12B.2 PLANNED WSR-88D IMPROVEMENTS

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1. INTRODUCTION

There are two different entities within the National Weather Service (NWS) with responsibilities to lead modifications for the Nation's Doppler Weather Radar network, the Weather Surveillance Radar-1988 Doppler (WSR-88D). The Office of Science and Technology (OST) is responsible for long term programs aimed at upgrading major portions of the WSR-88D to support new science. A division in the NWS Office of Operational Systems, the triagency Radar Operation Center (ROC), is responsible for WSR-88D operations and maintenance upgrades to replace obsolete parts or components, to upgrade hardware when projected requirements exceed projected capacity and to integrate and issue new WSR-88D software builds. The ROC and OST coordinate the enhancements ROC should implement once a major OST upgrade is complete. These proposals are considered by the NEXRAD stakeholder agencies (NWS, FAA, and DoD) for funding and final deployment approval. The purpose of this paper is to outline major WSR-88D upgrades the ROC plans over the next eight years. OST upgrades, know as Next Generation Radar (NEXRAD) Product Improvement (NPI), are the subject of a separate paper.

2. OVERVIEW OF ROC PROCESS

The ROC currently proposes eight major upgrade projects over the next eight years. In addition to these major projects, the ROC will implement minor projects or system upgrades as they are needed. Each major project has three distinct phases that correspond to the funding needed to support each phase. Projects can be implemented sooner or later than described in this paper, the time frame being dependent on funding availability for each project phase.

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(1) In the first project phase, ROC engineering staff investigate candidate hardware and perform development test and evaluation (DT&E) to determine what candidate solutions best meet project requirements. Results of this phase are presented to the NEXRAD agencies to obtain approval to move to production/deployment.

(2) Once initial engineering evaluation is complete, engineers finalize an engineering change proposal and work with other ROC staff to perform field tests on the selected hardware. Normally, this means selecting a few "beta" test sites where the new hardware will be installed to test system compatibility in an actual operational environment. Beta test is also used for installation procedure evaluation to ensure procedures are easily understood by installation staff, whether installers be local maintenance personnel or specialized installation teams.

(3) Once field tests are complete, ROC Retrofit Management Staff oversee the deployment of the new hardware. The deployment may be a fleet wide retrofit installed at one time by field maintenance staff, a phased installation by specialized installation teams, or a replacement on an "as needed" basis as old hardware fails or is found to be beyond the limits of cost effective repair.

3. DESCRIPTION OF ROC WSR-88D PROJECTS

The following describes the eight major WSR-88D proposed projects currently planned by the ROC.

Radar Signal Design Enhancements: Doppler meteorological radar systems exhibit some data quality issues and ambiguities that hamper operations, especially severe weather warnings and precipitation estimates. Among the most problematic of these is the so-called "Doppler dilemma" where the unambiguous range and velocity estimates are related to the selection of transmitted pulse repetition rate. This results in signal design trade offs that do not optimize performance in either range or velocity data. The ROC is working with the National Center for Atmospheric Research (NCAR) and the National Severe Storms Laboratory (NSSL) to develop enhanced radar signal designs to mitigate this problem. The candidate techniques call for additional hardware, such as phase shift controllers, and increased signal processing capability. The project provides for field testing in FY05

and deployment in FY07 and FY08. Because of the ongoing NPI upgrade of the WSR-88D Radar Data Acquisition (RDA) subsystem and the follow-on Dual Polarization upgrade, this project must be coordinated with NPI implementers and must be implemented after the RDA upgrade.

TCP/IP Communications: To increase severe weather warning lead times to the public, the NWS approved a requirement to transfer high-resolution products from WSR-88Ds into the NWS primary forecasting and warning display computer system, Automated Weather Information Processing System (AWIPS). By July 2002 all NWS WSR-88Ds had a high speed LAN-to-LAN interface between AWIPS and NWS owned WSR-88Ds. Department of Defense (DoD) and Federal Aviation Administration (FAA) radars at critical locations still lacked the necessary hardware interface to pass key high resolution products. FY03 funds were made available to install a digital interface at all WSR-88Ds. Once installed in the summer of 2004, NWS AWIPSs will receive high-resolution products from all WSR-88Ds in the continental United States, Alaska, Hawaii, Puerto Rico and Guam via the new digital interface.

RPG Distributed Processing: In past budgets, the ROC proposed a replacement of Radar Product Generator (RPG) Computer Hardware. This project has undergone significant changes. With RPG software builds 4, 5, and 6 in the planning phase, it is apparent the existing RPG processor will reach full capacity sooner than expected. The projection is that additional processing will be needed in FY 05 for RPG build 7 or 8. Rather than replacing the RPG processor, it is possible the existing processor will be kept intact and a new processor will be added in a distributed processing mode. Consideration is being given to using RED HAT LINUX based PCs since other NWS systems are converting to PC/LINUX hardware. The title of the project has been changed from “RPG Replacement” to “RPG Distributed Processing” and the proposed deployment has been accelerated from FY07-08 to FY05.

RPG Local Area Network (LAN) Switch: Since the WSR-88D is based on commercial hardware, some hardware changes are driven by commercial venders ceasing production of various hardware lines. Experience with commercial computer equipment shows that finding replacement parts for obsolete equipment becomes problematic after approximately five years. The RPG LAN switch is such a case. The LAN switch is no longer manufactured, can no longer be purchased and is approaching its “end of life.” RDT&E and prototype testing for a LAN switch replacement is needed in FY05 with system-wide retrofit in the FY06 time frame.

Composite Radome: Composite materials are now being used for a variety of applications. The DoD is testing the suitability of composite materials for various radome applications, equipment shelters and towers. Composite radomes represent a great potential for cost-avoidance and improved supportability since radomes constructed of composite materials theoretically can withstand severe weather events, such as high winds and severe hail, better than current WSR-88D radome materials. The ROC expects to leverage on DoD work in this area to determine if composite radomes are actually viable for WSR-88D application. Current plans call for modest investment in FY05 and FY06 to study new composite radomes for increased system reliability and reduced maintenance costs, although this work may be accelerated if funding is available. If initial study results are favorable, ROC engineering will purchase one radome for more stringent WSR-88D testing. Should tests be successful, the ROC expects a field test in FY08 and FY09. No fleet-wide retrofit is planned. Rather, the goal is to qualify a new radome technology so future radome replacements-due to hail, severe weather or overall radome aging and deterioration-will use composite technology. The expectation is gradual radome replacements because of aging will begin in FY10 and continue through FY20. At this time, the ROC has no plans to invest in composite tower technology. If future DoD work in this field appears applicable to WSR-88D application, a new composite tower project could be initiated to support coastal radars where corrosion is a concern.

Composite Shelters: WSR-88D’s located near oceans have a higher incidents of corrosion on towers and shelters than continental locations. Using composite shelters to replace badly corroded shelters at these sites could provide a considerable life cycle cost savings. The composite shelter project is similar to the composite radome project in that the ROC intents to leverage from DoD work and investigate the applicability of composite shelters for use in high corrosion environments. The current plan is to investigate composite shelter technology in FY05, FY06, and FY07. If proven, the ROC will subject a WSR-88D type composite shelter to independent testing. Assuming results are favorable, the ROC will survey all sites located in corrosive environments and determine those needing replacement on a time phased basis. Procurement is expected to begin in FY 10 and 11. Engineering estimates that approximately 20 WSR-88D sites eventually may need shelter replacement.

Transmitter Upgrade: This project provides for the upgrade or replacement of the WSR-88D trigger amplifier and modulator assemblies in the transmitter. The project will capitalize on advancements in technology that allow elimination of high voltage levels currently used in the trigger amplifier and modulator assemblies. Such technology is expected to increase reliability and maintainability, saving an estimated $300,000 per year in repair costs. The modification will also replace transmitter parts reaching end of life. The project will begin with a design study in FY03 and a demonstration on an existing WSR-88D transmitter in FY04. Production kit development is planned to take

place during FY05 with final acquisition and deployment in FY06.

Replacement of RDA Computer Hardware: Even though the Open Radar Data Acquisition (ORDA) is not yet deployed, the ROC must plan for the eventual replacement of that hardware. Experience shows commercial computer equipment reaches end of life and requires replacement approximately five or six years. Additionally, advances in new technology will likely require that the ORDA backplane be replaced at the same time. Current planning calls for initial investigations on ORDA replacement to take place in FY09 with deployment in FY10 and FY11. The project scope currently includes replacement hardware for the Sigmet processor, PC bus, software, storage devices, and input/output devices.

A summary of the project time frames is shown in the following table:

Modification Title	DT&E	Field Tests	Deployment
	Fiscal Year	Fiscal Year	Fiscal Year
Radar Signal Design Enhancements	FY 02-04	FY 05	FY 06-07
TCP/IP Communications	FY 01-02	FY 02	FY 02-04
RPG Distributed Processing	FY 04	FY 04	FY 05
RPG LAN Switch	FY 05	FY 05	FY 06
Composite Radome	FY 05-09	FY 10	FY 11-20
Composite Shelter	FY 05-07	FY 08-09	FY 10-11
Transmitter Upgrade/ Replacement	FY 04-05	FY 06	FY 07-08
Replacement of RDA Computer Hardware	FY 09	FY 10	FY 10-11

Table 1: Expected Project Time Frames

4. SUMMARY

The ROC maintains a WSR-88D modification plan with an associated eight year budget projection. At this time, eight major upgrades are planned for the WSR-88D as described in this paper. In addition to these upgrades, the NWS OST has a separate plan and budget that address larger scale hardware upgrades and software needed to support future WSR-88D scientific advances.