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Proper Post Charge Regulator Alignment

The No Defect Found (NDF) rate of the Post Charge Regulator (PCR) 3A8, a part of the WSR-88D Transmitter, has been operating at an astounding 80 to 90% when field-rejected units are tested at the National Reconditioning Center (NRC). A ROC Engineering investigation recently conducted at NRC in Kansas City revealed the problem lies in the generation of false Post Charge Regulator alarms due to mis-alignment of the four potentiometers in the 3A8 which set the operational limits of the regulator circuit within the 3A8.

Post Charge Regulator 3A8 regulates the Pulse Forming Network (PFN) voltage by bleeding off charge from the PFN at the completion of the PFN charge cycle at a rate proportional to the difference between the instantaneous PFN voltage and a reference voltage within the regulator. This regulation provides a constant PFN voltage at the time the Modulator fires within 0.01% (1 part in 10,000). This degree of regulation is required to reduce the phase noise of the Klystron output in order to obtain 45dB of Clutter rejection. Since the regulator must operate over a large range of Pulse Repetition Intervals, the aforementioned potentiometers are switched into the circuit as required to stabilize the operating parameters of the regulator.

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What's Inside?

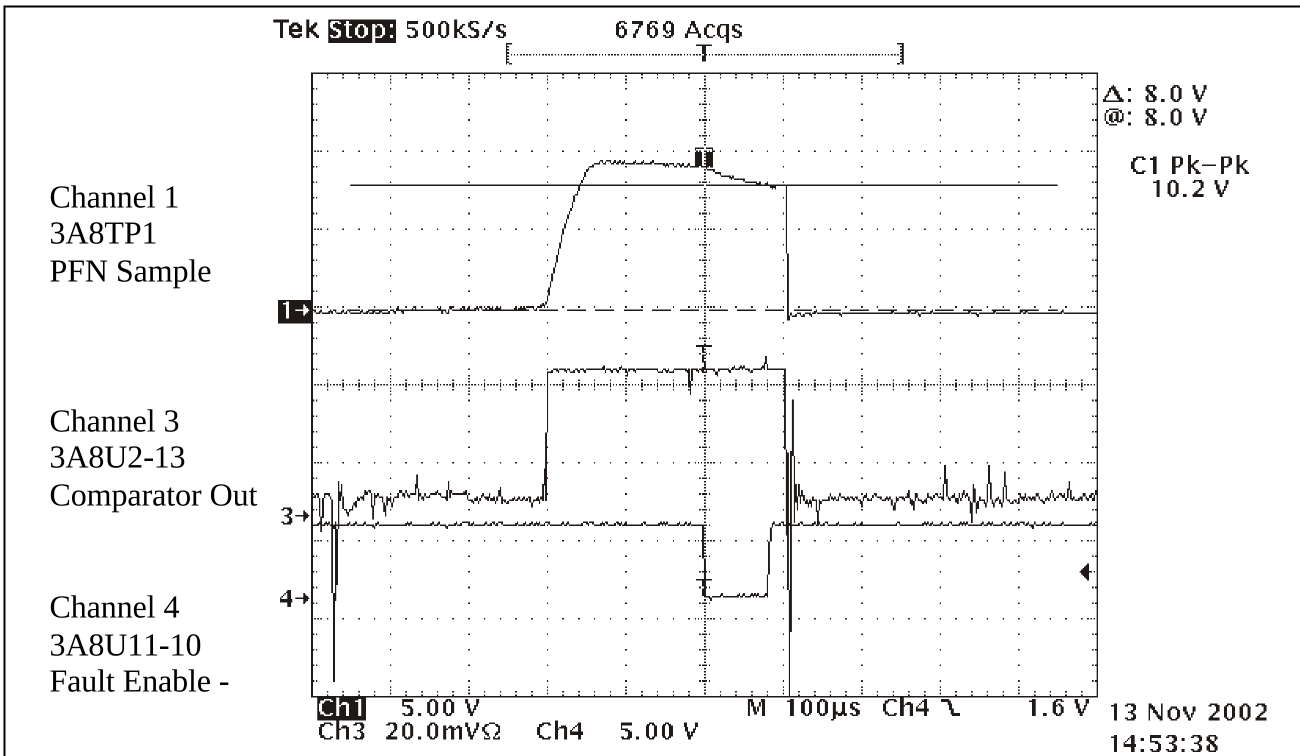

Figure 1: PCR Properly Aligned

Regulator Alignment

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The optimum performance, determined empirically, is obtained when the amplitude of the PFN sample voltage at 3A8TP1 is set to 8 Volts peak during PRF 5 at the time the Modulator fires. This is the adjustment level specified in the Transmitter Manual NWS EHB 6-511 Post Charge Regulator Alignment paragraph 7.8.6.3. Proper alignment is illustrated in Figure 1 Channel 1. The displayed channel is indicated in the figure by numbers followed by an arrow. A Built In fault detection circuit consisting of two comparators connected in parallel monitor the voltage at 3A8TP1 and declares a Post Charge Regulator fault if the voltage is larger than 10 volts or smaller than 0.5 volts during the time that the fault circuit is enabled. The enable signal is shown in Figure 1 Channel 4 trace. Note that the fault enable signal starts at the beginning of the regulation process and is seen as a dip in the TP1 signal that lasts for approximately 80 microseconds. The fault comparator output is displayed as Channel 3 scope trace. If the comparator output is outside the bounds of 0.5 to 10 volts, the comparator output will go negative. If this occurs while the fault enable signal is negative, a fault will be produced.

Now refer to Figure 2. Note the following:

1. TP1 (Channel 1) is adjusted to 9 volts at the time of Modulator firing instead of the required 8 volts.
2. TP1 is flat prior to the start of regulation and measures 10 volts. In this case, this voltage is slightly above the high end comparator limit, i.e., the regulator is over driven. Note that the comparator output, Channel 3, is negative for a short period while the fault detection circuit, Channel 4, is negative (i.e., enabled). This is the condition which causes the false Post Charge Regulator alarms and has led to the high NDF rate.
3. Referring back to Figure 1, note that the peak amplitude of TP1 prior to the start of regulation is only 9 volts instead of 10 volts as in Figure 2. This is below the upper fault limit as evidenced by the fact that the

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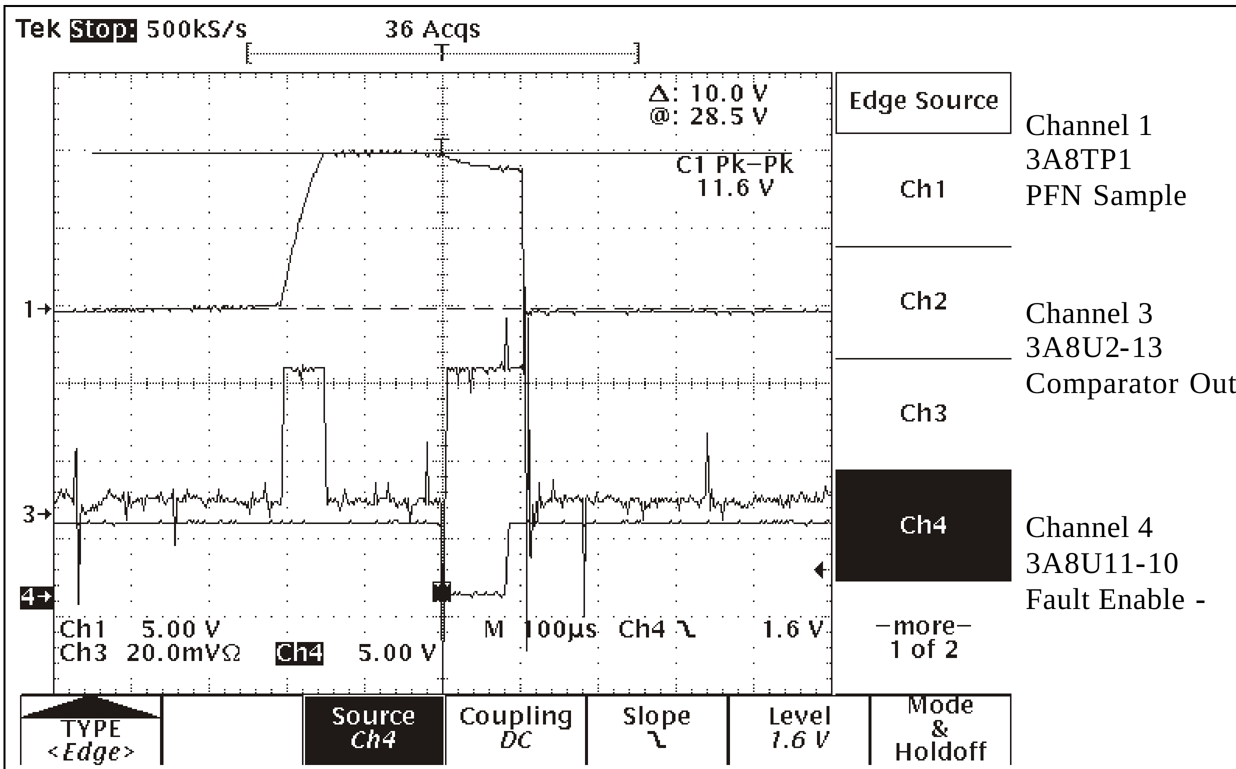

Figure 2: PCR Improperly Overdriven Causing Alarm

Regulator Alignment

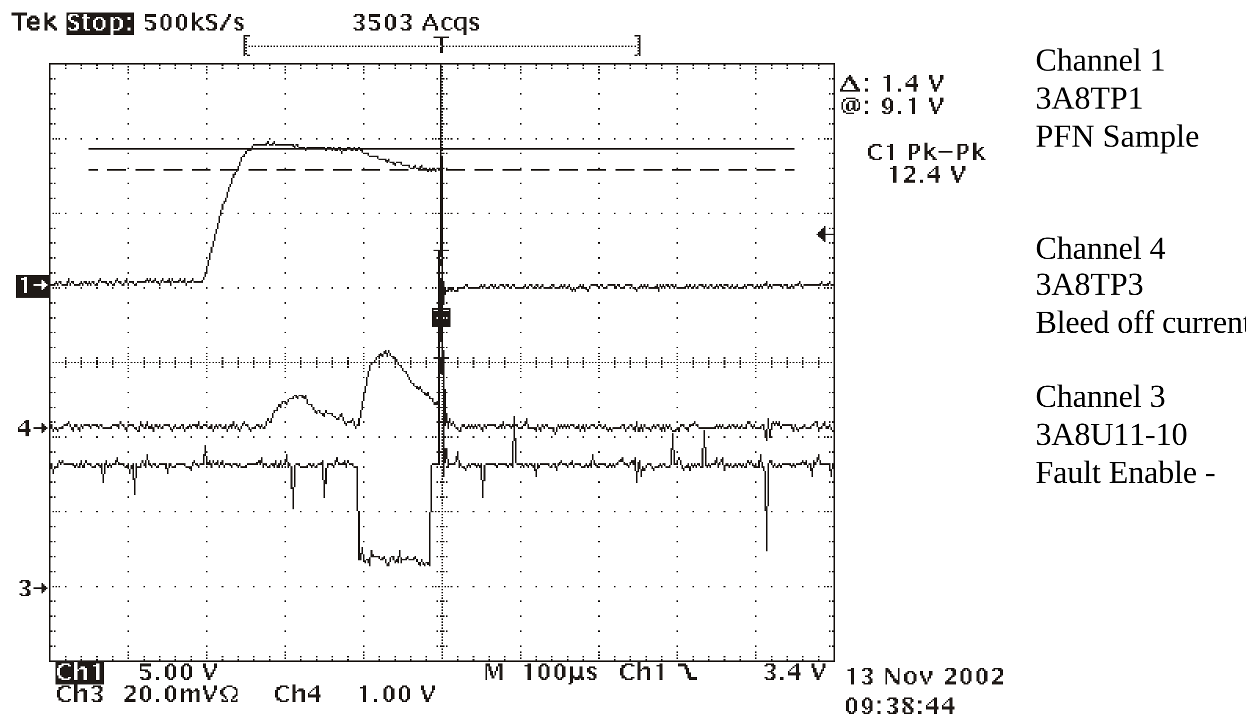

Figure 3: Perfectly Acceptable Bleed Off Current Condition

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comparator output is solidly positive during the positive portion of TP1.

Refer to Figure 3. Channel 1 is TP1, Channel 3 is the fault enable signal as before and Channel 4 is the waveform at TP3. TP3 is a measure of current in the regulator transistor. This current is the mechanism by which the charge on the PFN is bled off. Note that conduction of the bleed off transistor is indicated both before and after the start of regulation. This is okay and, indeed, desirable since conduction before regulation is the method by which excessive voltage at TP1 is reduced below the overdrive point before the fault circuit is enabled.

As illustrated by a comparison of Figure 1 and 2, the difference between the two conditions is subtle when only TP1 is viewed. However, this subtle difference is costing the Government considerable money and unnecessary maintenance actions in the field and at NRC. It is highly recommended that the alignment procedure per the tech manual, as augmented by the information in this article, be carefully checked before PCR's are rejected from the field. A Publication Change Request is in preparation to clarify the Transmitter tech manual procedure.

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NEXRAD Now is an informational publication of the WSR-88D Radar Operations Center (ROC).

We encourage our readers to submit articles for publication. The deadline for submission of articles for the upcoming issue is April 25, 2003. Please email all articles and comments to:

ruth.e.jackson@noaa.gov

All previous issues of *NEXRAD Now* can be viewed on the ROC Home Page at:

http://www.roc.noaa.gov/nnow.asp

Open Radar Data Acquisition Program

BACKGROUND

The Weather Surveillance Radar-1988 Doppler (WSR-88D) is one of the key underpinnings of the NWS Modernization effort begun more than a decade ago. The NEXRAD tri-agencies established the NEXRAD Product Improvement (NPI) Program shortly after the initial WSR-88D deployment. They recognized the need to update the system hardware and software to take advantage of new technologies. The ultimate objective is to achieve performance goals of the user agencies, including those NWS objectives developed in response to the Government Performance Results Act (e.g., increase tornado warning leadtime, reduce false alarm rate and improve detection accuracy).

The Open Radar Product Generator (ORPG) was the first WSR-88D sub-component to be developed and successfully deployed under NPI. Even while the ORPG was still in development, the National Severe Storms Laboratory (NSSL) began efforts on a Proof-of-Concept for the Open Radar Data Acquisition (ORDA) subsystem. NSSL demonstrated the Proof-of-Concept in May 2000, clearing the way for the initiation of the NPI ORDA Program. The NEXRAD Program Management Committee (NPMC) authorized a study of possible commercial alternatives in February 2002. In May of 2002, the NPMC accepted the recommendation to modify the ORDA Program approach to use the commercial SIGMET RVP8/RCP8 system. This article describes the program organization, technical aspects of the SIGMET ORDA, and current program status.

ORDA PROGRAM ORGANIZATION

The three agencies supporting NEXRAD are the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce, the Federal Aviation Administration (FAA) of the U.S. Department of Transportation, and the United States Air Force of the U.S. Department of Defense.

To create an orderly WSR-88D system evolution, the NEXRAD agencies established the NPI Program as a long-term program to plan, manage, and execute major improvements to the WSR-88D system. The NPI Program began in fiscal year (FY) 1993 as part of the NEXRAD Joint System Program Office (JSPO) Product Improvement (PI) Program. NPI moved to the NWS Office of System Development (OSD) in FY 1994 and subsequently became the responsibility of the Office of Science and Technology (OS&T) in the NWS restructure.

The contract for ORDA was awarded to RSIS, Inc., a Commerce Information Technology Solutions (COMMITS) Contractor, in July 2001. OS&T Program Management and Project Engineering staff are collocated with RSIS in Norman to provide timely and consistent program and technical direction. Focusing ORDA Program activity in Norman provides the opportunity to team with subject matter experts at the Radar Operations Center (ROC) and NSSL.

ORDA TECHNICAL ASPECTS

Earlier conference papers summarized RDA functionality and the components of the RDA subsystem to be replaced by the ORDA Program. Figure 1 illustrates the RDA architecture and those components being replaced. A subtle, but important characteristic of the ORDA Project using the SIGMET COTS solution is that the primary focus is on integration. Design is performed in the context of the SIGMET system and is constrained by the legacy technical environment. The agencies can realize project savings because less design work is required, but some of these savings are

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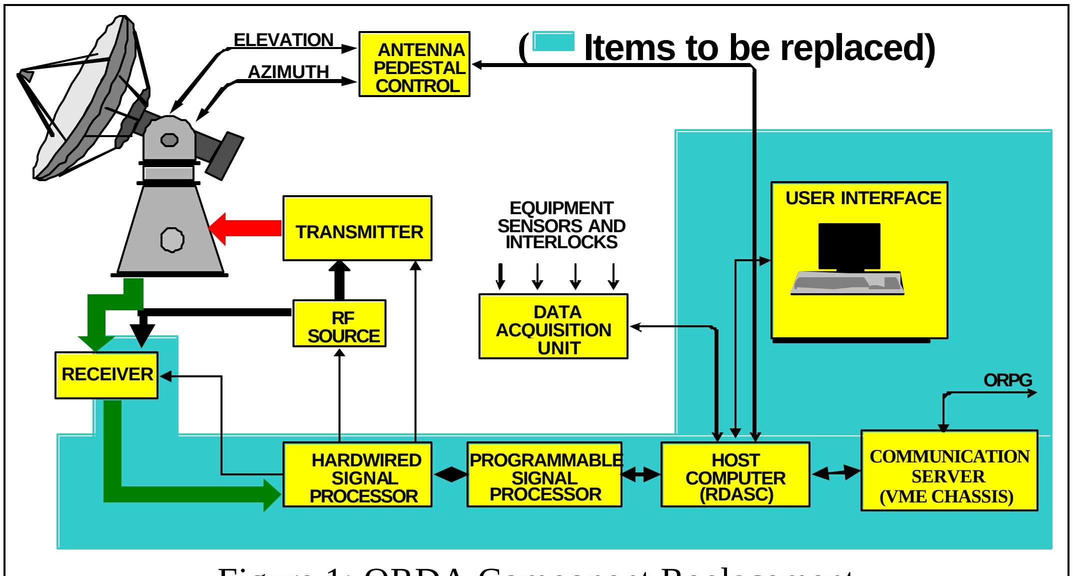

Figure 1: ORDA Component Replacement

ORDA Program

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offset by the effort to integrate a COTS product into the legacy operational system.

A significant change from the earlier proposed ORDA architecture is the inclusion of a digital receiver. The NPI Program had planned to replace the current analog receiver with a digital receiver as a part of a later integration project in the RDA (Dual Polarization). Supportability issues with the analog receiver, current receiver technology and immediate operations and maintenance cost drove the decision to proceed with a digital receiver. Inclusion of the digital receiver will simplify system calibration and reduce components, resulting in more consistent data quality and improved system reliability.

ORDA is composed of SIGMET's RVP8 Signal Processor/Digital Receiver, RCP8 Antenna/Radar Controller and Intermediate Frequency Digitizer (IFD). Both the Signal Processor and the Control Processor hardware use the same chassis, I/O card, and PCI-based single board computers (SBCs) with dual Pentium processors running the Linux operating system. Commercially-available processor technology make custom signal processor hardware and a real-time operating system unnecessary. RSIS is specifying commercially-available cables and simplified hardware interface panels. These steps will reduce the time required for installation, decrease the complexity of the installation, and make life-cycle support simpler and less expensive. This design also replaces the communications interface to the RPG with a communications server using TCP/IP, allowing the elimination of the outdated X.25 communications interface to the RPG.

The capability to infuse new science is an important requirement for ORDA. The SIGMET approach incorporates the Application Programing Interface (API), a collection of functions that defines an interface between SIGMET applications and user-developed applications. This API structure allows SIGMET to preserve their software baseline integrity and still provide flexibility in software development and maintenance. SIGMET's principal APIs are 1) the Interactive Radar Information System (IRIS) Antenna Driver and Built-In Test Equipment (BITE) API, supporting status, control and offline test customization, and 2) the RVP8 API, supporting the inclusion of user-developed signal processing algorithms.

An advantage of SIGMET software is it contains signal processing and control features that are targets for future RDA enhancements. These new features will be disabled in the initial deployment; the SIGMET implementation requires validation, and RPG and display software may require modification. However, SIGMET provides a roadmap, if not a solution for future RDA technical improvements.

RSIS is developing the operator interface application and will utilize the IRIS API. The Human-Computer Interface (HCI) will be a Java-based application, permitting rapid implementation of an interface for local and remote users. The new HCI will replace the current command line interface with a more graphical presentation, but retain similar terminology and functional performance.

Another key objective of the ORDA Project is to improve supportability and reliability. The new system will allow the elimination of 48 receiver and processor assemblies and 131 cables. Preliminary data indicates the new ORDA components are more reliable and less expensive than the components they replace.

PROGRAM STATUS

The initial technical focus was to quickly become familiar with the SIGMET signal processor and control processor. Hardware testing, vendor training, requirements analysis, and technical interchange meetings became the order of the day. With the redirection to the SIGMET solution, the Government and the Contractor had to review and revise the plan for Program performance.

Pending the availability of SIGMET RVP8/RCP8 products, RSIS and SIGMET have pursued integration efforts using SIGMET's precursor products, the RVP7 and RCP2. Many of the fundamental characteristics of these systems are the same, allowing integration pathfinding to occur. With the cooperation of the ROC, RSIS and SIGMET utilized an RDA testbed to explore integration and design issues. Because this testbed does not control a pedestal or radiate from an antenna (radiating into a dummy load instead) this pathfinding effort was necessarily constrained, but was sufficient to support significant progress. Over a five-week period in June and July of 2002, RSIS and SIGMET installed and tested all lines to/from the radar, with the exception of RF test signal pulse sampling. This effort included demonstration of such critical functions as transmitter control, Data Acquisition Unit and Data Control Unit communications. Because time on a radar is so important to the integration effort, we are working with the ROC and

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ORDA Program

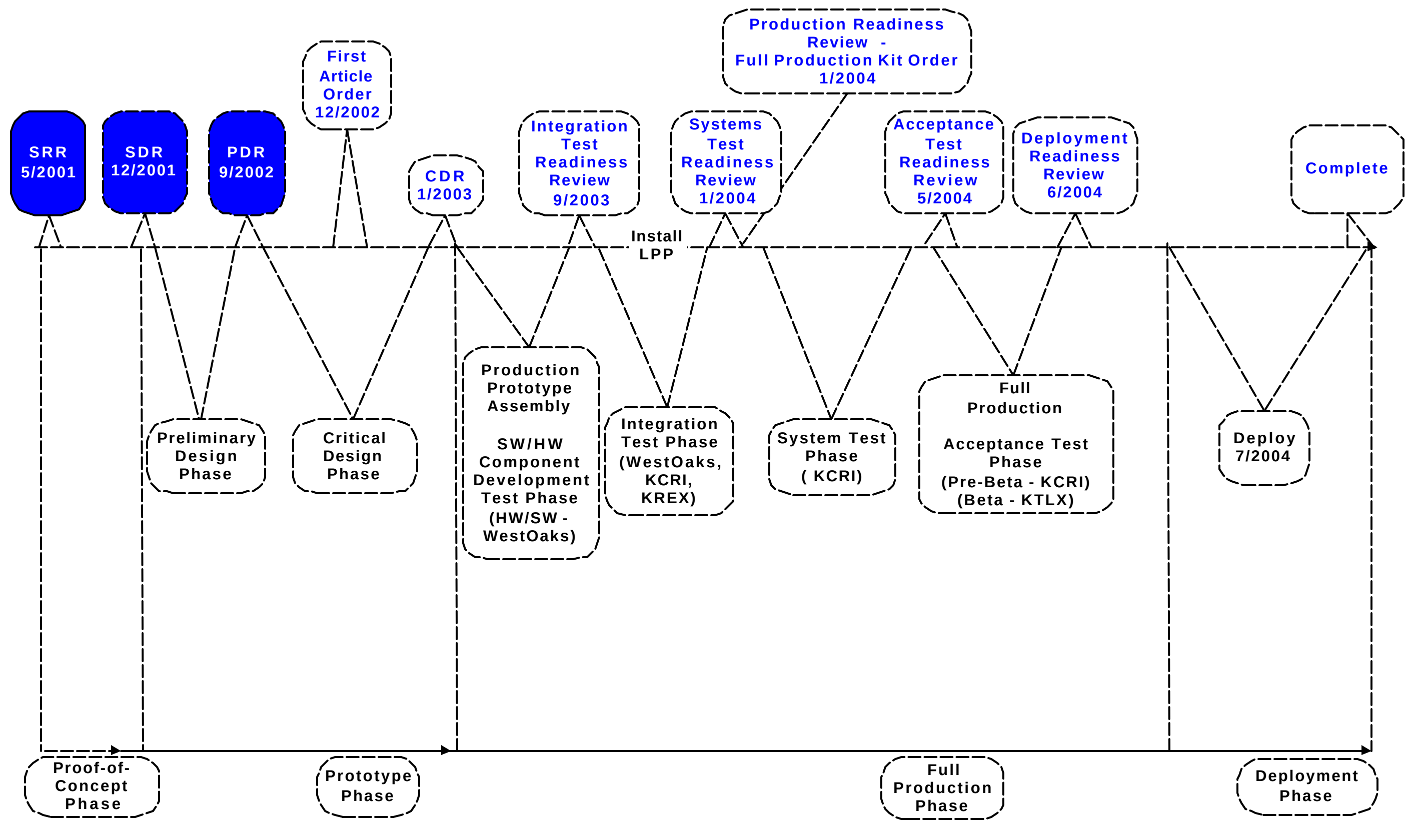

Figure 2: ORDA Program Schedule

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NSSL to develop options that will allow more access to a fully operational WSR-88D.

Other activities key to the Program redirection include familiarization of ROC, RSIS, and OS&T's technical staff with SIGMET. This training equips the staff with the knowledge to accomplish the required development, integration, and better understand how SIGMET fulfills WSR-88D requirements.

Requirements traceability throughout the various phases of the program are central to validating the SIGMET ORDA is successfully integrated into the WSR-88D. Technical interchange meetings among subject-matter experts from SIGMET, RSIS, ROC and NSSL are regularly scheduled to ensure a common understanding of the performance of the legacy RDA, and how the ORDA will meet or exceed the level of legacy performance.

The Program redirection focused on integration of COTS equipment and software instead of development motivated a change to the Program phase structure (see Figure 2). Much of the required development and design activity have been subsumed under the prototype phase. (The Program is in the prototype phase, conducting a successful PDR in September 2002). Testing and production readiness activities occur in the full production phase, with the deployment phase scheduled to begin in the Summer of 2004. A prime objective is to deploy ORDA sub-systems to those sites most affected by the severe weather season by Spring 2005.

Greg Cate
OS&T
NEXRAD Product Improvement, Program Leader

RPG Serial PPP Upgrade

In April 2003, Mod Note 65 will be sent to all RPG sites. This change will convert one dial-in port on the RPG from X.25 to Point-to-Point Protocol (PPP), as well as, four dedicated ports for DoD and FAA RPGs and five dedicated ports for NWS RPGs.

Later in 2003, the converted connections will be used by the DOD, as Air Force Weather Agency (AFWA) deploys Spiral II of the radar ingest and display program called Open Principal User Processor (OPUP). The improved OPUP uses a TCP/IP ingest application, which is also currently used by AWIPS for the LAN connection to the NWS radar. The PPP upgrade does not change telecommunications service for OPUP connections to the RPG. The connection is still plain old telephone service (POTS), and will require analog modems on each end. However, conversion does lay the foundation of software and network capable hardware, which can be evolved in the future to a more cost effective and better performing digital WAN service for DoD.

Sallie Ahlert
ROC Engineering Branch

Fuel Tank Anti-fouling Guidance

Two years ago, the RDA site at Shreveport, LA experienced a growth of fungus and bacteria in the generator fuel tanks. The biological activity was a result of water in the tanks and caused severe corrosion, which required replacement of the tanks. The Radar Operations Center (ROC) is concerned that other sites may have a similar problem of which they are unaware.

Another problem sites may encounter is aging fuel. Fuel that remains in the tank for over a year may oxidize, forming sediment in the tank and varnish deposits in the engine, resulting in poor generator performance. Fuel in some generator tanks could be over three years old. With the Transition Power Supply (TPS) installed to prevent power outages, generators are running less and using less fuel. Therefore, fuel aging is more likely to be a problem.

Since each site has a different fuel-storage environment and different fuel tank maintenance services available, the ROC has prepared guidance to help prevent and solve problems with water accumulation, biological fouling, and aging fuel in RDA and WFO fuel tanks. The guidance includes a list of fuel tank anti-fouling options. These options can be used to develop an anti-fouling plan that fits the needs and budget for each individual site. A list of resources is also included to aid in implementing the anti-fouling plans.

A tank infected with a fuel fouling fungus.

The ROC recommends discussing these issues with the sites' fuel supplier. Have the tanks inspected for water and biological fouling before the next fuel delivery. It is important to discover what fuel tank maintenance services are available locally, and whether additives are already in the fuel.

For a copy of the Fuel Tank Anti-fouling Guidance, please ask the regional Facilities Manager, or the WSR-88D Hotline.

Don Sander
RSIS/ROC Engineering Branch

RPG Upgrade for Frame Relay or Digital Communications

NWS host sites for DoD/FAA distant MSCFs, are you hungry for a distant MSCF that behaves like your local MSCF? Do you wish for a high speed AWIPS connection for the DoD/FAA NEXRAD radar(s) in your coverage area? An upgrade project is underway to improve service performance for NWS distant MSCF users and their remote dedicated AWIPS connections. ROC engineering is developing a frame relay interface to make this happen.

Frame relay is a proven packet technology, which has been widely used in private corporate networks throughout the world in the past decade. It supports corporate data and LAN traffic, but it also has been used successfully for Internet and voice. Frame Relay is designed to eliminate much of the overhead associated with older packet switching technologies, such as X.25 (which is currently used in NEXRAD). Frame Relay allows multiple virtual circuits (VCs) for logical separation and routing of different data streams. For our application, VCs will be sized to provide at least double the current bandwidth as compared to the existing analog AWIPS and distant MSCF circuits. The application software, in conjunction with certain features of TCP/IP, will be designed to provide end-to-end reliable connections on both data streams.

The current plan will initially target select locations, which have multiple connections between two NEXRAD sites. Examples include the Honolulu WFO, which is a host site to four FAA distant MSCFs. This same WFO also receives an AWIPS feed from each of the four FAA NEXRAD radar RPGs. The goal of the upgrade is to reduce recurring telecommunication costs, improve connection performance, and possibly reduce the NEXRAD equipment footprint at the WFO. While the current plan does not address conversion of all NEXRAD analog lines, the hardware will be installed in each ORPG router to support future NEXRAD communication improvements.

Since this modification may precede expansion of the AWIPS WAN, there may not be an immediate increase in the number of routine radar products available from the DoD/FAA radars. Increases will be incremental as AWIPS changes are made to accommodate additional traffic from these radars.

Christina Horvat
ROC Engineering Branch

Digital Videos Supplement Electronic Tech Manuals

The ROC is producing digital videos on CD-ROM to demonstrate complex and infrequently-performed maintenance procedures. The videos include closeups revealing fine detail to clearly illustrate each step. Step numbers superimposed in the corner of the screen match the video with the text version of the procedure. Technicians can quickly locate specific topics by scanning the video while viewing the step numbers. (Photo)

Screen shot from technical manual video.

The first two CD-ROMS, scheduled for February release, include nine videos. Volume 1 covers the Noise Path and Noise Source Calibration in EHB 6-510. Volume 2 demonstrates the Receiver Channel Alignment in EHB 6-510. Subsequent videos will include the RF Drive Path and CW Test Path Calibration.

When DVD becomes a standard, future releases of electronic tech manuals will include movie icons identifying procedures available in video format. Ultimately, an integrated package of text and video will be possible.

Dan Purcell
ROC Program Branch