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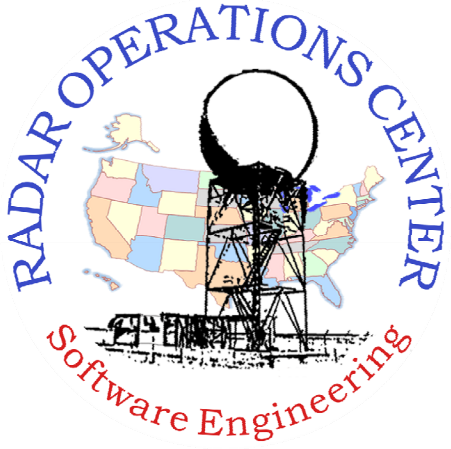
08 Apr 2010



Transfer of RPG Science to the Radar Operations Center

RADAR OPERATIONS CENTER

SOFTWARE ENGINEERING

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1. Executive Summary

Product improvement for the Next Generation RADAR (NEXRAD), also called Weather Surveillance RADAR 1988 Doppler (WSR-88D) system, includes development of software that implements new and/or improved science applications for the RADAR Product Generation (RPG). Implementation of these applications is typically performed by organizations from any of the three supporting agencies: the Federal Aviation Administration (FAA); Department of Defense (DoD)/Air Force Weather Agency (AFWA); and the National Weather Service (NWS). Implementing organizations (IO) currently include the Massachusetts Institute of Technology (MIT)/Lincoln Lab (LL) and the National Center for Atmospheric Research (NCAR) for the FAA, and the Office of Hydrologic Development (OHD)/Hydrologic Software Engineering Branch (HSEB) and the Office of Science and Technology (OS&T)/Systems Engineering Center (SEC) for the NWS. DoD/AFWA is currently sponsoring only Open Principal User Position (OPUP) improvements. The RADAR Operations Center (ROC), as the tri-agency representative, primarily implements improvements to the software infrastructure and new science applications that are supported by all three NEXRAD agencies.

This document formalizes software engineering processes for improving NEXRAD RPG science. The focus of this document is the transition of science applications to the ROC from the IO for integration into the RPG source code and documentation baselines.

Science products begin with either a new idea or a recognized customer need. Ideas which are shown to meet an operational need are evaluated and prioritized by a NEXRAD agency (typically the NEXRAD Technical Advisory Committee (TAC)), target deployment schedules are established, and requirements are captured. The requirements are brought before the System Recommendation Evaluation Committee (SREC). The SREC prioritizes requirements and decides when the requirements should be incorporated into a build. If the requirements for a specific algorithm are selected for inclusion in a future build, the algorithm requirements specifications are delivered to an IO for development and testing of the operational algorithm source code. As a member of the SREC, the ROC is involved in build decisions relating to content and schedules.

The transition process is depicted in Figure 1. This process starts when the entry conditions described in the preceding paragraph are met. As the receiving organization, the ROC participates in the Design Approach Review (DAR) and the Integration Readiness Review (IRR).

Each of the key process reviews is performed jointly by the IO and the ROC. Other organizations that participate on an as-needed basis are customers (e.g., OS&T Science Plans Branch (SPB); the Office of Climate, Weather, and Water Services (OCWWS); the FAA; and the DoD), and developers and trainers for affected systems (e.g., Advanced Weather Interactive Processing Systems (AWIPS) and OCWWS Warning Decision Training Branch (WDTB)).

From a transition perspective, the main review is the IRR. At the successful conclusion of this review, the science product is handed off from the IO to the ROC. The ROC then integrates the product into the WSR-88D software baseline and performs Integration, System, Operations, Full Load Performance and Beta tests prior to deployment to operational sites.

The IO continues to support the product and the ROC after handoff by providing package revisions, participating in reviews, and providing other assistance as needed.

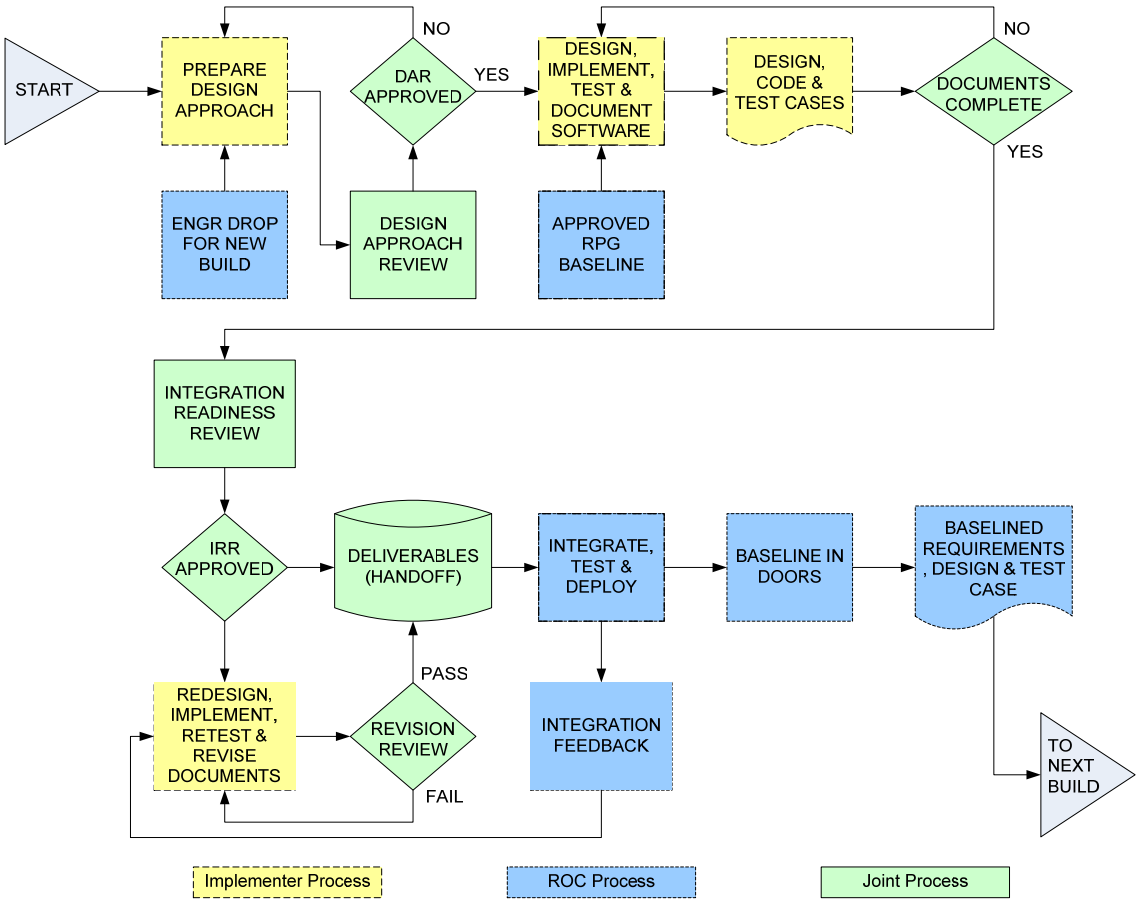

FIGURE 1 - TRANSITION PROCESS FROM THE IO TO THE ROC

2. Introduction

2.1 Background

Product improvement for the NEXRAD system includes development of software implementing new or improved science applications and products for the RPG. Product improvement begins with either a new idea or a recognized customer need. When this idea or need receives sponsorship from a supporting agency – either from the FAA, DoD, or NWS – a developer is typically tasked to produce prototype software. This action begins a three-phase process for inserting enhancements into the WSR-88D baseline: 1) technique development, 2) software implementation, and 3) system baseline integration.

Ideas that are shown to meet an operational need are evaluated and prioritized by each NEXRAD agency and target deployment schedules are established. Technique development is where ideas are prototyped and validated. Typically the NEXRAD TAC decides if and when an application is mature and ready for software implementation.

To encourage developers to focus on the science of an application or product enhancement rather than development environment details such as data access and base data preprocessing, the NWS developed the Common Operations and Development Environment (CODE). CODE combines the RPG baseline software with tools to aid software development along with a web-based suite of documentation. CODE runs on affordable hardware platforms running Red Hat Enterprise Linux using WSR-88D base data from the archives at the National Climatic Data

Center (NCDC) or data received via the Local Data Manager (LDM). Although maintained by SEC, CODE is available to all developers. Use of CODE greatly simplifies the integration process into the WSR-88D software baseline and is used by IOs for that reason. (See WSR-88D CODE Homepage at ***http://www.weather.gov/code88d/***).

At some point during or after the development process, the requirements are brought before the SREC which prioritizes requirements among the three agencies and recommends when requirements can be incorporated into a software release or build. The format for presentation is provided in the *WSR-88D Algorithm Process Checklist*, also called the *SREC Template,* is available as an attachment to the SREC Charter. When the requirements for a specific product improvement are selected for inclusion in a future build and the developers have completed the product improvement, the developer's code and associated documentation are delivered to an IO, also referred to as an "implementer."

At the present time, the software implementation organizations are MIT/LL and NCAR for the FAA, and the OHD/HSEB and OS&T/SEC for the NWS. As the tri-agency NEXRAD Operations and Maintenance (O&M) organization, the ROC also implements WSR-88D improvements; however, their focus is on improvements that benefit all three agencies, primarily infrastructure improvements.

Implementers are responsible for converting the developer's code or algorithm into a product that is suitable for integration by the ROC into the WSR-88D software baseline. The IO is responsible for the development of production quality software, performance of various software tests, and the generation of all necessary documentation.

The ROC is responsible for integration of the application(s) into the RPG software baseline, independent formal testing, and for operational deployment to WSR-88D field sites.

In addition to the primary responsibilities of each group depicted above, there is considerable interaction between the ROC and the IO throughout the implementation and integration phases. The ROC participates in major implementation reviews and is a member of the SREC. After handoff to the ROC, the IO is available to assist with software defect resolution and development of suitable training material.

2.2 Scope

The primary purpose of this documentation is to describe the process followed by the IO and the ROC during the transition of science improvements to the NEXRAD operational software baseline. Joint reviews occur at critical junctures, which lead to a handoff of specific deliverables to the ROC. Interaction between organizations occurs both before and after the handoff to the ROC from the IO. The transfer of RPG science improvements to the ROC includes informal correspondence, joint reviews, and specific deliverables. The process depicted in this document assumes that the tri-agency SREC has already specified that the software being implemented will be integrated in a future build. The focus of this document is the interaction between the ROC and the IO; it does not include the internal activities of the individual organizations.

It is also assumed that prior to handoff of software to the ROC and updates to requirements specifications are introduced to the documentation baseline by the IO, a CCR has been submitted and approved by the appropriate approval authority. The process of submitting a CCR and the processes involved in the approval of the CCR are beyond the scope of this document.

The remaining sections of this document describe and specify the following: Section 3, Description of the Transition Process, describes the transition process from the IO to the ROC, introducing the intent, content, and participation of the DAR and IRR; and Section 4, Description of Handoff Products, introduces required content of the handoff package and provides reference to details contained in the Appendices.

2.3 References

2.3.1 Access to Reference Documents

Reference documents are available via the Internet through the World Wide Web (WWW), File Transfer Protocol (FTP), or the Dynamic Object Oriented Requirements System (DOORS).

2.3.1.1 World Wide Web

The ROC maintains a website available via the Internet. It can be accessed through a WWW browser at ***http://www.roc.noaa.gov***.

Baselined versions of some requirements and specifications may be found on the ROC web site at ***http://www.roc.noaa.gov/WSR88D/WSR88DProgram.aspx***. Baselined versions of some ICDs may be found on the ROC web site at ***http://www.roc.noaa.gov/WSR88D/Program/ICDs.aspx***.

Standards, instructions, and other items of interest to the developer and user community may be found at ***http://www.roc.noaa.gov/WSR88D/Engineering/SPDSWENG.aspx***. It is recommended that potential researchers, users, developers, and associated organizations check this website regularly for updates from the ROC.

2.3.1.2 ROC File Transfer Protocol Server

The ROC maintains an FTP server available via the internet. It may be accessed through FTP client software. The IO will deliver all of its products to the ROC FTP server through a private account. To obtain a username, password, and other information about the ROC FTP server, contact ROC Information Technology and Services (IT&S) Customer Support by email at ***roc.is@noaa.gov***.

2.3.1.3 Dynamic Object Oriented Requirements System

Requirements, specifications, and ICDs may be found in DOORS. DOORS is accessible through the DOORS client software. Details on accessing and using DOORS are described in the DOORS Training Manual.

2.3.2 Reference Documents

Referenced documents may be available in DOORS, Agile or the ROC web site.

1. Software Recommendation and Evaluation Committee (SREC) Charter. Available at ***http://www.roc.noaa.gov/PDFS/SRECCharterOct2007.pdf***

2. *WSR-88D Algorithm Process Template* or *SREC Template.* Available from the SREC Secretariat/Tri-Agency Focal Point. It may also be found as an attachment to the SREC Charter and on the ROC web site at ***http://www.roc.noaa.gov/WSR88D/PublicDocs/ENG/WSR88D_Algorithm_Process_Template.pdf***.

3. DOORS Training Manual. Available on the ROC FTP site at ***ftp://ftp.roc.noaa.gov/Pub/DOORS/9.1/DOORS_9.1_Training.pdf***

4. WSR-88D System Specification (SS). Available at ***http://www.roc.noaa.gov/WSR88D/WSR88DProgram.aspx***.

5. Interface Control Documents (ICDs). Several ICDs are available online at ***http://www.roc.noaa.gov/WSR88D/Program/ICDs.aspx***.

6. *RPG C Coding Standards*. This document is available at ***http://www.roc.noaa.gov/WSR88D/PublicDocs/ENG/WPI0051.pdf***.

7. *Guidance on Adaptable Parameters Operator Handbook. This document is available at http://www.roc.noaa.gov/ssb/sysdoc/Operations.asp.*

8. *Publication Change Request (PCR) Form. This document is* available at ***http://www.roc.noaa.gov/ssb/sysdoc/pcrs/pcr.doc***

3. Description of the Transition Process

The transition process is depicted in Figure 1. This process starts when the NEXRAD agency directs the IO to prepare a design approach. This design approach is reviewed jointly by representatives from the ROC, the IO, customers (i.e., NWS, FAA, and DoD), developers and trainers for the affected systems. The second major review identified in Figure 1 is the IRR.

3.1 Required Reviews

The required reviews specified in Figure 1 are inter-organization meetings, with participants from the ROC, IO, External Organizations (EO), and other invited agencies. These meetings may be viewed as risk mitigation opportunities for new science products by providing a forum to identify impacts to RPG interfaces and to gain consensus on the approach for the new science development, the state of readiness of the new science package for integration into the RPG software baseline, impacts to external interfaces, and the completeness of changes and corrections to the packages after final review and handoff.

Based on pre-arranged agreements, stakeholders may attend via video teleconference (VTC) or teleconference. It is incumbent upon the responsible IO to ensure that all invited stakeholders have access to the meeting agenda and review or walkthrough materials prior to the start of the meeting.

3.1.1 Design Approach Review (DAR)

Once the initial design for the software project has been completed and documented, the IO and other organizations review the design in accordance with the method outlined in Appendix D. Attendees at the DAR are specified in Table 1. The DAR is a mandatory joint review with the customer, implementer(s), the ROC, and EOs having the objective of identifying required infrastructure changes, the new application architecture, external interface modifications, test approach, development schedule, development approach, focal points, dependencies, and risks very early in the development cycle. The DAR should provide an understanding of the planned general approach and schedule for the new science product, provide attendees with an opportunity to raise issues, and solidify future planning and interaction among the attendees. The review is facilitated by a DAR checklist (Appendix D).

3.1.2 Integration Readiness Review (IRR)

The IRR is a joint walkthrough of the science software package as it will be delivered to the ROC for integration into the RPG software baseline. Attendees at the IRR are specified in Table 1. The purpose of the IRR is to review the implemented (as built) software enhancements and associated documentation for completeness, and to assist the ROC with their planning for integration, test, and deployment. The procedure for performing the IRR is provided in Appendix E. The review is facilitated by an IRR checklist.

3.2 Participation In Reviews

Participants in each of the major reviews identified in Figure 1 are shown in Table 1. This table indicates whether participants are invited and expected to attend (T) or are notified and may

attend at their option (CC). A blank space indicates no notification required (e.g., not relevant to topic).

From a transition perspective, the main review is the IRR. At the successful conclusion of this review, the science product is handed off from the IO to the ROC. The ROC then integrates the product into the WSR-88D software baseline and performs system tests.

The IO continues to support the product and the ROC after handoff by providing package revisions, participating in reviews and providing other assistance as needed.

Stakeholder Group	Stakeholder FP	DAR	IRR
Implementers (varies)	NPI Dev Mgr	CC	CC
	OST/SEC	T	T
	OHD/HSEB	T	T
	MIT/LL	T	T
	NCAR	T	T
	Implementer	T	T
	CODE	CC	CC
Developers	varies	T	
Affected Systems and Training	OST/SEC - AWIPS	CC	CC
	AWIPS	CC	CC
	OST/MDL - SCAN	CC	CC
	OCWWS/WDTB	T	T
Integrator	ROC Mgmt	CC	CC
	ROC Applications	CC	CC
	ROC Software	T	T
	ROC Test	T	T
	ROC Config Mgmt	T	T
Customer (Varies)	OST/Program Mgmt	CC	CC
	OST/Science Plans	T	T
	OCWWS/Rqmts	T	T
	OCWWS/HSD	T	T
	FAA	CC	CC
	DoD	CC	CC

TABLE 1 – PARTICIPANTS IN MAJOR TRANSITION PROCESS REVIEWS

3.3 Package Submittal

The SREC determines the content and schedule for each RPG major release. Each build cycle consists of a software development phase, a testing phase and a deployment phase. IO must make new science software package deliveries to the ROC in conjunction with specific dates in the RPG development timeline for the build. The software package for a specific build is delivered for ROC integration one month prior to the start of the build's formal Integration Test. Delays by either the IO or the ROC can have a "domino effect" and significant schedule changes must be appropriately coordinated with the SREC as soon as they become possibilities.

The package submittal process requires use of the ROC FTP site and DOORS, where soft copies of all delivery products are uploaded by the IO for ROC access. Handoff package contents and delivery mechanisms are described in Section 4.

3.4 Package Revisions

After the IO has delivered the software package to the ROC for integration, the ROC may find problems with the package and request a revision to the package prior to completion of system integration and testing; this is represented in Figure 1 as the "Integration Feedback" process. The ROC request must allow sufficient time for the IO to modify the software and its documentation before the end of formal System Test for the build.

As soon as any problem has been detected, the ROC contacts the IO focal point to discuss the reason for the revision (e.g., lack of required documentation or software defect). The ROC provides a description of the revision needed, the impact of the revision, the priority of the revision, and its disposition. If this description is provided verbally, the ROC will follow up with a documented description of these items (e.g., email). For software or other defects, the impact category aids in setting the priority of the revision. These categories are:

> Critical – causes the system to be nonfunctional, or causes the failure of a critical component for which there is no acceptable workaround.
>
> Major – causes the failure of a critical component, but an acceptable workaround exists.
>
> Minor – any defect that does not fit the critical or major category.

If schedule delay or technical risk exceeds the release constraints, the new science product package, or just the defect correction, may be deferred to a later RPG build after mutual agreement by the IO and the ROC, with concurrence by the tri-agency SREC.

4. Description Of Handoff Products

At the successful conclusion of the IRR, the IO formally hands off the software to the ROC. The handoff package must be delivered to the ROC on or before the advertised delivery date for the target release. Delivery is made electronically using the ROC FTP site or via DOORS. Software and related products are delivered via FTP; baseline documentation is updated via DOORS. It is understood that the IO provides all software and related products described in Table 2 in soft copy to the ROC on the FTP site in individual directories for each of the software products; the IO may choose the format. A copy of the package items is maintained by the IO for record-keeping purposes. Baseline documentation is specially formatted within DOORS; the IO must maintain the same format.

Category	Deliverables	Reference	By
Baseline Documentation Additions and Changes	WSR-88D System Specification (SS) additions and changes	4.1	DOORS
	RPG Software Requirements Specification (SRS) additions and changes	4.2, Appendix B	DOORS
	Software Design Description (SDD) additions and changes	4.3	DOORS
	System Subsystem Design Document (SSDD) additions and changes	4.4	DOORS
	RPG Interfaces Control Requirements Document(s) (ICD) additions and changes	4.5, Appendix C	DOORS
Software Design Products	Implementation Test Matrix	Appendix E	FTP
	Infrastructure Details Matrix	Appendix E	FTP
	Source Code with “README” file	4.7	FTP
Adaptation and Configuration Data	Adaptation Data Matrix	Appendix E	FTP
	Configuration Data Matrix	Appendix E	FTP
	Implementation Test Procedures and Results	4.9	FTP
	Training Materials	4.10	FTP
Post-Handoff Support	IO points of contact (POC) for problems uncovered during integration and system test	4.11	FTP
	IO points of contact (POC) for problems uncovered during operations and maintenance	4.11	FTP

TABLE 2 – IRR DELIVERABLES

4.1 WSR-88D System Specification Additions And Changes

When the IO is ready to deliver a software package, the IO submits DOORS change proposals against the WSR-88D SS, which is made available for the Requirements Review process. Instructions for obtaining a DOORS accounts is provided in Appendix A; instructions for entering the requirements into the DOORS tool are provided in the DOORS Training Manual and in Appendix A. In accordance with the ROC Configuration Management Plan (CMP), the science change proposals against the WSR-88D SS will be included with the other proposal changes and incorporated into a Specification Change Notice (SCN). After the SCN review process, the associated Engineering Change Proposal (ECP) will receive approval by the WSR-88D CCB. Following this approval, the proposed changes will be incorporated into the WSR-88D SS and added to the baseline.

The IO should ensure that product descriptions include user options, input parameter criteria, display choices, new (alert) categories, etc.

4.2 RPG Software Requirements Specification Additions And Changes

The responsible IO derives software requirements for the software project from the system requirements. These requirements are also reviewed within the IO for consistency with and traceability to the system requirements, and testability. Once the software requirements have successfully passed their review process, the implementer enters them into DOORS. After approval at the CCB, the ROC integrates them into the RPG SRS. See Appendix B.

4.3 Software Design Description Additions And Changes

The SDD consists mostly of detailed design information that is automatically generated from RPG man pages. Changes to the RPG design resulting from new and upgraded science applications should be documented in man pages. Changes will then automatically be inserted into the SDD.

4.4 System-Subsystem Design Document Additions And Changes

Requirements changes at the SS level normally drive changes to the SSDD. Changes in this document are not typical with new or upgraded science applications. For more information, contact ROC CM at http://www.roc.noaa.gov/WSR88D/Comments.aspx.

4.5 Interface Control Documents Additions And Changes

If the new science requires an external interface modification, this impact must be identified, communicated to the community, and approved by the proper authority as early in the process as possible. The IO and the ROC must evaluate interfaces that are affected by the system and software changes to ensure that the new science product is compatible with existing interfaces and to avoid impacting other software or hardware items that share that interface. Where interfaces are modified, or new interfaces added, the IO documents the required changes to the ICDs for the RPG and external users, such as the FAA's Integrated Terminal Weather System (ITWS) and Weather and Radar Processor (WARP), AWIPS and OPUP (see the ICD for the RPG to Class 1 User). The ICD changes are also coordinated with the user community and the ROC through the DAR process. Once the ICD changes are coordinated, the IO updates the ICDs in DOORS using the format provided on the ROC FTP site. Changes are reviewed by the ROC and approved changes are integrated by the ROC into the interface requirements baseline.

The ROC is responsible for ensuring that the IO has the latest ICD baseline for all external interfaces, keeping in mind that the interfaces may change as builds are placed in the field while the IO is completing new science products for upcoming builds. The IO is responsible for

verifying that the product performs with the released ICDs as well as the proposed interface change.

4.6 Software Design Products

The software design is the first level of implementation of the software and interface requirements. The design description package includes infrastructure information, such as adaptation data, generation frequency, and generation trigger, in addition to usual design data such as input/output data and flow control. Generally, the software design needs to provide information suitable for testing and infrastructure impact assessments as indicated in the Test Matrix and the Infrastructure Details Matrix (Appendix E).

4.7 Source Code With "README" File

At each IO, the implementer uses the initial design to begin code development. The IO is responsible for ensuring that the coded modules follow the initial design to avoid requirements traceability and software maintainability pitfalls. Where design changes must be made to reflect more efficient or required code, the IO is responsible for ensuring that any design modifications are documented and reviewed.

The IO is required to provide new code that meets the coding guidelines specified in the *RPG C Coding Standards*. Waivers must be submitted to ROC CM for approval.

The package delivery should contain a text README file describing the contents of the delivery and location of the deliverables.

4.8 Adaptation And Configuration Data

The IO provides a complete description of all adaptation data. This description includes data element names, definitions, range of acceptable values, and specific site dependent values. This is accomplished by completing the Adaptation Data Matrix (Appendix E). In addition, the IO provides a description of all configuration data by completing the Configuration Data Matrix (Appendix E).

The IO will provide justification for any adaptable parameter they identify as having a Level of Change Authority (LOCA) of Unit Radar Committee (URC). The IO will also provide detailed guidance on the use of the adaptable parameter and the impact of changing the adaptable parameter will have on the system or algorithm performance.

4.9 Implementation Test Procedures And Results

The goal of thorough implementation testing by the IO is to verify the software requirements are meet and to find defects remaining in the software after completion of unit testing. Defect detection is especially true for "stressing" environments that may be encountered in the field but may be unfamiliar to the developer. To support the best possible IO test environment, the ROC provides test data sets and radar simulation tools to the IOs for use during implementation tests to ensure that the new science code works correctly with real RADAR data. The IO should, to the maximum extent possible, test known exceptions to ensure the software successfully handles the exceptions (e.g., input data errors, VCP restarts, disabled moments, etc) before the package reaches the ROC. The implementation test procedures and their results are also a required deliverable to the ROC as part of the integration package.

It is highly recommended the IO perform a thorough Computer Program Test & Evaluation (CPT&E). The CPT&E demonstrates how the code meets the requirements described in the Algorithm Enunciation Language (AEL), and proves that the code implements the intent of the AEL (i.e., the code is logically equivalent to the AEL). Besides demonstrating the code package

meets the requirement specifications, a thorough CPT&E generally uncovers software defects not found during Unit Level testing.

4.10 Documentation Updates

4.10.1 Technical Manual Updates

The IO will provide any required updates to technical manuals via a Publication Change Request (PCR) Submission Form. This is to include such documents as the *Guidance on Adaptable Parameters Operators Handbook*. Change requests may also be made through the Online PCR Form available at ***http://www.roc.noaa.gov/ssb/sysdoc/pcrs/form/default.aspx***. The status of change requests may be found in the PCR Database at ***http://www.roc.noaa.gov/ssb/sysdoc/pcrs***.

4.10.2 Requirements, Specifications, and ICD Updates

The IO will provide any required updates to requirements; specifications and ICDs via DOORS (see Appendices).

4.11 Training Materials

The IO will deliver training materials to the WDTB. Using the provided materials, the WDTB prepares training documents which are provided with the software build. Training material should include, but not limited to, a description of the new science application, strengths and weakness, guidance on field-editable adaptable parameters, and examples of algorithm output.

4.12 Post-Handoff Support

During System Integration and Test (I&T), the ROC may have questions, test anomalies, or other issues with the delivered software that require assistance from the IO. The IO provides, as part of the delivery package, an organizational contact point for I&T assistance.

The IO also provides support for problems that may be uncovered during operations and maintenance. As part of the delivery package, the IO specifies an organizational contact point for user and WSR-88D Hotline assistance.

Appendix A. Submitting Baseline Documentation Changes

An implementer's changes to the SS, SRS, and ICD are made directly to the documents via DOORS.

A-1 DOORS

The SS, SRS, and ICD baselines for the RPG are controlled at the ROC within the DOORS requirements management tool. Through an established user account, these documents are available to the IO and other external users through DOORS.

A-2 Redline Submittal Of Changes

The ROC does not accept redlined hardcopy changes to the SS, SRS, or ICDs. The DOORS tools are used by the ROC for RPG requirements management and modifications. The ROC requires that the IO and external users provide their own proposed updates to the specification. If an external user is unable to access these tools, updates can be made through the OS&T SEC via special arrangement. The SEC will provide the science package "implementer" role for users that lack the capabilities to access DOORS; those users should work with the SEC to develop proposed changes and enter the changes using DOORS. To insert hardcopy redlines into DOORS, contact the SEC's RPG point of contact at SEC_RPG_POC@noaa.gov.

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Appendix B. Software Requirements Updates

B-1 Changes To RPG Software Requirements Specification 2820003 (part 1)

Both the main text and the appendices of the SRS may need to be modified. The general content and level of detail provided should be consistent with the existing document. In some cases the same data must be entered into multiple documents. These cases are noted below.

Table 3.2.1.1.13.2 Generate Products must be identical to Table E-1A – Product Generation & Archive Performance Load in WSR-88D System Specification (SS) 2810000 and Table III in ICD for RPG to Class I User 2620001.

Table 3.2.1.13.2.2 Executive Algorithms must be identical to that shown in WSR-88D System Specification (SS) 2810000.

Add a subparagraph to 3.2.1.13.2.2 for the new product containing a high-level description of the product. The product descriptions in these paragraphs are similar to descriptions in other documents, including ICD for Product Specification 2620003.

Numbers used in Table 3.2.1.13.2.2.25 Product Annotation Data must be identical to those in WSR-88D System Specification (SS) 2810000. The annotation information in this paragraph is identical to information in ICD for Product Specification 262003.

Table 3.2.1.13.2.4 Alert Product Control should be identical to that shown in Appendix J – Meteorological Phenomena For Alerts of WSR-88D System Specification (SS) 2810000.

Algorithm Report R400-AR401.

NOTE: The Algorithm Report is referred to in 3.2.1.13.2.2 Executive Algorithms of RPG Software Requirements Specification (SRS) 2820003 (part 1). It is assumed that requirements statements containing AEL go here. Add/modify these statements for new/modified algorithms.

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Appendix C. Interface Control Document Updates

C-1 Guidelines For Interface Control Document Changes

Examples of ICD changes may be found on the ROC FTP site. Both the main text and the appendices may need to be modified. The general content and level of detail provided should be consistent with the existing document. In some cases the same data must be entered into multiple documents. These cases are noted below.

C-1.1 Changes To ICD for RPG to Class 1 User 2620001

For Table III - Message Codes for Products, add or modify product information in the table format used in the ICD. CODE is Product Code, NTR is the System Specification number found in WSR-88D System Specification (SS) 2810000. Information in this table must be identical to 3.2.1.13.2.2 Executive Algorithms of RPG Software Requirements Specification (SRS) 2820003 (Part 1).

The implementer should define new data packet types or message types, and add new alert categories to Table IV, as needed.

For Table V - Product Dependent Halfword Definition for Product Description Block, add or modify product information in the table format used in the ICD. Add description of product dependent parameters, including elevation angle for elevation products. Details of parameter definitions in this table are identical to those in Table IIa – Product Dependent half word Definitions for Product Request Message.

For Table VI – Product Dependent Definitions for Product Symbology Block, add the basic data content of the product, as needed.

If the product includes a Graphic Alphanumeric Block (GAB), add an entry in paragraph 3.2.1.3 Graphic Alphanumeric Block and describe in Table VII – Product Dependent Definition for Graphic Alphanumeric Block.

If the product includes a Tabular Alphanumeric Block (TAB), add an entry in paragraph 3.2.1.3 Tabular Alphanumeric Block and describe in Table VIII – Product Dependent Definitions for Tabular Alphanumeric Block.

C-1.2 Changes To ICD For Product Specification 2620003

Add new section N (major paragraph number) for each new product or set of related products. The paragraph number must correspond to the System Specification product number, also called the NTR number, in Appendix E – WSR-88D Products of WSR-88D System Specification (SS) 2810000.

a. Subparagraph N.1 is the “SSS Product Description.” It is identical to the description in Appendix E – WSR-88D Products of WSR-88D System Specification (SS) 2810000. Product descriptions are very similar to those in paragraph 3.2.1.13.2.2.X of RPG Software Requirements Specification (SRS) 2820003 (part 1).

b. Subparagraph N.2 contains the “Display Format.” A definition of the product data levels is provided. If the product is “displayable” the data must threshold levels (usually 8 or 16) must be defined along with the color to be displayed.

c. Subparagraph N.3 describes the “annotations” included with the product. NOTE: the annotation information must be identical to that in Table LIV – Product of 3.2.1.13.2.2.25 Product Annotation Data in RPG Software Requirements Specification (SRS) 2820003 (part 1).

d. Product interactions are described in Subparagraph N.4.

e. Comments include whether adaptable parameters are displayable and the format of the display1.

f. Add any new special symbols to Appendix A – Annotations, Symbols, Abbreviations, and Display Features. If no new symbols are defined, so state.

g. Add any product specific information to Appendix B – Graphic Display Formats, if applicable.

h. Add or modify TAB formats to Appendix C – Alphanumeric Tabular Formats, if applicable.

Appendix D. Design Approach Review

D-1 Design Approach Review Table

Entry Criteria	Requirements analysis completed. Design approach completed.
Input	DAR checklist. Algorithm for RPG integration (AEL or prototype, or both). Design approach & software architecture. List of baseline documents to be updated. List of required test cases and test data identified. Implementation schedule. Training and deployment approach/documentation. List of key focal points. Known issues or "features." Copy of the current RPG Build software (CODE)
Stakeholders	Developer IO Representative(s) Implementer EOs (e.g., AWIPS) Integrator Representative(s) Customer
Activities	Review all documentation. Verify that software design approach satisfies the algorithm definition, user requirements, and system requirements. Verify that test cases cover design, interfaces, and requirements. Verify training and deployment approach for user and Hotline Support sufficiency. Document action items.
Output	Red-lined or approved DAR checklist. Red-lined or approved design approach & software architecture. Red-lined or approved list of baseline documents targeted for modification. Red-lined or approved test cases/data sets. Red-lined or approved implementation schedule. Action items.
Exit Criteria	Meeting minutes distributed. Action items documented, evaluated, resolved, and/or closed.

TABLE D-1 – DESIGN APPROACH REVIEW TABLE

D-1.1 Entry Criteria

Before a DAR can be held, the requirements analysis and design approach will be completed.

D-1.2 Input

The information specified in the Table D-1 – Design Approach Review Table is provided to the DAR attendees at least one day prior to the review.

D-1.3 Stakeholders

The DAR is attended by the ROC and other stakeholders, providing them the opportunity to raise issues and ensure that the approach is acceptable. The IO designates a DAR Lead, who is responsible for scheduling the DAR, ensuring that all IO information has been provided to the

meeting participants, and facilitating the review itself. The implementer presents the materials described under Input of Table D-1 and may share the responsibilities of the DAR Lead. External organizations attend as necessary to discuss issues related to handling and displaying the new product, the impacts of interface changes, and the timing of the required changes. The ROC supports the DAR to gain an understanding of the new science product and its effect on the RPG infrastructure and interfaces, and to identify issues concerning the software design. The IO's customer attends on an as-needed basis for information gathering.

D-1.4 Activities

If the DAR Checklist is not completed prior to the start of the DAR, either it will be completed during the review or the DAR Lead will accept an action item to document open items. As indicated in Table D-1, the resolution and closure of these actions items is an exit criterion for the DAR.

The implementer gives a presentation of the input data to the DAR. Since detailed packages should have been delivered in advance, this presentation may focus on the key aspects of the approach and any requirement issues. Basically, the implementer needs to verify that each item in the DAR Checklist has been adequately addressed.

The implementer also presents the training approach for the new science product, to cover the ROC Hotline support, site deployment, and field users. Any known challenges to deploying the new science product to the field are highlighted during this presentation, and approaches to mitigating these challenges are provided for discussion. The participants assess the deployment and training approach for adequacy; the DAR Lead documents any shortcomings in the deployment and training approach.

Participants provide feedback on the architecture and its relationship to the requirements and the science algorithm, note any impacts to external interfaces, and identify issues relative to the software design approach. These issues are documented by the DAR Lead for later assignment to responsible engineers for assessment and resolution.

If the new science product has been assigned to an RPG build by the SREC, the implementer will present a schedule for completing the development by the required handoff date. The participants will review and discuss the schedule to ensure that adequate time has been allocated to software design and development, internal reviews, and software testing and revisions, and that adequate resources are available to complete the tasks in the given time frame. If the participants determine that the new science product will not be completed in time for its assigned handoff date, or that required external changes will not be completed to support the product at that time, they may request that the IO petition the SREC to move the product to a later build release. If the new science product has not yet been before the SREC, the implementer will also include the date for SREC presentation and potential handoff dates are part of the DAR.

D-1.5 Output

Minutes of the DAR are generated by the DAR lead or designee, to include: the approved or modified DAR checklist; the approved design approach and software architecture, as documented in the presentations or as modified by the participants; the approved or modified implementation schedule; the approved or modified training and deployment approach; the approved or modified test cases and test data sets; the approved or modified list of documents to be changed; and the list of actions items.

D-1.6 Exit Criteria

The DAR is successfully concluded when all action items from the review have been documented, analyzed, and resolved and the review minutes distributed to and accepted by the participants.

D-2 Design Approach Review Checklist

Design Approach Review Checklist

Date:	
Application:	
Participants:	
Agenda Item	**Status**
Identify CCR and briefly review user and system requirements	
Describe the operational concept	
Describe top-level architecture impacted	
Describe changes/support required from external systems	
Describe dependencies on external system changes	
Discuss how other agencies could benefit from capability	
Describe WSR-88D architecture impacted	
Describe required infrastructure changes	
Describe architecture of the application	
Identify downstream users of application output	
Discuss anticipated/potential hardware changes	
Describe design approach	
Describe data flow diagram	
Describe development approach	
Describe prototyping plans	
Discuss applicability for generalized functions	
Describe planned coding language and adherence to guidelines	
Identify planned COTS packages	
Identify which baseline will be used to build changes upon	
Describe test approach	
Identify simulators and other specialized tools neede to conduct testing	
List required test cases (RADAR data, external data)	
Review integration challenges	
Describe possible incompatibles, adaptation data, etc.	
Provide anticipated hardware/resource usage and performance	
Review current schedule	
Review changes to external interfaces	
Review tasks, milestones, and resource estimates	
Identify schedule dependencies	
Identify future reviews and discuss participation	
Review focal points for this application	
Describe dependencies	
Describe unknowns	
Describe risks	
Identify action items and closure plan	

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Appendix E. Integration Readiness Review

E-1 Integration Readiness Review Table

Entry Criteria	Successful completion of the DAR Completion of internal implementation test(s) DOORS account/access
Input	Software package products Completed IRR Checklist IRR Deliverables Matrix Infrastructure Details Matrix Adaptation Data Matrix Configuration Data Matrix Implementation Test Matrix
Stakeholders	IO representative(s) Implementer Customer ROC representative(s) Training representative(s)
Activities	Review action items and issues from DAR for resolution and closure Review all matrices for completeness Review system and software documentation (SS, SRS, SDD, SSDD, ICDs) for accuracy and completeness Review implementation test report Review training approach and materials Review focal points Complete IRR Checklist
Output	Redlined or approved system and software products List of remaining action items and issues to be resolved and closed Red-lined or approved training materials and approach Red-lined or approved list of focal points Completed IRR Checklist Red-lined or approved IRR Deliverables Matrix Red-lined or approved Infrastructure Details Matrix Red-lined or approved Adaptation Data Matrix Red-lined or approved Configuration Data Matrix Red-lined or approved Implementation Test Report Red-lined or approved Implementation Test Matrix Decision on whether to accept the handoff
Exit Criteria	Meeting minutes distributed Action items documented, evaluated, resolved, closed Decision to proceed/not to proceed

TABLE E-1 – INTEGRATION READINESS REVIEW TABLE

E-1.1 Entry Criteria

The IO schedules the IRR to occur after software implementation has been completed. Specific entry criteria for the IRR are listed in the IRR Table E-1.

E-1.2 Input

The implementer provides each participant a completed IRR Checklist, Infrastructure Details Matrix, Adaptation Data Matrix, Configuration Data Matrix, Implementation Test Matrix, and IRR

Deliverables Matrix. The implementer also places the software package products on the ROC FTP site, where they become available to the participants.

E-1.3 Stakeholders

The IO designates an IRR Lead, who is responsible for scheduling the IRR, ensuring that all IO information has been provided to the meeting participants, and facilitating the review itself. The implementer presents the materials described under Input of Table E-1 and may share the responsibilities of the IRR Lead. The IO, ROC, and WDTB representatives and Customer review the package materials and provide feedback to the implementer on accuracy and completeness.

E-1.4 Activities

Activities to be performed as part of the IRR are specified in Table E-1. The implementer presents a summary of the data being reviewed at the IRR, including system and software specification changes and ICD updates, noting which paragraphs and tables within these documents have been added or modified. Infrastructure changes to support the new science product on the RPG are also described. Participants review the changes and updates, and provide feedback to the implementer on where the changes are insufficient for the product.

The implementer presents the new science product design, inputs, and outputs, describing execution triggers and generation frequency of new/modified applications. The participants assess the design and its operational concept; the IRR Lead notes discrepancies in the design for the revision prior to ROC Integration testing.

The IRR Lead presents status of all action items and issues from previous reviews related to this new science product. If any reports, action items, or issues are open, the participants use a risk assessment to decide whether or not to approve the handoff for integration. If a decision is made to proceed, the IRR lead notes all open reports, action items, or issues, and presents this list to the ROC prior to the start of RPG Integration test for the product build. If the participants decide not to continue with the handoff, the IO notifies the SREC of the change and reschedules the presentation of the new science product for a later SREC.

The implementer presents a summary of the delivered package and a description of the implementation test results, including a review of the Implementation Test Matrix. Participants review the test summary and provide feedback to the implementer on whether the test program was sufficient for the new science product.

The implementer presents the Infrastructure Details Matrix and the Adaptation and Configuration Data Matrix. The participants review the matrices for consistency with information presented at earlier reviews, for correctness, and to determine areas of additional information need. The IRR Lead documents any deficiencies for inclusion in updates to the matrices prior to the start of the ROC's Integration test.

The implementer completes the IRR Deliverables Matrix. The IRR Lead notes the areas in the matrix that contain erroneous data or lack required information, which will be revised by the implementer prior to the start of ROC's Integration testing.

E-1.5 Output

The IRR results in approved or red-lined system and software products, including the ICDs. A list of open action items and issues is generated and forwarded to the ROC for their use in resolving problems in Integration and System testing. The IRR Deliverables Matrix is completed and all items noted on the matrix are provided to the ROC FTP site. The IRR participants decide whether or not to proceed with integration.

E-1.6 Exit Criteria

The IRR concludes when the IRR meeting minutes are distributed to and approved by the participants, and when all action items and issues resulting from the IRR have been evaluated, resolved, and closed. This may include the closure of missing items from the checklists and updates to the system and software products.

E-2 Integration Readiness Review Checklist

Integration Readiness Review Checklist

Date:	
Application:	
Participants:	
Agenda Item	**Status**
Identify CCR and briefly review user and system requirements	
Review operational concept	
Describe how the new capability will be used operationally	
Describe schedule for external systems change release	
Review architecture and implementation status	
Identify each system contributing to the end-to-end capability	
Briefly describe changes to RPG infrastructure, RPG application software, and external systems.	
Identify downstream users of application output	
Describe dependencies on external system changes	
Identify changes to centrally collected products	
Review the implemented software enhancement	
Identify required hardware changes	
Identify inputs/outputs of new/modified applications tasks	
Identify execution trigger and generation frequency	
Review infrastructure details (refer to Infrastructure Details Matrix)	
Review adaptation data (refer to Adaptation Data Matrix)	
Describe any required deviations and waivers	
Review software development testing	
Identify tested cases and scenarios (refer to Test Matrix)	
List CPU, memory, disk utilization, product sizes	
Identify known problems	
Discuss aspects of ROC integration and testing	
List dependencies on infrastructure change	
List required hardware changes	
List dependencies on external systems and external schedule	
List incompatibilities with external systems	
Describe simulators and other tools that may be required	
List required test cases	
Discuss deployment issues	
Adaptation data migration	
Systems compatibility	
Operations training approach	
Discuss content and method field will train	
Discuss how ROC Hotline will train	
Review content of handoff	
Review deliverables matrix	
Identify focal points	
Software maintenance	
ROC test	
Operational support	
Discuss any other dependencies, unknowns, and risks	

E-3 Integration Readiness Review Deliverables Matrix

Deliverables Matrix

Last Updated mm/dd/yy	By John Doe	**File Names**	**Status**	**Number Of Files** **n**ew/**m**odified/**d**eleted	**Number Of SLOC** **n**ew/**m**odified/**d**eleted
IRR Matrix	Name of this file				
Requirements	SS				
	SRS				
	AEL				
	Product Spec ICD				
	Class 1 ICD				
Software Design	Visio-type Chart				
	- Data Flows description				
	- Linear buffers used				
	- Adaptation Data used				
	- Disk files				
Test	Procedures				
	Reports				
	Input data, if applicable				
	Intermediate output data				
	Final output data				
Software Entities	makefiles				
	scripts				
	source code files				
	include files				
	product_tables				
	task_tables				
	data_tables				
	Task Man pages				
	Buffers Man pages				
ReadMe File					

E-4 Infrastructure Details Matrix

Infrastructure Details Matrix

Last Updated and Initials	task1	For modifications to existing tasks, list changes only task2
WSR-88D RPG Build number		
ROC CCR Number		
NTR # in SS		
Product Name		
Product Mnemonic		
Product Message Code		
Adaptation Data (yes/no)		
Product Dependent Request Parameters (yes and what data/no)		
CPU Priority (low/medium/high)		
Distribution Priority (low/medium/high)		
BZIP2 Compression (yes/no)		
Default Generation (yes and which cuts/no)		
Replay (yes/no)		
Alert Pairing (yes and which products/no)		
Archive III (yes and which cuts/no)		
Class 2 Availability (yes and which cuts/no)		
Product Size (per 04/22/96 case)		
CPU Utilization (Ultra 10)		
Task Size		
Memory Utilization		
Disk I/O (bytes/volume)		
Execution Cycle (elevation, volume)		
Generation Frequency (elevation, volume, time)		
Generation Trigger (buffer avail, time)		
Spatial Resolution		
Coverage Region		
Data Projection		
Data Resolution		
Data Units		
Blocks Contained In Product (which blocks)		
Packets Contained In Product (which packets)		
CPC Number		
Task Number		
Task Input Data Type(s)		
Task Input Data LB(s)		
Task Name		
Task Output Data Type(s)		
Task Output Data LB(s)		
Task Output Data Generation Frequency		
Task Output Data Spatial Resolution		
Task Output Data Coverage Region		
Task Output Data Resolution		
Task Output Data Units		
Task Output LB Size		

E-5 Test Matrix

Test Matrix

Last Updated mm/dd/yy by John Doe

	Case	Plan	Status
PERFORMANCE			
Measure system resource utilization (CPU, memory, disk, task size, product sizes), compare to baseline, assess requirement compliance	KOU1 04/21/96	m	
GNU Profiler for inner-process resource consumption		o	
MODULE TESTS			
Computations	na	m	
Boundaries	na	m	
Exceptions	na	m	
REQUIREMENTS TESTS			
Verify functional requirements (SS, SRS, ICDs)	na	m	
Adaptation data range test	na	m	
Generate elevation based over all possible elevations	na	m	
Request product over range of possibilities			
SITE AGILITY			
Low (8) and high altitude (10600) RADAR (ft)	na	o	
North (65 deg) and South (13 deg) latitude	na	o	
West (67, 165) and East (127, 144) hemisphere	na	o	
With and without blockage	na	o	
VCP AGILITY			
Standard VCPs (list those tested)	tbd	m	
New VCPs (list those tested)	tbd	m	
Each weather mode	tbd	m	
Fast VCP	tbd	m	
Slow VCP	tbd	m	
1 m/s velocity quantization	tbd	m	
RDA EXCEPTIONS			
Antenna drift	superob	m	
400 radials	tbd	m	
Wide radials	tbd	m	
Elevation cut and volume restarts	tbd	m	
SPECIAL CASES			
Large time jumps (back and forward)	na	m	
Spot blanking	hi res vil	m	
Disabled moments	tbd	m	
REGRESSION TESTING			
Compare developed vs. implemented	depends	o	
Compare implemented vs. integrated	depends	o	
STABILITY	live	m	
BOUNDARY CONDITIONS DATA SETS			
RDA simulator tool	na	o	
Simulated cylindrical storms	VNV 01/01/90	o	
Moment	KCRI 03/08/00	o	
Dummy Load	KCRI 01/05/00	o	
SUPPLEMENTAL DATA SETS		o	
Widespread stratiform precipitation	tbd	o	
Winter storm	tbd	o	
Tropical storm	tbd	o	
Warm clear air	tbd	o	
Cold clear air	tbd	o	
Interoperability with external systems	na	o	

E-6 Adaptation and Configuration Data Matrices

Adaptation
Data Matrix

Application Name	

Parent window	
Window title	

Internal Data Name	GUI Name	Units	Precision	Range	Specific Values	LOCA

Configuration
Data Matrix

Configuration file name	

Data description	Name	Units	Precision	Range	Specific Values

Appendix F. Acronyms

AEL	Algorithm Enunciation Language
AFWA	Air Force Weather Agency
AWIPS	Advanced Weather Interactive Processing Systems
CCB	Configuration Control Board
CCR	Configuration Change Request
CM	Configuration Management
CPT&E	Computer Program Test & Evaluation
CODE	Common Operations and Development Environment
DAR	Design Approach Review
DoD	Department of Defense
ECP	Engineering Change Proposal
EO	External Organization
FAA	Federal Aviation Administration
FTP	File Transfer Protocol
GAB	Graphic Alphanumeric Block
HSEB	Hydrologic Software Engineering Branch
I&T	Integration & Test
IT&S	Information Technology & Services
ICD	Interface Control Document
IO	Implementing Organization
IRR	Integration Readiness Review
ITWS	Integrated Terminal Weather System
LL	Lincoln Lab
LOCA	Level Of Change Authority
MDL	Meteorological Development Laboratory
MIT	Massachusetts Institute of Technology
NCDC	National Climatic Data Center
NEXRAD	NEXt generation RADar
NWS	National Weather Service
O&M	Operations and Maintenance
OCWWS	Office of Climate, Weather, and Water Systems
OHD	Office of Hydrologic Development
OPUP	Open Principal User Position
OS&T	Office of Science & Techology
RADAR	RAdio Detection And Ranging
ROC	RADAR Operations Center
RPG	RADAR Product Generator
SCN	Specification Change Notice
SEC	Systems Engineering Center
SPB	Science Plans Branch
SREC	System Recommendation Evaluation Committee
SRS	Software Requirements Specification
SS	System Specification
TAB	Tabular Alphanumeric Block
TAC	Technical Advisory Committee
URC	Unit Radar Committee
VCP	Volume Coverage Pattern
VTC	Video Tele-Conference
WARP	Weather and RADAR Processor
WDTB	Warning Decision Training Branch
WSR-88D	Weather Surveillance RADAR 1988 Doppler
WWW	World Wide Web