# SYSTEM TEST PLAN

# for the

## Radiosonde Replacement System (RRS)

**July 2003**

**U.S. DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
**National Weather Service/Office of Operational Systems**
**Field Systems Operations Center/Test and Evaluation Branch**

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## Acronyms

| | |
|---|---|
| $A_s$ | System Availability |
| AWIPS | Advanced Weather Interactive Processing System |
| BILS | Balloon Inflation and Launch Shelter |
| BIT | Built-In-Test |
| BWWFO | Baltimore, MD/Washington, DC Weather Forecast Office |
| CCB | Configuration Control Board |
| CLIMAT | NWS Monthly Site Upper Air Summary Product |
| COTR | Contracting Officer's Technical Representative |
| COTS | Commercial Off-The-Shelf |
| CDU | Control Display Unit |
| ERH | NWS Eastern Region Headquarters |
| EMRS | Engineering Management Reporting System |
| ESA | Electronics System Administrator |
| FTP | File Transfer Protocol |
| GPS | Global Positioning System |
| GUI | Graphical User Interface |
| hPa | Hecto-Pascal |
| km | Kilometer |
| kts | Knots |
| LDAD | Local Data Acquisition Device |
| LRIP | Low-Rate Initial Production |
| LRU | Line Replaceable Unit |
| LWX | National Weather Service identifier for the BWWFO. |
| MIC | Meteorologist-In-Charge |
| NCDC | National Climatic Data Center |
| NCEP | National Centers for Environmental Prediction |
| NCF | (AWIPS) National Control Facility |

| | |
|---|---|
| NHDA | NWS Headquarters Development AWIPS |
| NLSC | National Logistics Support Center |
| NRC | National Reconditioning Center |
| NMTW | NWS Headquarters Modernization Test and Integration AWIPS, WFO |
| NWS | National Weather Service |
| NWSO | National Weather Service Observing |
| NWSTC | NWS Training Center |
| NWSTG | NWS Telecommunication Gateway |
| OAT | Operational Acceptance Test |
| OBIT | Offline Built In Test utility suite |
| OMS | Offline Maintenance Suite |
| OPS11 | NWS Engineering and Acquisition Branch |
| OPS12 | NWS Maintenance Branch |
| OPS13 | NWS Configuration Branch |
| OPS22 | NWS Observing Systems Branch |
| OPS23 | NWS Software Branch |
| OPS24 | NWS Test and Evaluation Branch |
| OS7 | NWS Observing Services Division |
| OST11 | NWS Program Management Branch |
| OST31 | NWS Analysis Branch |
| PAMS | Product Availability Monitoring System |
| PCA | Physical Configuration Audit |
| PDB | Precision Digital Barometer |
| RH | Relative Humidity |
| RMA | Reliability, Maintainability, and Availability |
| RRS | Radiosonde Replacement System |
| RSIM | RRS System Integration Manager |
| RSOIS | Radiosonde Surface Observation Instrumentation System |

| | |
|---|---|
| RWS | RRS Workstation Subsystem |
| SIR | System Issue Report |
| SIT | System Integration Test |
| SRS | System Requirement Specification |
| SPS | Signal Processing System |
| SR&DC | Sterling Research and Development Center |
| ST | System Test |
| S/W | Software |
| TRG | Test Review Group |
| TRS | Telemetry Receiving System |
| UPS | Uninterruptible Power Supply |
| UTC | Universal Time Coordinated |
| WFO | Weather Forecast Office |
| WMO | World Meteorological Organization |
| WSH | National Weather Service Headquarters |
| WSOM | Weather Service Operations Manual |
| XDP | External Data Pump |

## 1.0 Introduction

The National Weather Service (NWS) will transition from the current radiosonde system into the new Radiosonde Replacement System (RRS) to collect and process upper air data using modern technology. The RRS will be nationally deployed after the government successfully completes a series of tests, the last two of which will be the System Test (ST) and the Operational Acceptance Test (OAT).

This plan describes the government tests performed during the ST. The ST will verify the RRS conforms to:

a. Federal Meteorological Handbook No. 3.

b. The RRS Workstation Subsystem (RWS) System Requirement Specification (SRS).

c. The RRS Concept of Operation performance standards.

In addition, the ST will verify NWS installation procedures for the RRS prior to commencing the OAT. The ST will be performed at the National Weather Service Headquarters (WSH) located in Silver Spring, Maryland; the NWS Sterling Research and Development Center (SR&DC) located in Sterling, Virginia, and the Baltimore, MD/Washington, DC Weather Forecast Office (WFO-LWX) also located in Sterling, Virginia. Assistance will be provided by the NWS Training Center (NWSTC) located in Kansas City, Missouri; the National Centers for Environmental Prediction (NCEP) located in Camp Springs, Maryland; and the National Climatic Data Center (NCDC) located in Asheville, North Carolina.

A ST Test Review Group (TRG) (see Section 1.5) will be established for the duration of the RRS ST. The group will coordinate issues and classify and resolve any problems identified during the ST. This group will review the ST activity reports, forms, and System Issue Reports (SIRs). They will also provide NWS management with a recommendation whether to proceed to the OAT.

## 1.1 Test Plan Organization

This ST plan is composed of two sections. Section 1 contains introductory material on the RRS major components and presents the test strategy, test objectives, and test prerequisites.

Section 2 describes the schedule and methodology for conducting the ST, the facilities employed, pre- and post-test activities. This section also contains information on test personnel and their responsibilities.

## 1.2 RRS Subsystems

The RRS consists of the following major subsystems:

a. Radiosonde Surface Observation Instrumentation System (RSOIS) and Precision Digital Barometer (PDB) – collects pre-release surface data.

b. Telemetry Receiving System (TRS) and associated Uninterruptible Power Supply (UPS) – tracks the Global Positioning System (GPS) radiosonde and receives radiosonde telemetry signal; the UPS allows radiosonde tracking and data collection to continue in the event of local power failure.

c. Signal Processing System (SPS) – translates the telemetry signal into displayable upper air parameters, both received and processed.

d. RWS – allows RRS operators to receive and process data from the TRS, SPS, RSOIS, and PDB. The RWS also controls the TRS, displays raw and processed data, and disseminates formatted products to the Advanced Weather Interactive Processing System (AWIPS). The primary software under test will be RWS Build 1.0.3.x (where "x" is an incremental software update). After the ST, the approved build delivered to the OAT sites will be designated as 1.1.

e. GPS radiosondes - allow upper air wind direction and speed to be determined from differential triangulation data transmitted by the 24-satellite GPS constellation. (Note: Due to algorithm implementation and production schedules, the initial ST and OAT will only use Sippican GPS radiosondes. A new ST and OAT will be conducted each time a new vendor's radiosondes become available or new algorithms are implemented.)

A possible future component to the RRS is a new Balloon Inflation and Launch Shelter (BILS). The BILS will be tested during a future ST when introduced.

## 1.3 Objectives

The purpose of the ST is to verify the RRS is fully functional, reliable, and ready for operational testing and installation at the OAT sites. The ST must meet the following objectives under *simulated* and *controlled* operational conditions (refer to Attachment D for evaluation methods):

a. Assess the RRS installation process (during ST Phase II - see Section 1.4.2).

b. Validate RWS system-level functional requirements.

c. Exercise all RRS subsystem interfaces to other NWS systems [e.g., the Advanced

Weather Interactive Processing System (AWIPS)/Local Data Acquisition Device (LDAD)].

d. Collect performance data for evaluating meteorological algorithms including solar radiation correction and generation of coded messages (evaluated by OPS22 and OS7).

e Collect data for use during the Reliability, Maintainability, and Availability (RMA) analysis using the Engineering Management Reporting System (EMRS).

f. Validate simulated end-to-end functionality (during ST Phase I - see Section 1.4.1) as well as an actual (during ST Phase II) end-to-end test at an operational site.

g. Assess the operational usability of RRS-generated data and products by a limited set of operational forecast applications.

Refer to Section 2.3.5 for the evaluation criteria of the above test objectives.

### 1.4 System Test Strategy

A successful System Integration Test (SIT) of the RRS is a prerequisite to the start of the ST. Transition from the SIT phase to the ST phase will occur in the following manner.

Prior to beginning the ST, the ST Director ( see Section 2.3.1.4) will send an e-mail to all RRS participants announcing an ST Readiness Review which will serve as a formal transition from the SIT to the ST. The e-mail will contain a list of items (hardware, software, and documentation) needed to begin the ST. The list will also include personnel responsible for providing for items from the list at or before the ST Readiness Review. The ST Readiness Review will be attended by the ST Team [composed of OPS22, OPS24, OS7, OST31, the NWS Telecommunications Gateway (NWSTG), and the NWSTC], all RRS subsystems Contracting Officer's Technical Representatives (COTRs), Regional Focal Points, RRS System Integration Manager (RSIM), and the RRS Program Manager.

At the ST Readiness Review, the RSIM will provide the ST Director with:

a. The RRS configurations and software versions used during the SIT,

b. Firmware versions contained in each RRS subsystem,

c. Line Replaceable Unit (LRU) version numbers), and

d. A list of any outstanding deficiencies and their respective work-arounds.

During the ST, the RRS TRG will meet weekly or as called by the ST Director if a Priority 1 or 2 SIR is found (refer to Section 1.5 for a definition of SIR priority levels). The TRG will discuss progress and adjudicate any problems found. All problems will be segregated into either hardware, radiosonde, or RWS software related issues. If the problem is major (i.e., a hardware or software problem which cannot be repaired within a reasonable time) and occurs between scheduled TRG meetings, the ST Director will convene an emergency TRG. The TRG will decide whether the ST should be suspended or continue. (Note: The RRS Program Manager is a voting member of the TRG.)

Hardware problems will be adjudicated by the TRG and submitted to the RRS Configuration Control Board (CCB) for resolution. If warranted, the TRG will suspend the ST pending repair. When a hardware issue is resolved, the respective hardware COTR will report the fix to the RRS CCB. The RRS Program Manager will then inform OPS24 the system is ready for testing to resume. For other hardware problems, the ST will continue while the RRS CCB determines how and when the problem(s) should be resolved.

RWS software problems will be submitted to the RWS CCB for adjudication. All critical problems (SIR Priority 1 and 2 - see Section 1.5 for definitions) will be provided to the RWS contractor for immediate resolution. Once the Priority 1 or 2 SIR is resolved, the RWS COTR will notify the RRS Program Manager of the revised software build's availability. The RRS Program Manager will provide the revised RWS software build to the ST Team for installation in the RWS test systems. For non-critical software problems, the ST will continue while the RWS CCB determines, after prioritization, how and when the problem(s) should be resolved. In addition, the RWS CCB will determine which future software build will contain the fix and when it will be distributed.

### 1.4.1 ST Phase I

The ST will be conducted in two phases with Phase I having two parts ("1A" and "IB"). The following sections discuss the requirements for each phase of testing.

ST Phase IA will verify the functional software requirements from the RWS Software Requirements Specification have been met to the satisfaction of NWS Management.

ST Phase IB will simulate operational use of the RRS and will commence after successful completion of Phase IA and prior to testing the RRS at an operational field site.

Phase IA will be conducted using pre-recorded upper air flights played through an External Data Pump (XDP) connected to a RWS located in the OPS24 test facility at WSH in Silver Spring, Maryland. The pre-recorded data sets will simulate various upper air meteorological conditions and "Check Message" verification. Simultaneously, up to three real time or "live" upper air flights a day will be conducted at the SR&DC, using the RRS defined by the RSIM and provided to OPS24. ST Phase IA will use Lot 2 pre-production radiosondes while Phase IB will use Lot 3 low-rate initial production (LRIP) radiosondes (the same radiosondes being delivered

to the OAT sites) as well as possibly an SPS with updated firmware. The updated SPS firmware, if necessary, will contain corrections to problems discovered in prior testing. In addition, field personnel will be present during the final month of Phase IB (see below) to exercise the RRS in a "continuous," simulated operations mode using live flights.

In both phases of the ST, test upper air products will be routed from the local AWIPS to NCEP for content and format evaluation and usability in NCEP's upper air models. In addition, flight archive information will be forwarded to the NCDC for format evaluation and its usability with NCDC-derived products. Both NCEP and NCDC will also provide performance data for inclusion in the performance measures. The NWSTC will employ the "Offline Maintenance Suite (OMS)" to verify their RRS Maintenance Course material.

See Section 2.3.3, Test Conduct, for additional information on how the ST Phase I will be performed.

#### 1.4.1.1 ST Phase IA

Phase IA will consist of performing a series of test procedures (see Attachment A) to exercise the full range of RRS functionality under a variety of simulated and live environmental conditions. Some of the areas tested will include, but will not be limited to:

a. RWS Software

b. Flight Rework

c. TRS Operations

d. Data Processing (algorithms) Analysis (performed by OPS22 and OS7)

e. Reliability Data Collection (performed by OPS24, but analyzed by OPS13)

f. Product Throughput (i.e., from RWS through the NWSTG to the NCEP, including backups)

g. RRS product format and data evaluation by NCEP

h. NWSTG's monthly upper air climate summary (CLIMAT) generation

i. NCDC archive generation and data evaluation by the NCDC

j. Maintenance Actions/Fault Isolation (primarily conducted by the NWSTC) using the OMS and the Offline Built-In-Test (OBIT) applications.

Test procedures not requiring live flights will be conducted at WSH. Live flights using pre-production Lot 2 radiosondes will be conducted at the SR&DC. Both synoptic and special flights will be conducted daily.

#### 1.4.1.2 ST Phase IB

During ST Phase IB, the live flights will use production Lot 3 LRIP radiosondes and the updated SPS, if applicable. The test procedures used during ST Phase IA will continue to be used to verify changing radiosondes does not have an adverse effect on functional requirements. Radiosonde signal quality as well as sensor operation will be observed in addition to sensor data processing by the RWS.

Between weeks 2 and 6 (see Table 6) of the ST and in parallel with the ST, OPS22 will be conducting a Full Operational Assessment of the RRS using a separate suite of hardware. OPS22 will schedule the scenarios to be tested during the live flight sequence. These scenarios will be based upon the Full Operational Assessment Plan (dated February 6, 2003) developed by OPS22. The Full Operational Assessment will cover:

a. A comparison of RRS with the Legacy Systems Performance Measures - Ground System

b. Communication

c. Software Performance

d. Radiosonde Performance

e. Aggregate statistics of the above categories

f. Applications/Model/Analyses

g. A Compressed Operational Evaluation.

To simulate a real upper air field site's operation prior to ST Phase II, field personnel will be invited to participate during the last four weeks of ST Phase IB. Their role will include evaluation of all aspects of RRS operations including:

a. GPS radiosonde preparation using a draft revised version of Observing Handbook No. 10, Rawinsonde Observations

b. RRS hardware setup

c. RWS graphical user interface (GUI) critique

d. Test procedure execution

e. Conducting live flights

f. Flight rework

g. Completing upper air flight documentation [i.e., the current H-6 (rejected radiosonde), B-29 (flight summary), and B-85 (site inventory) forms]

h. Operational usage of the RRS

i. RRS product analysis.

The field personnel will also assist in draft user documentation reviews, especially the draft RRS Training Guide. In addition, data will be collected for OPS22 to perform an initial analysis of RRS operational performance characteristics. The visiting field personnel will capture the operational performance data by operating like an operational site to the maximum extent possible, launching three flights (two synoptic and one special) a day, seven days a week. Because of their operational upper air experience, the field personnel will provide a "value added" element to the ST, giving additional confidence in the RRS prior to commencing ST Phase II. OAT sites will be requested first to provide volunteers. Other sites will be asked to provide volunteers if any OAT site declines to send personnel. The Electronics System Administrator (ESA) will be requested from the Sterling WFO to assist with system administration aspects of the system.

The RRS performance and stability is evaluated by the "operations" mode to verify the full archival function by filling up the archive and documenting the archives can handle the transition from one month to another. The archive content will be verified by NCDC. NCDC will be requested to supply analyses of archival data to OPS22.

As field personnel will be present during ST Phase IB, this may be considered a "dry run" for going to an operational site during ST Phase II.

Throughout the ST, EMRS data will be collected (using a modified EMRS A-26 form - see Attachment C) for OPS13 to perform an initial analysis of RRS reliability, availability, maintainability.

ST Phase I will be judged completed when all test procedures have been successfully completed which cover the full set of RRS functional requirements.

The TRG will recommend to the RRS Program Manager to proceed with Phase II only if the following conditions are met:

a. Phase I is successful (no outstanding Priority 1 or 2 SIRs).

b. The preliminary results of the Meteorological Comparisons Test indicate a high probability of success.

c. Site personnel have completed both Operator and Maintenance training.

d. All 1500 Lot 3 LRIP radiosondes and SPSs are delivered to the National Logistics Support Center (NLSC).

### 1.4.2 ST Phase II

ST Phase II is the final evaluation planned for RRS during the ST before the start of OAT. ST Phase II evaluates the RRS at a realtime NWS field site in which the a capability to return to the legacy system exists, if required. This capability will not be available during the OAT.

Phase II will be conducted by installing a RRS at the WFO-LWX and tested in a controlled, operational environment with the RRS used to produce official products. "Controlled, operational environment" in this context refers to Test Team members being on site and observing RRS operations as well as suggesting specific actions be performed to exercise the RRS to the maximum extent possible without effecting WFO-LWX's operational mission.

The legacy upper air system computer will be removed from the WFO-LWX intact and installed at the SR&DC, giving the WFO-LWX the capability of reverting to the legacy system for official products in the event of a catastrophic RRS failure (i.e., a hardware or software problem which cannot be repaired within a reasonable amount of time). WFO-LWX will be the only OAT site with the capability of reverting to the legacy system due to it being co-located with the SR&DC.

The WFO upper air personnel will be trained and will:

a. Evaluate documents

b. Run normal and special upper air flights using RRS

c. Evaluate NLSC spares.

During the Phase II installation at WFO-LWX (which may take up to two weeks), a product throughput test using test upper air products will be conducted to verify the products are received at the local AWIPS and at the NCEP.

Any problems experienced during Phase II will be adjudicated and resolved during the weekly TRG meeting in the same manner as during Phase I. If the problem is major, the ST Director will convene an emergency TRG. Based on input from the WFO-LWX Meteorologist-In-

Charge (MIC) and OPS22, the TRG will recommend to the RRS Program Manager and the Eastern Region RRS Focal Point whether WFO-LWX should revert to the legacy upper air system to continue producing their official products.

During the entire ST, RMA data will be collected, using a modified EMRS reporting system, on successful and unsuccessful launches, successful and unsuccessful flights, equipment (including radiosondes) operating times, number and type of hardware failures (including radiosonde failures), repair times, number of software failures, generation of products, accuracy of products, quality control of products by the NCEP, and the NCDC. This information will be examined by OPS13 to obtain a "snapshot" of the projected RRS reliability and system availability ($A_s$) during the ST. As the balloons are the same ones used with the legacy system, any defective balloons will not be included in the RMA analysis.

As the RRS is an adjunct system connected to the AWIPS, overall product throughput from the AWIPS data server to the AWIPS National Control Facility (NCF) will be measured by the Product Availability Monitoring System (PAMS). To be comparable to other NWS systems, OPS22 suggests 98.5 % of all RRS products should go from the local AWIPS LDAD and arrive at the NCF in less than one minute. In addition to PAMS data, OPS22 will conduct an analysis of the usual data collected to develop RRS performance characteristics similar to those of the legacy system.

At the successful completion of the Phase II operational evaluation, the TRG will recommend (with the concurrence of the WFO-LWX MIC) to the RRS Program Manager whether to proceed with the formal OAT. The TRG's recommendation will be based upon the success of the ST, a preliminary analysis of EMRS data, and the performance characteristics derived from the OPS22 analysis.

Following the ST, the ST Director will generate a report documenting the ST with conclusions and recommendations. The report will include (but not be limited to) RRS configurations, test participants, test procedure results, all problems observed and their solutions or work-arounds, RMA projections as derived from the EMRS data, and the product evaluations from both NCEP and NCDC.

See Section 2.3.3, Test Conduct, for additional information on how the ST Phase II will be performed.

### 1.5 Test Review Group (TRG)

The TRG is an assemblage of subject-matter experts and is chaired by the Chief, Test and Evaluation Branch (OPS24). The role of the TRG is to evaluate each observed deficiency (both repeatable and intermittent problems) as documented by a SIR, on its impact on daily field service operations and to make recommendations to the RRS Program Manager on SIR criticality.

During the ST, the TRG Chair will convene the TRG weekly to:

a. Review, clarify and validate deficiencies documented in SIRs

b. Prioritize and validate deficiencies and recommend corrective actions to the RRS Program Manager

c. Coordinate the resolution of other test-related issues.

If a major problem occurs between weekly meetings and requires a vote of the members whether to continue the ST, the ST Director shall convene an emergency TRG meeting.

Validated deficiencies will be categorized as follows:

a. Priority 1 SIR - A problem preventing the accomplishment of mission essential capabilities or the deficiency jeopardizes safety, security, or other critical requirements; no work-around exists.

ACTION: The TRG recommends suspension of the test to the RRS Program Manager. If suspended, the test resumes when the RRS Program Manager approves a proposed corrective action. When an approved corrective action is implemented, regression testing may be required.

b. Priority 2 SIR - A problem adversely affecting the accomplishment of a mission essential or technical capability, cost, or schedule risks; no work-around exists.

ACTION: The TRG recommends continuation or suspension (depending on the situation) of the test to the RRS Program Manager. If suspended, the test resumes when the RRS Program Manager approves a proposed corrective action. When an approved corrective action is implemented, regression testing may be required.

c. Priority 3 SIR - A problem adversely impacting the accomplishment of a mission essential capability or a problem adversely affecting technical, cost, or schedule risks, but a work-around exists.

ACTION: The test continues with the current system using a work-around until a permanent fix is available. Once the RRS Program Manager approves the fix, only those test areas affected by the problem will be retested.

d. Priority 4 SIR - A minor problem which results in user/operator inconvenience or annoyance, but does not affect a required, mission essential capability.

ACTION: The test continues with the current system; approved work-arounds may be implemented. Priority 4 deficiencies are submitted by the TRG to the RRS Program

Manager for adjudication.

e. Priority 5 SIR - All other software or hardware issues.

The TRG will be composed of the personnel identified in Table 1. Only those individuals identified as "Voting Member" will determine if the ST should be suspended. During ST Phase II, the WFO-LWX MIC, Eastern Region RRS Focal Point (ER42), and OPS22 will determine if the WFO-LWX should revert to the legacy upper air system; however, the recommendation will be presented to the RRS Program Manager by the ST Director as spokesperson for the MIC, ER42, and OPS22.

**Table 1: RRS Test Review Group (TRG) Personnel**

| Name/Organization | Function | Phone | Voting Member |
|---|---|---|---|
| Jerald Dinges (OPS24) | Test Review Group Chair | 301-713-0326 x160 | |
| Samuel Cochran (OPS24) | System Test Director | 301-713-0326 x112 | ✔ |
| Jae Lee (OPS24) | System Test Support | 301-713-0326 x158 | |
| Ken Bashford (OPS24) | System Test Support/OAT Director | 301-713-0326 x113 | |
| James Fitzgibbon (OPS22) | System Test Support | 703-661-1243 | ✔ |
| Eddie Roberts (OPS23) | RWS Software COTR | 301-713-0191 x119 | ✔ |
| Walter Scott (OST31) | RRS Integration Manager | 301-713-1570 x146 | ✔ |
| Tom Roberts (OST11) | RRS Program Manager | 301-713-1975 x124 | ✔ |
| John Uhlman (OPS12) | Hardware Installation Notes | 301-713-1845 | ✔ |
| Ivan Navarro (OPS11) | Radiosonde COTR | 301-713-0844 x134 | ✔ |

| Name/Organization | Function | Phone | Voting Member |
|---|---|---|---|
| Darryl Modracek (OPS11) | TRS COTR | 301-713-1842 x111 | ✔ |
| Greg Dalyai (OPS11) | GPS Equipment and RWS Hardware COTR | 301-713-1842 x109 | ✔ |
| William Blackmore (OPS22) | Upper Air Technical Support | 301-713-2093 x107 | ✔ |
| Robert Thomas (OS7) | Upper Air Technical Support | 301-713-0722 x127 | ✔ |
| * Sergio Marsh (ER42) | Eastern Region Upper Air Program Manager | 631-244-0169 | ✔ |
| * Alton Abernathy (SR42) | Southern Region Upper Air Program Manager | 817-978-7777 x136 | ✔ |
| * Jerry Finke (CR41) | Central Region Upper Air Program Manager | 816-891-7734 x441 | ✔ |
| * Harold Knocke (WR2X3) | Western Region Upper Air Program Manager | 801-524-5137 x276 | ✔ |
| * Larry Hubble (AR42) | Alaska Region Upper Air Program Manager | 907-271-5135 | ✔ |
| * Karl Turner (PR12) | Pacific Region Upper Air Program Manager | 808-532-6437 | ✔ |
| William Ryman (OS612) | National Weather Service Training Center | 816-880-9368 x242 | ✔ |
| * WFO-LWX | James Travers - Meteorologist-In-Charge | 703-260-0107 x222 | ✔ |
| Jeff Ator (NP12) | NCEP Upper Air Technical Focal Point | 301-763-8000 x7104 | ✔ |
| Stuart Hinson (CC11) | NCDC Upper Air Technical Focal Point | 828-271-4437 | ✔ |

* TRG Member only during ST Phase II.

Following completion of a successful ST (i.e., no outstanding Priority 1 or 2 SIRs), the TRG will convene to review the findings and recommend to the RRS Program Manager whether to

proceed with the OAT.

## 1.6 Prerequisites, Assumptions, and Risks

This section describes the actions that must precede the ST; the availability of equipment needed for the ST; and a description of risks associated with performing the ST.

### 1.6.1 Prerequisites

Common to both ST Phase I and Phase II are the following prerequisites:

a. The AWIPS build used during the ST must be build OB1 (or later).

b. The Motorola Codex modem connected to an LDAD Xyplex modem must have firmware version 8.1 to support the RRS.

The following sections list the specific requirements necessary to commence each phase of the ST.

#### 1.6.1.1 System Test Phase I Prerequisites

a. There are no outstanding Priority 1 or 2 SIRs.

b. The RSIM conducts and successfully completes a SIT on a first article suite of RRS equipment with no outstanding Priority 1 or 2 SIT SIRs and recommends to the RRS Program Manager to commence the ST.

c. All TRS firmware updates were tested during the SIT.

d. All Sippican SPS firmware updates were tested during the SIT.

e. The GPS equipment assembly (antenna and repeater) was Government tested and accepted.

f. The RWS was set up as an OAT RWS (i.e., non-essential Windows applications removed by OPS23) and was tested as such during the SIT.

g. One hundred (100) Lot 2 radiosondes are available during Phase IA.

h. The WFO-LWX ESA is trained to serve as the RRS System Administrator.

i. A Test Readiness Review is conducted and the system is determined ready to begin the ST Phase I. During the review, the RSIM will provide OPS24 with complete system configurations to include all subsystem and LRU version numbers.

j. Draft RRS documentation identified in Table 4 is delivered.

k. Lot 3 LRIP radiosondes have successfully completed a Government Physical Configuration Audit (PCA).

l. One Hundred and thirty (130) Lot 3 LRIP radiosondes are available during Phase IB.

#### 1.6.1.2 System Test Phase II Prerequisites

a. NWS management is satisfied RRS requirements were met (at least in intent) during ST Phase I and there are no outstanding Priority 1 or 2 SIRs.

b. An unopened shipment of hardware (consisting of one pallet of Lot 3 LRIP radiosondes; a RRS metric tool kit; an SPS; and a GPS base antenna) from the NLSC is available for the beginning of the ST Phase II and is provided exactly as intended for shipment to the deployment sites.

c. All WFO-LWX upper air personnel have received operator and maintenance training (either formal or informal) to allow participation in Phase II.

d. A System Test Phase II Readiness Review is conducted and the system is determined ready to begin the ST Phase II and this recommendation is made to the RRS Program Manager.

e. The preliminary results of the Meteorological Comparisons Test (conducted by OPS22) indicate a high probability of success.

f. The new GPS radiosonde module has successfully completed Government flight testing.

g. Final draft RRS documentation (identified in Table 4) are available.

h. The WFO-LWX Site Installation Plan is available.

i. The MicroArt Decommissioning Checklist has been approved by the WFO-LWX MIC.

j. The legacy upper air computer has been moved and installed at the SR&DC as a backup in the event of a catastrophic RRS failure.

k. The Sippican solar radiation correction software has been tested and is included in the RWS software.

l. There are sufficient spares at the NLSC/National Reconditioning Center (NRC) to

support WFO-LWX.

### 1.6.2 Assumptions

Each phase of the ST has its own assumptions which are identified in the following sections. Common to both ST Phases is the assumption all RRS subsystems under test have been successfully tested and accepted by the Government from the subsystem's respective contractor.

#### 1.6.2.1 System Test Phase I Assumptions

a. The operational XDP simulator is connected to the test RWS at WSH. The appropriate data sets are provided by OPS22 to exercise anomalous flight conditions.

b. Experienced upper air personnel from field sites will be available to assist with test evaluation.

c. Visiting field personnel will receive informal RRS familiarization from WSH personnel during the ST.

#### 1.6.2.2 System Test Phase II Assumptions

a. A communication path is available from the RWS through AWIPS and the NWSTG to NCEP and NCDC for distribution of upper air products with test headers. Also, the NWSTG is configured for using RRS products to generate monthly upper air CLIMAT products.

b The NWS Eastern Region Headquarters (ERH) will serve as the service backup to the WFO-LWX as there is no other RRS to provide a backup.

c. The legacy system decommissioning report has been cleared by the WFO-LWX MIC.

### 1.6.3 Risks

Both Phases of the ST share the same risks:

a. Not all seasonal weather variations will exist during the scheduled test period. Simulating these conditions will introduce a degree of uncertainty.

b. Lot 3 LRIP radiosondes might not be available in sufficient quantities due to production lead time or unforeseen factory slippage.

c. The RWS software delivered as Build 1.0.3.x at the beginning of ST might not have been tested by the Government during the SIT.

## 2.0 Method of Accomplishment

The following sections describe the test schedule, facilities, configuration, resources, and personnel roles and responsibilities used to conduct the ST.

### 2.1 Schedule

The ST will be conducted in accordance with the following schedule:

**Table 2: ST Schedule**

| Dates | | Action |
|---|---|---|
| Start | End | |
| | | ST Phase I Readiness Review at WSH |
| Week 1 | Week 8 | Conduct ST Phase IA at WSH and SR&DC |
| Week 9 | Week 15 | Conduct ST Phase IB at WSH and SR&DC |
| Week 16 | Week 16 | Combined ST Phase I "Wrap-up" meeting and ST Phase II Readiness Review at WSH; Validation of SIRs found during ST Phase I |
| Week 17 | Week 18 | ST Phase II Install and Checkout at WFO-LWX |
| Week 19 | Week 23 | Conduct ST Phase II at WFO-LWX |
| Week 23 | Week 23 | ST "Wrap-up" Meeting at WSH |
| Week 24 | Week 32 | Prepare ST Report for submission to the RRS Program Manager |

### 2.2 Test Facilities

The ST will be conducted at the WSH OPS24 Test Facility and the NWSTG in Silver Spring, Maryland, the SR&DC test facility, the WFO-LWX, and the NWSTC at Kansas City, Missouri.

Upper air focal points at both the NCEP and NCDC will assist in examining the usability of the RRS products. NCEP will determine if the atmospheric data is formatted correctly and is useable in their meteorological models; NCDC will determine if the archived climatological data can be retrieved and used in their products. The NWSTG will verify they can use the RWS products for their monthly upper air product (the CLIMAT message).

### 2.2.1 WSH Hardware/Software (Phase I and II)

A RWS workstation located in the OPS24 Test Facility at WSH will be used during Phases I and II of the ST. In addition to the RWS Inline Simulator, an XDP will interface to the RWS. The XDP has the capability to "replay" captured data sets from previous upper air flights with specific weather conditions from around the country. If anomalous upper air flights are not available, special data sets may be manually created by modifying real flights to provide anomalous weather conditions (i.e., specific periods or types of missing data, out of range sensor data, etc.) to check for specific error conditions.

The WSH AWIPS Simulator will be used to receive test messages from the RWS.

### 2.2.2 SR&DC Hardware/Software (Phase I and II)

A fully configured RRS located on the ground (rather than atop the balloon inflation and launch facility) at the SR&DC will be used during Phases I and II of the ST. The WSH AWIPS [NWS Headquarters Modernization Test and Integration AWIPS, WFO (NMTW) and NWS Headquarters Development AWIPS (NHDA), as backup] will be used to receive test messages from the RWS.

### 2.2.3 National Weather Service Training Center (NWSTC) (Phase I and II)

The NWSTC will have a minimal RRS configuration as their role is to conduct RRS maintenance training. Specifically, the NWSTC configuration will consist of an RSOIS, a TRS, a RWS, and the OMS/OBIT Utility Suite to assist field personnel in fault isolation to the LRU. The NWSTC RWS hardware will only be connected to a generic, laptop computer simulating an AWIPS LDAD to assist when using the OBIT to isolate RWS to AWIPS communication problems.

### 2.2.4 Baltimore, MD/Washington, DC Weather Forecast Office (WFO-LWX) Hardware/Software (Phase II)

A fully configured RRS located at WFO-LWX will be used during Phase II of the ST. The TRS and Base GPS antenna will be situated inside the radome on top of the inflation building.

The WFO-LWX AWIPS will be used to receive official messages from the RWS/RRS and to send upper air products to the NCEP via the NWSTG using the current communications path. During system failure and recovery testing, the ERH will serve as the WFO-LWX primary Service Backup site to process the WFO's upper air products.

The RWS will be used to generate archive flight data which will be submitted to the NCDC over the internet by File Transfer Protocol (FTP) after every flight instead of as is currently done with the legacy system.

## 2.3 Test Methodology

The following sections provide a description of how the ST will be conducted. It will be the responsibility of the Test Director to ensure the test is performed as outlined. Any deviation from the test methodology will be documented in the ST report. If there are any changes to the ST procedures, the changes will be provided to the ST test team prior to conduct of the affected tests.

### 2.3.1 Test Resources

The following sections describe the RRS test configurations, supporting documentation, and test personnel roles and responsibilities. The ST configuration information is summarized in Table 3. (Note: NWSTG, NCEP, and NCDC are not included in Table 3 as they do not have any RRS hardware and are only used to evaluate RRS products.)

**Table 3: ST Hardware and Data Resources**

| Site | ST | RSOIS | PDB | TRS | RWS | SPS | AWIPS | OBIT | XDP | Data |
|---|---|---|---|---|---|---|---|---|---|---|
| WSH 69001* | Phase I | No | No | No | Yes | No | NMTW | No | Yes | Simulated |
| SR&DC 69990* | Phase I | Yes | Yes | Yes | Yes | Sippican | NMTW/ NHDA | Yes | No | Live |
| NWSTC | Phase I | Yes | No | Yes | Yes | Sippican | NWSTC AWIPS | Yes | Yes | None |
| WFO-LWX 72403* | Phase II | Yes | Yes | Yes | Yes | Sippican | WFO-LWX and Service Backup Site | Yes | No | Live |

* WMO Site Identifier

#### 2.3.1.1 Support Documentation

RRS support documentation hardware/software installation and operational instructions will be used in the ST. Reference to these documents will be made as required throughout the test. The list of documentation and procedures includes, but is not limited to, those items contained in Table 4:

**Table 4: RRS Documentation**

| |
|---|
| System Test Procedures for the RRS |
| RWS System Requirements Specification |
| Build 1.1 Release Notes (draft)/Version Description Document |

| |
|---|
| The RRS home page: http://www.ua.nws.noaa.gov/RRS.htm |
| RRS Operator Training Guide |
| Weather Service Operations Manual (WSOM) 30-2109 (EHB-9) Update |
| RRS Technical Manual |
| WSOM 30-2101 (EHB-1) Update |
| WSOM 30-2104 (EHB-4) Update |
| National Weather Service Observing (NWSO) Handbook 10 Update |
| TRS Logistics Management Information (Maintenance) |
| SIPPICAN Radiosonde/Signal Processing System (SPS) Workstation S/W User's Manual |
| SIPPICAN SPS Operations and Maintenance Manual |
| Radiosonde Surface Observing Instrumentation System (RSOIS) User/Maintenance Manual |
| RSOIS-TM, Organizational Level Maintenance Manual |

#### 2.3.1.2 National Centers for Environmental Prediction (NCEP) Role

Under controlled conditions, NCEP personnel from the Environmental Modeling Center will attempt to open and import RRS products into their meteorological models and perform quality control of the data. If the products are properly formatted and found to be of an acceptable level for use in the models, then they will be deemed to have passed.

##### 2.3.1.2.1 Phase I Role

NCEP will compare the RRS products with official products from WFO-LWX. This comparison will occur during the ST Phase IB using the WFO-LWX legacy upper air system and RRS launched balloons at the SR&DC. This will be accomplished by launching both balloons simultaneously during synoptic windows. (Note: The SR&DC and the WFO-LWX share the same balloon preparation facility.) NCEP will add the ST system WMO identifier to their "THKS" web page (http://www.ncep.noaa.gov/NCO/DMQAB/QAP/thanks/) and display the status of the data along with the data from the WFO-LWX.

##### 2.3.1.2.2 Phase II Role

During Phase II, the NCEP will monitor the official products from WFO-LWX and will report the status of the data on their "THKS" web page. The WMO identifier for the ST system will be removed from the display.

#### 2.3.1.3 National Climatic Data Center (NCDC) Role

Archived RRS atmospheric data will be submitted to the NCDC for format evaluation and usability. The submitted data is considered successful if NCDC can read the archived data and use it to produce climatic products.

##### 2.3.1.3.1 Phase I Role

After each live flight, archived flight data will be sent to NCDC using FTP. NCDC will evaluate the RRS product format and will use the data in their products.

##### 2.3.1.3.2 Phase II Role

During Phase II, the NCDC will evaluate the receipt of official upper air products FTPed from both the NWSTG and the WFO-LWX to NCDC and will report the status of the data on their web page.

#### 2.3.1.4 National Logistic Supply Center (NLSC)/National Reconditioning Center (NRC) Role

The NLSC/NRC will only have a role during ST Phase II. Initially, NLSC will provide WFO-LWX with a TRS, a pallet of GPS radiosondes. a RRS metric tool kit; an SPS; and a GPS base antenna for initial installation. In the event of a hardware failure, the WFO-LWX ESA will diagnose the problem to the lowest LRU, request a new item from the NLSC, and return the defective LRU to the NRC for repair. After repair, the unit will be returned to the NLSC for future distribution.

#### 2.3.1.5 Test Personnel and Responsibilities

The NWS personnel participating in the ST are listed in Table 5.

**Table 5: Test Personnel**

| Name/Organization | Function | Phone | E-mail |
|---|---|---|---|
| Samuel Cochran (OPS24) | RRS ST Director | 301-713-0326 x112 | samuel.cochran@noaa.gov |
| Jae Lee (OPS24) | RRS Test Team | 301-713-0326 x158 | jae.lee@noaa.gov |
| Ken Bashford (OPS24) | RRS Test Team | 301-713-0326 x113 | kenneth.bashford@noaa.gov |

| Name/Organization | Function | Phone | E-mail |
|---|---|---|---|
| Bert Viloria (OPS24) | RRS Test Team | 301-713-0326 x131 | bert.viloria@noaa.gov |
| Don Johnson (OPS23) | Software Test Support | 301-713-0191 x172 | donald.johnason@noaa.gov |
| Jim Fitzgibbon (OPS22) | SR&DC Test Support | 703-661-1243 | james.fitzgibbon@noaa.gov |
| Bill Blackmore (OPS22) | OPS22 Analytical Support | 301-713-2091 x107 | william.blackmore@noaa.gov |
| Fred Branski (OPS32) | NWSTG Test Support | 301-713-0864 x146 | fred.branski@noaa.gov |
| William Ryman (OS612) | NWSTC Test Support | 816-880-9368 x242 | william.ryman@noaa.gov |
| Carl Bower (OS7) | Analytical Support (Data Processing and Algorithm Analysis) | 301-713-0722 x145 | carl.bower@noaa.gov |
| Bob Thomas (OS7) | Analytical Support (Data Processing and Algorithm Analysis) | 301-713-0722 x127 | robert.thomas@noaa.gov |
| Field Personnel TBD | RRS Test Support | | |
| Jeff Ator (NP12) | NCEP Analytical Support | 301-763-8000 x7104 | Jeff.Ator@noaa.gov |
| Stuart Hinson (CC11) | NCDC Analytical Support | 828-271-4437 | Stuart.Hinson@noaa.gov |

The specific WFO-LWX, OS7, and other field personnel assisting in the ST have yet to be identified, but will be included in the ST Report.

The following describes the major roles and responsibilities of the test personnel.

**Test Director** - Ensures all tests defined for the ST are completed and the results properly documented in the ST report. Responsible for collecting and presenting all test trouble reports to the TRG for classification and convening emergency TRG meeting, if necessary. Following completion of the ST, the Test Director will conduct a "wrap-up" meeting of the TRG, provide details to the RRS Program Manager what was tested, report the ST conclusions, and recommend whether to proceed with the OAT. He ensures all test trouble reports documented and classified during the ST are forwarded to the proper WSH organization or board for adjudication; writes the ST report to document the test results and recommendations. The Test Director also serves as a member of the test team.

**Test Team** - Responsible for performing individual test procedures as assigned; documents the results of each test in test logs; electronically completes trouble report forms when problems/discrepancies are observed; provides the Test Director with all completed forms (if not entered electronically). Informs the Test Director with comprehensive technical information on how the tests were conducted and any problems encountered.

**Test Support** - Responsible for providing technical support and information as required when RRS questions arise; forwards RRS hardware and software discrepancies (when directed by the RRS Program Manager) to the respective contractor for resolution.

**NWSTG Test Support** - Responsible for evaluating RRS product throughput and the ability of the NWSTG to generate monthly upper air CLIMAT products using RRS products.

**NWSTC Test Support** - Responsible for evaluating RRS maintainability; conducting RRS maintenance training; performing hardware evaluations as time permits.

**NCEP Test Support** - Responsible for evaluating RRS products for format and usability in meteorological models and performing quality control checks.

**NCDC Test Support** - Responsible for determining if archived RRS atmospheric data from radiosonde flights is in the proper format for use in producing NCDC climatic products.

**Field Personnel Test Support** - Responsible for conducting test procedures to evaluate system functionality and usability; participates in documentation reviews; prepares radiosonde during pre-flight and assists in both synoptic and special balloon launches. Responsible for assisting with product quality control and collecting performance data.

**Analytical Support** - NCEP and NCDC personnel are responsible for evaluating synoptic products for accuracy, usability, timeliness, and the ability to be archived and retrieved. OPS22 and OS7 personnel are responsible for evaluating all RRS algorithms and products for accuracy and maintaining ST flight logs.

### 2.3.2 Installation

For Phase I, installation of the RRS hardware at the SR&DC will be completed during the SIT prior to ST commencement. The installation will be performed by a combination of Government and contractor personnel, as appropriate. RWS software Build 1.0.3 will be installed at WSH and SR&DC prior to ST commencement.

For Phase II, installation of the RRS hardware (as specified in Section 1.6.1.2) and RWS Build 1.1 software will be performed at the WFO-LWX (using the Site Installation Plan and the RRS Deployment Plan) by the RRS Deployment Team (specific individuals to be determined). The installation will be witnessed by OPS24 Test Personnel and site personnel. Also, at this time the installation documentation will be evaluated and any comments forwarded to the Test Director.

### 2.3.3 Test Conduct

The ST will be conducted in two phases. The first phase will take place at WSH and the SR&DC test facilities utilizing field personnel as much as practicable. The second phase will take place at the WFO-LWX located in Sterling, VA. In addition, RRS maintainability and fault isolation will be evaluated at the NWSTC during the entire ST. Assistance will be provided by both the NCEP and NCDC during the ST. NCEP's Environmental Modeling Center will evaluate RRS products for format, use in meteorological models, and will perform quality control of the products. NCDC will evaluate the archived RRS atmospheric data for proper format for use in their climatic products. The NWSTG will evaluate the use of upper air products in their monthly CLIMAT report. NLSC/NRC will be used to evaluate replacement shipment and depot level repair during ST Phase II.

#### 2.3.3.1 Test Cases

Specific test cases to verify RRS functionality were developed for the test procedures identified in Attachment A- RRS Test Procedure Description. In brief, the areas to be tested (or evaluated) include:

a. Hardware and Software Installation.

b. RWS System Administration Functions.

c. Evaluation of RWS Functional Capabilities during live and simulated flights, flight rework, data quality control, product throughput, upper air applications, and anomalous flight conditions.

d. RRS Failure and Recovery (includes loss of power during a flight).

e. Documentation itemized in Table 4 and Training (On-Site Operator Training as well

as NWSTC Maintenance Training).

Detailed procedures for each test case are found in System Test Procedures for the Radiosonde Replacement System (RRS). These procedures will be utilized during ST Phase I.

### 2.3.3.2 ST Phase I Conduct

Prior to ST commencement, the OST31 RSIM must conduct a successful RRS SIT with no outstanding Priority 1 or 2 SIRs. In accordance with the schedule contained in Table 2, the Test Director will conduct a Test Readiness Review with the RSIM. During this review, the RSIM will turn over the RRS hardware/software suite (complete with all subsystem and LRU version numbers) to OPS24 for the ST along with a list of known discrepancies and draft copies of all RRS documentation. The Test Director will also provide the RRS Program Manager with details of what will be tested during the ST, how the ST will be conducted, and how discrepancies will be handled. OPS22 will provide a schedule to the test team for the test personnel to follow indicating what aspects of the system will be tested during a particular Synoptic or Special flight. For example, a given flight might simulate multiple releases requiring the software to handle the situation per the software requirements.

A partial system (consisting of the TRS, SPS, RSOIS, and RWS only) will be installed at the NWSTC. NWSTC personnel will exercise the system as much as possible from a maintenance perspective to verify the RRS is operational and can be maintained.

Neither the NCEP or NCDC have any RRS equipment. Their role is to examine product format for use in meteorological prediction models (by NCEP) and the ability to use archived atmospheric data in climatic products (by NCDC).

Prerecorded data sets from previous upper air flights will be used for those tests requiring anomalous check messages. For a normal, non-eventful flight, Data Set No. 1007 (recorded on January 17, 2002 at the SR&DC) will be used.

The ST will be conducted by performing a combination of simulated and live flights with some of the flights chosen for rework. The ST Phase I will be conducted as itemized in Table 6:

## Table 6: ST Phase I Test Concept

| week | WSH facility | | SR&DC facility Live Flights | | | Comments |
|---|---|---|---|---|---|---|
| | XDP/ procedure checkout | rework | Daily flights including rework | Weekly Total | | |
| | | | | Synoptic | Special | |
| P. IA-week 1 | X | | 1 Special @15UTC | 0 | 4 | 1) ST Phase IA Readiness Review will be conducted on the first day.<br>2) Installation and checkout will be performed on both systems.<br>3) Live flights will be conducted last four days of the week. |
| P. IA-week 2 | X | | 2 Synoptic @00UTC, 12UTC<br>1 Special @03UTC | 10 | 5 | Rework will be performed on live flights as time permits throughout ST Phase IA. |
| P. IA-week 3 | X | X | 2 Synoptic @00UTC, 12UTC<br>1 Special @15UTC | 10 | 5 | |
| P. IA-week 4 | X | X | 2 Synoptic @00UTC, 12UTC<br>1 Special @18UTC | 10 | 5 | |
| P. IA-week 5 | X | X | 2 Synoptic @00UTC, 12UTC<br>1 Special @06UTC | 10 | 5 | |
| P. IA-week 6 | X | | 2 Synoptic @00UTC, 12UTC<br>1 Special @09UTC | 10 | 5 | |
| P. IA-week 7 | X | | 2 Synoptic @00UTC, 12UTC | 8 | 0 | (Labor Day week–no flights on Monday) |
| P. IA-week 8 | X | | 2 Synoptic @00UTC, 12UTC | 10 | 0 | |

| week | WSH facility | | SR&DC facility Live Flights | | | Comments |
|---|---|---|---|---|---|---|
| P. IB-week 1 | X | | 1 Special @15UTC | 0 | 4 | 1) ST Phase IB Readiness Review will be conducted on the first day.<br>2) Installation and checkout will be performed on both systems.<br>3) Live flights will be conducted last four days of the week. |
| P. IB-week 2 | X | | 2 Synoptic @00UTC, 12UTC<br>1 Special @15UTC | 14 | 7 | 1) Rework will be performed on live flights as time permits throughout ST Phase IB at both test facility.<br>2) Field Personnel Present |
| P. IB-week 3 | X | X | 2 Synoptic @00UTC, 12UTC<br>1 Special @18UTC | 14 | 7 | Field Personnel Present |
| P. IB-week 4 | X | X | 2 Synoptic @00UTC, 12UTC<br>1 Special @06UTC | 14 | 7 | Field Personnel Present |
| P. IB-week 5 | X | X | 2 Synoptic @00UTC, 12UTC<br>1 Special @03UTC | 12 | 6 | Field Personnel Present<br><br>(Columbus Day week) |
| P. IB-week 5 | X | X | 2 Synoptic @00UTC, 12UTC<br>1 Special @03UTC | 14 | 7 | Field Personnel Present |
| P. IB-week 7 | | X | 2 Synoptic @00UTC, 12UTC<br>1 Special @21UTC | 10 | 5 | ST IB wrap-up meeting is scheduled for the last day. This meeting also serves as a ST Phase II Readiness Review meeting. |
| **Total**<br><br>(It is suggested 10% additional radiosondes be available in the event of radiosonde failure.) | | | | **146** | **72** | NOTE: These number may vary based on holidays and resource. These numbers do not include extra radiosondes in the event of radiosonde failure out of the box. |

Attachment A itemizes the tests that will be performed during ST Phase I to verify the software functional requirements. Test cases will be performed using both simulated and live radiosonde flights. A subset of the live flights will be used for rework. The ST procedures are categorized by functional area. Only test number 430 will utilize data sets for anomalous weather/flight conditions.

Attachment B summarizes the data sets needed to perform Test 430, Anomalous Flight Situations. (Additional data sets may be added to Attachment B as they become available.)

If any abnormalities (other than those induced for test purposes) or indications of noncompliant operations are observed during the ST Phase I, SIRs will be written to document the problem and called to the immediate attention of the RRS ST Director. The Test Director will present the discrepancies to the TRG for classification and recommendation.

During the period in which field personnel will be assisting with the ST (Phase IB), one OAT site a week will have first priority of sending two persons to the SR&DC. Other sites will be invited to send field personnel if an OAT site declines to do so. One of the individuals will work during the day shift, the other during the evening/night shift with the two shifts overlapping for about three hours. OPS22 will provide the specific scenario for each flight conducted by field personnel.

This schedule assumes the invited field personnel will be present for and assist with the Monday 12UTC launch. Field personnel will also assist in running the upper air data sets contained in Test Procedure 430. A member of the OPS24 Test Team will be present during each shift.

#### 2.3.3.3 ST Phase II Conduct

Prior to ST Phase II commencement, the Test Director will conduct a test Readiness Review with the TRG, WFO-LWX management, and upper air focal points. During this review, the Test Director will turn over to the WFO-LWX MIC a list of known discrepancies and final copies of all RRS documentation. The Test Director will also provide the MIC with preliminary results of the ST Phase I, how the ST Phase II will be conducted, and how discrepancies will be handled.

Unlike ST Phase I, Phase II will be conducted in a controlled, operational environment (see Section 1.4.2 for definition) using the RRS for official synoptic products. During Phase II, the RRS will be operated by WFO-LWX personnel rather than the RRS Test Team, who will serve in an advisory capacity only. The synoptic products will be evaluated by WSH, NCEP and NCDC personnel for accuracy, usability, timeliness, and the ability to be archived and retrieved.

During Phase II, WFO-LWX personnel will be required to collect appropriate data (identified in ST Procedure 701) for use in the initial RMA analysis. In addition, the same operational performance data as is now collected for the legacy system will be gathered for analysis by OPS22.

In parallel with Phase II, the Test Team will continue to conduct Phase I regression tests on any "fixes" prior to delivery to the WFO-LWX.

If any abnormalities are observed during Phase II, SIRs will be written to document the problem and will be provided to the TRG for adjudication.

In the event of hardware failures, the WFO-LWX ESA will identify the defective LRU, request a replace from the NLSC, and return the defective component to the NRC for repair and subsequent redistribution. This will be the only manner in which the RRS replacement part/depot level repair process will be evaluated.

Table 7 summarizes the ST Phase II actions.

**Table 7: ST Phase II Summary**

| Date | Action |
|---|---|
| Start | ST Phase I "Wrap Up" Meeting. TRG Recommends to RRS PM Whether to Proceed With Phase II. |
| Week 1 - Week 2 | RRS Installation at WFO-LWX; Test Products Submitted to Both NWSTG, NCEP and NCDC for Format Evaluation. (Note: This may not require two weeks) |
| Week 3 - Week 6 | ST Phase II Conducted at WFO-LWX; RRS Used for Synoptic Products; NCDC and NCEP Evaluates Products for Accuracy. |
| Week 7 | ST Phase II "Wrap Up" Meeting. TRG Recommends to RRS PM Whether to Proceed With OAT. |

### 2.3.4 Reliability, Maintainability, and Availability (RMA) Data Collection

RMA information will be collected during the ST using the EMRS (see Attachment C). The collected data will be used by the RRS Program Office to assess the potential reliability, maintainability, and availability only during the ST. The RMA values will not be a prediction of future RRS RMA, but only an initial estimate.

The ST mission reliability and availability values will be calculated for the mission critical RRS subsystems using the block diagram shown in Figure 1, using the following equations:

Reliability - $R(t) = e^{-\lambda t}$

Availability - $\frac{MTBMF}{MTBMF + MDT}$

Where: $\lambda$ is the total failure rate (critical failures only)

MTBMF is the mean time between critical failures = $1/\lambda$

MDT is the mean downtime, assumed to be 48 hours

Mission critical RRS subsystems are defined as those RRS components, the failure of any one item will prohibit the completion of a successful flight and subsequent product generation.

(Note: The balloons are the same as used with the legacy system and are not considered a part of the RRS. Any balloon deficiencies will not be included in the RMA calculations.)

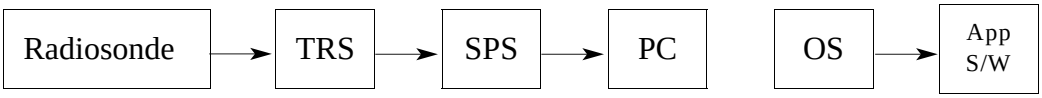


**Figure 1 - Block Diagram of RRS With Only Mission-Critical Items**

### 2.3.5 Post-ST Analysis, Test Recommendations, and Report

The following sections describe how the data collected during the ST will be analyzed, how a recommendations to proceed to the OAT is determined and a report written.

#### 2.3.5.1 Evaluation of Objectives

The ST Objectives identified in Section 1.3 will be evaluated by the methods specified in Table 8.

**Table 8: RRS System Test Objectives and Evaluation Methods**

| Objective | Evaluation Method |
|---|---|
| Validate RWS System-Level Functional Requirements | Successful completion of the test procedure for each test case will be used as one of the pass/fail criteria. If any abnormalities are observed during test procedure conduct, SIRs will be written to document the problem and will be provided to the TRG for adjudication. The TRG will prioritize all SIRs and determine if they warrant being submitted to the RRS CCB. The TRG will not submit a recommendation to the RRS Program Manager to proceed to the OAT if there are any unresolved Priority 1 or 2 SIRs. |
| Exercise all RRS subsystem interfaces to other NWS systems [e.g., the AWIPS/Local Data Acquisition Device (LDAD)] | Successful completion of SIT and hardware related ST test procedures . |
| Collect performance data for evaluating meteorological algorithms including solar radiation correction and generation of coded messages | Analysis by OPS22 and OS7 subject matter experts. |

| Objective | Evaluation Method |
|---|---|
| Collect data for use during the Reliability, Maintainability, and Availability (RMA) analysis using the Engineering Management Reporting System | OPS13 to analyze data colled using a modified EMRS A-26 form. |
| Validate simulated end-to-end functionality (during ST Phase I - see Section 1.4.1) as well as an actual (during ST Phase II) end-to-end test at an operational site. This will include RRS product format and data evaluation. | **NWSTG** will evaluate the products by generating their monthly CLIMAT report.<br>**NECP** will attempt to open and import RRS products into their meteorological models and perform quality control of the data.<br>**NCDC** will evaluate archive generation and data quality for their products. |
| Assess the operational usability of RRS-generated data and products by a limited set of operational forecast applications. | OPS24 and OPS22 will examine RRS products distributed by the AWIPS NCF and their use in AWIPS UA applications. |
| Assess Maintenance Actions/Fault Isolation using the OMS and the Offline Built-In-Test (OBIT) applications. | Evaluated by the NWSTC. |
| Verify the Radiosonde Replacement System Project Agreement document minimum RRS performance requirements. | OPS24 will collect data for OPS22 analysis as follows:<br><br>1. Percentage of all naturally terminating test flights processing data above the 400 hecto-Pascal (hPa) level is equal to or greater than 95%.<br><br>2. Percentage of all naturally terminating test flights processing data above the 10 hPa level is equal to or greater than 60%.<br><br>3. Percentage of all test flights with 90% of wind and temperature values passing NCEP quality control tests will be 97% or greater.<br><br>4. Percentage of all test flights transmitting messages within three hours of balloon release is 95% or greater. |
| Legacy System Performance Measures (LSPM) | Data collected by the RRS Test Team and OPS22, but analyzed by OPS22. |

### 2.3.5.2 Test Result Analysis

The recommendation to proceed to the OAT will be based on an analysis of the following criteria:

a. Successful completion of the test procedure for each test case will be used as one of the pass/fail criteria. If any abnormalities are observed during test procedure conduct, SIRs will be written to document the problem and will be provided to the

TRG for adjudication. The TRG will prioritize all SIRs and determine if they warrant being submitted to the RRS CCB. The TRG will not submit a recommendation to the RRS Program Manager to proceed to the OAT if there are any unresolved Priority 1 or 2 SIRs.

b. The second result analysis will be an examination of RRS upper air observation products output for content correctness as well as initial operational performance characteristics. This analysis will be performed by OPS22 and OS7 subject matter experts with OPS24 coordinating data analysis from NCEP and NCDC.

c. During the ST, reliability data will be collected using the NWS EMRS. The EMRS data will be provided to the RRS Program Manager for assessing the ST reliability. This reliability value will not be a prediction of future RRS reliability but only an initial estimation.

d. The Radiosonde Replacement System Project Agreement document states the minimum RRS performance requirements in terms of operational use. The following minimum performance requirements are extrapolated from this document and tailored to the ST:

1. Percentage of all naturally terminating test flights processing data above the 400 hecto-Pascal (hPa) level is equal to or greater than 95%.
2. Percentage of all naturally terminating test flights processing data above the 10 hPa level is equal to or greater than 60%.
3. Percentage of all test flights with 90% of wind and temperature values passing NCEP quality control tests will be 97% or greater.
4. Percentage of all test flights transmitting messages within three hours of balloon release is 95% or greater.

The statistics for the above will be calculated for each system independently and as a group for all systems used during the ST. The statistics will be adjusted to remove, where and when necessary, inappropriate data such as defective balloons or an operator induced failure to test a specific requirement.

### 2.3.5.3 Test Recommendations and Report

Following completion of the ST Phase I, the ST Test Director will conduct a “Wrap-up” meeting for the TRG detailing what was tested, a summary of any discrepancies found, major findings, and recommendations. The TRG will review the materials presented by the Test Director and make a recommendation to the RRS Program Manager whether to proceed with ST Phase II.

At the conclusion of ST Phase II, the ST Director will conduct a final "Wrap-up" meeting for the TRG detailing what was tested, a summary of any discrepancies found, major findings, and recommendations. The TRG will review the materials presented by the Test Director. If no Priority 1 or 2 deficiencies have been found, and work-arounds are developed and documented for deficiencies that cannot be fixed until a future build, a recommendation will be forwarded to the RRS Program Manager to proceed with the OAT. The ST Director will provide the OAT Team with a copy of all outstanding deficiencies.

After the final "Wrap-up" meeting, the Test Director will prepare a formal report of all test activities, including details of any deficiencies. The report will also include findings and recommendations.

## Attachment A - RRS Test Procedure Description

| Test Number | Title | Purpose |
|---|---|---|
| **000 Series - Installation** | | |
| 001 | RRS Installation | Conducts both hardware and software installations; verifies the various installation cancellation options; removes the RWS software; and then re-installs the RWS software. |
| 002 | TRS/Control Display Unit (CDU) Remote Operations | Exercises TRS functions, remotely, and verifies ability to lock out the Local CDU during TRS maintenance. System interfaces are verified by means of an offline utility. |
| 003 | SPS Communication Status | Verifies communications between the SPS and the RWS. |
| 004 | Offline Utility Suite Validation | Exercises a utility designed to perform system built in test (BIT) to isolate faults to the LRU. |
| 005 | Radiosonde Calibration Checks | Exercises the methods to calibrate radiosondes prior to launch. |
| **200 Series - System Administration** | | |
| 201 | Tools File and Directory | Verifies the ability of offline utilities to create and remove various levels of user accounts; save and print files; and manipulate files. |
| 211 | Flight Management - NCDC Archive Utility | Verifies the ability of using the offline Archive Utility to prepare the flight archive to NCDC. |
| 212 | Flight Management - Flight Import and Export Utility | Exercises the ability to import and export flight data from and to other RRS'. |
| 214 | Flight Management - Flight Deletion Utility | Exercises the ability for Site Managers and Administrators to delete selected flight data. |
| 215 | Flight Management - Flight Summary Utility | Exercises the ability to view the flight summary of radiosonde flights. |

| Test Number | Title | Purpose |
|---|---|---|
| 220 | Application Utility | Exercises the ability to change system configurations. |
| 221 | Application - Plots Utility | Exercises the ability to change the various colors used on the many RWS plots. |
| 231 | Administration - User Administrative Utility | Exercises the Site Manager and System Administrator capabilities of adding, modifying , and deleting user accounts. |
| 233 | Administration - Master Station Utility and Station Data Info | Exercises the ability to update Master Station Data contained on media and to manually update site specific Station Data. |
| 234 | Administration - Database Backup and Restore Utility | Verifies the ability to create database backups and to restore the database from backups. |
| 235 | Administration - File Location Utility | Exercises the ability to store files in alternate directories rather than the default directories. |
| 236 | Administration - Pre-flight Information Utility | Exercises the various combinations of entering pre-flight information into the RWS application. |
| **400 Series -Evaluation of RWS Functional Capabilities** | | |
| 400 | Inline Simulator GUI Checkout | Exercises the RWS Graphical User Interface (GUI) options available when running a simulated flight. |
| 401 | Nominal Inline Simulator Flight | Includes radiosonde activation, pre-flight, radiosonde baseline, synoptic flights, and launch sequence while utilizing the RWS Inline Simulator capability. |
| 402 | Nominal Flight - XDP | Using an external data pump (XDP) to simulate RRS subsystem input, this procedure verifies the ability to run an uneventful, live flight. |
| 402A | Plots -Overlays | Exercises the various plot capabilities as well as the ability to overlay a plot from a pervious flight. |
| 403 | Nominal Flight - Live | The RRS is exercised utilizing a live flight totally dependent on current environmental conditions. |
| 403A | Search Mode | Exercises the various search mode options. |

| Test Number | Title | Purpose |
|---|---|---|
| 404 | Flight Rework Capability | Verifies the ability to perform flight rework functions on a previous upper air flight--both a recent flight and an imported flight from another RRS. |
| 405 | Special vs Synoptic Flight Functions | Exercises the differences between running a synoptic flight and a flight conducted during non-synoptic time periods. |
| 410 | Data Quality Control Checks | Verifies the operator's ability to perform quality control checks of the flight data prior to product transmission. |
| 411 | RWS In-flight Operations | Exercises those options available to the operator while a flight is in progress. This includes opening multiple plots, tabular displays, performing overlays, and general system stress. |
| 413 | Product Throughput | Demonstrates rudimentary end-to-end transmission of products from the RWS to the LDAD database. If permitted, products will also be sent to NCEP for evaluation. |
| 420 | UA Applications Verification | Verifies usability of RRS data by AWIPS applications such as the Skew-T, Log P display and site specific applications or other special purpose applications. |
| 430 | Anomalous Flight Situations | Exercises the RWS capability to handle anomalous flight/environmental conditions by using the XDP running special data sets. |
| **500 Series - System Back-ups and Recovery** | | |
| 501 | System Failure/Recovery | Examines the RRS's ability to sustain operations and recover from various hardware and software failures including loss of power during a flight. |
| **600 Series - Documentation and Training** | | |
| 601 | Documentation Review | Examines applicable upper air documentation to ensure it has been updated to include RRS. Documentation content will not be evaluated for accuracy. |

| Test Number | Title | Purpose |
|---|---|---|
| 602 | Training | A high-level evaluation of available operator training guides/videos used on-site and maintenance training material provided by the NWSTC. |
| **700 Series - RRS Reliability, Maintainability, and Availability** | | |
| 701 | RRS RMA | Presents the calculated system availability and provides a methodology for collecting relevant data for system reliability and maintainability statistical analysis. |
| 702 | Flight Data Collection | This is not a test procedure as such, but a means of documenting the algorithm and performance data collection methodology for each RRS flight (both simulated using the External Data Pump (XDP) and Live) for subsequent analysis. The data collected will be assembled into a "folder" to facilitate data quality and algorithm analysis by OPS22 and OS7. Specific directions for running an XDP flight may be found in Test Procedure 402; Test Procedure 403 contains directions for running a live flight. |
| 703 | EMRS Instructions | This is not a test procedure as such, but detailed step-by-step procedures for completing the modified EMRS A-26 form used during the ST and the OAT for reliability and availability data gathering. |
| **800 Series - Miscellaneous Software Management** | | |
| 800 | Miscellaneous Software Management | Miscellaneous software requirements that do not fit into an Administrative, Maintenance, or Operational category. |

## Attachment B - Anomalous Flight Situation Data Sets

| Data Set Flight Number | Description |
|---|---|
| **Missing Data** | |
| 1004 | Missing winds; no winds for first 30 seconds; max winds 108 knots (kts) |
| 1122 | Icing; excessive missing data; minimum pressure 495.8 hPa |
| **Wind Anomalies** | |
| 1006 | Max winds 132 kts; slant range 162 kilometer (km) |
| 1039 | Max winds 247 kts; slant range 252 km |
| **Relative Humidity (RH) Anomalies** | |
| 1118 | High tropopause; tropopause 79.7 hPa, strong inversion, rapid RH change 91% to 1% |
| **Tropopause Anomalies** | |
| 1095 | High tropopause; tropopause 85.7 hPa; < -80° C |
| **Ascension Rate Anomalies** | |
| 1096 | Less than 250 m/min ascension rate; Minimum Pressure 9.5 hPa |
| **Floating Balloon** | |
| 1137 | Max winds 70 kts; strong low level winds; floating balloon; min pressure 57.5 hPa |
| 4001 | Floating balloon; constant pressure at 200 hPa > 5 minutes |
| 4004 | Floating balloon; constant pressure at 600 hPa < 5 minutes |
| **Radiosonde Failure** | |
| 1148 | Radiosonde failure; minimum pressure 368.0 hPa |
| **Termination Anomalies** | |
| 1290 | Balloon burst; minimum pressure 4.7 hPa |
| **Temperature Anomalies** | |

| Data Set Flight Number | Description |
|---|---|
| 1613 | Low level temperature inversion off surface |
| 2138 | Multiple super adiabatic lapse rates up to 20 minutes; lapse rate greater than 9.77° C/km |
| 5001 | Failed temperature sensor; constant temperature for >= 5 minutes from surface to 400 hPa |
| 5003 | Isothermal (delta < 0.5° C) for < 10 minutes (isothermal layer) |
| 5004 | Out of Range Temperature Spikes |
| 5005 | Within Range Temperature Spikes |
| **Freezing Levels** | |
| 1655 | Seven freezing levels |
| **Pressure Anomalies** | |
| 4005 | Negative Pressure |
| 4006 | Pressure spikes out of range |
| 4007 | Pressure spikes within range |

## Attachment C - Modified EMRS Form

(This information was prepared by OPS13 and is used with their permission.)

The RRS System Test (ST) plan describes special documentation procedures that ST personnel must complete. In addition to the special documentation set forth by the ST plan, ST personnel will report the following activities via the EMRS. The EMRS can be accessed via the EMRS web page or paper copies of EMRS forms may be used. If paper copies are used, all documentation must be entered into the electronic EMRS by the close of business each day. ST personnel performing test operations and flights will use the EMRS Maintenance Request form to document the date and time at the beginning of each test operation or test flight. The required documentation must include the status or outcome of the test and the date and time the test ended. ST personnel must submit a separate EMRS report for each test operation or flight.

1. **RRS Operation**. Test flights will begin when the radiosonde undergoes initial operational checks and verification. Enter this date/time on EMRS form in the fields labeled Open Date and Time. Test flights end when .... Enter this date/time in the field labeled Description. Include comments indicating that the flight was successful. Submit the EMRS maintenance request form to document the event. (See Figure 2.)

   a. If the radiosonde fails initial operational checks enter the status of the radiosonde in the Description field. Include the serial number and the date/time the radiosonde failed. Submit the EMRS maintenance request form to document the failed radiosonde. (See Figure 3.)

   b. If the flight is unsuccessful, enter the cause of the failure. If possible enter a description of the failed component. Submit the EMRS maintenance request form to document the unsuccessful flight. (See Figure 4.)

2. **RRS Monitoring and Maintenance**. EMRS Maintenance Request forms submitted for the RRS ST will be monitored on an ongoing basis. ST personnel will log into EMRS to verify the status of each test operation or flight. Successful flights will be reviewed and verified by completing the EMRS report. RRS component failures will be investigated by ST personnel. ST personnel will take the appropriate maintenance action and document that activity in EMRS. All monitoring and maintenance activities performed by ST personnel will be documented according to the instructions in NWS Instruction 30-2104, Maintenance Documentation.

**Figure 2 - Sample EMRS Report for Successful Flight**

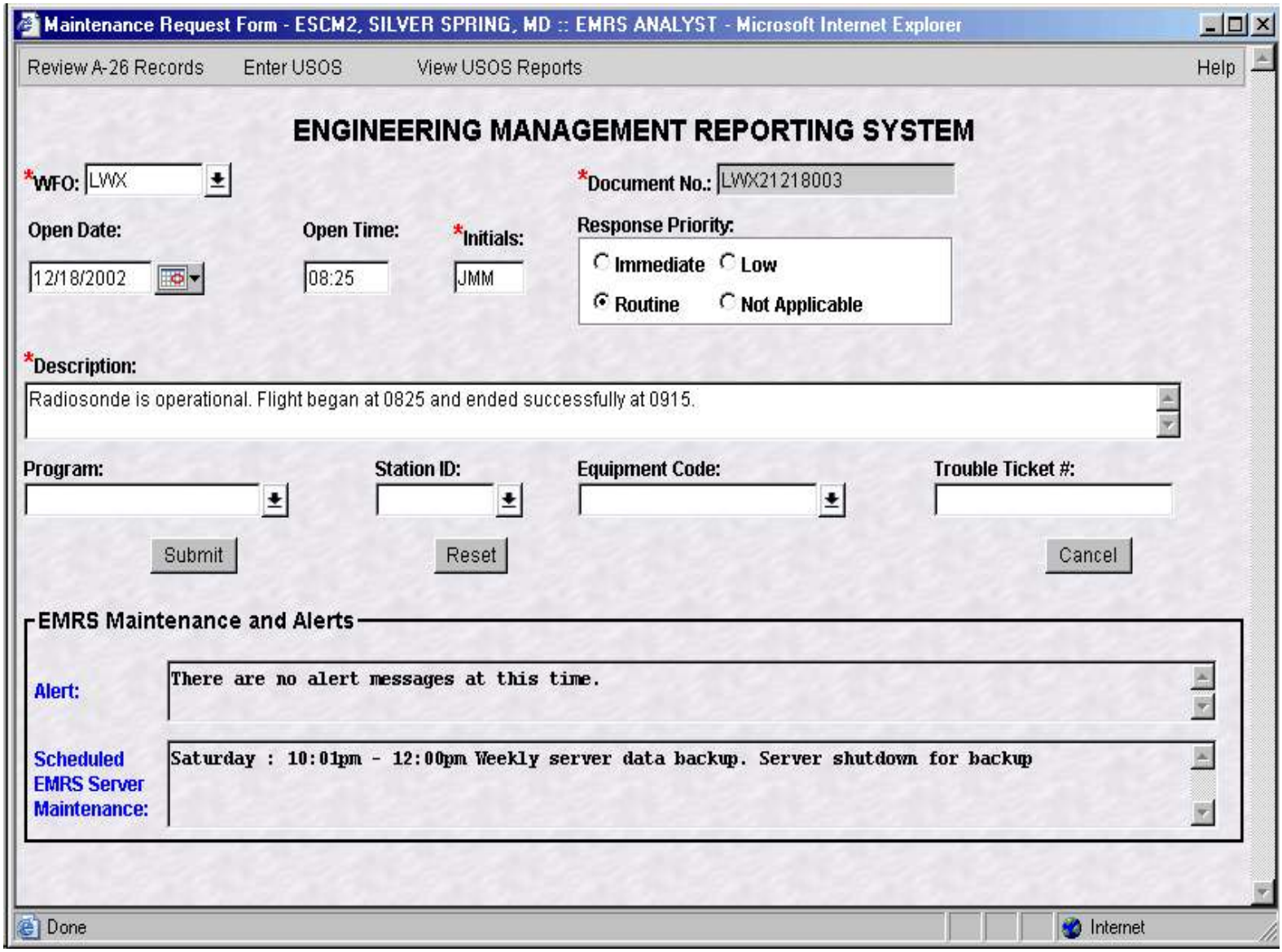

**Figure 3 - Sample EMRS Report for Failed Radiosonde**

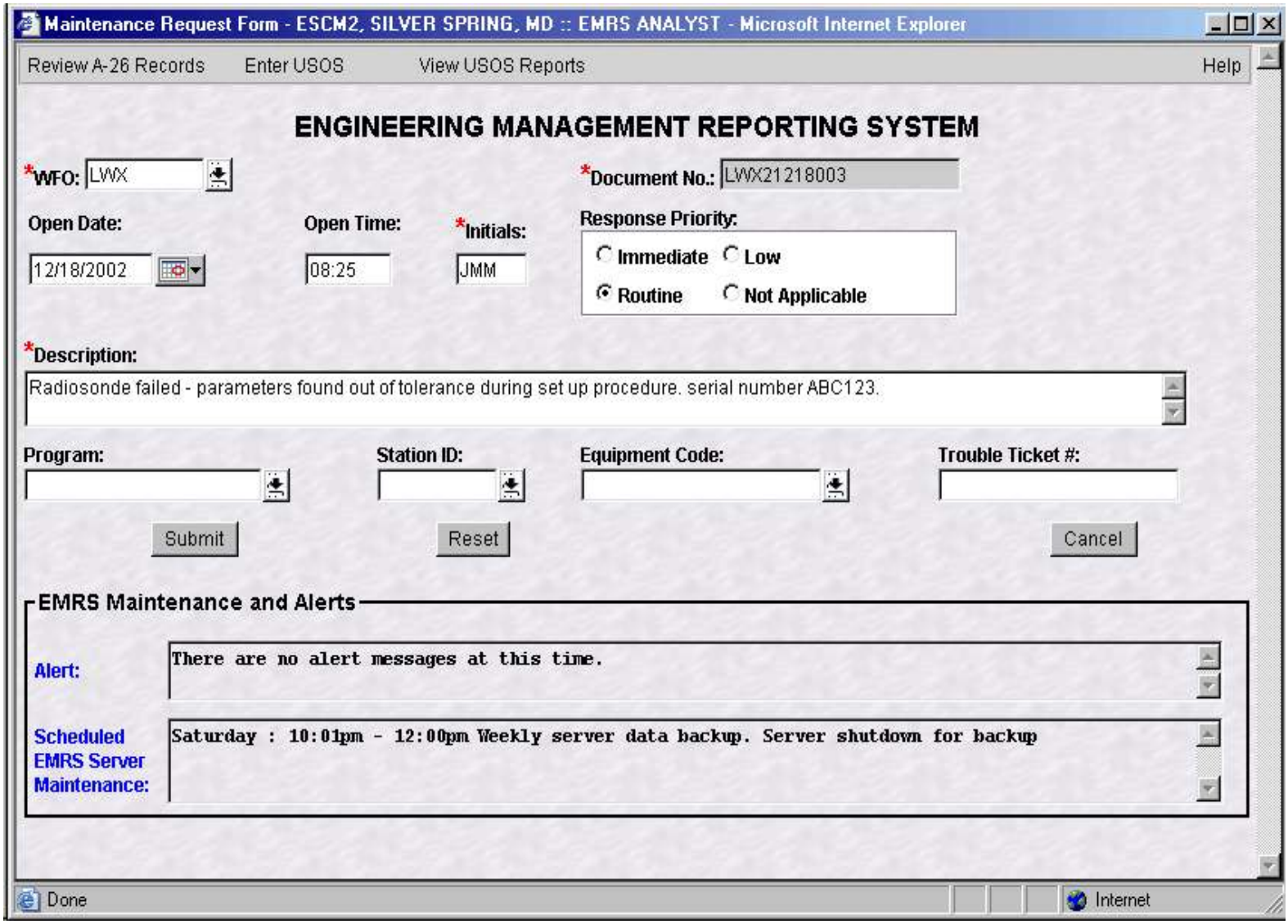

**Figure 4 - Sample EMRS Report for Failed Flight**