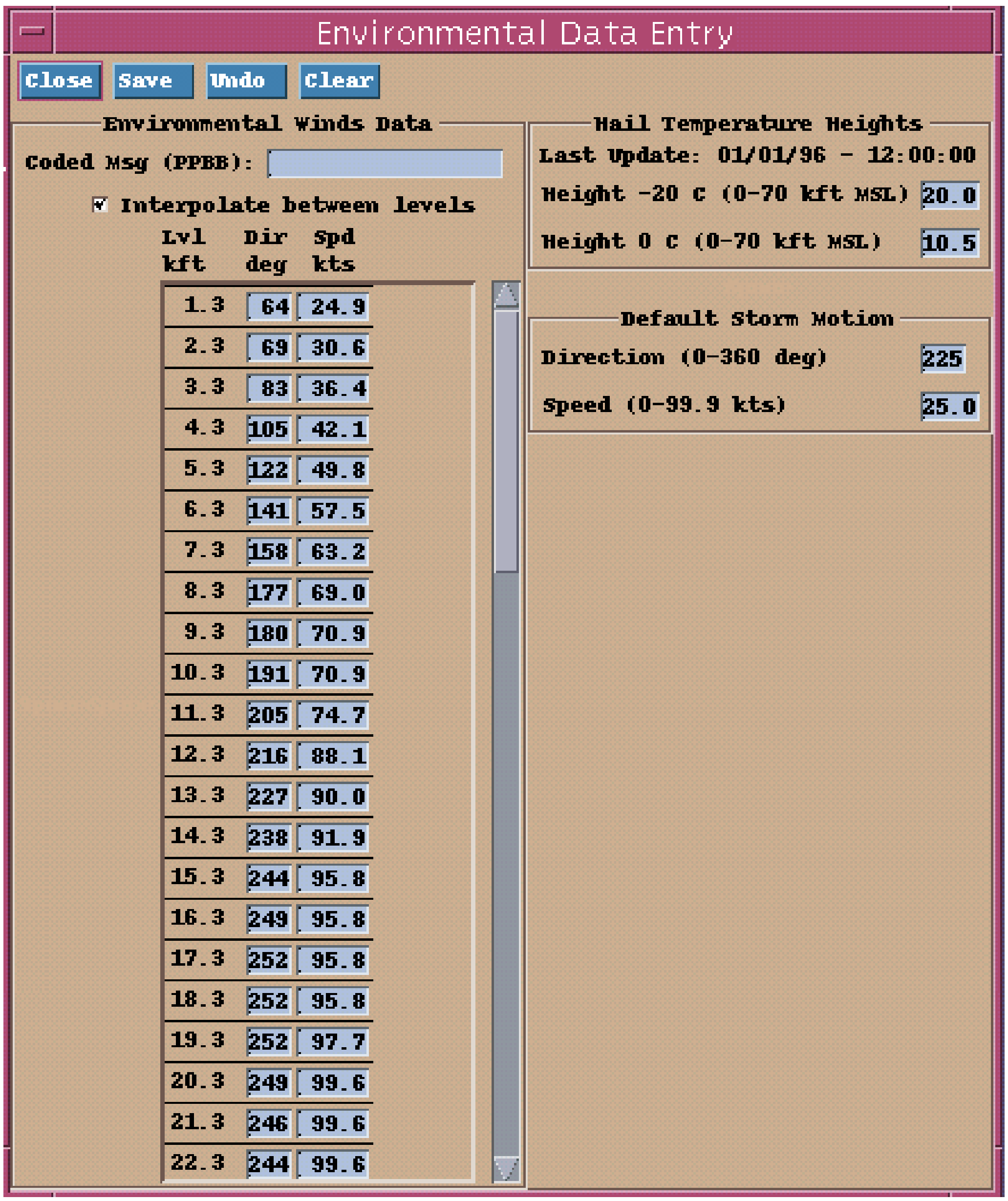



Figure 14-2. Environmental Data Entry

## 14.3 Hail Temperatures Heights/Default Storm Motion

These parameters are located in the upper right hand corner of the Environmental Data Entry window. They are not password protected and can be changed at any time. See Figure 14-2.

# Chapter 15
# Passwords

## 15.1 Passwords

The URC LOCA password may be changed for security reasons at each site. To change the URC password, click first on the Application icon HCI Properties. The HCI Properties window appears. (See Figure 15-1). Click on the **Passwords** button, and the Change Passwords window appears. (See Figure 15-2). Select the URC button, and enter in the old and new passwords as appropriate.


Figure 15-1. HCI Properties

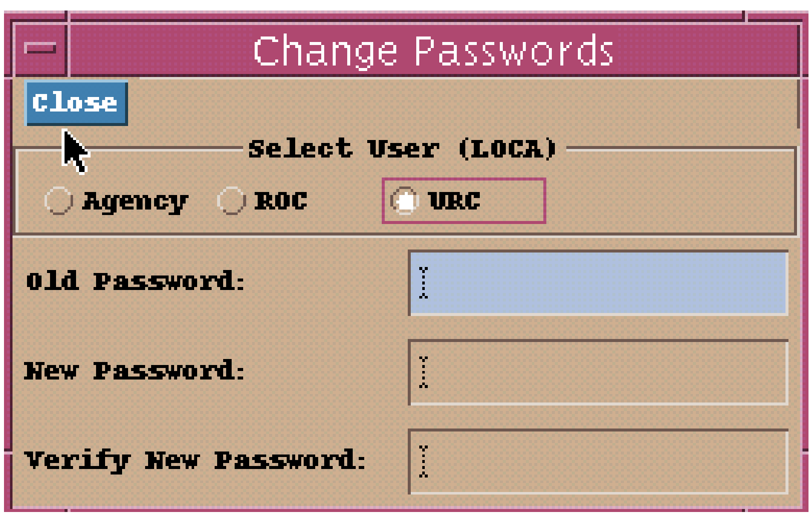



Figure 15-2. Change Passwords

# Chapter 16

# RPG Control - Default Weather Mode

## 16.1 Default Weather Mode

Open the RPG Box, click on the Control button, and the RPG Control window opens. Under the System Control set of six buttons is the line stating: Default weather Mode: with a text string following.  The options are either Clear Air (B) or Precipitation (A) (Figure 16.1, RPG Control).

This option defines the mode that the RPG will return to if it is restarted or turned off/on. The choice of either weather mode is allowed with the URC LOCA password.

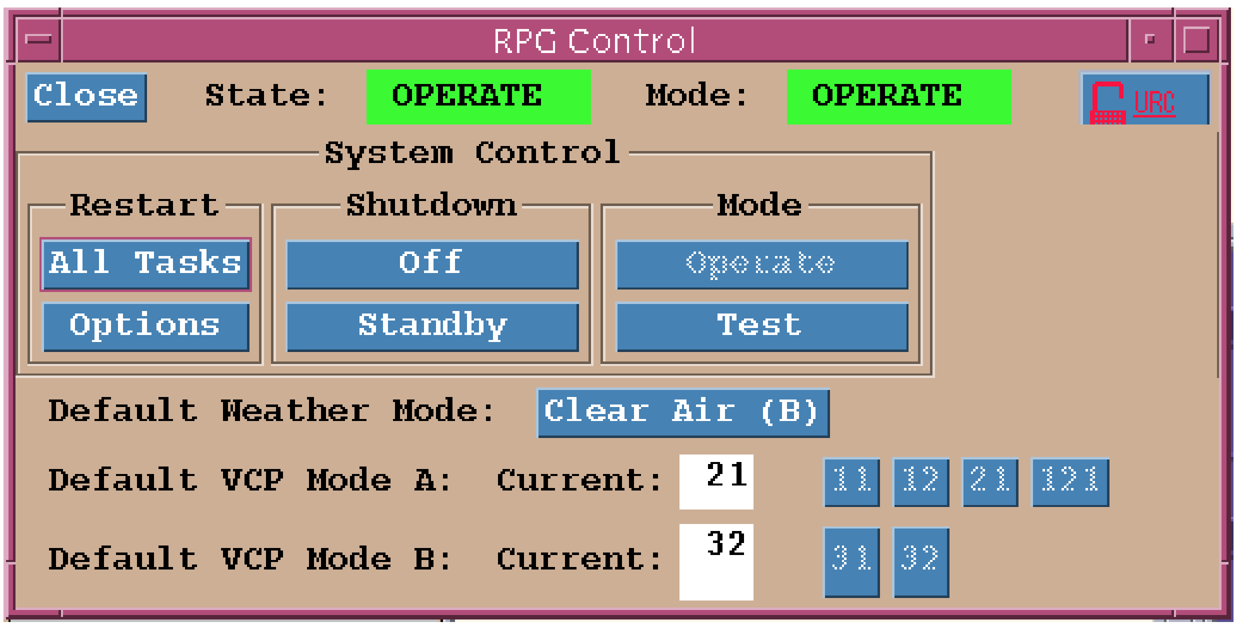



Figure 16-1.  RPG Control